

National Park Service
U.S. Department of the Interior

Grand Canyon National Park



Special Flight Rules Area in the Vicinity of Grand Canyon National Park

Actions to Substantially Restore Natural Quiet

Final Environmental Impact Statement FES 12-21

Volume One of Two



DRAFT
Not Finalized
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Cover Image: Grand Canyon Aerial, Colorado River, Geikie Peak

View from one of the routes in the National Park Service Modified Preferred Alternative from the Environmental Impact Statement, Special Flight Rules Area in the Vicinity of Grand Canyon National Park, illustrating high quality views and grandeur from a scenic air tour. This view looks west at the Colorado River: Geikie Peak and Scylla Butte on the left; Scorpion Ridge and Tuna Creek on the right. Image taken November 15, 2010 with a Nikon D90, Accessed at: http://www.flickr.com/photos/grand_canyon_nps/5477155394/in/set-72157626136162880/

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June 2012

1 **UNITED STATES DEPARTMENT OF THE INTERIOR**
 2 **NATIONAL PARK SERVICE**
 3 **FINAL ENVIRONMENTAL IMPACT STATEMENT (FES 12-21)**
 4 **SPECIAL FLIGHT RULES AREA IN THE VICINITY OF GRAND CANYON NATIONAL PARK**
 5 **GRAND CANYON NATIONAL PARK**
 6 **COCONINO COUNTY, ARIZONA**
 7

8 **Abstract** This *Final* Environmental Impact Statement (EIS) for the Special Flight Rules Area (SFRA) in the
 9 Vicinity of Grand Canyon National Park (GCNP) identifies and assesses a No Action Alternative and three Action
 10 Alternatives for management of overflight activity in Grand Canyon National Park to *protect resources, and*
 11 substantially restore the natural quiet *and experience of the park*.¹ Action Alternatives differ in combination and
 12 implementation of strategies used to accomplish goals and objectives identified in Chapter 1. Key features of the
 13 four Alternatives being considered include
 14

15 **Alternative A No Action/Current Condition**

- 16 • continue current management and current helicopter and fixed-wing air-tour routes
- 17 • long and short-loop air-tours operate in Zuni Point and Dragon Corridors year-round
- 18 • annual allocation of 93,971 air-tour flights
- 19 • no quiet-technology incentives or conversion requirement
- 20 • four existing General Aviation corridors
- 21 • Flight-free Zone ceilings at 14,499 feet, except Sanup at 7,999 feet

22
23 **Alternative E Alternating Seasonal Use**

- 24 • short-loop air-tours alternate use of Zuni Point and Dragon Corridors seasonally
- 25 • no long-loop tours over North Rim; no routes over Marble Canyon; dogleg in Dragon Corridor
- 26 • annual allocation of 93,971 air-tour and air-tour related flights
- 27 • daily cap of 364 air-tour and air-tour-related flights
- 28 • full conversion to quiet-technology aircraft by date to be determined
- 29 • only quiet-technology aircraft allowed on East End routes early and late hours of flight day
- 30 • three modified general-aviation corridors
- 31 • all Flight-free Zone ceilings raised to 17,999 feet, and three zone boundaries enlarged

32
33 **Alternative F Modified Current Condition**

- 34 • similar to current routes and altitudes, except seasonal shift in Dragon Corridor, and changes in West End routes
- 35 • annual allocation of 93,971 air-tour flights
- 36 • incentives for quiet-technology aircraft conversion to quiet-technology aircraft in 10 to 12 years
- 37 • One general-aviation corridor eliminated; three general-aviation corridors as in Alternative A
- 38 • Flight-free Zone ceilings same as current; Flight-free Zone boundaries changed to accommodate seasonal shift
39 in Dragon Corridor

40
41 **Modified NPS Preferred Alternative**

- 42 • **Peak Season (April 1-November 14) short-loop routes in Zuni Point and Dragon Corridors open for air-tour
43 operations**
- 44 • **Peak Season (April 1-November 14) long-loop route over North Rim open for air-tour operations**
- 45 • **Peak Season (April 1- November 14), long-loop air-tour routes over North Rim phased-in to quiet-technology
46 only over four years**
- 47 • **Off-Peak Season (November 15-March 31), short-loop route in Dragon Corridor open**

¹ *The 1987 National Parks Overflights Act (Public Law 100-91) Section 3(b) mandates the Secretary of the Interior submit to the Federal Aviation Administration Administrator recommendations “regarding actions necessary for the protection of resources in the Grand Canyon from adverse impacts associated with aircraft overflights. The recommendations shall provide for substantial restoration of the natural quiet and experience of the park and protection of public health and safety from adverse effects associated with aircraft overflight.”*

² *Park areas are defined on Map 3.2*

- 1 • **Off-Peak Season (November 15-March 31), Zuni Point Corridor and long-loop routes closed**
- 2 • **no air-tour routes over Marble Canyon**
- 3 • **dogleg in Dragon Corridor**
- 4 • **increased altitudes for some air-tour route segments**
- 5 • **annual allocation of 65,000 commercial air-tour and air-tour-related operations (8,000 more air-tour flights**
- 6 **than reported by air-tour operators in any year 2004-2011)**
- 7 • **daily cap of 364 air-tour flights classified as commercial air tours. All flights on SFRA routes classified as**
- 8 **commercial air tours with limited exceptions for maintenance and training flights**
- 9 • **air-tour route changes to better protect Nankoweap area and Little Colorado River confluence**
- 10 • **incentives for quiet-technology aircraft; conversion to quiet-technology aircraft required within ten years**
- 11 • **four general-aviation corridors with modifications in two, Fossil Canyon and Dragon Corridors**
- 12 • **Blue Direct North changed to Z-shaped Route³**
- 13 • **West End routes proposed in the DEIS Preferred Alternative changed back to Alternative A, Current**
- 14 **Condition**
- 15 • **Flight-free Zone ceilings raised to 17,999 feet with exceptions for 1) aircraft in transit on Victor airways**
- 16 **V210, V257, and V293 at or above 14,500 feet (the current minimum en route altitude for those airways in**
- 17 **that area), 2) aircraft under positive control of an air-traffic control center or tower when necessary for**
- 18 **safety, 3) administrative use under an appropriate written waiver issued by FAA at the request of the**
- 19 **manager(s) of the over-flown land(s)**
- 20

21 *As further defined in Chapter 2, Elements Common to All Alternatives, operations currently not subject to*
 22 *annual allocations will remain not subject to annual allocations and any daily caps. However, flights currently*
 23 *not subject to allocations are growing and unlimited in number (for example, flights in support of Hualapai*
 24 *Tribe), and proposals exist to include additional flights as not subject to annual allocations (for example, flights*
 25 *in support of Navajo Nation). Unlimited numbers of flights could undo many gains realized by measures in this*
 26 *EIS. Also, the 2000 allocation limits were originally intended to temporarily limit commercial air tours and be*
 27 *revisited at a later date. To address such issues, NPS intends to examine the entire allocation system parkwide,*
 28 *including flights currently not subject to allocations, in a subsequent planning effort building on this EIS*
 29 *process. This will likely require additional NEPA compliance and FAA rulemaking.*

30
 31 Potential environmental consequences of each Alternative are evaluated for a range of impact topics including:
 32 Soundscape, Wilderness Character, Ethnographic Resources, Visitor Use and Experience, Wildlife, Special Status
 33 Species, and Socioeconomic Environment.

34 **Public Review and Comment**

35
 36 *A 30-day no-action period will follow publication of a Notice of Availability for this Final Environmental Impact*
 37 *Statement (FEIS) in the Federal Register. The NPS accepted public comments during the public comment period*
 38 *on the Draft EIS and addresses them in this FEIS. Following the 30-day no-action period, a Record of Decision*
 39 *(ROD) will be prepared to document the NPS decision and rationale for that decision. The ROD will be released*
 40 *to the public, and a summary published in the Federal Register.*

41
 42 The **Final EIS can be found** on the NPS Planning, Environment, and Public Comment database (PEPC) at
 43 <http://www.parkplanning.nps.gov/grca>. Select the link Special Flight Rules Area in the Vicinity of Grand Canyon
 44 National Park.

³ *The Z-shaped Route is shown on Map 2.5*

EXECUTIVE SUMMARY

FINAL ENVIRONMENTAL IMPACT STATEMENT (FES 12-21)

SPECIAL FLIGHT RULES AREA IN THE VICINITY OF GRAND CANYON NATIONAL PARK

Background

Public Law 100-91, referred to hereafter as the 1987 Overflights Act, requires restoration of natural quiet and visitor experience in Grand Canyon National Park (GCNP). Section 3(b) mandates the Secretary of the Interior to submit to the FAA Administrator recommendations “regarding actions necessary for the protection of resources in the Grand Canyon from adverse impacts associated with aircraft overflights. The recommendations shall provide for substantial restoration of the natural quiet and experience of the park and protection of public health and safety from adverse effects associated with aircraft overflight.” (For a chronology of significant aircraft overflights events and laws concerning Grand Canyon National Park, see Appendix A). In March 1987, the FAA established a Special Flight Rules Area (SFRA) and other flight restrictions in the vicinity of GCNP to “reduce the impact of aircraft noise on the park” (52 Fed. Reg. 9768).

Since *passage of the* 1987 Overflights Act, *phased* steps have been taken to restore *substantially* natural quiet in GCNP. *In 1995, NPS completed a required Report to Congress based on a number of studies evaluating whether SFAR 50-2⁴ resulted in a substantial restoration of natural quiet. As discussed in the final rule in 1996 (Docket 28537, December 31, 1996; 61 FR 69302), NPS found that SFAR 50-2 had not resulted in substantial restoration of natural quiet. In that rule FAA stated, “An NPS analysis using 1989 FAA survey data of commercial sightseeing route activity indicated that 43 percent of GCNP met the NPS criterion for substantially restoring natural quiet. However, a subsequent NPS analysis using 1995 FAA survey data indicated that 31 percent of GCNP met the NPS criterion for substantially restoring natural quiet.” These findings led NPS to conclude noise mitigation benefits of SFAR 50-2 were being significantly eroded.*

Pursuant to the 1987 Overflights Act, NPS interpreted and defined “substantial restoration of natural quiet” in GCNP as “50% or more of the park achieving natural quiet (i.e. no aircraft audible) for 75% to 100% of the day.” In 2008, NPS clarified that Substantial Restoration of Natural Quiet in GCNP will be achieved when reduction of noise from aircraft operations below 18,000 feet mean sea level (MSL) results in 50% or more of GCNP achieving restoration of the natural quiet (i.e., no aircraft audible) for 75% to 100% of the day, each and every day (73 Fed. Reg. 55130). The NPS also clarified that 50% of GCNP is a *minimum* in the restoration goal.

In April 2000, Congress passed the National Parks Air Tour Management Act (Public Law 106-181). The Act affirmed the requirement to achieve Substantial Restoration of Natural Quiet in GCNP, and required the FAA to designate reasonably achievable requirements for fixed-wing aircraft and helicopters to employ quiet-aircraft technology at GCNP. The Act also called for the FAA, in consultation with the NPS and the Grand Canyon Working Group⁵, to create incentive routes for commercial air-tour quiet-technology aircraft⁶ operating in GCNP, as long as the routes do not negatively impact substantial restoration of natural quiet, tribal lands, or safety.

⁴ Special Federal Aviation Regulation **50-2**, extended the Special Flight Rules Area from the surface up to and including 14,499 feet mean sea level (MSL) and extended the boundary to include the northeast extension of Marble Canyon; prohibited flights below a certain altitude with certain exceptions; established three Flight-free Zones from the surface to 14,499 feet MSL, and one up to 7,999 feet MSL above large areas of GCNP; and provided special corridors to help general-aviation aircraft navigate the Special Flight Rules Area while avoiding Flight-free Zones, commercial air-tour operators, and transient operators through the canyon area

⁵ The **Grand Canyon Working Group** was established under authority of the National Parks Overflights Advisory Group, and consisted of representatives from NPS, FAA, air-tour operators, environmental groups, tribes, commercial and general aviation, recreational interests, and other Federal agencies. The Working Group developed recommendations for proposed actions to meet the statutory mandate contained in the 1987 Overflights Act. Specifically, the purpose was to: review data and analysis, identify and review issues related to overflight noise, consider a variety of Alternatives to address issues, and make recommendations for a Grand Canyon Overflight Plan. Information on the Grand Canyon Working Group is Accessed at http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/grand_canyon_overflights/documents/documents_list.cfm

1 **PURPOSE AND NEED**

2
3 **Purpose**

4
5 The purpose of action is to complete and implement a recommendation through this EIS to *protect resources, substantially restore natural quiet and experience of the park, and protect public health and safety from adverse effects associated with aircraft overflights* at Grand Canyon National Park. This action is compliant with the 1987
6 Overflights Act mandate. The proposed action will also meet other applicable provisions of the 1987 Overflights Act
7 and the National Parks Air Tour Management Act (Public Law 106-181), as well as other laws, regulations, policies
8 and objectives of the NPS. In addition, it is intended to be compliant with FAA laws, regulations and policies
9 regarding aviation safety and airspace management.
10
11

12
13 **Need**

14
15 The proposed action (the *Modified* NPS Preferred Alternative) to *protect resources, substantially restore natural quiet and experience of the park, and protect public health and safety from adverse effects associated with aircraft overflights* in Grand Canyon National Park is needed in response to a series of National Environmental
16 Policy Act (NEPA) documents and FAA rulemakings that have occurred since 1987. These actions reduced adverse
17 effects of aircraft overflights and increased the amount of GCNP achieving Substantial Restoration of Natural Quiet,
18 with the current condition⁷ Peak Day⁸ achieving 55% restoration according to noise modeling results. However, NPS
19 is concerned sensitive natural and cultural resources and ground-based visitors in some park areas continue to be
20 adversely affected by aircraft overflights. *The 1987 Overflights Act requires protection of resources, and restoration of natural quiet and visitor experience in Grand Canyon National Park. Section 3(b) mandates the Secretary of the Interior submit to the Federal Aviation Administration (FAA) Administrator recommendations “regarding actions necessary for the protection of resources in the Grand Canyon from adverse impacts associated with aircraft overflights. The recommendations shall provide for substantial restoration of the natural quiet and experience of the park and protection of public health and safety from adverse effects associated with aircraft overflight.”* The NPS determined additional action is needed to achieve Substantial Restoration of Natural
21 Quiet at more than minimum levels (50%), to improve visitor experience, *protect resources*, and ensure restoration
22 of natural quiet is maintained over time.
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32 **SIGNIFICANCE OF GRAND CANYON NATIONAL PARK**

33
34 Grand Canyon National Park, established in 1919, encompasses approximately 1,216,000 acres of public land on the
35 Colorado Plateau’s southern end, and is a globally significant natural resource containing scenic vistas known
36 throughout the world. In recognition of its significant values, GCNP was designated as a World Heritage Site on
37 October 26, 1979.
38

39 A 277-mile stretch of the Colorado River runs through GCNP, and thousands of miles of tributary side canyons are
40 included in park boundaries. Exposed geologic strata rise more than a mile above the river, representing one of the
41 most complete geological records seen anywhere in the world. GCNP contains several major ecosystems, from the
42 lower canyon’s Sonoran Desert to North Rim’s coniferous forest. Many plant and animal species make up these
43 diverse ecosystems, including migratory and threatened and endangered species.

⁶ Procedures for determining the Grand Canyon National Park quiet-aircraft technology designation status for different aircraft are defined in Part 93 of chapter I of Title 14, Code of Federal Regulations. Designation of Grand Canyon National Park quiet-aircraft technology is generally based on measured flyover sound levels of an aircraft and seating configuration. Table 3. shows types of aircraft designated Grand Canyon National Park quiet-technology aircraft

⁷ Current Condition is the situation described in Alternative A, No Action/Current Condition

⁸ Peak Day Noise analysis for this EIS is based on a 12-hour time period of 7 a.m. to 7 p.m. on the Peak Day; the day with the highest total number of air-tour and air-tour-related operations. Based on a review of the best available data at the time EIS noise modeling analysis began in 2005, Peak Day occurred August 8, 2005, with a total 635 operations. This day forms the basis for Base Year analyses for the Alternatives. Data for subsequent years was checked to ensure use of 2005 Peak Day as the basis for Base Year analysis was still reasonable

1 Eleven American Indian tribes attach traditional cultural significance to Grand Canyon, the Colorado River, and
 2 various sites and resources within the landscape of Grand Canyon. Many park sites and resources are considered
 3 sacred by tribal communities, and are integral to maintaining beliefs, ancestral ties, and cultural identities of these
 4 communities. Among Grand Canyon's *traditionally associated* tribes, lands of the Havasupai Tribe, Hualapai Tribe,
 5 and Navajo Nation adjoin the park boundary.

6
 7 More than four million recreational park visits occur yearly, primarily on South Rim. Recreational pursuits include
 8 sightseeing, hiking, photography, nature study, and river running.

9
 10 The EIS analyzes the following impact topics *developed from internal and public scoping on the DEIS (See*
 11 *Appendix C)*

- 12 • Soundscape
- 13 • Wilderness Character
- 14 • Ethnographic Resources
- 15 • Visitor Use and Experience (ground-based and air-tour visitors)
- 16 • Wildlife and Special Status Species
- 17 • Socioeconomic Environment

18 19 SUMMARY OF ALTERNATIVES

20
 21 Four Alternatives were evaluated: Alternative A, No Action/Current Condition, and three Action Alternatives.
 22 Alternative A is required by the National Environmental Policy Act as the baseline against which to compare Action
 23 Alternatives. Evaluation covers a Base Year⁹ and Ten-Year Forecast¹⁰ during which air-tour aircraft use was
 24 projected based on route configurations and operations of each Alternative.

25
 26 **ALTERNATIVE A, NO ACTION/ CURRENT CONDITION** continues all aspects of current management for general
 27 aviation and air-tour operations in the Special Flight Rules Area. Although some air-tour operators use quiet-
 28 technology aircraft, there are currently no requirements or incentives to do so. Under Alternative A, operations will
 29 continue in the Special Flight Rules Area's

- 30 • East End¹¹: 8 a.m. to 6 p.m. May through September
- 31 9 a.m. to 5 p.m. October through April
- 32 • West End: No limits on daily or seasonal allowable operation times.
- 33 • No maximum daily cap; air-tour annual allocation of 93,971 flights

34
 35 Under Alternative A, a range of air-tour aircraft noise would be present in the Special Flight Rules Area. Sounds
 36 would be concentrated beneath air-tour routes such as Zuni Point and Dragon Corridors in the East End, beneath
 37 Blue Direct routes that bisect the Special Flight Rules Area in a generally east-to-west direction, and, in the
 38 northwest corner of the West End, where concentrated short-loop tours occur.

- 39 • Alternative A *is predicted to make progress toward* Substantial Restoration of Natural Quiet in 55% of GCNP
 40 Base Year, and in 53% of GCNP Ten-Year Forecast
- 41 • In Marble Canyon, air-tour sounds would be of relatively low intensity and occurrence. Few adverse effects on
 42 resources and values would be expected in this area
- 43 • East End, beneath Zuni Point and Dragon Corridors, air-tour noise would be present from over half to virtually
 44 100% of the day. This would have adverse effects on natural Soundscape, Wilderness Character, Ethnographic
 45 Resources, Visitor Use and Experience, Wildlife, and Special Status Species. Beneath Bright Angel Flight-free

⁹ The best available data as of the end of 2005 is used as the Base Year for noise modeling. Since 2005, the 2005 database has been checked against data from subsequent years, and although there are some differences, given all factors contributing to those differences, the 2005 database continues as a reasonable base for evaluating impacts of Alternatives in this EIS

¹⁰ Ten-Year Forecast is the best estimate of what will occur ten years after implementing each Alternative, starting from the Base Year scenario. For the Ten-Year Forecast, growth in aircraft operations was assumed as explained in Appendix D. Also, full implementation of each Alternative's action elements is assumed to be achieved in the Ten-Year Forecast (for example, full conversion to quiet-technology aircraft if that is an Alternative element)

¹¹ As shown in Map 3.2, for the purpose of this Environmental Impact Statement, Grand Canyon National Park is divided to four geographical sections, 1) Marble Canyon, 2) East End, 3) Central, and 4) West End

1 Zone, air-tour sounds would diminish away from the corridors, based on GCNP's complex terrain. Near the
2 river, natural ambient sounds would reduce effects of air-tour noise

- 3 • Central area, air-tour noise would be quite low, with limited impacts on resources and visitors. Key impacts
4 would include adverse effects on Wilderness Character and Visitor Use and Experience
- 5 • West End, sound from air-tour aircraft using the Blue Direct routes to and from Las Vegas would affect rim and
6 canyon locations above natural sound levels but would be below ambient sound levels near the river. Beneath
7 West End's Blue and Green air-tour routes, high levels of nearly continuous noise would occur in some
8 locations, resulting in adverse impacts on natural Soundscapes, Wilderness Character, Ethnographic Resources,
9 Visitor Use and Experience, Wildlife, and Special-Status Species
- 10 • For air-tour visitors and operators, Alternative A would provide a variety of options for tours. Iconic landforms
11 and resources would continue to be viewed. Air-tour industry growth would increase air tours over Grand
12 Canyon between Base Year and Ten-Year Forecast conditions

13
14 **ALTERNATIVE E, ALTERNATING SEASONAL USE** would implement seasonal air-tour route use and maximize GCNP
15 area in Flight-free Zones. This Alternative includes reduction in hours and area available for air-tour overflights to
16 increase ground-based opportunities for natural quiet. A mix of curfews and conversion to best available quiet-
17 technology aircraft would be implemented to *make progress toward* objectives. Alternative E would allow a daily
18 maximum 364 total operations by air-tour and air-tour-related flights in the SFRA, and an annual maximum 93,971
19 flights.

20
21 Under Alternative E, a range of air-tour aircraft noise would continue in the SFRA. As described for Alternative A,
22 air-tour sounds would remain concentrated in the East and West Ends and beneath Blue Direct North.

- 23 • Alternative E *is predicted to make* the greatest *progress toward* Substantial Restoration of Natural Quiet of
24 proposed Alternatives. Base Year, Alternative E *is predicted to make progress toward* Substantial Restoration
25 of Natural Quiet in 75% of GCNP during Alternative E's Peak Season¹² (July 1 through September 15), and in
26 78% of GCNP during Alternative E's Off-Peak Season (September 16 through June 30). For the Ten-Year
27 Forecast, Alternative E *is predicted to make progress toward* Substantial Restoration of Natural Quiet in 84%
28 of GCNP during Alternative E's Peak Season, and 86% of GCNP during Alternative E's Off-Peak Season
- 29 • Extension of Bright Angel Flight-free Zone northward would virtually eliminate air-tour noise at Marble
30 Canyon
- 31 • Alternating seasonal use of Zuni Point and Dragon Corridors, and elimination of a long-loop tour between
32 corridors over North Rim would reduce overall East End air-tour aircraft noise, resulting in notable seasonal
33 improvements for resource conditions and visitors at a variety of locations in this area
- 34 • Blue Direct South would be eliminated, and Blue Direct North would be reconfigured with a shortened segment
35 passing over the SFRA. These changes would result in reduced Central area and West End impacts from air
36 tours
- 37 • Conditions at the far West End would remain largely unchanged from current conditions
- 38 • Alternative E would provide fewer options for air-tour visitors and operators than Alternatives analyzed. Views
39 of iconic landforms would be reduced and long-loop tours eliminated. Effects of these changes could be
40 decreased flight operations and passenger volume compared to Alternative A

41
42 **ALTERNATIVE F, MODIFIED CURRENT CONDITION** minimizes changes from current practices. East End seasonal
43 route changes would move Dragon Corridor air-tour routes west December 1 through January 31. Blue Direct routes
44 would be reconfigured and would include additional time over the canyon to enhance tour aspects. Allowable hours
45 of operation would be the same as Alternative A. This Alternative supports a broad array of changes including
46 Dragon Corridor seasonal shifts, one general-aviation corridor closure, and quiet-technology incentives. Alternative
47 F would have the same annual allocation provision (93,971 commercial air-tour operations) as Alternative A. There
48 would be no daily cap under this Alternative.

¹² Because Action Alternatives (E, F, and *Modified NPS Preferred*) propose seasonal route shifts, Alternatives are evaluated for different Peak and Off-Peak Seasons. Each season can encompass periods of both high and low visitation. Peak and Off-Peak Seasons refer more to the analysis than visitation levels. Dates may correspond to avian nesting, non-motorized vs. motorized river use, and spring/fall high-demand Wilderness backpacking use to provide opportunity to experience these under quieter conditions

- 1 • Base Year, Alternative F *is predicted to make progress toward* Substantial Restoration of Natural Quiet in 51%
2 of GCNP during Alternative F's Peak Season (February 1 through November 30), and in 59% of GCNP during
3 Alternative F's Off-Peak Season (December 1 through January 31). Ten-Year Forecast, Alternative F *is*
4 *predicted to make progress toward* Substantial Restoration of Natural Quiet in 66% of GCNP during
5 Alternative F's Peak Season, and 75% of GCNP during Alternative F's Off-Peak Season
- 6 • In Marble Canyon, air-tour sounds would be of relatively low intensity and occurrence. Few adverse effects on
7 resources and values would be expected
- 8 • Dragon Corridor seasonal use would relocate air-tour sounds west from the current Dragon Corridor, reducing
9 overall East End air-tour noise to a limited degree Ten-Year Forecast
- 10 • In the Central area, air-tour noise would be quite low, with limited impacts on resources and visitors. Key
11 impacts would include adverse effects on Wilderness Character and Visitor Use and Experience
- 12 • West End, high air-tour-sound levels would persist but would decrease over the Ten-Year Forecast with quiet-
13 technology conversion, providing benefits to resources and visitors in this area
- 14 • Under Alternative F, opportunities for air-tour visitors and operators would be similar to Alternative A for East
15 and West End visitors. Blue Direct routes would provide air-tour visitors with more time over the canyon than
16 any other proposed Alternative. A range of tours would be available year-round, and iconic views would be
17 available for aerial viewing from a variety of routes
18

19 **MODIFIED NPS PREFERRED ALTERNATIVE creates a quiet season by closing routes east of Dragon Corridor Off-
20 Peak Season. Zuni Point short-loop tours and long-loop tours over North Rim are closed Off-Peak Season, but
21 open Peak Season. Marble Canyon is closed to air-tour operations year-round.** The Alternative includes raising
22 Flight-free Zone upper boundaries, quiet-technology incentives, modified tour routes to avoid sensitive resources,
23 modified curfews, full conversion to quiet-technology aircraft, and moving most non-tour flights outside the SFRA.
24 Air-tours and air-tour-related operations would have an annual allocation limit of 65,900 flights (**8,000 more air-
25 tour flights than reported by air-tour operators in any year 2004-2011**), with a daily cap of 364 air-tours (**50 more
26 than on the 2005 Peak Day**).

- 27 • Base Year, the *Modified NPS Preferred Alternative is predicted to make progress toward* Substantial
28 Restoration of Natural Quiet in 57% of GCNP during the *Modified NPS Preferred Alternative's* Peak Season
29 (*April 1-November 14*), and in 74% of GCNP during the *Modified NPS Preferred Alternative's* Off-Peak
30 Season (*November 15-March 31*). Ten-Year Forecast, the *Modified NPS Preferred Alternative is predicted to*
31 *make progress toward* Substantial Restoration of Natural Quiet in 73% of GCNP during the *Modified NPS*
32 *Preferred Alternative's* Peak Season, and 85% of GCNP during the *Modified NPS Preferred Alternative's* Off-
33 Peak Season
- 34 • **Elimination of air-tour routes over Marble Canyon would virtually eliminate aircraft noise in that area**
- 35 • East End, as with the other Alternatives, air-tour aircraft noise would continue to be concentrated beneath air-
36 tour routes in Zuni Point and Dragon Corridors. However, an overall noise reduction would occur with seasonal
37 **closure of Zuni Point Corridor and the long loop route (November 15-March 31)**, curfews, and conversion to
38 all quiet-technology aircraft (Ten-Year Forecast). This portion of the SFRA would see a variety of benefits to
39 resources and visitors, depending on proximity to air-tour routes
- 40 • Central area, conditions would be as described for Alternative A, with generally negligible air-tour noise
41 impacts
- 42 • West End air-tour routes would be **the same as** current conditions, and effects on resources and visitors would
43 be **the same as** those described for Alternative A, **except for Blue Direct North which changes to the Z-shaped**
44 **Route for an overall noise reduction**
- 45 • The *Modified NPS Preferred Alternative* would provide a range of tours year-round, and iconic views would be
46 available for aerial viewing from a variety of routes
- 47 • The *Modified NPS Preferred Alternative* represents the Environmentally Preferred Alternative because it
48 provides the best balance between resource protection and a wide range of beneficial uses of the environment
49

50 ELEMENTS COMMON TO ALL ALTERNATIVES

51 Several elements to manage aircraft over the park and within the Special Flight Rules Area would be common to all
52 Alternatives, including Alternative A, as described below.

53
54 As clarified in the Federal Register on September 24, 2008 (73 Fed. Reg. 55130),

- Substantial Restoration of Natural Quiet at Grand Canyon National Park will be achieved when reduction of noise from aircraft operations at or below 17,999 feet MSL within the Special Flight Rules Area results in 50% or more of the park achieving restoration of natural quiet (i.e., no aircraft audible) for 75% to 100% of the day, each and every day. Fifty percent of the park is a *minimum* in the restoration goal
- Substantial Restoration of Natural Quiet from all aircraft above 17,999 feet MSL means there will be overall reduction in aviation noise generated above 17,999 feet MSL above the park over time through implementation of measures in accordance with FAA commitments (*See Chapter 2, Elements Common to All Alternatives*)

Although this EIS does not propose Alternatives to manage aircraft operating at or above 18,000 feet MSL, noise impacts generated by these aircraft are considered in the Cumulative Effects analysis.

Unless ***changed by the Modified NPS Preferred Alternative and subsequent FAA rulemaking***, existing SFRA regulations (14 Code of Federal Regulations (CFR) Part 93 Subpart U) would continue to apply and be enforced.

As further defined in Chapter 2, Elements Common to All Alternatives, operations currently not subject to annual allocations will remain not subject to annual allocations and any daily caps. However, flights currently not subject to annual allocations are growing and unlimited in number (for example, flights in support of Hualapai Tribe), and proposals exist to include additional flights as not subject to annual allocations (for example, flights in support of Navajo Nation). Unlimited numbers of flights could undo many gains realized by measures in this EIS. Also, the allocation system was originally intended to temporarily limit commercial air tours and be revisited at a later date. To address such issues, NPS intends to examine the entire allocation system parkwide, including flights currently not subject to allocations, in a subsequent planning effort building on this EIS process. This will likely require additional NEPA compliance and FAA rulemaking.

FAA, in consultation with NPS, may create or modify weather route segments and/or procedures as needed to ensure safety of flight. Reporting procedures will be modified in Rulemaking. See Chapter 2, Elements Common to All Alternatives, for more information.

IMPLEMENTATION, MONITORING, AND ADAPTIVE MANAGEMENT

Monitoring and noise modeling will be conducted as part of an adaptive management approach to ensure noise provisions of sections 804 of Public Law 106-181 would be met.

After a Record of Decision (ROD) has been signed, the NPS will provide a recommendation to the FAA for implementation through rulemaking. Additionally, in coordination with stakeholders, the NPS will develop a detailed plan for monitoring and adaptive management to ensure park goals and objectives are met, including Substantial Restoration of Natural Quiet.

ENVIRONMENTAL CONSEQUENCES

An impact analysis for each impact topic was completed for each Alternative in the EIS. Beneficial and adverse environmental consequences ranging in intensity from negligible to major occur in all four Alternatives. Tables 2.7 to 2.15 provide a matrix of impacts by Alternative and impact topic, and Chapter 4 describes the impacts in detail. Chapter 4's impact analysis identifies intensity, context, duration, timing, and cumulative effects for each topic by each Alternative. The ***Modified*** NPS Preferred Alternative meets all goals and objectives, and provides opportunities for excellent air-tour and ground-based visitor experiences while protecting natural and cultural resources.

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CHAPTER 1 INTRODUCTION

HISTORY LEADING UP TO THIS ENVIRONMENTAL IMPACT STATEMENT

The 1975 Grand Canyon Enlargement Act (Public Law 93-620) stated, “Whenever an aircraft or helicopter activity or operation is likely to cause injury to the health, welfare, or safety of visitors or cause a significant adverse effect on natural quiet and experience of the park, the Secretary shall submit recommendations for rules and regulations or other actions appropriate to protect public health, welfare, and safety or the natural environment within the park.”

Public Law 100-91, hereafter referred to as the 1987 Overflights Act, requires **protection of resources**, restoration of natural quiet **and visitor experience** in Grand Canyon National Park (GCNP). Section 3(b) mandates the Secretary of the Interior submit to the Federal Aviation Administration (FAA) Administrator recommendations “regarding actions necessary for the protection of resources in the Grand Canyon from adverse impacts associated with aircraft overflights. The recommendations shall provide for substantial restoration of the natural quiet and experience of the park and protection of public health and safety from adverse effects associated with aircraft overflight.” (Appendix A is a chronology of significant aircraft overflights events and laws concerning Grand Canyon National Park).

The 1987 Overflights Act required the Secretary of the Interior’s recommendation contain provisions prohibiting the flight of aircraft below the canyon rim, and designate Flight-free Zones excepting flights for administration and emergency operations, and flights required for transporting persons and supplies to and from Supai Village and lands of the Havasupai Tribe. In addition, the Act provided an **exception** for helicopters that fly a direct route between a point on north rim outside the park and locations on the Hualapai Reservation solely for transporting people and guides to or from boat trips on the Colorado River.

Since 1987 Overflights Act passage, steps have been taken to restore natural quiet in GCNP. In March 1987, the Federal Aviation Administration established a **Special Flight Rules Area (SFRA)** (see Map 1.1) and other flight restrictions in the park vicinity to reduce aircraft accident risk and to “reduce the impact of aircraft noise on the park.” (March 26, 1987, Federal Register notice establishing Special Federal Aviation Regulation, SFAR 50, summary, vol. 52, no. 58, p. 9768.)

On May 27, 1988, the FAA issued Special Federal Aviation Regulation **50-2**, revising procedures for aircraft operation in the airspace above the park. Among its provisions, SFAR 50-2

- extended the Special Flight Rules Area from the surface up to and including 14,499 feet mean sea level (MSL) and extended the boundary to include the northeast extension of Marble Canyon;
- prohibited flights below a certain altitude with certain exceptions;
- established three Flight-free Zones from the surface to 14,499 feet MSL, and one up to 7,999 feet MSL above large areas of GCNP; and
- provided special corridors to help general-aviation aircraft navigate the Special Flight Rules Area while avoiding Flight-free Zones, commercial air-tour operators, and transient operators through the canyon area

A major provision of the 1987 Overflights Act required the Department of the Interior submit a **Report to Congress** on whether SFAR 50-2 had successfully restored natural quiet in the park. In 1994, a Report was submitted to Congress on Effects of Aircraft Overflights on the National Park System (published in July 1995 but commonly referred to as the 1995 Report to Congress); part of this report specifically focused on Grand Canyon National Park. *As discussed in the final rule in 1996 (Docket 28537, December 31, 1996; 61 FR 69302), NPS found that SFAR 50-2 had not resulted in substantial restoration of natural quiet. In that rule FAA stated, “An NPS analysis using 1989 FAA survey data of commercial sightseeing route activity indicated that 43 percent of GCNP met the NPS criterion for substantially restoring natural quiet. However, a subsequent NPS analysis using 1995 FAA survey data indicated that 31 percent of GCNP met the NPS criterion for substantially restoring natural quiet.” These findings led NPS to conclude noise mitigation benefits of SFAR 50-2 were being significantly eroded.* The report recommended numerous revisions to SFAR 50-2 to substantially restore natural quiet in GCNP.

1 In April 1996, a **Presidential Memorandum** directed the Secretary of Transportation, in consultation with the
2 Secretary of the Interior and National Park Service (NPS) Director, to take further action to restore natural quiet in
3 the park (see Need for Action). The Presidential Memorandum also required development of a plan to complete
4 restoration and maintenance of natural quiet in GCNP should Final Rulemaking determine such a plan necessary.
5 In December 1996, FAA issued a **Final Environmental Assessment and Finding of No Significant Impact**
6 **(FONSI), and a Final Rule** (61 Federal Register 69302) implementing some of the recommendations included in
7 the 1995 Report to Congress, including, 1) Flight-free Zones and corridors; 2) minimum flight altitudes; 3) general
8 operating procedures; 4) curfews in the eastern part of the park (Zuni Point and Dragon Corridors); 5) reporting
9 requirements; and 6) a limit on number of commercial sightseeing aircraft that could operate in the SFRA. The 1996
10 Final Rule modified SFRA dimensions, increasing vertical airspace limits from 14,499 feet MSL up to but not
11 including 18,000 feet MSL. The rule also modified existing and established new, Flight-free Zones (Bright Angel,
12 Desert View, Toroweap /Shinumo, and Sanup Flight-free Zones) and flight corridors (Zuni Point, Dragon and
13 Tuckup Corridors). However, implementation of portions of the 1996 Rule (Flight-free Zones, flight corridors,
14 airspace structure) encountered a series of delays, modifications, reissuance, and litigation.
15

16 In February 2000, FAA issued the **Final Supplemental Environmental Assessment Special Flight Rules in the**
17 **Vicinity of the Grand Canyon National Park and Finding of No Significant Impact**. This 2000 Environmental
18 Assessment (EA) supplemented the December 1996 Final Environmental Assessment. The 2000 EA completed by
19 the FAA, as lead agency, in cooperation with the NPS and Hualapai Tribe, attempted to resolve the issue of
20 restoring natural quiet to GCNP. The 2000 Final Supplemental Environmental Assessment evaluated proposed rules
21 to modify SFAR 50-2, including changes to the SFRA and Flight-free Zones, changes in commercial air-tour routes,
22 and changes in limits on number of commercial air-tour operations authorized to operate in the SFRA.
23

24 In April 2000, the FAA published a **Final Rule** (Air Tour Limitation Rule, 65 Federal Register 17708) to replace the
25 limit on number of commercial aircraft as contained in the 1996 Final Rule. The 2000 provision *temporarily* limited
26 *the* number of commercial air-tour operations in the SFRA to 93,971, *with the expectation that the limits would be*
27 *revisited at a later date*. This is the total number of flights reported by air-tour operators May 1, 1997 to April 30,
28 1998. *Based on economic impacts to the Hualapai Tribe projected as a result of this Final Rule, the rule granted*
29 *an exception for flights in support of the Hualapai Tribe from annual allocations for air-tour operations*.
30

31 In addition, the Rule revised reporting requirements for SFRA commercial air tours.
32

33 FAA also published another Final Rule at the same time (65 Federal Register 17736) that modified SFRA
34 dimensions and Flight-free Zones. These Rules were part of an overall strategy to control aircraft noise in GCNP
35 and achieve the 1987 Overflights Act's statutory mandate. However, implementation of airspace and route changes
36 encountered a series of delays, reissuance of modifications, and litigation. A modified route structure (new routes on
37 the SFRA's West End, and continuation of previous East End routes) was implemented in April 2001.
38

39 Also in April 2000, Congress passed the **National Parks Air Tour Management Act (NPATMA)** (Public Law
40 106-181). This Act affirmed the requirement to achieve Substantial Restoration of Natural Quiet in GCNP. It
41 required FAA designate reasonably achievable requirements for fixed-wing aircraft and helicopters to employ quiet-
42 aircraft technology¹³. The Act also called for FAA, in consultation with NPS and Grand Canyon Working Group¹⁴ to
43 create incentive routes for commercial air-tour quiet-technology aircraft operating in GCNP, as long as the routes do

¹³ Procedures for determining the Grand Canyon National Park quiet-aircraft technology designation status for different aircraft are defined in Part 93 of chapter I of Title 14, Code of Federal Regulations. Designation of Grand Canyon National Park quiet-aircraft technology is generally based on measured flyover sound level of an aircraft and seating configuration. Table 3.15 shows types of aircraft designated Grand Canyon National Park quiet-technology aircraft

¹⁴ The Grand Canyon Working Group was established under authority of the National Parks Overflights Advisory Group, and consisted of representatives from NPS, FAA, air-tour operators, environmental groups, tribes, commercial and general aviation, recreational interests, and other Federal agencies. The Working Group developed recommendations for proposed actions to meet the statutory mandate contained in the 1987 Overflights Act. Specifically, the purpose of the group was to: review data and analysis, identify and review issues related to overflight noise, and consider a variety of Alternatives to address issues. Information on the Grand Canyon Working Group is Accessed at http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/grand_canyon_overflights/documentation/Grand%20Canyon%20Working%20Group%20Final%20Report%2017%20July%202009.pdf

1 not negatively impact substantial restoration of natural quiet, tribal lands, or safety. Commercial air-tour operations
2 by fixed-wing or helicopter aircraft that employ quiet-aircraft technology and replace existing aircraft, or were in an
3 operator's fleet on the date of enactment of this Act, or were subsequently modified to meet quiet-technology
4 requirements, are not subject to use of an annual allocation as applies to other commercial air-tour operations flying
5 over the park—provided the cumulative impact of such operations does not increase noise in the park. This Act also
6 required any methodology adopted by a Federal agency to assess air-tour noise in any unit of the national park
7 system, including Grand Canyon National Park, be based on reasonable scientific methods.
8

9 In May 2000, FAA implemented the **Final Rule** limiting commercial air-tour operations and expanding the SFRA
10 East End boundary. However, FAA determined Final Rule implementation for air-tour route changes for GCNP's
11 East End, and expansion of the Desert View Flight-free Zone as outlined in the Final 2000 Supplemental EA, should
12 be delayed to address safety concerns raised after the Final Rule (65 Federal Register 69846, 69848). Between May
13 2000 and January 2006, FAA issued several Final Rules extending the delay for implementation of East End
14 changes.
15

16 On January 25, 2006, the NPS and FAA published in a **Notice of Intent** (NOI) to prepare this EIS (71 Federal
17 Register 4192).
18

19 On February 24, 2006, FAA issued another **Final Rule** (71 Federal Register 09439) that further delayed
20 implementation of airspace and commercial air-tour route changes for GCNP's East End *until February 2011*. This
21 further delay was to allow the NPS and FAA, in consultation with the U.S. Institute for Environmental Conflict
22 Resolution and involved park stakeholders, to consider additional measures to be incorporated into the EIS to
23 address quiet-aircraft technology provisions.
24

25 In a September 24, 2008, **Federal Register** notice (73 Fed. Reg. 55130), NPS clarified Substantial Restoration of
26 Natural Quiet at GCNP will be achieved when reduction of noise from aircraft operations below 18,000 feet MSL
27 results in 50% or more of the park achieving restoration of the natural quiet (i.e., no aircraft audible) 75% to 100%
28 of the day, each and every day. Further, NPS defined Substantial Restoration of Natural Quiet from all aircraft above
29 17,999 feet MSL to mean there will be an overall reduction in aviation noise generated above 17,999 feet MSL over
30 the park over time through implementation of measures in accordance with commitments made by FAA¹⁵ (*See*
31 *Chapter 2, Elements Common to All Alternatives*). NPS also clarified that 50% of the park is a *minimum* in the
32 restoration goal.
33

34 *A December 1, 2010 Resolution (Memorandum signed January 21, 2011) between DOT and DOI delineated FAA*
35 *and NPS responsibilities for the EIS process. See Chapter 1, Relationship of NPS and FAA for more*
36 *information.*
37

38 *In February 2011, NPS released Special Flight Rules Area in the Vicinity of Grand Canyon National Park Draft*
39 *Environmental Impact Statement (NPS 2011). Formal 120-day public comment period ended June 20, 2011*
40

41 *June 2012, NPS releases this FEIS.*
42

43 PURPOSE OF AND NEED FOR ACTION

44 Purpose of Action

45 The purpose of action is to complete and implement a recommendation through this EIS to *protect resources,*
46 *substantially restore natural quiet*¹⁶ *and experience of the park, and protect public health and safety from adverse*
47 *effects associated with aircraft overflights* at Grand Canyon National Park. This action is compliant with the 1987
48 Overflights Act statutory mandate. The proposed action will also meet other applicable provisions of the 1987
49
50

¹⁵ *Letter from FAA Assistant Administrator for Aviation Policy, Planning and Environment Dan Elwell to David M. Verhey,*
Assistant Secretary Fish and Wildlife and Parks dated March 6, 2007; and September 24, 2008, Federal Register notice (73
Federal Register 55130) Accessed at <http://edocket.access.gpo.gov/2008/pdf/E8-22343.pdf>

¹⁶ Natural quiet refers to natural ambient sound conditions found in parks (natural soundscape), meaning all natural sounds that
exist in parks in absence of human-caused noise

1 Overflights Act and the National Parks Air Tour Management Act (Public Law 106-181), as well as other laws,
 2 regulations, policies and objectives of the NPS. In addition, it is intended to be compliant with FAA laws,
 3 regulations and policies regarding aviation safety and airspace management.

4 5 **Objectives**

6
7 NPS has the following objectives for the proposed action

- 8 1. Improve and maintain Substantial Restoration of Natural Quiet and enhance GCNP visitor experience
- 9 2. Provide a reasonable opportunity for visitors to safely experience Grand Canyon by air tour, without adversely
 10 affecting the national airspace system
- 11 3. Protect public health from adverse effects associated with aircraft overflights
- 12 4. Protect wilderness character in Wilderness in the Special Flight Rules Area
- 13 5. Provide primitive recreation opportunities without aircraft intrusions in most backcountry areas, most
 14 Colorado River locations, and destination points accessed by both backcountry and river visitors
- 15 6. Provide recreational opportunities with limited aircraft intrusions for visitors at developed areas along the rim
 16 and major front-county destination points accessible by road
- 17 7. Protect sensitive wildlife habitat and cultural resources
- 18 8. Provide a quality aerial viewing experience while protecting park resources and minimizing conflicts with
 19 other park visitors
- 20 9. Maintain an economically viable and safe air-tour industry

21
22 These objectives are based on several sources including *the 1916 Organic Act, the 1978 Redwoods Act*, the 1987
 23 Overflights Act, the 1995 NPS Report to Congress, the 1996 Presidential Memorandum Earth Day Initiative, Parks
 24 for Tomorrow, and mission statements of agencies participating in the Grand Canyon Working Group. *Alternatives*
 25 *carried forward for analysis must meet project objectives to a large degree, although not necessarily completely*
 26 *or equally.*

27 28 **Need for Action**

29
30 The proposed *action (the Modified NPS Preferred Alternative) to protect resources, substantially restore natural*
 31 *quiet and experience of the park, and protect public health and safety from adverse effects associated with*
 32 *aircraft overflights* in Grand Canyon National Park is needed following a series of FAA rulemaking actions and
 33 National Environmental Policy Act (NEPA) documents issued since 1987 (see Chapter 1, History Leading Up to
 34 This Environmental Impact Statement *and Appendix A, Overflights Chronology*).

35
36 Actions since 1987 have reduced adverse effects of aircraft overflights and increased the amount of GCNP *making*
 37 *progress toward* substantial restoration of natural quiet, with current condition¹⁷ Peak Day¹⁸ *progressing* 55%
 38 *toward* restoration. However, NPS is concerned that sensitive natural and cultural resources and ground-based
 39 visitors in some park areas continue to be adversely affected by aircraft overflights. The park service has determined
 40 additional action is needed to *protect park resources*, achieve Substantial Restoration of Natural Quiet at more than
 41 minimum levels, *improve visitor experience, and ensure protection of resources and restoration of natural quiet*
 42 *and experience is maintained over time.*

43
44 *Although actions since 1987 have reduced adverse effects of aircraft overflights and made progress toward*
 45 *protecting park resources and achieving SRNQ and experience of the park, NPS is concerned that sensitive*
 46 *natural and cultural resources and ground-based visitor experience in some park areas continue to be adversely*

¹⁷ Current Condition is the situation described in Alternative A, No Action/Current Condition

¹⁸ Peak Day *Noise analysis for this EIS is based on a 12-hour time period of 7 a.m. to 7 p.m. on the Peak Day; the day with the highest total number of air-tour and air-tour-related operations. Based on a review of the best available data at the time EIS noise modeling analysis began in 2005, Peak Day occurred August 8, 2005, with a total 635 operations. This day forms the basis for Base Year analyses for the Alternatives. Data for subsequent years was checked to ensure use of 2005 Peak Day as the basis for Base Year analysis was still reasonable*

1 ***affected by aircraft overflights. The park service has determined additional action is needed to protect park***
2 ***resources, achieve SRNQ and experience, and ensure protection and restoration is maintained over time.***

3 On April 22, 1996, President Clinton issued a Presidential Memorandum titled the Earth Day Initiative, Parks for
4 Tomorrow. Among other things, the Memorandum directed the Secretary of Transportation, in consultation with the
5 Secretary of the Interior and the NPS Director, to issue proposed regulations to appropriately limit sightseeing
6 aircraft over GCNP to reduce aircraft noise immediately, and make further substantial progress to restore natural
7 quiet while maintaining aviation safety in accordance with the 1987 Overflights Act.
8

9 In April and May 2000, the FAA adopted Final Rules modifying Special Federal Aviation Regulation 50-2 (SFAR
10 50-2). The Final Rules modified commercial air-tour routes and limited commercial air-tour operations within the
11 SFRA. However, safety concerns were raised concerning portions of the Final Rules, and FAA subsequently
12 determined implementation of proposed commercial air-tour route changes for GCNP's East End should be delayed
13 to address the safety concerns.
14

15 The proposed action also addresses 2002 decision of the D.C. Circuit Court of Appeals in the case of *United States*
16 *Air Tour Association v. FAA*, 298 F.3d 997 regarding the definition of Substantial Restoration of Natural Quiet and
17 noise methodology in the FAA 2000 Final Supplemental Environmental Assessment Special Flight Rules in the
18 Vicinity of the Grand Canyon National Park and Finding of No Significant Impact (FONSI). *Substantial Restoration*
19 *of Natural Quiet* was defined in the NPS 1995 Report to Congress (NPS 1994), and subsequently clarified in 2002
20 and 2008 (see Chapter 1, History Leading Up to This Environmental Impact Statement).
21

22 Finally, the proposed action supports compliance with relevant quiet-technology provisions of section 804 of the
23 National Parks Air Tour Management Act of 2000 (Public Law 106-181).
24

25 To address all of the above needs, on January 25, 2006, the NPS and FAA jointly published a Notice of Intent to
26 Prepare an EIS for Actions to Substantially Restore Natural Quiet to the Grand Canyon National Park in 71 Federal
27 Register 4192.
28

29 In addition to NEPA compliance, changes proposed to SFAR 50-2, as contained in Title 14 of the Code of Federal
30 Regulations (CFR), Part 93, Subpart U, require an FAA rulemaking action. This EIS satisfies NEPA requirements
31 and, once a Record of Decision (ROD) is reached, will lead to an FAA rulemaking.
32

33 This Special Flight Rules in the Vicinity of the Grand Canyon National Park Environmental Impact Statement is
34 written in accordance with the Council on Environmental Quality's (CEQ) implementing regulations for the
35 National Environmental Policy Act; and NPS Director's Order 12, Conservation Planning, Environmental Impact
36 Analysis, and Decision Making.
37

38 **APPROPRIATE USE**

39 Section 1.5 of NPS Management Policies 2006, Appropriate Use of the Parks, directs the NPS to ensure allowed
40 park uses will not cause impairment of, or unacceptable impacts on, park resources and values. A new form of park
41 use may be allowed in a park only after a determination has been made in the professional judgment of the park
42 manager that it will not result in unacceptable impacts.
43
44

45 Section 8.1.2 of NPS Management Policies 2006, Process for Determining Appropriate Uses, provides evaluation
46 factors to determine appropriate uses. All proposals for park uses are evaluated for

- 47 • consistency with applicable laws, executive orders, regulations, and policies,
 - 48 • consistency with existing plans for public use and resource management,
 - 49 • actual and potential effects on park resources and values,
 - 50 • total costs to the National Park Service, and
 - 51 • whether the public interest will be served
- 52

53 Park managers must continually monitor all park uses to prevent unacceptable impacts. If unacceptable impacts
54 emerge, the park manager must engage in a thoughtful, deliberate process to further manage, constrain, or
55 discontinue the use.
56

1 Section 8.2 of NPS Management Policies 2006 states, “To provide for enjoyment of the parks, the National Park
2 Service will encourage visitor use activities that

- 3 • are appropriate to the purpose for which the park was established; and
- 4 • are inspirational, educational, or healthful, and otherwise appropriate to the park environment; and
- 5 • will foster an understanding of and appreciation for park resources and values, or will promote enjoyment
6 through a direct association with, interaction with, or relation to park resources; and
- 7 • can be sustained without causing unacceptable impacts to park resources and values”

8
9 Commercial air tours are an established use at GCNP. Under appropriate circumstances, **commercial air tours can
10 meet EIS objectives in Chapter 1, and can be consistent with applicable laws and policies** and with the park’s
11 General Management Plan (GMP) and related park plans.

12 13 NATURE OF THE FEDERAL ACTION

14
15 The decision by NPS, on behalf of the Secretary of the Interior, is to submit specific recommendations to the FAA
16 for implementation. Under 1987 Overflights Act provisions, the FAA Administrator is required to implement, by
17 appropriate regulation, the Secretary of the Interior’s recommendation without change, unless the Administrator
18 determines implementation would adversely affect aviation safety. FAA rulemaking would follow receipt of the
19 NPS recommendation. A summary of the process is provided in Figures 4.2 to 4.5.

20 21 NPS Mission

22
23 The 1916 NPS Organic Act directs the Department of the Interior and National Park Service to manage national
24 park system units “to conserve the scenery and the natural and historic objects and the wild life therein and to
25 provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the
26 enjoyment of future generations” (16 United States Code 1). Congress reiterated this mandate in the Redwood
27 National Park Expansion Act of 1978, which states the NPS must conduct its actions in a manner that will ensure no
28 “derogation of the values and purposes for which these various areas have been established, except as may have
29 been or shall be directly and specifically directed by Congress” (16 United States Code 1a-1). If a conflict between
30 visitor use and resource protection should occur, this Act confirms Congressional intent to favor resource protection.

31 32 Relationship of NPS and FAA

33
34 As stated in 1987 Overflights Act section 3(b)(1), the Secretary of the Interior is responsible for providing the NPS
35 recommendation to the FAA Administrator regarding “actions necessary for the protection of resources in the Grand
36 Canyon from adverse impacts associated with aircraft overflights. The recommendations shall provide for
37 substantial restoration of the natural quiet and experience of the park and protection of public health and safety from
38 adverse effects associated with aircraft overflight.” Section 3(b)(2) of the 1987 Overflights Act directs the FAA
39 Administrator to implement the recommendations of the Secretary of the Interior without change unless the
40 Administrator determines implementing the recommendations would adversely affect aviation safety. **Aviation
41 safety concerns were discussed between NPS and FAA numerous times during the planning process, and
42 measures to address those concerns were fully integrated into the NPS Preferred Alternative in the DEIS and the
43 Modified NPS Preferred Alternative in this FEIS. Following release of the FEIS, FAA will provide safety
44 concern/risk analysis to NPS concerning the Modified NPS Preferred Alternative, along with suggestions on ways
45 to avoid adverse aviation safety effects as soon as potential problems have been identified.**

46
47 In 2006 NPS and FAA released a Notice of Intent to prepare this EIS as joint lead agencies. However, in **a 2010
48 Resolution (Memorandum signed January 31, 2011 between DOT and DOI)** the agencies clarified their roles and
49 responsibilities under the 1987 Overflights Act. FAA **withdrew** as a joint lead agency in the EIS, **and NPS became**
50 solely responsible for NEPA documentation including environmental analysis and impact determinations to support
51 its recommendations to FAA under the 1987 Overflights Act. The analyses and impact determinations in the EIS
52 **were** made by NPS, and are specific to the 1987 Overflights Act and have no broader application.

53
54 FAA’s implementation of the NPS recommendation is a non-discretionary ministerial action under the Overflights
55 Act. FAA will propose a rule and other necessary actions to regulate air-tour operations over Grand Canyon
56 National Park in accordance with NPS recommendations in the EIS and Record of Decision without change unless

1 there are potential adverse effects on aviation safety—in which case FAA, in consultation with NPS, will eliminate
2 those adverse effects and implement the revised recommendations.

3 4 **GUIDANCE FOR THIS DOCUMENT**

5
6 Direction for Alternatives considered in this EIS is based on applicable legislative mandates, agency policies,
7 administrative commitments, and Grand Canyon Working Group input and recommendations.

8 9 **Legal and Policy Framework**

10
11 The **National Environmental Policy Act of 1969** (NEPA) and its implementing regulations establish a broad
12 national policy to protect and enhance the quality of the human environment and develop programs and measures to
13 meet national environmental goals.

14
15 **Public Law 100-91, hereafter referred to as the 1987 Overflights Act**, requires *protection of resources, substantial*
16 *restoration of natural quiet and experience of the park, and protection of public health and safety from adverse*
17 *effects associated with aircraft overflights* in Grand Canyon National Park. Section 3(b) mandates the Secretary of
18 the Interior submit to the FAA Administrator recommendations “regarding actions necessary for the protection of
19 resources in the Grand Canyon from adverse impacts associated with aircraft overflights. The recommendations
20 shall provide for substantial restoration of the natural quiet and experience of the park and protection of public
21 health and safety from adverse effects associated with aircraft overflight.”

22
23 Section 804 of the **National Parks Air Tour Management Act of 2000** (Public Law 106-181) requires a rule
24 establishing routes or corridors for commercial air-tour operations that employ quiet-aircraft technology for Grand
25 Canyon tours originating in Clark County, Nevada, and local-loop tours originating at Grand Canyon National Park
26 Airport¹⁹ in Tusayan, Arizona. These routes or corridors can be designated only in areas that will not negatively
27 impact substantial restoration of natural quiet, tribal lands, or safety. Commercial air-tour operations by fixed-wing
28 or helicopter aircraft that employ quiet-aircraft technology and replace existing aircraft, or were in an operator’s
29 fleet on the date of enactment of this Act, or were subsequently modified to meet quiet-technology requirements,
30 shall not be subject to use of an annual allocation as applies to other commercial air-tour operations flying over the
31 park—provided the cumulative impact of such operations does not increase noise at Grand Canyon or negatively
32 affect achieving Substantial Restoration of Natural Quiet at the park.

33
34 The **Wilderness Act** states Wilderness must be managed in a manner that leaves it unimpaired for future use and
35 enjoyment as Wilderness. In 1993, the NPS prepared an update to the original 1980 Final Wilderness
36 Recommendation that proposed that 1,139,077 acres in the park (94% of the park’s total area) be designated as
37 wilderness. Of this total area, 1,109,257 acres were proposed for immediate designation and 29,820 acres were
38 proposed as potential wilderness (NPS 1993). NPS Management Policies 2006 and Director’s Order 41, Wilderness
39 Preservation and Management, stipulate the NPS will take no actions that would diminish Wilderness eligibility of
40 lands proposed for Wilderness designation until Congress and the President have taken final action. Thus, most of
41 the park is being managed as *de facto* Wilderness.

42
43 Section 7 of the **Endangered Species Act** charges all Federal agencies aid in conservation of listed species (Section
44 7[a][1]), and requires Federal agencies ensure their activities are not likely to jeopardize continued existence of
45 listed species or adversely modify designated critical habitats (Section 7[a][2]).

46
47 Section 106 of the **National Historic Preservation Act** (NHPA) requires Federal agencies take into account effects
48 of their undertakings on historic properties, including traditional cultural properties, either listed in, or eligible to be
49 listed in, the National Register of Historic Places. The National Register includes districts, sites, buildings,
50 structures, and objects important for their significance in American history, architecture, archeology, engineering,
51 and culture. Historic properties listed in the National Register can be significant to a local community, state, tribe, or
52 the nation as a whole.

¹⁹ Grand Canyon National Park Airport is located outside Grand Canyon National Park in the town of Tusayan, Arizona, and is also referred to in this document as Grand Canyon Airport

1 **NPS Management Policies 2006** sets policy for topics addressed in this EIS including public participation,
2 environmental analysis, Wilderness, natural and cultural resource management, and use of national parks.
3 Additionally, Management Policies directs NPS take all necessary steps to avoid or mitigate unacceptable impacts
4 from aircraft overflights and work cooperatively with FAA, national defense, and other agencies to ensure
5 authorized aviation activities affecting national park system units occur in a safe manner and do not cause
6 unacceptable impacts on park resources and values and visitor experiences (Section 8.4).

7
8 **NPS Director's Order 12, Conservation Planning, Environmental Impact Analysis, and Decision Making,**
9 establishes guidance by which the NPS carries out its responsibilities under the National Environmental Policy Act.

10
11 **NPS Director's Order 28, NPS Cultural Resource Management Guideline,** provides basic guidance and
12 procedures for NPS managers, planners, and cultural resource specialists to effectively carry out cultural resources
13 research, planning, and stewardship. In accordance with applicable laws and policies, NPS Director's Order 28
14 provides specific guidance for management of archeological resources, historic/prehistoric structures, cultural
15 landscapes, Ethnographic Resources, and museum collections.

16
17 **NPS Director's Order 47, Soundscape and Noise Management,** sets NPS guidance and procedures regarding
18 Soundscape management. The order states NPS policies will "require, to the fullest extent practicable, the
19 protection, maintenance, or restoration of the natural Soundscape resource in a condition unimpaired by
20 inappropriate or excessive noise sources." The order further states that in planning for Soundscape preservation and
21 noise management, park managers "must use the best science available to determine the impact of existing or
22 proposed noise sources on the Soundscape, wildlife..., cultural resources, other resources and values, and the visitor
23 experience, as appropriate."

24
25 **Title 14 of the Code of Federal Regulations, Part 93, Subpart U, Special Flight Rules in the Vicinity of Grand**
26 **Canyon National Park, Arizona,** prescribes special operating rules for all persons operating aircraft in airspace in
27 the vicinity of the park. Although certain provisions could change if an Alternative considered in this EIS was
28 implemented, other provisions would not change including: general operating procedures (section 93.309),
29 minimum terrain clearance requirement (section 93.311), requirements for commercial SFRA operations (section
30 93.315), most provisions regarding transfer and termination of annual allocations (section 93.321), and procedures
31 for determining quiet-aircraft technology designation status for each aircraft (Appendix A to Subpart U).

32 33 **Court-Mandated Direction**

34
35 In 2002, the U.S. Circuit Court of Appeals denied the U.S. Air Tour Association's challenge to the Air Tour
36 Limitation Rule. *However, in response to a challenge of the same rule by the Grand Canyon Trust,* the Court ruled
37 the NEPA document's²⁰ use of an average annual day for measuring Substantial Restoration of Natural Quiet is
38 inconsistent with the NPS definition. The Court *also* held that, in the absence of any reasonable justification,
39 excluding non-tour aircraft from the noise model methodology was arbitrary and capricious, requiring
40 reconsideration (See Appendix A for GCNP restoration of natural quiet history).

41 42 **Special Mandates and Administrative Commitments**

43
44 Special mandates and administrative commitments related to this document include

45
46 The **Grand Canyon Working Group** was established under authority of the National Parks Overflights Advisory
47 Group,²¹ and consisted of representatives from NPS, FAA, air-tour operators, environmental groups, tribes,
48 commercial and general aviation, recreational interests, and other Federal agencies. The Working Group developed
49 recommendations for proposed actions to meet the statutory mandate contained in the 1987 Overflights Act.

²⁰ Federal Aviation Administration issued the Final Supplemental Environmental Assessment Special Flight Rules in the Vicinity of the Grand Canyon National Park and Finding of No Significant Impact 2000

²¹ National Parks Overflights Advisory Group (NPOAG) – Advisory group of representatives of FAA, NPS, general aviation, air-tour operators, environmental concerns, and Indian tribes established by the Air-tour Management Act of 2000 to provide continuing advice and counsel on commercial air-tour operations over and near national parks

1 Specifically, the purpose was to: review data and analysis, identify and review issues related to overflight noise, and
2 consider a variety of Alternatives to address the issues. (Information on the Grand Canyon Working Group accessed
3 at http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/grand_canyon_overflights/documents/documents_list.cfm
4

5 An April 22, 1996, **Presidential Memorandum**, Earth Day Initiative, Parks for Tomorrow, called for Substantial
6 Restoration of Natural Quiet in GCNP to be achieved by April 22, 2008.

7 8 **BACKGROUND**

9 10 **Grand Canyon National Park Description**

11
12 Map 1.1 shows the Grand Canyon National Park vicinity. The park, established in 1919, encompasses approximately
13 1,216,000 acres of public land on the Colorado Plateau's southern end, and is a globally significant natural resource
14 containing scenic vistas known throughout the world. In recognition of its significant values, GCNP was designated
15 a World Heritage Site on October 26, 1979.

16
17 A 277-mile stretch of the Colorado River runs through GCNP, and thousands of miles of tributary side canyons are
18 included in the boundaries. The exposed geologic strata—layer upon layer from the bedrock Vishnu Schist to the
19 capping Coconino Limestone—rise more than a mile above the Colorado River, representing one of the most
20 complete geologic records seen worldwide.

21
22 Eleven American Indian tribes attach traditional cultural significance to Grand Canyon, the Colorado River, and
23 various sites and resources in Grand Canyon's landscape. Many GCNP sites and resources are considered sacred by
24 tribal communities and integral to maintaining beliefs, ancestral ties, and cultural identities of these communities.
25 Among Grand Canyon's *traditionally associated* tribes, land of the Havasupai Tribe, Hualapai Tribe, and Navajo
26 Nation adjoin GCNP's boundary.

27
28 GCNP contains several major ecosystems—from the lower canyon's Sonoran Desert to North Rim's coniferous
29 forest. Many plant and animal species make up these diverse ecosystems. Although many wild creatures live their
30 entire lives in the protected park, migratory species also benefit from park sanctuary.

31
32 More than four million recreational visits are recorded each year, primarily on South Rim. Recreational pursuits
33 include sightseeing, river running, hiking, photography, and nature study. However, a Grand Canyon vacation can
34 become more than a recreational or scenic venture. The canyon's grandeur and awesome physical forces can
35 transform a perceptive visitor's experience from a casual trip to one that influences stewardship responsibilities.
36

37 **Park Purpose and Significance**

38 39 **Purpose of Grand Canyon National Park**

40 Park purpose is based on enabling legislation and legislation governing the NPS. As a place of national and global
41 importance, the park will be managed to

- 42 • preserve and protect its natural and cultural resources and ecological processes, as well as its scenic, aesthetic,
43 and scientific values
- 44 • provide opportunities for visitors to experience and understand environmental interrelationships, resources, and
45 values without impairing resources

46 47 **Significance of Grand Canyon National Park**

48 Grand Canyon's national and international significance includes

- 49 • Designation as a World Heritage Site, a place of universal value, containing superlative natural and cultural
50 features preserved as the heritage of all people
- 51 • Grand Canyon is an ecological refuge, with relatively undisturbed remnants of dwindling ecosystems (such as
52 boreal forest and desert riparian communities), and numerous rare, endemic, or specially protected
53 (threatened/endangered) plant and animal species
- 54 • A natural gene pool due to biological diversity and unique conditions

- 1 • Grand Canyon’s geologic record is particularly well exposed and includes a rich and diverse fossil record, and a
- 2 great diversity of geological features and rock types
- 3 • Numerous caves contain extensive and significant geological, paleontological, archeological, and biological
- 4 resources
- 5 • Eleven American Indian tribes have identified cultural ties to Grand Canyon, with some considering the canyon
- 6 their original homeland and place of origin
- 7 • More than 12,000 years of human occupation resulted in an extensive archeological record, hundreds of miles
- 8 of established prehistoric and historic routes and trails, and nationally significant examples of rustic architecture
- 9 • Grand Canyon has internationally recognized scenic vistas, qualities, and values
- 10 • Grand Canyon is recognized as a place with unusual and noticeable natural quiet and direct access to numerous
- 11 opportunities for solitude
- 12 • All of the natural, cultural, and scenic qualities of the Grand Canyon, coupled with the canyon’s vast size, give
- 13 rise to inspirational/spiritual values and a sense of timelessness
- 14 • The vast majority of the park provides opportunities for Wilderness experiences
- 15 • The Colorado River, as it flows through the park, provides opportunities for one of the world’s premier river
- 16 experiences, including one of the longest stretches of navigable whitewater on earth

17 SCOPE OF ANALYSIS

18 Geographical Boundary of the Study Area

19
20
21
22 The Study Area (Map 1.2) for this EIS includes the park boundary and the entire Special Flight Rules Area. The
23 Study Area’s size is identical to the Study Area for the 2000 Supplemental EA, and defined by the smallest
24 rectangular box encompassing the whole SFRA—about 140 miles east-west and about 85 miles north-south, and
25 encompasses GCNP as well as adjacent tribal and other Federal lands. Within the Study Area, the NPS administers
26 Grand Canyon National Park, Lake Mead National Recreation Area, Glen Canyon National Recreation Area, and
27 Grand Canyon-Parashant National Monument. Owners and managers of other lands within the Study Area are
28 specified in Chapter 3.

29
30 This EIS focuses primarily on the SFRA in describing the Affected Environment and analyzing impacts of
31 Alternatives. However, to assess Cumulative Effects of noise from flights and other sources outside the SFRA that
32 may be affecting GCNP, the Study Area is larger than the Special Flight Rules Area.

33 Altitude Boundary and Types of Flights Included in Analysis

34
35
36 Airspace at and above 18,000 feet MSL is considered Class A airspace, and aircraft operations must be in
37 accordance with Federal Aviation Regulation Part 91. Federal Aviation Regulation 91.135, among other things,
38 requires pilots be in contact with FAA air traffic controllers. Airspace at 17,999 feet MSL and below is divided into
39 four categories identified as Class B, C, D, or E. Class G airspace (with no air traffic controller requirements) also
40 exists in some parts of the U.S. below 14,499 feet MSL—primarily in the western U.S. Each of these airspace
41 classes has separate requirements, contained in Federal Aviation Regulation Part 91, to which a pilot must adhere.
42 Requirements for pilots operating in the SFRA in the vicinity of GCNP are contained in Federal Aviation Regulation
43 Part 93, Subpart U.

44
45 All aircraft categories shown below were analyzed to assess effects on Substantial Restoration of Natural Quiet and
46 other impact topics. All air-tour and air-tour-related operations *below* 18,000 feet MSL and within the SFRA are
47 analyzed in this EIS. All aircraft operating at or *above* 18,000 feet MSL in the Study Area’s lateral boundaries
48 including military, high-altitude commercial and general-aviation overflights, are included in analysis of Cumulative
49 Effects. For the purpose of this EIS, overflights are divided into the following categories

Air-Tour and Related Operations Categories

Air Tours	Advertised air-tour flights and charter flights offered by commercial air-tour operators
Grand Canyon West	Helicopter and fixed-wing air-tour flights that land at the Hualapai Reservation. Helicopter flights generally fly between the Las Vegas area and Grand Canyon West Airport on the reservation and/or helipads on Hualapai lands along the Colorado River. Most fixed-wing flights fly between the Las Vegas area and Grand Canyon West Airport. Flights are <i>currently not subject to</i> using an annual allocation according to Federal Aviation Regulations Part 93
Over the Edge/ Elevator Flights	Helicopter flights between Grand Canyon West Airport and helipads on Hualapai land along the Colorado River
Transportation, Repositioning, Maintenance, etc.	Aggregate category of all flight operations supporting air tours. Transportation is non-tour, commercial transportation flights only, which typically occur between Las Vegas and Grand Canyon National Park Airport, but could occur between any two points. Repositioning refers to a non-tour operation by an air-tour operator moving an aircraft for logistical reasons
Brown Routes	Non-tour routes used with enough regularity and consistency they have been charted for pilot awareness and general safety. Most Brown route activity supports various Native American operations, such as river-related traffic in and out of Bar Ten and Whitmore Wash, and travel to and from Supai Village
Other Aircraft Overflights	Military, general aviation, and administrative flights operating at or below 17,999 feet MSL in the Study Area

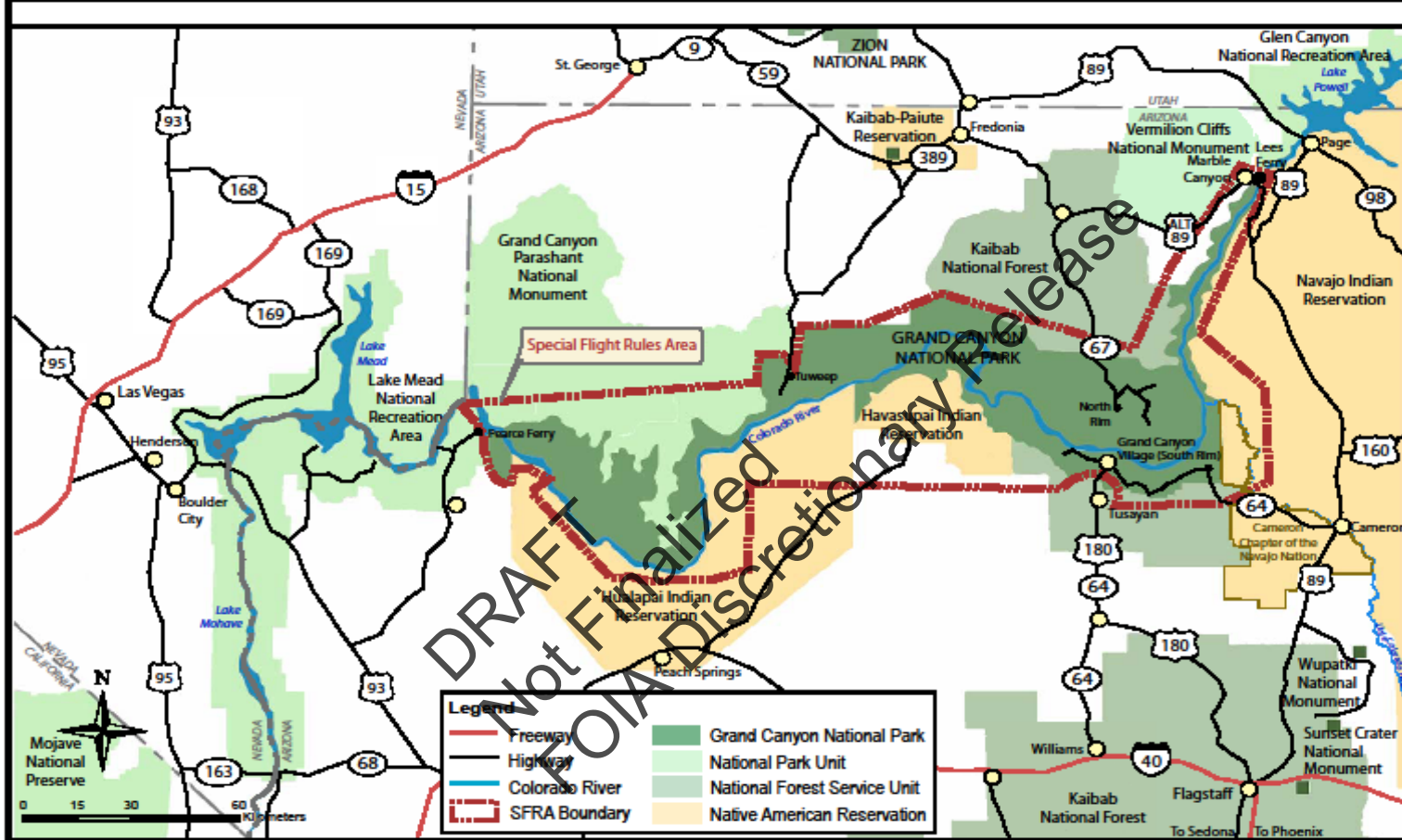
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6

Time Frame

This EIS analyses conditions for a ten-year period.

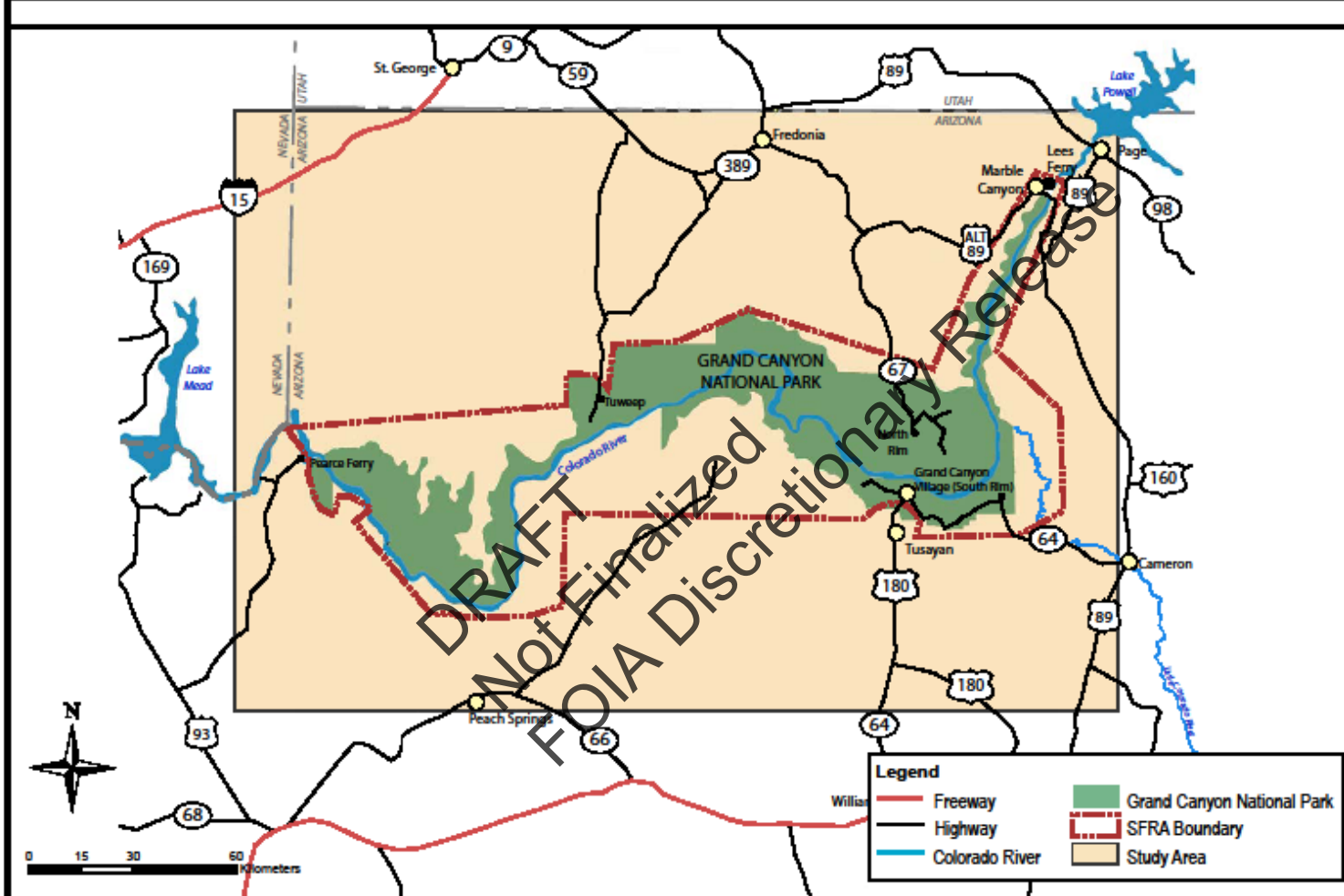
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Map 1.1 Grand Canyon National Park and Vicinity



Map 1.2

Study Area



1 **Hualapai Tribe *Exception***

2
3 The Federal government granted the Hualapai Tribe an *exception* from commercial air-tour annual allocations
4 requirement per the April 4, 2000, FAA commercial air-tour limitation rule in the *GCNP SFRA* (14 CFR Part
5 93.319). This rule was issued by FAA as one part of an overall strategy to control aircraft noise, and assist NPS in
6 achieving its statutory mandate to substantially restore natural quiet at GCNP. . This exception *did not and* does not
7 relieve operators associated with the *Hualapai* Tribe from other restrictions while flying over GCNP and within the
8 SFRA.
9

10 *However, the 2000 Rulemaking made clear the Hualapai exception was based on economic impacts. The*
11 *allocations rule was intended to temporarily limit commercial air tours and be revisited at a later date. Because 1)*
12 *flights currently not subject to allocations have increased exponentially adding significant noise to Grand*
13 *Canyon, 2) the Grand Canyon West Airport and related development on Hualapai tribal lands has increased*
14 *greatly since 2000, and 3) comments received during the DEIS public comment period brought attention to the*
15 *significant increase in impacts from these flights without limits, which could undo many of the gains realized by*
16 *the measures in this EIS, NPS intends to examine the entire allocation system parkwide, including flights*
17 *currently not subject to allocations, in a subsequent planning effort building on this EIS process. This will likely*
18 *require additional NEPA compliance and FAA rulemaking.*
19

20 **Quiet-Technology Allocation Exemption**

21
22 Section 804 of the National Parks Air Tour Management Act (Public Law 106-181) addresses quiet-aircraft
23 technology requirements for Grand Canyon National Park. Section 804(b) requires establishment of routes or
24 corridors for commercial air-tour operations employing quiet technology, provided the routes or corridors can be
25 located in areas that will not negatively impact substantial restoration of natural quiet, tribal lands, or safety.
26 Sections 804(c) and (d) provide that commercial air-tour operations at GCNP employing quiet-aircraft technology
27 that replace or modify an existing aircraft shall not be subject to annual flight allocations that apply to other
28 commercial air-tour operations provided the cumulative impact of such operations does not increase noise at Grand
29 Canyon. Section 804(e), *indicates* that nothing in the National Parks Air Tour Management Act shall be construed to
30 relieve or diminish the statutory mandate under Public Law 100-91 to achieve *protection of resources, substantial*
31 *restoration of natural quiet and experience of the park, and protection of public health and safety from adverse*
32 *effects associated with aircraft overflights* at GCNP and obligations of the Secretary and Administrator to
33 promulgate regulations to achieve substantial restoration.
34

35 **The Modified NPS Preferred Alternative** would phase-in over time additional quiet-technology routes until all
36 routes may be used only by quiet-technology aircraft after ten years. This would include *the* long-loop route *when*
37 *open during Peak Season*, phased-in over a four-year period (see Chapter 2). The **Modified NPS Preferred**
38 **Alternative** would provide a quiet-technology annual allocation exemption period January through March (but the
39 **Modified NPS Preferred Alternative's** daily cap would still apply). NPS would continue to monitor and collect data
40 regarding quiet-technology operations, and could phase-in additional periods for the quiet-technology annual
41 allocation exemption if found consistent with Section 804.
42

43 **Alternative E** would provide 1.5 hours at the beginning of each flight day and 2.5 hours at the end when only
44 aircraft using best available quiet technology would be allowed to fly. At the end of a time period to be agreed upon,
45 all routes would be open only to aircraft using best available quiet technology.
46

47 **Alternative F** would immediately provide two routes open only to quiet-technology aircraft, with all routes open
48 only to quiet-technology aircraft after 10 to 12 years. It also would forgive air-tour fees for operations using quiet
49 technology, and would eliminate the requirement to use an annual allocation for quiet-technology operations if the
50 additional flights did not adversely impact substantial restoration of natural quiet.
51

52 **Alternative A** does not include quiet-technology incentives, routes, or conversion requirements.
53
54

1 **Administrative Flights**

2
3 Administrative flights are conducted by the park, tribes, U.S. Forest Service (USFS), and Bureau of Land
4 Management (BLM), that administer lands within the SFRA, as well as non-Federal entities (e.g., law enforcement
5 agencies, *utilities*). These flights are managed under FAA 7711-1 waivers, and are *generally* not subject to measures
6 considered in the Alternatives. FAA 7711-1 waivers are issued by FAA to allow regulatory deviations when *FAA*
7 determines a proposed operation can be safely conducted. In the context of this EIS, 7711-1 waivers or special
8 authorizations allow for deviations from certain operational SFRA requirements. They are issued to safely
9 accommodate certain operations by governmental, tribal, or other entities that could not otherwise be accomplished
10 within the existing regulatory framework.

11 **Associated Transport Flights of River Passengers**

12
13
14 Whitmore river-passenger exchanges occur April through September generally by 10 a.m. River passenger
15 exchanges (helicopter flights) are *not prohibited* under the provisions of the 1987 Overflights Act, *per section 3(c)*.
16 FAA regulates associated transport flights on Brown routes to/from Bar Ten airstrip. Thus, these flights are not
17 subject to measures considered in Alternatives such as use of an annual allocation or daily cap.

18 **RELATIONSHIP WITH OTHER RULES, PLANS, OR DOCUMENTS**

19
20 Several plans that have or may influence this EIS are described briefly here, along with relationship to this EIS.

21 **1995 General Management Plan for Grand Canyon**

22
23
24 Grand Canyon's 1995 General Management Plan provides management objectives and park vision. The GMP
25 indicates the NPS would discourage changes at Grand Canyon National Park Airport in Tusayan that would result in
26 increased noise pollution in the park. The GMP also designated park Management Zones and recognized the
27 importance of park natural quiet and scenic resources.

28 **Colorado River Management Plan**

29
30
31 The 2006 Colorado River Management Plan (CRMP) determines Colorado River recreational use management.
32 Helicopter transport of river passengers from the designated helipad on the Hualapai Reservation near Whitmore
33 Wash to a point on the north rim outside GCNP (Bar Ten airstrip) is *excepted* from provisions of the 1987
34 Overflights Act, per section 3(c). The Hualapai determine which helicopters fly in and out of Whitmore; however,
35 NPS regulates number and timing of Whitmore river passenger exchanges. The CRMP spread number of launches
36 by day of week and throughout the week, reduced trip size, and expanded use season thereby reducing the number of
37 people on the river at one time.

38
39
40 The Hualapai Tribe also manages helicopter use carrying passengers to and from helicopter pads on Hualapai land in
41 the Quartermaster Canyon area and Grand Canyon West airport. These helicopters allow access and egress for day
42 trips and short pontoon trips. The trips provide a viewing opportunity, and sometimes refreshments, before
43 transporting passengers out of the canyon. While the CRMP regulates river use, the NPS does not regulate helicopter
44 use across tribal lands outside park boundaries.

45 **South Rim Visitor Transportation Management Plan**

46
47
48 South Rim Visitor Transportation Management Plan (NPS 2008e) *was implemented* in 2010 to provide a
49 transportation system that addresses the park's most pressing transportation issues. The Plan affects how visitors
50 access South Rim and circulate among points of interest. In addition, the Plan affects GCNP visitation distribution,
51 improves South Rim transportation, and benefits overall visitor experience. Although the Plan did not address
52 aircraft overflights, they were considered in analyzing Cumulative Impacts.

1 **Backcountry Management Plan**

2
3 *NPS is initiating the process to revise the 1988 Backcountry Management Plan (BCMP) to comply with the 1995*
4 *General Management Plan and NPS Management Policies 2006. The Plan's scope will include visitor use and*
5 *backcountry access, natural and cultural resource stewardship, and proposed Wilderness. The plan will*
6 *complement other recently completed plans such as the Colorado River Management Plan and Fire Management*
7 *Plan. It is expected Corridor Trails (Bright Angel, and North and South Kaibab) will be included in the plan.*
8 *Although the plan does not address aircraft overflights, the BCMP is considered in Cumulative Impacts in this*
9 *EIS (See Appendix G).*

10 **Grand Canyon—Parashant National Monument Management Plan and Environmental Impact Statement**

11
12
13 The Resource Management Plan and Environmental Impact Statement for the Arizona Strip Field Office, the
14 Vermilion Cliffs National Monument and the Bureau of Land Management portion of Grand Canyon—Parashant
15 National Monument, and General Management Plan and Environmental Impact Statement for the NPS portion of
16 Grand Canyon Parashant National Monument (BLM 2007) addresses land-use desired conditions on the Bureau of
17 Land Management public domain, as well as within the national monument. Changes in aircraft routes proposed in
18 this EIS could affect portions of Grand Canyon—Parashant National Monument, and thus are considered in analysis
19 of impacts in this EIS.

20 **Kaibab National Forest Management Plan**

21
22
23 The U.S. Forest Service manages lands on the Kaibab National Forest near and adjacent to GCNP on both North and
24 South Rims, including Ten X Campground, Coconino Rim Semi-primitive Non-motorized Use Area, Kanab Creek
25 Wilderness, and Saddle Mountain Wilderness. A 1988 Forest Management Plan (amended in 2008 (USFS 2008),
26 provides guidance for forest resource management, recreation and other activities. In 2010, the U.S. Forest Service
27 initiated an EIS while developing a revised land management plan for the Kaibab National Forest. The revised plan
28 will address desired conditions, including resources such as natural quiet that may be affected by GCNP overflights.
29 Changes in aircraft routes proposed in this EIS could affect portions of the Kaibab National Forest, and thus are
30 considered in analysis of impacts in this EIS.

31 **U.S. Fish and Wildlife Service Biological Opinion on Proposed Revisions to Flight Rules in the Vicinity of** 32 **Grand Canyon National Park (2000)**

33
34
35 The U.S. Fish and Wildlife Service (USFWS) issued a Biological Opinion (BO) (USFWS 2000) in response to the
36 November 8, 1999 NPS Biological Assessment (BA) on proposed new flight rules in the vicinity of GCNP, as
37 required under the Endangered Species Act's Section 7. Formal consultation addressed only proposed flight rules
38 changes in the 1999 Supplemental EA. Formal consultation will be conducted as required, prior to issuance of a
39 ROD, with the USFWS under the Endangered Species Act and 50 CFR 402.16 due to proposed modifications in
40 flight routes and operations. *See Chapter 5, Consultation and Coordination, for recent consultations with*
41 *USFWS.*

42 **PUBLIC AND INTERNAL SCOPING**

43 **Description of Scoping Process**

44
45
46
47 Scoping is the early and open process for determining the range of issues to be addressed during the planning
48 process. The general public; NPS and FAA staff; representatives from state, tribal, and Federal agencies; and
49 representatives from various organizations identified issues and concerns during scoping for this EIS. Comments
50 were solicited during a series of public meetings, through planning newsletters, and from stakeholders. An account
51 of the public scoping process is provided in Chapter 5. Appendix C includes a summary of the 2006 public scoping
52 comments. Appendix H includes DEIS public comments and responses.

53
54 *On February 4, 2011, NPS released the Draft Environmental Impact Statement, Special Flight Rules Area in the*
55 *Vicinity of Grand Canyon National Park, Actions to Substantially Restore Natural Quiet, through a Notice of*
56 *Availability (NOA) posting, for public review and comment. The DEIS was designed to provide a comprehensive*

1 *look at impacts to natural and cultural resources and visitor experience from current overflight activity in Grand*
2 *Canyon National Park and from proposed actions to substantially restore natural quiet. The DEIS evaluated four*
3 *Alternatives proposed to help NPS achieve its mission to preserve park resources while achieving goals and*
4 *objectives listed in Chapter 1.*
5

6 *The DEIS Notice of Availability posting by EPA in the Federal Register (February 18, 2011)²², initiated a formal*
7 *120-day public comment period ending June 20, 2011. Public meetings to provide an overview of the DEIS and*
8 *accept public comment were held in Phoenix and Flagstaff, Arizona, and Henderson, Nevada, and attended by*
9 *174 people. Press releases, website updates, and public meetings were used to request public input and*
10 *disseminate information about DEIS Alternatives and their impacts. During the public comment period, NPS*
11 *received approximately 29,000 submissions (correspondence) at public meetings, via the NPS Planning,*
12 *Environmental and Public Comment website, email, and regular mail from the public, tribes, agencies,*
13 *organizations, and businesses. Substantive comments are addressed as revisions to this FEIS in bold italic text or*
14 *as responses to comments in Appendix H.*
15

16 **IMPACT TOPICS**

17
18 An important part of planning is seeking to understand consequences of making one decision over another.
19 Environmental impact statements identify anticipated impacts of possible actions on resources, park visitors, and
20 neighbors. Impacts are organized by topic, such as “impacts on the visitor experience” or “impacts on vegetation and
21 soils.” Impact topics focus environmental analysis and ensure relevance of impact evaluation. Impact topics
22 identified for analysis are outlined in this section; they were identified based on Federal laws and other legal
23 requirements, Council on Environmental Quality regulations, NPS policies and guidelines, staff subject-matter
24 expertise, and issues and concerns expressed by the public, tribes, and other agencies early in the planning process
25 (see previous section). Also included is a discussion of some impact topics considered but not analyzed in detail in
26 this EIS for the reasons given below.
27

28 **Impact Topics Retained for Analysis**

29
30 Impact topics or components of the human environment possibly affected by the Alternatives and analyzed in detail
31 in this EIS include
32

33 **Soundscape**

34 NPS Management Policies 2006 and NPS Director’s Order 47, Sound Preservation and Noise Management (NPS
35 2000), recognize natural Soundscapes are a park resource, and call for the NPS to preserve, to the greatest extent
36 possible, the park’s natural Soundscapes. NPS Management Policies and Director’s Orders further state NPS staff
37 will restore degraded Soundscapes to the natural condition whenever possible, and will protect natural Soundscapes
38 from degradation due to noise. Noise can adversely affect, directly and indirectly, natural Soundscape, Wildlife, and
39 other park resources. Noise can also adversely impact Visitor Experience. Visitors have opportunities to experience
40 tranquility in an environment of natural sounds in many park areas. Alternative actions that could potentially
41 increase or decrease sound level in GCNP due to aircraft overflights within the SFRA at or below 17,999 feet MSL
42 are of concern to visitors, tribes, businesses, the public, private landowners, adjacent land managers, other Federal
43 agencies, and NPS managers and are analyzed in this EIS.
44

45 (Note: Soundscape is only analyzed for Grand Canyon National Park and other NPS units within the Special Flight
46 Rules Area. Effects of noise on Visitor Use and Experience, Wildlife, Special Status Species, and Wilderness
47 Character are addressed under those impact topics.)
48

49 **Wilderness Character**

50 Ninety-four percent of Grand Canyon National Park is proposed for Wilderness designation. In accordance with
51 NPS policies, lands proposed for Wilderness designation are managed as Wilderness until Congress acts to
52 designate Wilderness or remove it from consideration. Wilderness Character, including opportunities for solitude

²² Accessed at: 76 FR 9575. <https://federalregister.gov/a/2011-3720>

1 and/or primitive, unconfined recreation, and apparent naturalness, are key to many visitors' experiences and to park
2 management. In addition, several existing and proposed Wilderness areas exist outside GCNP, but within the Study
3 Area, including designated Wilderness in Grand Canyon-Parashant National Monument, Kaibab National Forest,
4 and in Lake Mead National Recreation Area's Arizona and Nevada portions. Alternatives under consideration could
5 result in changes in sound level, sound presence, and visual appearance (i.e., low-flying aircraft) over existing or
6 proposed Wilderness areas. Impacts on existing or proposed Wilderness areas are of concern to visitors, the public,
7 and managing Federal agencies.

9 **Ethnographic Resources**

10 An ethnographic resource is "a site, structure, object, landscape, or natural resource feature assigned traditional
11 legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with
12 it" (NPS 1998). Ethnographic Resources traditionally significant to Grand Canyon's *traditionally associated* tribes
13 may be affected by actions proposed in this EIS regarding air-tour overflights. Therefore, potential impacts on
14 Ethnographic Resources are analyzed in this EIS.

16 **Visitor Use and Experience**

17 One of the purposes of national parks is to provide for public enjoyment, education, and inspiration. GCNP's high-
18 quality visitor experiences attract visitors from around the world. River running, backpacking, day hiking,
19 sightseeing, camping, and wildlife viewing are some of the many opportunities offered. Commercial air-tour aircraft
20 flying over GCNP have noise, visual, and potentially related aesthetic effects that can affect the experience of
21 ground-based visitors. Changes in flight routes and/or air-tour operations could affect the experience of ground-
22 based visitors in different parts of the park. These changes are of concern to visitors, NPS managers, and the public.

24 GCNP offers superlative opportunities for visitors to see the park from ground or air. Air tours attract visitors
25 worldwide who want to see Grand Canyon from the air. As with ground-based visitors, changes in flight routes
26 and/or air-tour operations could affect the experience of air-tour visitors. These changes would be of concern to
27 visitors, air-tour operators, NPS managers, and the public and are thus analyzed in this EIS.

29 **Wildlife**

30 Grand Canyon supports a diverse wildlife population, including insects, birds, reptiles, amphibians, and mammals.
31 The park's wildlife populations are an important resource and one of the attractions that add to the quality of visitor
32 experience. Some of GCNP's birds (e.g., golden eagles and other nesting raptors) and mammals (e.g., bighorn) are
33 susceptible to disturbance from noise. Potential impacts of concern would be modification of animal behavior in
34 response to overflights, and alteration of feeding, breeding, and socializing habits. Indirect effects of concern would
35 be accidental injury, energy loss, and impacts to offspring survival (NPS 1994). Adverse impacts on wildlife would
36 be of concern to visitors, the public, and NPS managers and are analyzed in this EIS.

38 **Special Status Species**

39 The Endangered Species Act of 1974, as amended, requires examination of impacts on all Federally listed
40 threatened or endangered species. NPS Management Policies 2006 repeats this requirement and adds the stipulation
41 that analysis examine impacts on state-listed species and Federal species proposed for listing. Federally listed
42 threatened and endangered species of concern include the Mexican spotted owl (*Strix occidentalis lucida*),
43 California condor (*Gymnogyps californianus*), and southwestern willow flycatcher, (*Empidonax traillii extimus*).
44 **While not federally listed, other species of concern are** American peregrine falcon (*Falco peregrinus anatum*), **bald**
45 **eagle (*Haliaeetus leucocephalus*), and golden eagle (*Aquila chrysaetos*).** Changes in flight routes and/or aircraft
46 operations, noise, visual effects, and proximity to species are evaluated in this EIS, including potential for collisions
47 between birds and aircraft, whether low-level flights over species and habitat would result in harassment, disruption
48 of normal behavior patterns, and other effects. Any actions that would adversely affect these species are of concern
49 to the USFWS, NPS managers, other agencies, tribes, and the public and are thus analyzed in this EIS.

51 **Socioeconomic Environment**

52 NEPA requires examination of social and economic impacts caused by Federal actions as part of a complete analysis
53 of potential impacts on the human environment. Consideration will be given to potential economic effects on air-
54 tour operators, general aviation, commercial carriers, tribal enterprises, and local and regional economies. Issues for
55 consideration include income from tourism, fuel consumption, employment, intrinsic value, and logistical costs.
56 Therefore, potential impacts on socioeconomic environment are analyzed in this EIS.

1 **Impact Topics Considered and Dismissed from Detailed Analysis**

2
3 Council on Environmental Quality Regulations for Implementing the National Environmental Policy Act (40 CFR
4 Part 1500-1508), and NPS Director's Order 12 require an EIS to identify and focus on significant environmental
5 issues and de-emphasize and eliminate from detailed review insignificant or non-applicable issues. Accordingly, the
6 following issues are not analyzed in this EIS. *Effects to topics in this section are expected to be minor or less.*

7 8 **Air Quality and Climate Change**

9 Grand Canyon National Park is classified as a mandatory Class I area under the Clean Air Act (42 United States
10 Code 7401 et seq.). Under this most stringent air quality classification, it is mandated GCNP be protected against
11 degradation of air quality and an increase in air pollution. Furthermore, the Clean Air Act sets the goal of natural
12 visibility conditions, free of human-caused haze. NPS Management Policies 2006 provide guidance for protection of
13 air quality under both the 1916 NPS Organic Act and the Clean Air Act to ensure the best possible air quality in
14 parks and actively promote and pursue measures to protect air-quality-related values. Current park air quality is
15 generally good, with pollution levels generally below those established by the U.S. Environmental Protection
16 Agency (EPA) to protect human health. However, the EPA has proposed ranges of more stringent national health
17 and welfare standards for ozone. Depending on levels of the final standards, measured ozone at GCNP could violate
18 the new standards, and the park could be designated as a nonattainment area for ozone. Although conformity
19 requirements would apply in an ozone nonattainment area, estimated emissions from this project are expected to be
20 below the minimum threshold for which a conformity determination must be performed. In addition, visibility is
21 usually worse than natural levels due to regional haze originating outside GCNP boundaries and smoke from local
22 and regional wildland fires. In-park air pollutant emissions are dominated by wildland fire and motor vehicles,
23 including visitor vehicles, commercial tour buses, and park-operated shuttle buses, with lesser contributions from
24 watercraft, aircraft, boilers, generators, campfires, woodstoves, and other sources (NPS 2002).

25
26 Using data from the above micro-inventory, the park's air quality specialist determined that although aircraft emit
27 air pollutants within Grand Canyon National Park, minor changes in pollutant production resulting from the
28 Alternatives considered in this EIS would not make an appreciable difference in park haze or ozone levels. These
29 changes would not make an appreciable difference in air quality or climate change in the Study Area. Consequently,
30 air quality and climate change are not a determining factor in selecting among the Alternatives, and were dismissed
31 from further analysis.

32 33 **Prime and Unique Agricultural Farmlands**

34 No prime or unique agricultural soils occur in the Study Area. Thus, this topic was dismissed from further
35 consideration.

36 37 **Consistency with Land Use Plans, Policies, and Controls**

38 Commercial air tours are an established use over Grand Canyon National Park and are generally consistent with the
39 park's General Management Plan and other related park plans. Several landowners adjacent to GCNP, including but
40 not limited to Grand Canyon-Parashant National Monument, Lake Mead National Recreation Area, Kaibab National
41 Forest, and Navajo Nation, may be affected by changes in air tours being proposed in the Alternatives. Resources
42 and visitor experiences on these adjacent lands could be affected and are analyzed as part of the impact topics being
43 considered in this EIS. However, none of the changes being proposed would be expected to alter existing land uses,
44 given that general aviation flights, air-tour flights, military flights, and commercial jets are already flying over the
45 areas. Based on conversations between park staff and these adjacent landowners, none of the proposed actions in the
46 Alternatives is believed to conflict with existing land use plans, policies, and controls used by these landowners.
47 Thus, this impact topic was dismissed from further consideration.

48 49 **Wild, Scenic, and Recreational Rivers**

50 Although the Colorado River and its tributaries have been studied for Wild and Scenic River eligibility, no decision
51 has been reached on whether or not to propose river segments for designation. The Little Colorado River was
52 included in the eligibility study for inclusion in the National Wild and Scenic River system. Aircraft overflights
53 were taken into account in determining the eligibility of the Colorado River, the Little Colorado River, and other
54 tributaries as Wild and Scenic Rivers. Any changes in aircraft routes or air-tour operations would not have more
55 than a minor impact on either river's outstanding remarkable values (e.g., recreation). Thus, the Alternatives would

1 not affect the decision to propose Wild and Scenic Designation or river management, and the topic was dismissed
2 from further analysis.

4 **Other Specially Designated Areas**

5 Grand Canyon National Park is a World Heritage Site, designated by the United Nations Educational, Scientific and
6 Cultural Organization (UNESCO).

7
8 In addition, six administratively designated Research Natural Areas (RNA) exist in GCNP, and one National Natural
9 Landmark (NNL) extends from USFS land into the park. However, no actions are being taken as a result of
10 Alternatives being considered that would affect purposes of the designations or substantially alter use and
11 management of these areas. Air tours were being conducted in large numbers at the time of World Heritage Site
12 designation in 1979. While aircraft overflights are mentioned as a management problem in the World Heritage
13 nomination (http://whc.unesco.org/archive/advisory_body_evaluation/075.pdf), aircraft overflights did not affect
14 sufficiently the character of the Grand Canyon World Heritage Site at the time of nomination and do not currently
15 threaten its designation. Likewise, air tours have flown over GCNP for many years with no adverse effects of a
16 magnitude that would threaten its RNAs or NNL. Therefore, this topic was dismissed from further consideration.

18 **Archeological Resources**

19 Archeological resources are “material remains or physical evidence of past human life or activities which are of
20 archeological interest, including the record of the effects of human activities on the environment” (NPS 1998).
21 Actions proposed in this EIS do not have potential to significantly affect the park’s archeological resources
22 (Brumbaugh n.d.; King 1996). *Aircraft overflight actions in the Alternatives would be expected to have little
23 potential to affect archaeological resources unless archeological resources have an ethnographic context. There
24 is no ground disturbance associated with implementation of Alternatives. None of the aircraft actions would be
25 expected to cause noise or generate vibrations that could affect archeological resources. The character, including
26 setting, of significant historic properties listed or eligible for listing on the National Register would be
27 maintained. Potential to affect archeological resources is discussed under the ethnographic context and is
28 dismissed as a separate impact topic.*

30 **Prehistoric/Historic Buildings and Structures**

31 Prehistoric and historic buildings are enclosed structures constructed principally to shelter any form of human
32 activity (e.g., residential, industrial, commercial, agricultural, or other human use). *Aircraft overflight actions in the
33 Alternatives would be expected to have little potential to affect prehistoric/historic buildings and structures unless
34 these resources had an ethnographic context. There is no ground disturbance associated with implementation of
35 Alternatives. None of the aircraft actions would be expected to cause noise or generate vibrations that could
36 affect these resources. The character, including setting, of significant historic properties listed or eligible for
37 listing on the National Register would be maintained. The potential to affect prehistoric/historic buildings and
38 structures is discussed under the ethnographic context and is dismissed as a separate impact topic.*

40 **Cultural Landscapes**

41 According to the NPS Cultural Resource Management Guideline, a cultural landscape is “a reflection of human
42 adaptation and use of natural resources and is often expressed in the way land is organized and divided, patterns of
43 settlement, land use, systems of circulation, and types of structures that are built. The character of a cultural
44 landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use reflecting
45 cultural values and traditions.” *Cultural* landscapes exist at several park locations, but none of the aircraft
46 overflights actions in the Alternatives would be expected to result in ground disturbance or cause noise-generated
47 vibrations sufficient to damage prehistoric or historic structures. *Under all Alternatives, character-defining
48 features of cultural landscapes, including setting, would be maintained.* Therefore, cultural landscapes were
49 dismissed from further analysis.

51 **Museum Collections**

52 Museum collections can include a diverse range of items such as prehistoric and historic objects, artifacts, works of
53 art, archival documents, and natural history specimens. None of the Alternatives would affect how museum
54 collections are acquired, accessioned and cataloged, preserved, protected, or made available for access and use.
55 Thus, this topic was dismissed from further analysis.

1 **Indian Trust Resources**

2 Indian trust resources are land, water, minerals, timber, and other natural resources held in trust by the United States
3 for the benefit of a tribe or an individual tribal member. No Indian trust resources are located in Grand Canyon
4 National Park. Impacts on tribal lands within the Study Area but outside the park are discussed in specific resource
5 topics in Chapters 3 and 4. Therefore, this topic was dismissed from further analysis.
6

7 **Aquatic Habitat and Species**

8 The Colorado River and its tributaries contain a variety of native and nonnative fish. No changes are being proposed
9 in uses of the river, and no actions are proposed that would affect in-stream flows, water quantity and quality, or
10 aquatic biota, which in turn could affect fish populations. None of the Alternatives will affect fish populations. No
11 changes are being proposed that would affect management of fish in the river. Thus, this topic was dismissed from
12 further analysis.
13

14 **Vegetation**

15 None of the Alternatives being considered would result in developments, actions, or uses that would result in new
16 ground disturbance, fires, development of social trails, trampling of vegetation, or spread of nonnative or invasive
17 species, all of which could affect plant populations and distributions. Aircraft flying over GCNP do not affect the
18 park's plants. No changes would occur in management of park vegetation. Thus, none of the Alternatives will affect
19 park plants. This topic was therefore dismissed from further consideration.
20

21 **Special Status Species (Other Than Those Identified Above)**

22 Several threatened, endangered, or special status species would not be affected by the Alternatives including the
23 western yellow-billed cuckoo (*Coccyzus americanus*), Yuma clapper rail (*Rallus longirasis yumanensis*), Mexican
24 long-tongued bat (*Choeronycteris Mexicana*), spotted bat (*Euderma maculatum*), western red bat (*Lasiurus*
25 *borealis*), Hualapai Mexican vole (*Microtus mexicanus hualpaiensis*), southwestern river otter (*Lontra canadensis*
26 *sonora*), black-footed ferret (*Mustela nigripes*), northern leopard frog (*Rana pipiens*), bonytail chub (*Gila elegans*),
27 Virgin River chub (*Gila seminuda*), razorback sucker (*Xyrauchen texanus*), woundfin (*Plagopterus argentissimus*),
28 Little Colorado spinedace (*Lepidomeda vittata*), Kanab ambersnail (*Oxeloma haydeni kanabensis*), and eight species
29 of listed plants. Aircraft overflights do not affect populations of listed plants or aquatic species mentioned above.
30 (See also earlier dismissal of vegetation and aquatic species.) The Hualapai Mexican vole does not occur in the park.
31 The southwestern river otter and black-footed otter have been extirpated. Bat species are not active during times air-
32 tour flights would occur, and thus would not be affected. It is also likely overflights are not affecting Yuma clapper
33 rail populations. *This rail may occur in riparian habitats which air-tour routes largely avoid or fly over at altitudes*
34 *greater than 4,000 feet above ground level. Yuma clapper rails have not been detected in Grand Canyon National*
35 *Park since 2000 and, prior to that, records show no more than four detections of this species 1996 to 2000.*
36 Habitat on the park's West End has been altered due to river downcutting. Individual rails may find their way to the
37 canyon rim, where aircraft are flying at lower altitudes, but this would be very unlikely. Thus, effects of Alternatives
38 on these listed species are dismissed from further analysis.
39

40 **Coastal Resources**

41 This impact topic was dismissed because GCNP does not have coastal resources.
42

43 **Wetland Resources and Floodplains**

44 Although wetlands and floodplains occur in the Study Area, no new developments, actions, or uses are proposed in
45 the Alternatives that would result in loss or disturbance of wetlands or floodplains. Likewise, no changes are
46 proposed that would affect the area's hydrology or change NPS-management of wetlands or floodplains. Because
47 none of the Alternatives would affect these resources, they were dismissed from further analysis.
48

49 **Water Resources (Surface and Subsurface Water Quality and Quantity)**

50 No new developments, actions, or uses proposed in the Alternatives would result in water pollution, a change in
51 quantity of water flowing through GCNP, or a change in other hydrological conditions. No changes are being
52 proposed that would affect NPS management of park water resources. This impact topic was dismissed from further
53 analysis.

1 Soils

2 No new developments, actions, or uses are proposed in the Alternatives that would result in new ground disturbance
3 or possibly change soil erosion, the area's productivity, or drainage patterns. No changes are proposed that would
4 affect NPS management of soils. Thus, this topic was dismissed from further consideration.
5

6 Caves

7 Although caves occur in the Study Area, no new actions or uses are proposed in the Alternatives that would affect
8 caves, including changes to hydrology, cave formation, mineral formation, or wildlife habitat. No changes are
9 proposed that would affect NPS management of caves. Consequently this topic was dismissed from further analysis.
10

11 Paleontological Resources

12 GCNP has a variety of paleontological resources. However, no new developments, actions, or uses are proposed in
13 the Alternatives that could affect these resources, including changes to hydrology, soil erosion, or collection of and
14 research on paleontological resources. No changes are being proposed that would affect NPS management of
15 paleontological resources. Thus, this impact topic was dismissed from further analyses.
16

17 Construction Impacts

18 None of the Alternatives will involve construction of new facilities, thus there will be no construction impacts and
19 this topic is dismissed from further analysis.
20

21 Energy Requirements and Conservation Potential/Natural or Depletable Resource Requirements and 22 Conservation Potential

23 Aircraft expend fuel flying over the park and surrounding lands. However, none of the Alternatives being considered
24 would appreciably increase overall number of air tours flying over the park, and thus none would result in a
25 substantial change in energy consumption. Therefore, this topic was dismissed from further analysis.
26

27 Environmental Justice

28 Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-
29 Income Populations, directs Federal agencies to assess whether their actions have disproportionately high and
30 adverse human health or environmental effects on minority and low-income populations. Guidelines for
31 implementing this executive order under NEPA are provided by the Council on Environmental Quality,
32 Environmental Justice, Guidance under the National Environmental Policy Act (1997). According to the EPA,
33 "Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color,
34 national origin, or income with respect to the development, implementation, and enforcement of environmental
35 laws, regulations, and policies." (<http://www.epa.gov/compliance/environmentaljustice/basics/index.html>)
36

37 The *Modified* NPS Preferred Alternative responds to several requests from tribal governments and communities
38 including

- 39 • rerouting an existing helicopter support route that services Supai Village on the Havasupai Reservation (this
40 rerouting was requested by the Havasupai Tribe to lessen impacts present under the current condition [current
41 condition is defined in Alternative A])
- 42 • *tribal requests to relocate air-tour routes west of the Colorado River/Little Colorado River confluence. Re-*
43 *locating routes away from the confluence area would avoid impacts to traditional cultural properties*
44 *significant to the Navajo, Hopi, and other tribes, and would restore quiet to the sacred area*
 - 45 ○ *This move also responds to DEIS comments received from Navajo tribal members living near the*
46 *Confluence*

47
48 The *Modified* NPS Preferred Alternative would also eliminate the Blue Direct South air-tour route. In the absence of
49 Blue Direct South, some tour operations would be expected to travel outside the SFRA, while others would be
50 expected to travel *on the Z-shaped Route which replaces the* Blue Direct North air-tour route. Some of the flights
51 displaced from Blue Direct South may fly north of Peach Springs on the Hualapai Reservation on existing Victor

1 Airways V208-210, V235, and V562 to and from the Peach Springs VOR.²³ No changes are proposed to these
2 airways, and a significant increase in the number of flights in this area is not anticipated.
3

4 **Modified** NPS Preferred Alternative implementation would not result in significant noise or other environmental
5 impacts on minority or low-income populations in the Study Area. In working toward substantially restoring natural
6 quiet, in the context of visitor activity, including air-tour activity, in Grand Canyon National Park, the NPS and FAA
7 have worked with American Indian tribes adjacent to or associated with Grand Canyon. This effort is intended to
8 reduce or avoid adverse impacts, especially from noise.
9

10 **Modified** NPS Preferred Alternative implementation would have no disproportionately high and adverse human
11 health or environmental effects on low-income populations or minority groups. Therefore, this topic is dismissed
12 from further analysis. Analyses of other impacts to American Indian tribes that inhabit and have ties to areas in and
13 around GCNP are found in Chapters 3 and 4, Socioeconomic and Ethnographic Resources. Information about
14 involvement of American Indian tribes and sovereign governments during EIS development are in Chapter 5.
15

16 **Public Health and Safety**

17 Consistent with NPS Director's Order 12, Conservation Planning, Environmental Impact Analysis, and Decision-
18 making, and other mandates, the NPS has responsibilities for park visitor safety, and the agency includes public
19 health and safety as an impact topic in its NEPA documents. The NPS requested additional information from the
20 FAA regarding safety of park ground visitors with respect to potential accidents by air-tour aircraft. FAA researched
21 25 years (1982-2006) of National Transportation Safety Board (NTSB) accident data involving Parts 91, 135, and
22 121 air-tour operations over the national park system in its entirety, not just Grand Canyon National Park. In the 390
23 accidents recorded over the 25-year period, fatalities involved only aircraft passengers and operational personnel.
24 During the same 1982-2006 time period, NTSB recorded five accidents involving commercial air-tour aircraft in
25 GCNP. Four of these were minor accidents involving a single aircraft, and occurred prior to 1986. The last accident
26 occurred on June 18, 1986, in which two aircraft collided. There was no air-traffic management plan in place at the
27 time of these accidents. On September 22, 1988, the FAA promulgated a Special Federal Aviation Regulation 50-2,
28 creating a controlled airspace affecting all commercial air-tour operations in Grand Canyon. Since then, over 2.5
29 million commercial air tours have been conducted in the park without a commercial air-tour accident. No one on the
30 ground has been injured or killed in any of the 25-year history at Grand Canyon National Park or in any of the 390
31 accidents that occurred over the entire national park system. An estimated five million air-tour operations were
32 conducted during that time frame over all national parks. Based on these historical statistics, the risk of death or
33 injury to a ground visitor at Grand Canyon National Park from a commercial air-tour accident is in the zero to
34 remote range.
35

36 To the extent possible, NPS administrative flights are routed away from developed areas for noise abatement and to
37 avoid increased risk to visitors, residents, facilities, and park resources (including historic buildings and districts
38 listed in the National Register). All Alternatives fully evaluated in this EIS are consistent with this practice, and
39 locate air-tour routes over less populated areas of the park and Study Area.
40

41 FAA's primary mandate is aviation safety. Under Part 49 U.S. Code 40103(b)(2), the FAA Administrator shall
42 prescribe air traffic regulations on the flight of aircraft (including regulations on safe altitudes) for

- 43 • navigating, protecting, and identifying aircraft;
- 44 • protecting individuals and property on the ground;
- 45 • using the navigable airspace efficiently; and
- 46 • preventing collision between aircraft, between aircraft and land or water vehicles, and between aircraft and
47 airborne objects
48

49 Public safety is built into the legislative mandate governing Grand Canyon. ***It is also built into the Alternatives as
50 elements of the Alternatives were developed and discussed with FAA and the Grand Canyon Working Group with
51 safety a primary consideration.*** Consistent with the 1987 Overflights Act, the FAA Administrator has responsibility

²³ Very High Frequency Omnidirectional Range – A navigation tool used by pilots operating under visual flight conditions. Each VOR throughout the national airspace system is named for identification purposes, and each operates on a unique radio frequency. Aircraft navigate on victor airways and jet airways using VORs

1 to implement recommendations of the Secretary of the Interior/National Park Service without change unless the
2 Administrator determines implementing the recommendations would adversely affect aviation safety. If the
3 Administrator determines implementing the recommendations would adversely affect aviation safety, the
4 Administrator is responsible, in consultation with the Secretary of the Interior and after notice and opportunity for
5 hearing, for reviewing the recommendations to eliminate adverse effects on aviation safety. This FEIS *reflects*
6 changes made to the NPS Preferred Alternative for reasons of mitigating and reducing aviation safety risks
7 *identified by FAA, and rulemaking will further ensure safety is adequately addressed.*
8

9 Accidents involving air-tour aircraft are rare, and the probability of an accident low. After considering potential
10 effects, and based on environmental conditions, air-tour characteristics, and visitor use patterns that exist specifically
11 at Grand Canyon National Park, the NPS has determined that risks to public health and safety would be negligible
12 under NPS NEPA criteria. Since, by definition, implementation of an Alternative must be safe, and since the remote
13 nature of potential impacts would not vary among Alternatives, the topic of public health and safety was dismissed
14 from further analysis.
15

16 **Hazardous Materials, Pollution Prevention, and Solid Waste**

17 None of the overflight routes or air-tour operations in the Alternatives would result in an appreciable change in
18 amount of waste produced, or a change in generation or disposal of hazardous materials or solid waste. Thus, this
19 impact topic was dismissed.
20

21 **Lightscape and Light Emissions**

22 None of the air-tour operations in the Alternatives would occur at night. Thus, none of the Alternatives would affect
23 the park's lightscape or light emissions. Therefore, this topic was dismissed.
24

25 **Park Operations and Management**

26 NPS Director's Order 12, Conservation Planning, Environmental Impact Analysis, and Decision-making, provides
27 guidance to national parks on inclusion of park operations as an impact topic. Although NPS Management Policies
28 2006 does not specifically address park operations, virtually every action or proposal evaluated in the NEPA process
29 has either a direct or indirect effect on park operations. Although management of air-tour overflights may have
30 varying degrees of impact on personnel, funding, and time, there would not be a discernible difference in effects
31 among the four Alternatives (including No Action) evaluated in this EIS. In addition, NPS air-tour management
32 includes planning, coordination with the FAA and other agencies and stakeholders, noise monitoring, and fee
33 collection. It is estimated that approximately 2.5 to 3 full-time equivalent employees (FTEs) could be necessary to
34 address effects from overflights and conduct a broader Soundscape management program. This projection is based
35 on past staffing efforts for monitoring and managing overflights and Soundscapes at Grand Canyon National Park. If
36 there needed to be changes in staffing in the future to manage overflights, these effects would be minor or less.
37

38 Because there would be no discernible difference in impacts among Alternatives, and effects from impacts of
39 Alternatives would be minor or less, park operations and management was dismissed from further analysis.
40

41 **Urban Quality and Design Built Environment**

42 NEPA regulations at 40 CFR 1502.16 require urban quality and design of the built environment be considered if
43 potentially affected. None of the Alternatives require construction of new facilities. Therefore this impact topic was
44 dismissed from further analysis.
45

46 **DEIS PUBLIC COMMENT**

47
48 *With distribution of the Draft Environmental Impact Statement, there was a 120-day public review and comment*
49 *period. After this period, the EIS Planning Team evaluated all comments received from other Federal agencies,*
50 *tribes, organizations, businesses, and individuals regarding the Draft document, and incorporated appropriate*
51 *changes into this Special Flight Rules in the Vicinity of Grand Canyon National Park Final Environmental*
52 *Impact Statement (FEIS), including the Modified NPS Preferred Alternative (Chapter 2). This FEIS includes*
53 *letters from governmental agencies, tribes, public officials, and substantive public comments on the Draft EIS,*
54 *and NPS responses to those comments in Appendix H.*
55
56

1 **NEXT STEPS**
2

3 Following distribution of this FEIS and a 30-day no-action period, a Record of Decision will be signed. The Record
4 of Decision will document NPS selection of the **Modified** NPS Preferred Alternative for implementation.
5

6 NPS will present the **Modified** NPS Preferred Alternative as a recommendation **from the Secretary of the Interior to**
7 **the FAA Administrator** for implementation through rulemaking that addresses changes in airspace configuration
8 **and** procedures affecting SFAR 50-2 including route changes **and** Flight-free Zone dimensions and altitudes (which
9 also define air-tour corridors and general-aviation corridors).
10

11 FAA will regulate overflights of Grand Canyon National Park in accordance with the NPS recommendation in the
12 FEIS and ROD “without change,” unless there are potential adverse effects on aviation safety, in which case FAA in
13 consultation with NPS will mitigate those adverse effects and implement the revised recommendation. The process
14 is outlined in Figure 4.5.
15

16 ***No changes are proposed in this EIS affecting aircraft at or above 18,000 feet MSL. However, FAA commitments***
17 ***made in 2007 remain in place to look for opportunities to reduce impacts from high-altitude aircraft through***
18 ***aircraft noise reduction, airspace redesign, and advanced navigational capability, as described in the Federal***
19 ***Register (73 FR 19246-19248 and 73 FR 55130-55131).***
20
21

DRAFT
Not Finalized
FOIA Discretionary Release

CHAPTER 2 ALTERNATIVES

INTRODUCTION

The National Environmental Policy Act requires an EIS consider a range of reasonable Alternatives, including a No Action Alternative. NEPA requires the No Action Alternative be evaluated as a baseline for comparison for other Alternatives, even if a No Action Alternative may not be implemented due to legal, regulatory, or other considerations, including a legislative command to act.

As required in Council on Environmental Quality regulations (40 CFR 1502.14), agencies must “rigorously explore and objectively evaluate all reasonable Alternatives” in an EIS. CEQ defines reasonable Alternatives as those technically and economically feasible. Alternatives must also: meet project objectives, resolve needs, and alleviate potentially significant impacts on important resources. CEQ is also clear agencies should not pare Alternatives to only those that are cheap, easy, or the agency’s favorite. Rather, feasibility is an initial measure of whether the Alternative makes sense and is achievable (DO 12, page 20).

Through the EIS process, eight Alternatives (A, B, C, D, E, F, G, and the NPS Preferred Alternative) were considered *in the DEIS* for management of commercial air-tour and general-aviation operations over Grand Canyon in the SFRA. For reasons defined in Alternatives and Actions Considered and Dismissed from Further Consideration, Alternatives B, C, D, and G were dismissed from further consideration. In 2009 NPS, in consultation with FAA and stakeholders, refined the NPS Preferred Alternative. During that process much iteration of Alternatives E, G, and elements of Alternative A were explored. The outcome of those efforts *was the DEIS* NPS Preferred Alternative. As a result, four Alternatives (*A, E, F, and the NPS Preferred*) were retained *in the DEIS* for evaluation.

After the 120-day public comment period on the DEIS (February-June 2010), NPS evaluated substantive comments from 29,000 correspondences on the Alternatives and worked to incorporate changes, and complete analysis on, a Modified NPS Preferred Alternative. Alternatives retained in this FEIS are

Alternative A No Action/Current Condition **Map 2.2**

- continue current management and current helicopter and fixed-wing air-tour routes
- long and short-loop air-tours operate in Zuni Point and Dragon Corridors year-round
- annual allocation of 93,971 air-tour flights
- no quiet-technology incentives or conversion requirement
- four existing General Aviation corridors
- Flight-free Zone ceilings at 14,499 feet, except Sanup at 7,999 feet

Alternative E Alternating Seasonal Use **Map 2.3**

- short-loop air-tours alternate use of Zuni Point and Dragon Corridors seasonally
- no long-loop tours over North Rim; no routes over Marble Canyon; dogleg in Dragon Corridor
- annual allocation of 93,971 air-tour and air-tour related flights
- daily cap of 364 air-tour and air-tour-related flights
- full conversion to quiet-technology aircraft by date to be determined
- only quiet-technology aircraft allowed on East End routes early and late hours of flight day
- three modified general-aviation corridors
- all Flight-free Zone ceilings raised to 17,999 feet, and three zone boundaries enlarged

Alternative F Modified Current Condition **Map 2.4**

- similar to current routes and altitudes, except seasonal shift in Dragon Corridor, and changes in West End routes
- annual allocation of 93,971 air-tour flights
- incentives for quiet-technology aircraft; conversion to quiet-technology aircraft in 10 to 12 years
- One general-aviation corridor eliminated; three general-aviation corridors as in Alternative A
- Flight-free Zone ceilings same as current; Flight-free Zone boundaries changed to accommodate seasonal shift in Dragon Corridor

1 **Modified NPS Preferred Alternative** **Map 2.5**

- 2 • **Peak Season (April 1-November 14) short-loop routes in Zuni Point and Dragon Corridors open for air-tour**
 3 **operations**
- 4 • **Peak Season (April 1-November 14) long-loop routes over North Rim open for air-tour operations**
- 5 • **Peak Season (April 1- November 14), long-loop air-tour routes over North Rim phased-in to quiet-technology**
 6 **only over four years**
- 7 • **Off-Peak Season (November 15-March 31), short-loop routes in Dragon Corridor open**
- 8 • **Off-Peak Season (November 15-March 31), Zuni Point Corridor and long-loop routes closed**
- 9 • **no air-tour routes over Marble Canyon**
- 10 • dogleg in Dragon Corridor
- 11 • increased altitudes for some air-tour route segments
- 12 • annual allocation of 65,000 **commercial** air-tour and air-tour-related **operations**
- 13 • daily cap of 364 air-tour flights **classified as commercial air tours. All flights on SFRA routes classified as**
 14 **commercial air tours with limited exceptions for maintenance and training flights**
- 15 • air-tour route changes to better protect Nankoweap area and Little Colorado River confluence
- 16 • incentives for quiet-technology aircraft; conversion to quiet-technology aircraft required within ten years
- 17 • four general-aviation corridors with modifications in **Fossil Canyon and Dragon Corridors**
- 18 • **Blue Direct North changed to Z-shaped Route**
- 19 • **West End routes proposed in the DEIS NPS Preferred Alternative changed back to Alternative A, Current**
 20 **Condition**
- 21 • Flight-free Zone ceilings raised to 17,999 feet with exceptions for aircraft in transit on Victor airways or under
 22 positive control of an air-traffic control center or tower
- 23 • **as further defined in Chapter 2, Elements Common to All Alternatives, operations currently not subject to**
 24 **annual allocations will remain not subject to annual allocations and daily caps; however, NPS intends to**
 25 **examine the entire allocation system parkwide, including flights currently not subject to annual allocations,**
 26 **in a subsequent planning effort building on this EIS process**

27

28 **Alternatives Components**

29

30 All Alternatives apply to aircraft operating in the GCNP SFRA (Map 1.2). Within this area, Alternatives include
 31 requirements such as

- 32 • Flight-free Zones where air-tour operations and general aviation aircraft are not allowed. These zones extend
 33 from ground surface up to a specified altitude
- 34 • General aviation corridors that allow all aircraft to cross Grand Canyon in **four-mile-wide**²⁴ **corridors** between
 35 Flight-free Zones²⁵
- 36 • Specified routes and altitudes air-tour operators must follow when operating in the SFRA
- 37 • Time limitations on when air-tour flights may be conducted, such as operating hours of commercial air tours or
 38 seasonal air-tour route use
- 39 • Limitations on numbers of flights conducted by commercial air-tour operators on a daily or annual basis

40

41 As described in Chapter 1, all Alternatives apply to airspace between the ground surface and an altitude of 17,999
 42 feet MSL. Mitigation measures that apply to Action Alternatives (E, F, and the **Modified** NPS Preferred Alternative)
 43 appear in Chapter 2, Mitigation Provisions to Manage Aircraft Noise under Action Alternatives.

²⁴ *Each corridor is four nautical miles wide (approximately 4.5 statute miles)*

²⁵ *General Aviation Corridors. Four flight corridors exist to assist aircraft in navigating the Special Flight Rules Area while also avoiding nearby Flight-free Zones (see Map 2.5). The names of these four corridors (from east to west) are Zuni Point, Dragon, Fossil Canyon and Tuckup. Zuni Point and Dragon Corridors can be used by all aircraft (i.e., air tour, transient and general aviation operations). However, Fossil Canyon and Tuckup Corridors are for transient and general aviation operations only. Northbound transient and general aviation aircraft fly at 11,500, 13,500, 15,500, and 17,500 feet MSL in these corridors. These same aircraft fly at 10,500, 12,500, 14,500 or 16,500 feet MSL when southbound*

1 Formulation of Alternatives

2
3 Alternatives for managing the SFRA were developed to meet EIS objectives. *Objectives are based on several*
4 *sources including the 1916 Organic Act, the 1978 Redwoods Act, the 1987 Overflights Act, the 1995 NPS Report*
5 *to Congress, the 1996 Presidential Memorandum Earth Day Initiative, Parks for Tomorrow, and mission*
6 *statements of agencies participating in the Grand Canyon Working Group. At all stages of the planning process,*
7 *including all aspects of Alternative development and impact analysis, measures to ensure protection of public*
8 *health and safety were fully integrated into all Alternative elements and all complete Alternatives (also see DEIS*
9 *Chapter 1, p. 23, Impact Topics Considered and Dismissed from Detailed Analysis, Public Health and Safety).*
10 *Alternatives carried forward for analysis must meet project objectives to a large degree, although not necessarily*
11 *completely or equally.*

12
13 Alternatives also consider public scoping comments, and tribal, agency, and Grand Canyon Working Group input,
14 *and comments on the DEIS.* As described in Chapter 1, Grand Canyon Working Group was established under
15 authority of the National Parks Overflights Advisory Group, and consists of representatives from NPS and FAA, air-
16 tour operators, environmental groups, tribes, commercial and general aviation, recreational interests, and other
17 Federal agencies. GCWG was tasked with assisting the agencies in meeting the statutory mandate contained in
18 Public Law 100-91. As a result, Alternatives incorporate many Working Group recommendations and ideas.
19

20 Participants in Alternatives Formulation Process

21 The Grand Canyon Working Group began assisting agencies developing preliminary EIS Alternatives in early 2006.
22 Over the course of numerous Working Group meetings, March 2006 through December 2007, several options for
23 managing aircraft overflights were proposed by Working Group members and stakeholder groups. An additional
24 Working Group meeting was held to discuss a Draft NPS Preferred Alternative in July 2009.
25

26 In spring 2006, as part of the EIS process, the EIS Planning Team²⁶ reviewed more than 1,200 public scoping
27 comments to identify options (which were of varying scope and complexity) to meet the goal of substantial
28 restoration of natural quiet. Key elements suggested by the Grand Canyon Working Group, those submitted during
29 *DEIS* public scoping, *and comments received during the DEIS public comment period*, were developed into a
30 reasonable range of Alternatives analyzed in this EIS. The EIS Planning Team applied its best professional judgment
31 in developing these Alternatives to meet EIS objectives.
32

33 ELEMENTS COMMON TO ALL ALTERNATIVES

34
35 Several elements to manage aircraft over the park and in the SFRA are common to all Alternatives, including
36 Alternative A, as described below. As clarified in the Federal Register April 9 and September 24, 2008,

- 37 • Substantial Restoration of Natural Quiet at Grand Canyon National Park will be achieved when reduction of
38 noise from aircraft operations at or below 17,999 feet MSL within the Special Flight Rules Area results in 50%
39 or more of the park achieving restoration of natural quiet (i.e., no aircraft audible) for 75% to 100% of the day,
40 each and every day. 50% of the park is *a minimum in the* restoration goal
- 41 • Substantial Restoration of Natural Quiet from all aircraft above 17,999 feet MSL means there will be an overall
42 reduction in aviation noise generated above 17,999 feet MSL above the park over time through implementation
43 of measures in accordance with FAA commitments
44

45 FAA's commitments were formally conveyed to *DOI in a letter from Dan Elwell, FAA Assistant Administrator for*
46 *Aviation Policy, Planning and Environment to David M. Verhey, Assistant Secretary Fish and Wildlife and Parks*
47 *dated March 6, 2007; and mentioned in September 24, 2008, Federal Register notice (73 Fed. Reg. 55130)*
48 *accessed at <http://edocket.access.gpo.gov/2008/pdf/E8-22343.pdf>. Commitments include*

- 49 • Aircraft noise reduction FAA will actively pursue efforts to continue to reduce aircraft source
50 noise throughout the aviation system

²⁶ The EIS Planning Team included representatives from the NPS (Grand Canyon National Park, AZ; Natural Sounds Program, Ft. Collins, CO; Denver Service Center {DSC}, Denver, CO; Intermountain Regional Office, Denver, CO); FAA, Bureau of Indian Affairs (BIA), U.S. Department of Transportation, Volpe Center, Cambridge, MA; Parsons Corporation (DSC subcontractor)

- 1 • Airspace redesign When FAA is engaged in airspace redesign that affects a national park
2 and there are alternative choices consistent with safety, operational, and environmental parameters, *FAA* will
3 give favorable consideration to alternative routes away from sensitive park resources
- 4 • Advanced navigational capability *As FAA transitions to a more dynamic, satellite-based technology,*
5 *future navigational flexibility will allow FAA to reconsider opportunities to reduce national park overflights*
6 *not possible today without severe airspace impacts*
7

8 Although this EIS does not propose Alternatives to manage administrative flights or aircraft operating at or above
9 18,000 feet MSL, noise impacts generated by these aircraft are considered in Cumulative Effects analyses.

10 Unless *changed by the Modified NPS Preferred Alternative and subsequent FAA rulemaking*, existing SFRA
11 regulations, 14 Code of Federal Regulations (CFR) Part 93 Subpart U, would continue to apply and be enforced.
12
13

14 *In all Alternatives, operations currently not subject to allocations will remain not subject to annual allocations*
15 *and any daily caps, including operations in support of the Hualapai Tribe²⁷, operations when solely over tribal*
16 *lands and clearly outside park boundaries²⁸, limited training and maintenance flights²⁹, and other operations*
17 *which by law cannot be prohibited (Whitmore and Bar Ten)³⁰. However, flights currently not subject to*
18 *allocations are growing and unlimited in number, and proposals exist to include additional flights as not subject*
19 *to allocations (for example, flights in support of Navajo Nation³¹). Unlimited numbers of flights could undo many*
20 *gains realized by measures in this EIS. Also, the 2000 allocation limits were originally intended to temporarily*
21 *limit commercial air tours and be revisited at a later date. To address such issues, NPS intends to examine the*
22 *entire allocation system parkwide, including flights not currently subject to allocations in a subsequent planning*
23 *effort building on this EIS process. This will likely require additional NEPA compliance and FAA rulemaking.*
24

25 *In consultation with NPS, FAA may create or modify “weather” route segments and/or procedures as needed to*
26 *ensure safety of flight. Commercial air-tour operators only use weather routes to avoid instrument meteorological*
27 *conditions (IMC) or other adverse weather. Nothing should compromise a pilot’s ability to take whatever steps*
28 *are necessary to maintain the safety of his/her passengers and aircraft. Additionally, current procedures only*
29 *require a pilot or commercial air-tour operator to send FAA a copy of written deviation reports concerning flights*
30 *into or through a Flight-free Zone. All other deviation reports are retained at the pilot’s flight operations office*
31 *for not less than 90 days. Chapter 2, Provision D of FAA’s GCNP SFRA Procedures Manual (LAS FSDO*
32 *1380.2A of 04/19/2001) defines deviations as flying “more than one half (1/2) statute mile either side of a*
33 *prescribed route; deviation by more than 500 feet from the assigned route altitude for longer than one (1)*
34 *minutes; flight into or through a Flight-free Zone.*
35

36 Monitoring and noise modeling will be conducted as part of an Adaptive Management approach to ensure noise
37 provisions of sections 804 of Public Law 106-181 would be met.
38

39 Grand Canyon place names commonly mentioned in Alternatives are shown in Map 2.1.

²⁷ *Operations meeting conditions in 14 CFR Part 93.319(f), and flying on Green-4 or Blue-2 routes, or “solely over tribal lands and clearly outside park boundaries” as defined in the footnote immediately below*

²⁸ *Areas within any lands or water within GCNP boundaries, including any portion of the Colorado River to the high-water-mark located along the south bank of the Colorado River and adjacent to the Hualapai Reservation, and any other location where the park boundary is under dispute with a neighboring tribe, would not be considered “solely over tribal lands and clearly outside park boundaries”*

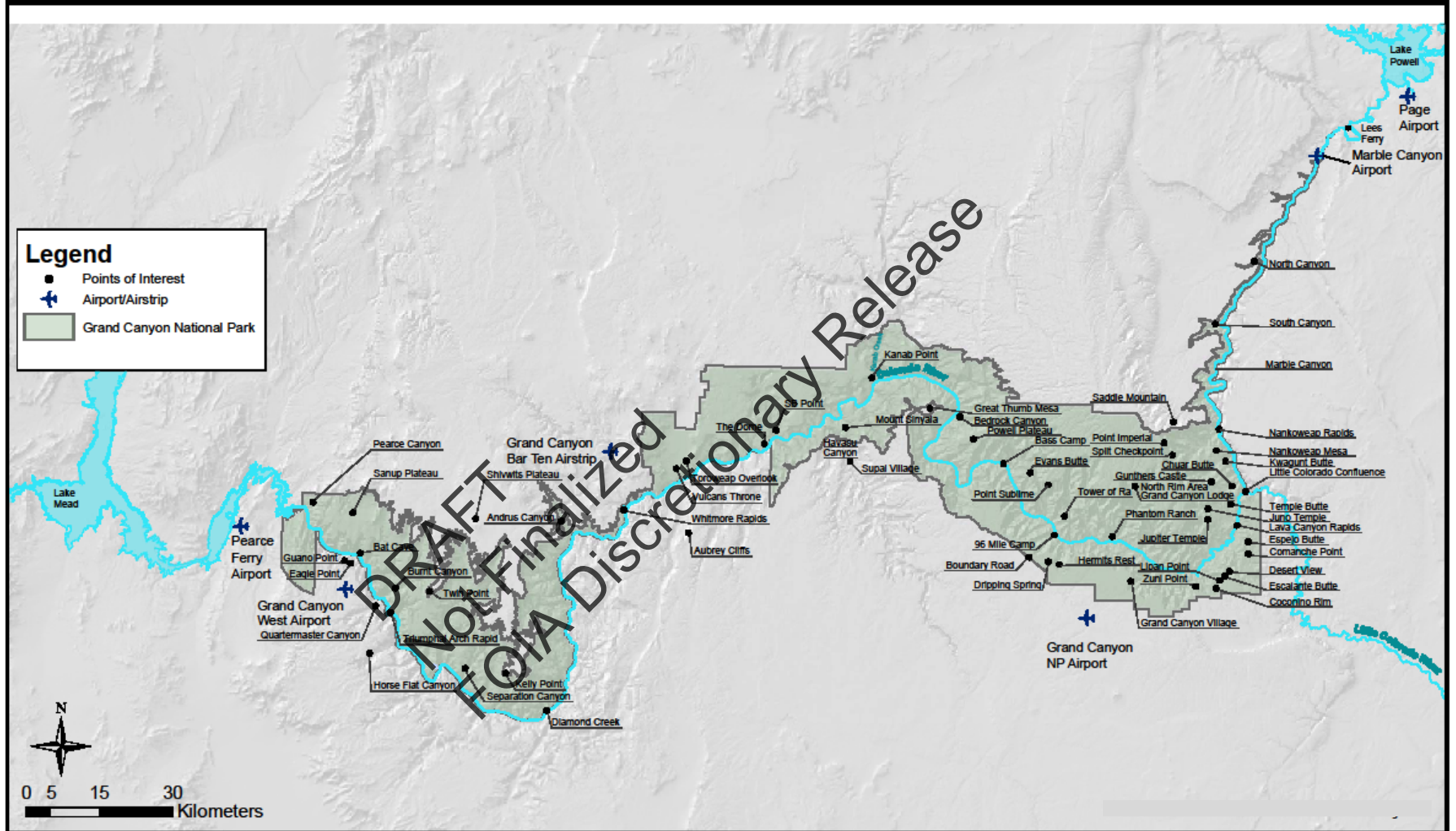
²⁹ *Training and maintenance flights not subject to allocations would be limited only to flights classified for training or maintenance purposes and not carrying passengers for revenue, and only when necessary for safety*

³⁰ *Public Law 100-91, Section 3(c) states SFRA rules shall not prohibit the flight of helicopters which fly a direct route between a point on North Rim outside GCNP and locations on the Hualapai Indian Reservation (as designated by the Tribe) and whose sole purpose is transporting individuals to or from boat trips on the Colorado River and any guide of such trip*

³¹ *The proposal referred to involves potential flights not solely over Navajo Nation lands, such as flights on any SFRA route (including but not limited to Black-1 or Green-1) or flights with any portion over GCNP lands conducted under any sort of waiver or permit*

Map 2.1

Locations



1
2

1 **ALTERNATIVE A** **NO ACTION, CURRENT CONDITION**

3 **Concept**

5 Alternative A (Map 2.2), would continue current commercial air-tour management practices in the airspace above
6 GCNP. It is included to provide an understanding of current practices and what would occur if no action is taken
7 based on this EIS. In Chapter 4, Environmental Consequences, Alternative A provides a baseline against which
8 other Alternatives are compared to determine impacts.

10 **Special Flight Rules Area (SFRA)**

12 Alternative A would maintain the existing Special Flight Rules Area shown in Map 2.2. The SFRA extends about
13 135 miles on an east-west axis and is generally about 30 miles north to south (about ten miles at the narrowest
14 locations). It also includes a 45-mile-long and 6- to 10-mile-wide extension to the northeast over the Marble Canyon
15 area.

17 The SFRA is an airspace established by the FAA to manage aircraft, including air tours, over and around GCNP. In
18 some areas, the northern SFRA boundary corresponds with GCNP's northern boundary, but SFRA boundaries were
19 generally drawn to be at least five miles outside the park boundary. Within its boundary, the SFRA extends up to
20 17,999 feet MSL.

22 **Flight-free Zones**

24 The four SFRA Flight-free Zones are shown in Map 2.2, from east to west they include

26 **Desert View Flight-free Zone** extends about six miles east-west, and seven miles north-south. Park features in this
27 zone include Comanche Point, Desert View Watchtower, Escalante Butte, and Lipan Point, which is on the
28 boundary of Zuni Point Corridor. No flights are allowed below 14,500 feet MSL in Desert View Flight-free Zone
29 except administrative use under an appropriate written waiver approved by both the FAA and the manager(s) of the
30 over-flown land(s).

32 **Bright Angel Flight-free Zone** is separated from Desert View Flight-free Zone by Zuni Point Corridor. Bright
33 Angel Flight-free Zone extends about 17 miles on each side. Park features in this zone are the most heavily visited
34 park areas and include Grand Canyon Village, North Rim developed area, and the Cross-Canyon Corridor trails and
35 campgrounds. No flights are allowed below 14,500 feet MSL in Bright Angel Flight-free Zone except administrative
36 use under an appropriate written waiver approved by both FAA and the manager(s) of over-flown land(s).

38 **Toroweap/Shinumo Flight-free Zone** is separated from the Bright Angel Flight-free Zone by Dragon Corridor. It
39 also is crossed by Fossil Canyon and Tuckup General-Aviation Corridors. Toroweap/Shinumo Flight-free Zone is a
40 long, crescent-shaped area, generally extending about 60 miles along the Colorado River. Park features in this zone
41 east to west include Point Sublime, Bass Camp, Kanab Point, Mount Sinyala, the Dome, Toroweap Overlook, and
42 Vulcans Throne. The Flight-free Zone's southern, west, and northwest boundaries generally correspond to the park
43 boundary. Except in general-aviation corridors, flights are not allowed below 14,500 feet MSL in Toroweap/
44 Shinumo Flight-free Zone except administrative use under an appropriate written waiver approved by both FAA and
45 the manager(s) of over-flown land(s).

47 **Sanup Flight-free Zone** is almost 20 miles southwest of Toroweap/Shinumo Flight-free Zone's western boundary.
48 This wide gap between Flight-free Zones, in which general aviation is allowed, is not a formally designated flight
49 corridor. The irregularly shaped Sanup Flight-free Zone, on the SFRA's west side, is about 22 miles east-west, and
50 17 miles north-south. Features in this zone include remote areas in western Grand Canyon National Park, and
51 eastern Lake Mead National Recreation Area (also part of Grand Canyon-Parashant National Monument), including
52 Separation Canyon, Sanup Plateau, and Kelly Point on the Shivwits Plateau. The Flight-free Zone's southern and
53 eastern boundaries generally correspond to the park boundary. No flights are allowed below 8,000 feet MSL in
54 Sanup Flight-free Zone (the same as the minimum sector altitude for general aviation in that area) except
55 administrative use under an appropriate written waiver approved by both FAA and the manager(s) of over-flown
56 land(s).

1 General Aviation Corridors

2
3 *Four flight corridors exist to assist aircraft in navigating the Special Flight Rules Area while also avoiding*
4 *nearby Flight-free Zones (see Map 2.5). The names of these four corridors (from east to west) are Zuni Point,*
5 *Dragon, Fossil Canyon and Tuckup. Zuni Point and Dragon Corridors can be used by all aircraft (i.e., air tour,*
6 *transient and general aviation operations). However, Fossil Canyon and Tuckup Corridors are for transient and*
7 *general aviation operations only. Northbound transient and general aviation aircraft fly at 11,500, 13,500,*
8 *15,500, and 17,500 feet MSL in these corridors. These same aircraft fly at 10,500, 12,500, 14,500 or 16,500 feet*
9 *MSL when southbound. The four SFRA general-aviation corridors are shown in Map 2.2.*

10 From east to west, flight corridors are

11 **Zuni Point Corridor** provides general aviation opportunity to cross GCNP between Desert View and Bright Angel
12 Flight-free Zones. The corridor is about 4.5-miles wide along its entire six-mile length. Aircraft using this corridor
13 overfly South Rim's Zuni and Moran Points. Air-tour operations also occur in this flight corridor below altitudes
14 available for general aviation.

15
16 **Dragon Corridor**, between Bright Angel and Toroweap/Shinumo Flight-free Zones, is about 15-miles long. It is
17 about 4.5-miles wide along its northern half widening to about 9.5 miles at its southern end. Park features overflown
18 by aircraft using this corridor include Hermits Rest, Hermit Trail, The Dragon, and Tower of Ra. Air-tour operations
19 also occur in this flight corridor below altitudes available for general aviation.

20
21 **Fossil Canyon Corridor** crosses the park through Toroweap/Shinumo Flight-free Zone, and is about 4.5-miles wide
22 along its entire 18-mile length. Park features overflown by aircraft using this corridor include Great Thumb Mesa,
23 Bedrock Canyon, and Powell Plateau.

24
25 **Tuckup Corridor** crosses GCNP through Toroweap/Shinumo Flight-free Zone, and is about 4.5-miles wide, but
26 due to the surrounding Flight-free Zone's irregular shape, the corridor is about ten-miles long on its east side and 15-
27 miles long along its west side. Aircraft using this corridor overfly SB Point.

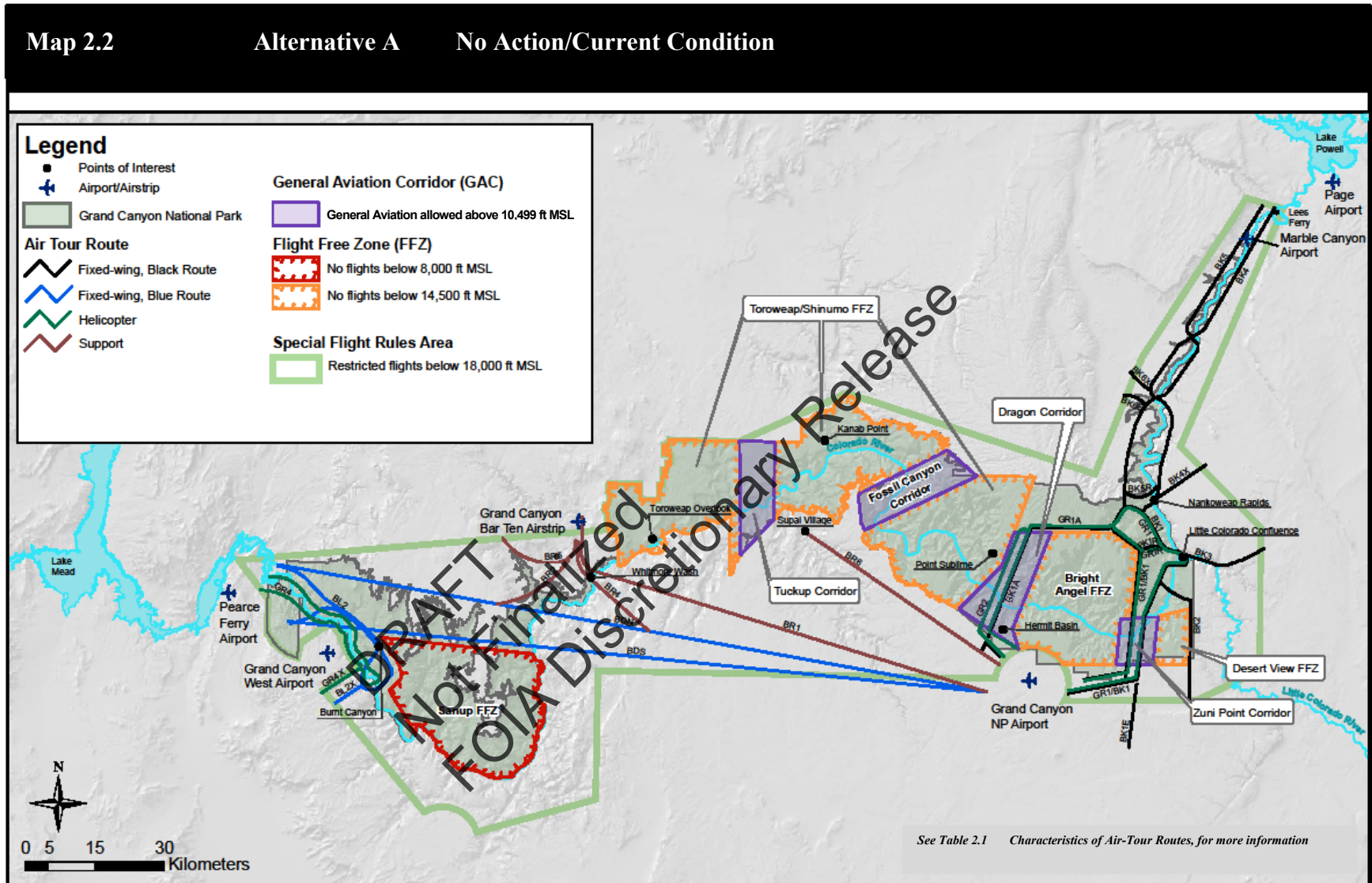
28 Air-tour Routes

29
30 Multiple SFRA air-tour routes are shown in Map 2.2. The following colors clarify pilot understanding about aircraft
31 routes

- 32 • **Black:** fixed-wing aircraft
- 33 • **Green:** helicopters
- 34 • **Brown:** tribal support operations. The Supai Brown-6 route is primarily used by helicopters to ferry supplies
35 and passengers to and from Supai Village in support of the Havasupai Tribe. Brown-1, -2, -4, and -5 routes are
36 for fixed-wing aircraft to access Bar Ten Ranch airstrip, which in part, is in support of helicopter access to
37 Hualapai tribal lands in the canyon for river passenger transport
- 38 • **Blue:** Direct fixed-wing routes between the Las Vegas area and Grand Canyon National Park Airport in
39 Tusayan. Blue-2 route is between the Las Vegas area and Grand Canyon West Airport

40
41 Each includes a specified path and altitude. Pilots are not allowed to deviate from routes by more than 0.5 miles
42 laterally and 300 feet vertically. Conformance is critical as multiple aircraft can use a route simultaneously.

43
44 Table 2.1 presents route characteristics. Route designation abbreviations in parenthesis correspond to route
45 designations found on Alternative maps.



1
2

Table 2.1 Alternative A Characteristics of Air-tour Routes in the GCNP SFRA

Route Designation	Start and End Points	General Description	Altitude (feet MSL)
Black Routes Fixed wing Only			
Black-1 (BK1)	Begins and ends at the SFRA south boundary Most flights originate at Grand Canyon National Park Airport	Loop route travels north along east side of Zuni Point Corridor, loops over Little Colorado/Colorado River confluence, loops north around Nankoweap area, turns south at Split checkpoint south of Point Imperial, returns toward SFRA southern boundary along west side of Zuni Point Corridor, then turns westbound to return to Grand Canyon Airport or exit SFRA. Bad weather option: return to south at Gunthers Castle via Black-1R	Northbound aircraft at 8,000 feet or 9,000 feet Southbound aircraft at 8,500 feet or 9,500 feet
Black-1A (BK1A)	Begins at Split checkpoint south of Point Imperial; ends at south end of SFRA	At Split checkpoint south of Point Imperial, flights from Zuni Point Corridor travel west across North Rim to Dragon Corridor, then south the length of Dragon Corridor, then turn east to Grand Canyon Airport or other destinations outside the SFRA	Aircraft at 9,500 feet westbound beginning at the Split checkpoint south of Point Imperial. Southbound leg through Dragon Corridor flown at 8,500 feet
Black-1E (BK1E)	Begins at south SFRA boundary to enter Black-1 . Ends at Black-1 where it turns north to enter Zuni Point Corridor	Route enters SFRA from south about ten miles east of Grand Canyon National Park Airport. Flight travels north to join Black-1 northbound	9,000 feet northbound along entire length
Black-2 (BK2)	Begins at south SFRA boundary; ends at Black-1	Route enters SFRA from south about 20 miles east of Grand Canyon National Park Airport. Flight route is north along east side of Desert View Flight-free Zone, turns to northwest and proceeds toward Espejo Butte and Lava Canyon Rapids, and merges with Black-1 southwest of Temple Butte	8,000 feet northbound along entire length
Black-3 (BK3)	Begins at east SFRA boundary; ends at Black-1 near river confluence	Westbound route enables tour operators to enter SFRA from east along Little Colorado River merging with Black-1 where it crosses Little Colorado River	8,500 feet along entire length
Black-4 (BK4)	Starts at Black-1 north of Nankoweap Mesa; ends at SFRA north boundary near Lees Ferry	Northbound route along Marble Canyon. Departs from Black-1 north of Nankoweap Mesa. Travel on east side of Marble Canyon until South Canyon, crosses to west side. At North Canyon, aircraft cross to east side of Marble Canyon and remain on east side until exiting SFRA north of Lees Ferry	7,500 feet or 9,000 feet from Nankoweap Mesa to North Canyon 7,500 feet or 5,500 feet from North Canyon to the SFRA north boundary
Black-4X (BK4X)	Starts at Black-4 north of Nankoweap Mesa; ends at SFRA east boundary	Escape route if bad weather encountered on North Rim. Aircraft fly to northeast to exit SFRA and return to starting point (usually Grand Canyon National Park Airport) by route of their choosing outside SFRA	First three miles at 9,000 feet or 7,500 feet. No altitude specified for remainder of distance to SFRA boundary
Black-5 (BK5)	Starts at SFRA north boundary near Lees Ferry; ends at Black-1 route south of Saddle Mountain	Southbound route along Marble Canyon. Enters SFRA north of Lees Ferry. Travel on west side of Marble Canyon until North Canyon, crosses to east side. At South Canyon, aircraft cross to west side of Marble Canyon and remain on west side until merging with Black-1 or looping via Black-5R to Black-4 to return northbound	5,000 feet or 6,500 feet from SFRA north boundary to North Canyon; 6,500 feet from North Canyon to South Canyon, climb to 8,500 feet from South Canyon to Black-1 . Bad weather escape route (Black-5R) eastbound along Saddle Canyon to merge with Black-4 at 7,500 feet or 9,000 feet
Black-6 (BK6)	Enters and exits SFRA at South Canyon confluence with Marble Canyon	Enables tour operators from airports to the west to enter SFRA and Marble Canyon routes, and provides exit route for all pilots flying Marble Canyon routes. Entry route on south rim of South Canyon; exit route along north rim of South Canyon	Eastbound (entry) at 8,500 feet. Westbound (exit) at 7,500 feet or 9,000 feet

Table 2.1 Alternative A Characteristics of Air-tour Routes in the GCNP SFRA

Route Designation	Start and End Points	General Description	Altitude (feet MSL)
Green Routes Helicopter Only			
Green-1 (GR1)	Same as Black-1	Same as Black-1	Altitude is 7,500 feet throughout route
Green-1A (GR1A)	Same as Black-1A , except ends at north end of Dragon Corridor	Same as Black-1A , except ends at north end of Dragon Corridor	9,000 feet westbound throughout route
Green-2 (GR2)	Begins and ends at SFRA south boundary. Most flights originate at Grand Canyon Airport	Loop route travels north along west side of Dragon Corridor, turns south just before North Rim, and returns to SFRA south boundary along east side of Dragon Corridor	7,500 feet throughout route, except short climb to clear terrain at north end of route
Green-4 (GR4)	Begins and ends at SFRA west boundary at Lake Mead's east end	Loop route travels eastbound along south side of Colorado River, turns west between Quartermaster and Horse Flat Canyons, and returns westbound to SFRA west boundary along north side of river	5,000 feet throughout route
Green-4X (GR4X)	Starts from Green-4 at Quartermaster Canyon; ends at SFRA southwest boundary	Helicopters travel up Quartermaster Canyon (to the southwest) to exit the SFRA, then travel by a route of their choosing outside the SFRA	Flights exit SFRA on southwest bound route at 5,000 feet
Brown Routes Support Operations			
Brown-1 (BR1)	Begins at SFRA south boundary; ends near Bar Ten airstrip	Fixed-wing only westbound route between SFRA boundary near Grand Canyon Airport and Bar Ten airstrip	8,500 feet from SFRA south boundary to National Canyon, 8,000 feet or 7,000 feet National Canyon to Bar Ten airstrip
Brown-2 (BR2)	Begins at Blue Direct North Route; ends near Bar Ten airstrip	Fixed-wing northeast-bound route for aircraft that enter SFRA at west boundary to Bar Ten airstrip	6,500 feet descending to Bar Ten airstrip
Brown-4 (BR4)	Begins near Bar Ten airstrip; ends at Blue Direct North Route	Fixed-wing southeast-bound route for aircraft traveling from Bar Ten airstrip toward SFRA south boundary, including Grand Canyon Airport	7,500 feet climbing to merge with Blue Direct North
Brown-5 (BR5)	Begins near Bar Ten airstrip; ends at SFRA north boundary	Fixed-wing northbound route leaving Bar Ten airstrip first travels south then west before exiting SFRA to north at Andrus Canyon	8,500 feet throughout route
Brown-6 (BR6)	Begins at SFRA south boundary; ends near Supai Village	Helicopter only west and eastbound route between Grand Canyon National Park Airport and Supai Village	Aircraft both directions travel at 300 feet above ground level (AGL)
Blue Routes Fixed-Wing Only			
Blue Direct North (BDN)	Las Vegas airports to/from Grand Canyon Airport	Fixed-wing only route between Las Vegas area and Grand Canyon Airport	Varies by segment, 8,500 feet or 10,500 feet westbound, 7,500 feet or 9,500 feet eastbound
Blue Direct South (BDS)	Las Vegas airports to/from Grand Canyon Airport	Fixed-wing only between Las Vegas area and Grand Canyon Airport	Varies by segment: 10,500 feet westbound, 9,500 feet eastbound from SFRA west boundary, descending to 7,500 feet on approach to Grand Canyon National Park Airport
Blue-2 (BL2)	Las Vegas airports to/from Grand Canyon West Airport	Enters SFRA eastbound at Pearce Canyon, travels eastbound north of river, turns south at Burnt Springs Canyon, crosses river east of Quartermaster Canyon. Turns and crosses back over river west of Horse Flat Canyon proceeds northwest on north side of river. Flights turn west after passing Bat Cave checkpoint to cross south of river and exit SFRA	5,500 feet or 7,500 eastbound, and 6,500 feet or 8,500 feet westbound
Blue-2X (BL2X)	Leaves Blue-2 south of river east of Quartermaster Canyon to exit SFRA	Travels southwest between Quartermaster and Horse Flat Canyons to exit SFRA then travel by a route of their choosing outside the SFRA	Flights exit SFRA on southwest bound route at 5,500 feet or 7,500 feet

1 **Allowable Times of Operation**

2
3 Under Alternative A, flights would continue to be limited by season and time of day. Specifically, commercial
4 flights through East End's Zuni Point and Dragon Corridors would continue 8 a.m. to 6 p.m., May through
5 September, allowing ten hours flight time. October through April, flights would continue 9 a.m. to 5 p.m., allowing
6 eight hours flight time.

7
8 There are no limitations on allowable times of daily or seasonal operation for Marble Canyon or West End air-tour
9 routes.

10
11 **Numbers of Flights Allowed**

12
13 Under Alternative A, there would continue to be no maximum flight operations daily cap. Commercial air-tour
14 operations annual allocation would continue at 93,971 flights. See Chapter 1, History Leading Up to This EIS, for
15 how the annual allocation was established. Each air-tour operator has a specified number of annual allocations
16 available for their use. Each commercial air tour requires use of an allocation; however, the annual allocation does
17 not apply to transportation, repositioning, and other air-tour-related flights. Tour operators are responsible for
18 reporting number of flights to the FAA quarterly. FAA generally provides this data to GCNP on a delayed-quarterly
19 basis. GCNP uses this data for fee management and monitoring purposes. Air-tour operations on Brown routes and
20 those in support of the Hualapai Tribe *would not be subject to* annual allocations.

21
22 **Quiet-Technology Incentives and Conversion**

23
24 Alternative A does not include quiet-technology incentives or conversion provisions. There are no additional
25 mitigation provisions to manage aircraft noise under Alternative A.
26
27

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Not Finalized
FOIA Discretionary Release

1 **ALTERNATIVE E ALTERNATING SEASONAL USE**

2 3 **Concept**

4
5 Alternative E (Map 2.3) would alternate use of Zuni Point and Dragon Corridors seasonally, and eliminate a long-
6 loop tour between Zuni Point and Dragon Corridors over North Rim, providing areas of GCNP with no air-tour
7 noise during portions of the year. Dragon Corridor air-tour routes could be used September 16 through June 30. Zuni
8 Point Corridor routes could be used July 1 through September 15. There would be an annual allocation of 93,971,
9 and a daily cap of 364 for flights classified as air tours, transportation, repositioning, and other air-tour-related
10 flights. Operations on Brown routes and those in support of the Hualapai Tribe would *continue not subject to* annual
11 allocations and daily caps.

12
13 Other major features include eliminating one of the four general-aviation corridors (Fossil Canyon), expanding East
14 End Flight-free Zones, changing direct-flight routes to/from Las Vegas to either avoid or fly over less of the park,
15 raising Flight-free Zone upper boundaries, expanded curfews, and conversion to best available quiet technology over
16 time.

17 18 **Special Flight Rules Area**

19
20 Alternative E would not include any changes to Special Flight Rules Area boundaries. Operations in support of the
21 Hualapai Tribe would continue *not subject to* annual allocations and daily caps.

22 23 **Flight-free Zones**

24
25 The upper boundary of all Flight-free Zones would be increased to 17,999 feet MSL. No flights would be allowed
26 below 18,000 feet MSL except administrative use under an appropriate written waiver approved by both the FAA
27 and the manager(s) of the over-flown land(s).

28
29 **Desert View Flight-free Zone** would be enlarged by extending its boundary north to about twice its current length.

30
31 **Bright Angel Flight-free Zone** would be substantially enlarged by extending its boundary north to include all of the
32 SFRA surrounding Marble Canyon. The Flight-free Zone's southwest corner would be expanded west to
33 accommodate the Dragon Corridor dogleg to reduce aircraft noise at popular Hermits Rest and Hermit Trail visitor-
34 use areas. The Flight-free Zone would be expanded east to include features such as Jupiter and Juno Temples and
35 Gunthers Castle.

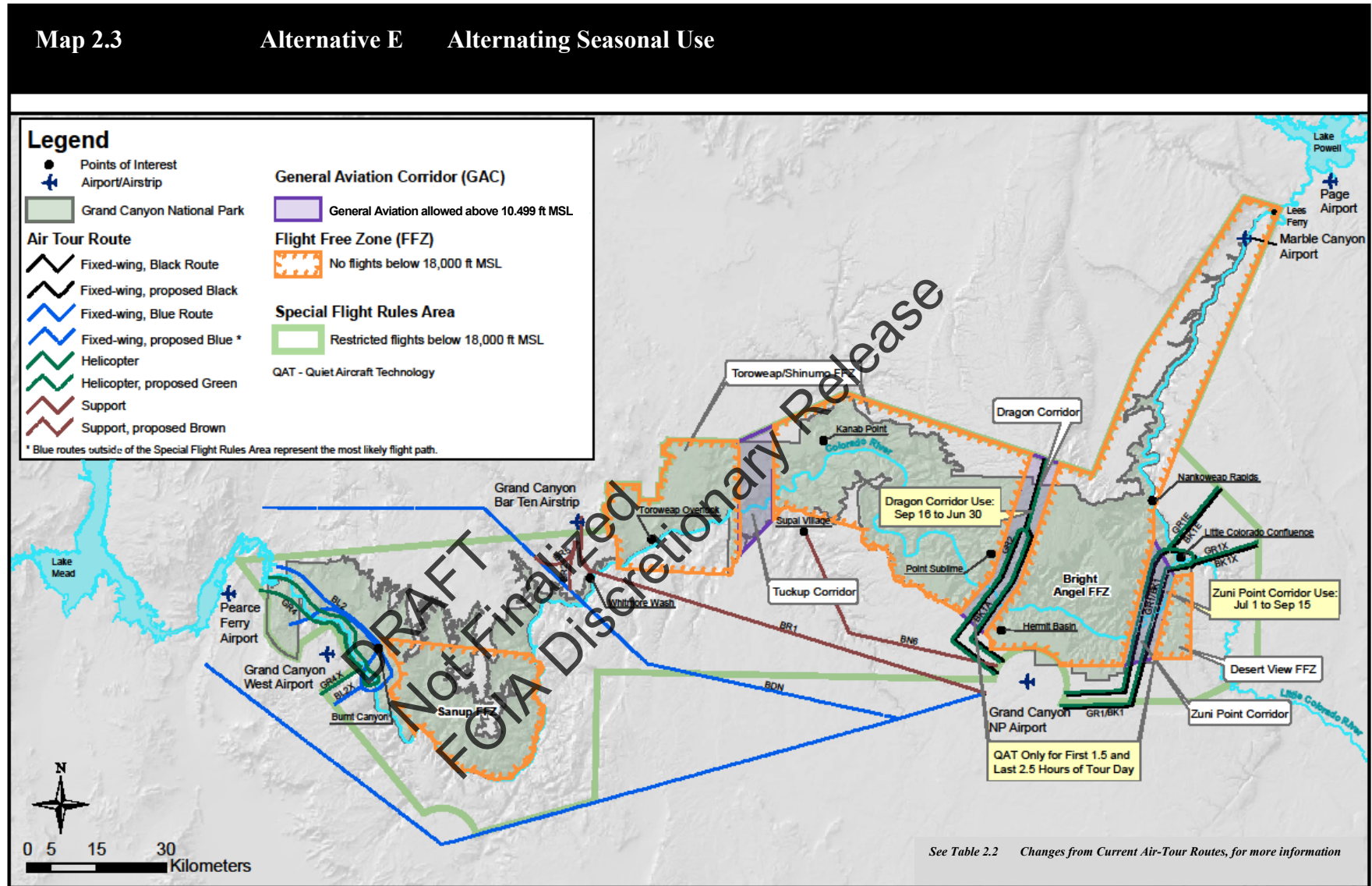
36
37 **Toroweap/Shinumo Flight-free Zone** would be increased in size by extending its northern boundary east of
38 Tuckup Corridor from the GCNP boundary to the SFRA boundary and west of Tuckup Corridor by extending its
39 southern boundary south of the park boundary to encompass some Hualapai tribal lands.

40
41 Except for the increase in its upper boundary, no changes would be made in **Sanup Flight-free Zone**.

42 43 **General-Aviation Corridors**

44
45 *Four flight corridors currently exist to assist aircraft in navigating the Special Flight Rules Area while also*
46 *avoiding nearby Flight-free Zones (see Map 2.5). The names of these four corridors (from east to west) are Zuni*
47 *Point, Dragon, Fossil Canyon and Tuckup. Zuni Point and Dragon Corridors can be used by all aircraft (i.e., air*
48 *tour, transient and general aviation operations). However, Fossil Canyon and Tuckup Corridors are for transient*
49 *and general aviation operations only. Northbound transient and general aviation aircraft fly at 11,500, 13,500,*
50 *15,500, and 17,500 feet MSL in these corridors. These same aircraft fly at 10,500, 12,500, 14,500 or 16,500 feet*
51 *MSL when southbound. In this Alternative, three corridors would be open for year-round general-aviation use*
52 *(Map 2.3).*

53
54 **Zuni Point Corridor** would be extended northeast to about twice its current length, with the northernmost extent
55 near Kwagunt Butte. Its alignment would be shifted east to accommodate eastern expansion of **Bright Angel Flight-**
56 **free Zone.**



1 **Air-tour Routes**
 2

3 Except as noted in Table 2.2, air-tour routes would be the same as described in Table 2.1 for Alternative A.
 4

Table 2.2 Alternative E Changes from Current (Alternative A) Air-tour Routes

Route Designation	General Description
Black Routes Fixed wing Aircraft Only	
Zuni Point Corridor Routes	Zuni Point Corridor routes would be used by air-tour aircraft only July 1 to September 15 (closed to air-tour aircraft remainder of year). Aircraft would travel at 8,000 or 8,500 feet MSL. Black-1A would only be used September 16 to June 30 (closed remainder of year). Fixed-wing aircraft required to travel above highest rim on route (8,000 or 9,000 feet MSL depending on route and terrain). Only fixed-wing aircraft considered best available quiet-technology aircraft allowed to use Black-1 and Black-1A during first 90 minutes and last 150 minutes of the tour day. See Allowable Times of Operation below
Black-1 (BK1)	Moved east, shortened and narrowed slightly on north end. Flights on Black-1 would travel eastbound from Grand Canyon Airport until south of Zuni Point where flights would turn northeast and travel at 8,000 or 9,000 feet MSL. After passing Temple Butte, flights would turn east to cross the Little Colorado River approximately two miles east of the confluence. Flights then turn west to cross the Colorado River and proceed past Gunthers Castle, then southbound along Zuni Point Corridor's west side to return to South Rim. An entrance and exit route would be provided at northeast corner of Black-1 (BK1E and BK1X) . Nankoweap loop, as described in Alternative A, would be eliminated. Route would continue to be flown counterclockwise, entering and exiting South Rim at the current location and altitudes along the SFRA boundary
Dragon Corridor Routes	Only fixed-wing aircraft considered best available quiet-technology aircraft allowed to use Black-1 and Black-1A during first 90 minutes and last 150 minutes of the tour day. See Allowable Times of Operation below
Black-1A	Route across North Rim and down Dragon Corridor eliminated. However, Black-1A segment that follows Dragon Corridor would be converted to a loop route entering and exiting Dragon Corridor from the south and be flown clockwise. A dogleg in the route to the southwest would be created to reduce aircraft noise at Hermits Rest and Hermits Trail popular visitor use areas. Exit route provided at north end with aircraft climbing to 10,000 feet MSL to avoid terrain and helicopters below
Other East End Routes	
Black-2	Eliminated
Black-3	Eliminated
Black-4	Along Marble Canyon eliminated
Black-5	Along Marble Canyon eliminated
Black-6	Along Marble Canyon eliminated
Green Routes Helicopters	
Zuni Point Corridor Routes	Only helicopters considered best available quiet-technology aircraft would be allowed to use Green-1 and Green-2 routes during first 90 minutes and last 150 minutes of tour day. See Allowable Times of Operation below
Green-1	Green-1 would be moved east and shortened on its north end to match the relocated Black-1 and Zuni Point Corridor. Helicopters would travel in this corridor July 1 to September 15 (closed remainder of year) at a constant 7,500 feet MSL, same as Alternative A. Route alignment would provide a flyover of the confluence. Nankoweap loop eliminated. Entrance/exit route provided in the northeast corner of Green-1 (GR1E and GR1X)
Dragon Corridor Routes	
Green-1A	Across North Rim eliminated
Green-2	Would continue as a loop route entering and exiting Dragon Corridor from south. Green-2 open September 16 to June 30 (closed remainder of year). Exit route provided at north end. Altitude throughout Green-2 would be 7,500 feet MSL, but exit route would be 300 feet above ground level (AGL)

Table 2.2 Alternative E Changes from Current (Alternative A) Air-tour Routes

Route Designation	General Description
Brown Routes Support Operations	
Brown-1	Configuration and altitude same as Alternative A
Brown-2	Follow existing route south to intersect realigned Blue Direct North that would cross Grand Canyon near Twin Peaks and Andrus Canyon. Route altitudes same as Alternative A
Brown-4	Eliminated
Brown-5	Follow existing route south to intersect realigned Blue Direct North that would cross Grand Canyon near Twin Peaks and Andrus Canyon. Route altitudes same as Alternative A
Brown-6	Realigned so aircraft from Grand Canyon Airport would travel predominantly west to Havasu Canyon then northwest directly over this canyon. Limited to operations in support of the Havasupai Tribe at Supai Village. Flights continue at 300 feet AGL
Blue Routes Fixed-Wing Only	
Blue Direct North	Alignment changed to reduce length in SFRA and shorten length of Grand Canyon overflown. Route would cross Grand Canyon near Twin Peaks, where it would proceed northwest out of SFRA then due west. Anticipated route outside SFRA is depicted in Map 2.3. Northwest segment flown at 9,500 feet MSL eastbound, and 10,500 feet MSL westbound; segment through park and southeast segment flown eastbound at either 9,500 feet or 7,500 feet MSL, and westbound at either 8,500 feet or 10,500 feet MSL
Blue Direct South	Eliminated. Anticipated travel to/from Las Vegas on existing Victor airways depicted in Map 2.3. For this analysis, it was estimated aircraft would fly at 9,500 feet MSL eastbound, and 10,500 feet MSL westbound

Allowable Times of Operation

Alternative E would place curfews on commercial operations in Zuni Point and Dragon Corridors that change daily relative to sunrise and sunset to ensure at least 150 minutes of quiet time after sunrise and 100 minutes of quiet time before sunset. The following examples illustrate length of tour day for air-tour aircraft using Zuni Point Corridor July 1 to September 15, and Dragon Corridor September 16 to June 30. Mid-point in the corridor use period was used for the examples.

Example 1: Mid-August, sunrise is approximately 6 a.m. and sunset 6 p.m. Aircraft could be present on Zuni Point Corridor air-tour routes 8:30 a.m. to 5:20 p.m. Only best available quiet-technology aircraft would be permitted to fly routes in the corridor during the first 90 minutes and last 150 minutes of the tour day (i.e., 8:30 to 10:00 a.m., and 2:50 to 5:20 p.m. in this example). In addition, there would be a 60-minute mid-day curfew to create a noise-free interval. Length of the tour day for best available quiet-technology aircraft would be nearly seven hours, 8:30 a.m. to 5:20 p.m. Time allowed for non-quiet-technology aircraft would be nearly four hours, 10:00 a.m. to about 2:50 p.m.

Example 2: Mid-February, sunrise is approximately 7:30 a.m., and sunset 6 p.m. Aircraft could be on air-tour routes in Dragon Corridor 10:00 a.m. to approximately 4:20 p.m. Only best available quiet-technology aircraft would be permitted to fly routes during the first 90 minutes and the last 150 minutes of the tour day, and there would be a 60-minute mid-day curfew. Length of the tour day for best available quiet-technology aircraft would be approximately 5.5 hours, 10:00 a.m. to 4:20 p.m. Time allowed for non-quiet-technology aircraft would be nearly 1.5 hours, 11:30 a.m. to approximately 1:50 p.m.

West End routes would continue without daily or seasonal flight times and curfews.

Numbers of Flights Allowed

Alternative E would allow a daily cap 364 total operations by air-tour and air-tour-related flights in the SFRA, based on peak-day use data for commercial operations from 2004 to 2006.

Alternative E would allow an annual allocation 93,971 operations by air-tour and air-tour-related flights.

Commercial operations on Brown routes and those in support of the Hualapai Tribe would continue *not subject to* annual allocations and daily caps.

1 **Quiet-Technology Incentives and Conversion**

2
3 Alternative E quiet-technology incentives would include allowing only air-tour aircraft using best available quiet
4 technology to fly in designated corridors during the designated season. This incentive would be implemented after
5 an agreed date for full conversion to aircraft using best available quiet technology. Until the full-conversion date,
6 only best available quiet-technology aircraft would be allowed to fly in Zuni Point or Dragon Corridors (whichever
7 is open) during the first 90 minutes and the last 150 minutes of the tour day. Also, all new or replacement aircraft
8 must use best available quiet technology.
9
10

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Not Finalized
FOIA Discretionary Release

1 **ALTERNATIVE F MODIFIED CURRENT CONDITION**

2 3 **Concept**

4
5 Alternative F (Map 2.4) meets Chapter 1 objectives by minimizing changes from current practices. Changes include
6 modification of West End air-tour routes at the request of the Hualapai Tribe, as well as a seasonal shift to Dragon
7 Corridor routes. February 1 through November 30, Dragon Corridor would be open as currently configured.
8 December 1 through January 31, Dragon Corridor air-tour routes would be relocated seven miles west to reduce air-
9 tour noise during part of the year near the current Dragon Corridor. Operations in support of the Hualapai Tribe
10 would continue *not subject to* annual allocations.

11 12 **Special Flight Rules Area**

13
14 The notch³² in the SFRA boundary near Grand Canyon West Airport would be modified to reduce aircraft noise at
15 Eagle and Guano Points. This boundary change would include Hualapai Over the Edge flights in the SFRA; such
16 flights are currently outside the SFRA. These flights in support of the Hualapai Tribe would continue *not subject to*
17 annual allocation and daily cap requirements.

18 19 **Flight-free Zones**

20
21 Alternative F would not result in any changes to **Desert View or Bright Angel Flight-free Zones**.

22
23 **Toroweap/Shinumo Flight-free Zone**'s eastern boundary would be moved west to accommodate Dragon Corridor
24 modifications, as described below.

25
26 **Sanup Flight-free Zone**'s northern boundary would be moved south to accommodate modifications of Blue Direct
27 routes, as described below.

28
29 Flight-free zone ceilings would be the same as Alternative A. No flights would be allowed below Flight-free Zone
30 ceilings except administrative use under an appropriate written waiver approved by both the FAA and the
31 manager(s) of the over-flown land(s).

32 33 **General Aviation Corridors**

34
35 *Four flight corridors currently exist to assist aircraft in navigating the Special Flight Rules Area while also*
36 *avoiding nearby Flight-free Zones (see Map 2.5). The names of these four corridors (from east to west) are Zuni*
37 *Point, Dragon, Fossil Canyon and Tuckup. Zuni Point and Dragon Corridors can be used by all aircraft (i.e., air*
38 *tour, transient and general aviation operations). However, Fossil Canyon and Tuckup Corridors are for transient*
39 *and general aviation operations only. Northbound transient and general aviation aircraft fly at 11,500, 13,500,*
40 *15,500, and 17,500 feet MSL in these corridors. These same aircraft fly at 10,500, 12,500, 14,500 or 16,500 feet*
41 *MSL when southbound. In this Alternative, three corridors would be open for year-round general-aviation use, as*
42 *shown on Map 2.4, and one would be eliminated.*

43
44 **Zuni Point Corridor** would remain the same as Alternative A.

45
46 **Dragon Corridor** size and boundary would change. The corridor's west side would be narrowed to the east, the
47 north boundary would be extended slightly, and the southeast corner would be eliminated. This configuration would
48 be in use year-round for general aviation.

49

32 The SFRA boundary forms a notch around Grand Canyon West Airport so that the airport area is outside the SFRA to facilitate traffic to and from the airport. The notch is entirely over Hualapai tribal lands south of the Colorado River. In Alternatives A and E, it is approximately 6-statute-miles long and 6.5-miles wide at its northeastern end narrowing to approximately 5-miles wide at its southwestern end. In Alternative F and the NPS Preferred Alternative, the notch is narrowed to approximately 5-miles wide throughout to include visitor areas at Eagle and Guano Points inside the SFRA

- 1 **Fossil Canyon Corridor** would be eliminated.
- 2
- 3 **Tuckup Corridor** would remain the same as Alternative A.
- 4

5 **Air-tour Routes**

6 Except as noted in Table 2.3, air-tour routes would be the same as described in Table 2.1 for Alternative A.

7

Table 2.3 Alternative F Changes from Current (Alternative A) Air-tour Routes

Route Designation	General Description
Black Routes Fixed wing Aircraft Only	
Zuni Point Corridor Routes	
Black-1 (BK1)	Same as Alternative A. Route flown at 8,000 feet MSL for quiet-technology aircraft; 9,000 feet MSL for non-quiet-technology aircraft
Dragon Corridor Routes	December 1 through January 31, Dragon Corridor's north end would shift seven-miles west of current location. Aircraft would travel west at 9,500 feet MSL beginning south of Point Imperial across North Rim until approximately Evans Butte, then turn south at 8,500 feet MSL. During this period, present Dragon Corridor would become flight-free for all commercial operations
Black-1A	Seasonal shift of Black-1A . February 1 through November 30, Black-1A same as Alternative A. Route across North Rim flown at 9,500 feet MSL; southbound portion at 8,500 feet MSL, same as Alternative A
Green Routes Helicopter	
Dragon Corridor Routes	December 1 through January 31, Dragon Corridor's north end would shift seven-miles west of current location. Helicopters would travel west at 9,000 feet MSL beginning south of Point Imperial across North Rim until approximately Evans Butte, then turn south at 7,500 feet MSL. During this period, present Dragon Corridor would become flight-free for all commercial operations
Green-1A	December 1 through January 31, route extended west across North Rim to Evans Butte, where helicopters would turn southwest to merge with Green-2 . Flights on Green-1A would be at 9,000 feet MSL, as in Alternative A, merging with Green-2 heading southbound at 7,500 feet MSL
Green-2	Seasonal shift in helicopter use would occur on Green-2 . February 1 to November 30, route would be same as Alternative A. December 1 through January 31, Dragon Corridor's north end would shift seven-miles west of its current location. Helicopters would start the clockwise loop at 7,000 feet MSL near Grand Canyon Airport, climbing to 7,500 feet MSL before crossing South Rim to travel the loop, and descend to 7,000 feet MSL when returning to the airport. During this period, the present Dragon Corridor would be flight-free
West End Routes	
Green-4	Southern portion eliminated. Northern portion would allow two-way traffic, but westbound route component would be used by quiet-technology aircraft only. Helicopters would travel at 4,000 feet MSL eastbound, and westbound quiet-technology aircraft could loop north at 5,000 feet MSL. Quiet-technology aircraft would thus offer a longer route over the canyon entirely in the park. Non-quiet-technology aircraft would exit route using Green-4X at Horse Flat Canyon at 5,000 feet MSL
Brown Routes Support Operations	
Brown-2	Eliminated
Blue Routes Fixed-Wing Only	
Blue Direct North	Becomes a one-way, eastbound, quiet-technology route allowing an improved river tour. From a junction at Burnt Springs Canyon to allow two entry/exit access points from Las Vegas area, route would cross Shivwits Plateau at 7,500 feet MSL, turn northeast along the river at 6,500 feet MSL toward Twin Peaks, then resume current route at Aubrey Cliffs at 7,500 feet MSL until reaching Grand Canyon Airport
Blue Direct South	Serves as a more direct, two-way, non-quiet-technology route. Moves south of Grand Canyon West Airport to avoid Eagle and Guano Points; split at Burnt Springs Canyon to allow access to/from Las Vegas area. Eastbound aircraft 9,500 feet MSL across Shivwits Plateau, descending to 7,500 feet toward Grand Canyon Airport. Westbound aircraft at 10,500 feet MSL after climbing out of Grand Canyon Airport

9

10

11 **Allowable Times of Operation**

12

13 Alternative F would have the same curfew times as Alternative A. There would continue to be no daily or seasonal flight times or curfews for West End routes. East End flights May through September would continue 8 a.m. to 6 p.m., allowing ten hours flight time. Flights October through April would continue 9 a.m. to 5 p.m., allowing eight hours flight time.

16

1 Dragon Corridor routes and alignment would be used February 1 to November 30. December 1 to January 31, air-
2 tour flights would be routed as in Table 2.3, with the northern end seven-miles west of current Dragon Corridor.
3

4 **Numbers of Flights Allowed**

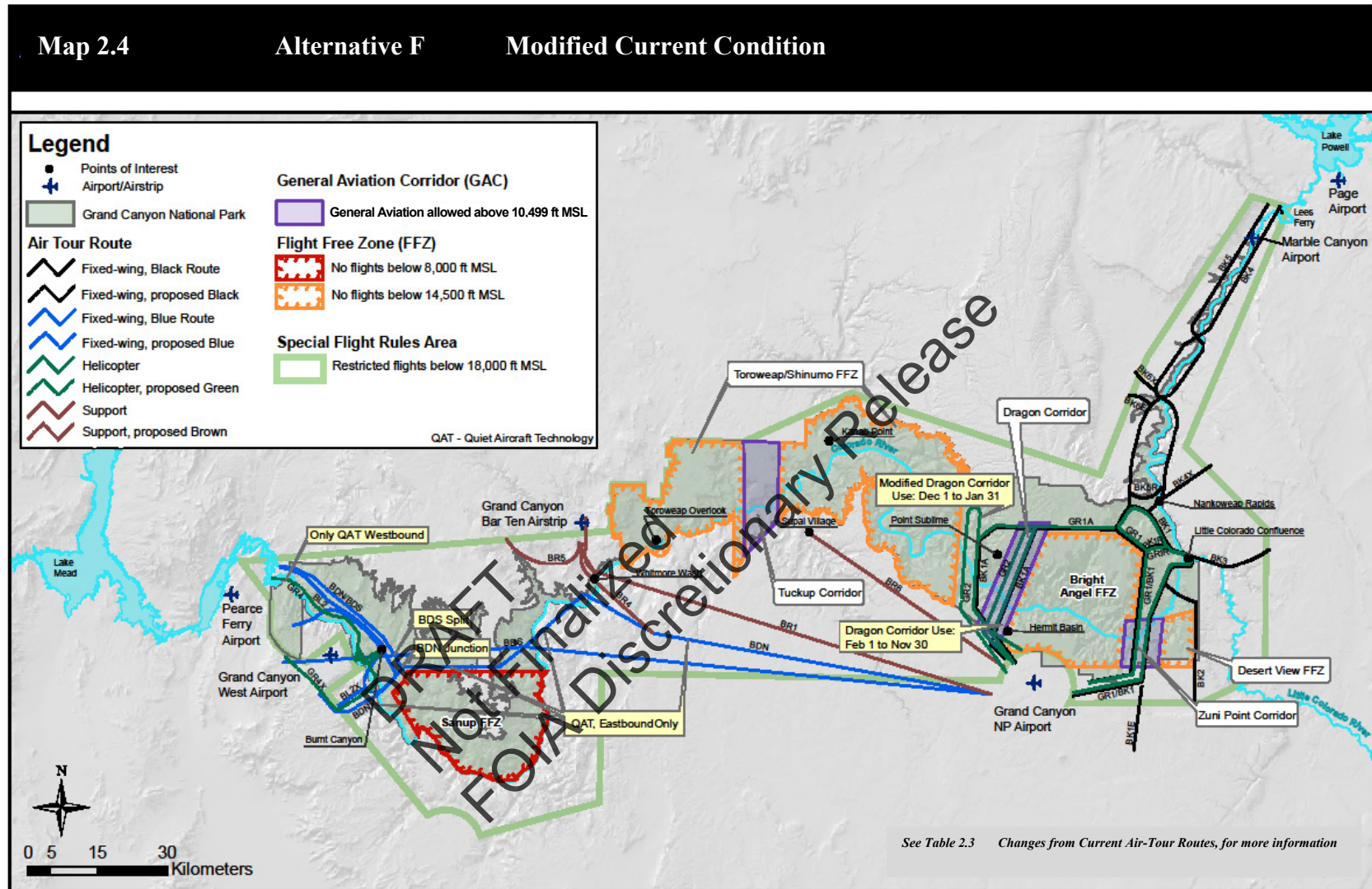
5
6 Alternative F would have the same annual allocation provision (93,971 commercial air-tour operations) as
7 Alternative A. There would be no daily cap under this Alternative.
8

9 **Quiet-Technology Incentives and Conversion**

10 A variety of incentives would be offered to air-tour operators who convert to quiet technology, including

- 11 • Forgiveness of fees charged for SFRA flights
- 12 • Additional flights, as long as the cumulative impact of such flights does not increase noise in the park, and does
13 not adversely impact substantial restoration of natural quiet
- 14 • Provision of a West End quiet-technology helicopter route on westbound portion of Green-4. Blue Direct North
15 eastbound route would be used by quiet-technology aircraft only
- 16 • On Black-1, quiet-technology aircraft would be allowed to fly at 8,000 feet MSL while non-quiet-technology
17 aircraft would be required to fly at 9,000 feet MSL
- 18 • Over a 10- to 12-year period, flight operations would convert to quiet-technology aircraft
19
20

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1
2

1 **MODIFIED NPS PREFERRED ALTERNATIVE**

3 **Concept**

5 The *Modified* NPS Preferred Alternative *creates a quiet season by closing routes east of Dragon Corridor Off-Peak Season. Zuni Point short-loop tours and long-loop tours over North Rim are closed Off-Peak Season, but*
 6 *open Peak Season. Marble Canyon is closed to air-tour operations year-round. The Alternative includes raising*
 7 *Flight-free Zone upper boundaries, quiet-technology incentives, modified tour routes to avoid sensitive resources,*
 8 *modified curfews, full conversion to quiet-technology aircraft, and moving most non-tour flights outside the*
 9 *SFRA. Air-tours and air-tour-related operations would have an annual allocation limit of 65,000 flights (8,000*
 10 *more air-tour flights than reported by air-tour operators in any year 2004-2011), with a daily cap of 364 air-tours*
 11 *(50 more than on the 2005 Peak Day).*

13 The *Modified* NPS Preferred Alternative (Map 2.5) *includes*

- 15 • *Peak Season (April 1-November 14) short-loop routes in Zuni Point and Dragon Corridors open for air-tour*
 16 *operations*
- 17 • *Peak Season (April 1-November 14) long-loop routes over North Rim open for air-tour operations*
- 18 • *Peak Season (April 1- November 14), long-loop air-tour routes over North Rim phased-in to quiet-technology*
 19 *only over four years*
- 20 • *Off-Peak Season (November 15-March 31), short-loop routes in Dragon Corridor open*
- 21 • *Off-Peak Season (November 15-March 31), Zuni Point Corridor and long-loop routes closed*
- 22 • *no air-tour routes over Marble Canyon*
- 23 • *dogleg in Dragon Corridor*
- 24 • *increased altitudes for some air-tour route segments*
- 25 • *annual allocation of 65,000 commercial air-tour and air-tour-related operations*
- 26 • *daily cap of 364 air-tour flights classified as commercial air tours. All flights on SFRA routes classified as*
 27 *commercial air tours with limited exceptions for maintenance and training flights*
- 28 • *air-tour route changes to better protect Nankoweap area and Little Colorado River confluence*
- 29 • *incentives for quiet-technology aircraft; conversion to quiet-technology aircraft required within ten years*
- 30 • *four general-aviation corridors with modifications in Fossil Canyon and Dragon Corridors*
- 31 • *Blue Direct North changed to Z-shaped Route*
- 32 • *West End routes proposed in the DEIS NPS Preferred Alternative changed back to Alternative A, Current*
 33 *Condition*
- 34 • *Flight-free Zone ceilings raised to 17,999 feet with exceptions for aircraft in transit on Victor airways or under*
 35 *positive control of an air-traffic control center or tower*
- 36 • *as further defined in Chapter 3, Elements Common to All Alternatives, operations currently not subject to*
 37 *annual allocations will remain not subject to annual allocations and daily caps; however, NPS intends to*
 38 *examine the entire allocation system parkwide, including flights currently not subject to annual allocations,*
 39 *in a subsequent planning effort building on this EIS process*

41 **Special Flight Rules Area**

42 *No changes to the SFRA boundary.*

45 **Flight-free Zones**

46
 47 The upper boundary of all Flight-free Zones would be increased to 17,999 feet MSL. No flights would be allowed
 48 below 18,000 feet MSL except, 1) aircraft in *transit on* Victor airways V210, V257, and V293 at or above 14,500
 49 feet (*the current minimum en route altitude for those airways in that area*), 2) aircraft under positive control of an
 50 air-traffic control center or tower when necessary for safety, 3) administrative use under an appropriate written
 51 waiver *issued by FAA at the request of* the manager(s) of the over-flown land(s). *General Aviation pilots could*
 52 *also choose to deviate around Flight-free Zones to a nearby General Aviation flight corridor where they could fly*
 53 *between 10,500 feet and 17,999 feet depending on direction of travel, or as low as the minimum sector altitude in*
 54 *areas outside flight corridors and Flight-free Zones.*

1 **Desert View Flight-free Zone** would have no changes except the upper boundary increase.

2
3 **Bright Angel Flight-free Zone** would be modified by expanding the southwest corner west to the park boundary.
4 This action would accommodate creation of the Dragon Corridor dogleg that would reduce aircraft noise at popular
5 Hermits Rest and Hermit Trail visitor-use areas.

6
7 **Toroweap/Shinumo Flight-free Zone** would be decreased in size by moving the southeast corner slightly west to
8 accommodate the Dragon Corridor dogleg.

9
10 **Sanup Flight-free Zone** would have no changes except the upper boundary increase.

11 **General Aviation Corridors**

12 *Four flight corridors exist to assist aircraft in navigating the Special Flight Rules Area while also avoiding*
13 *nearby Flight-free Zones (see Map 2.5). The names of these four corridors (from east to west) are Zuni Point,*
14 *Dragon, Fossil Canyon and Tuckup. Zuni Point and Dragon Corridors can be used by all aircraft (i.e., air tour,*
15 *transient and general aviation operations). However, Fossil Canyon and Tuckup Corridors are for transient and*
16 *general aviation operations only. Northbound transient and general aviation aircraft fly at 11,500, 13,500,*
17 *15,500, and 17,500 feet MSL in these corridors. These same aircraft fly at 10,500, 12,500, 14,500 or 16,500 feet*
18 *MSL when southbound. In this Alternative, all four corridors would remain open for year-round general-*
19 *aviation use, as shown on Map 2.5.*

20
21 **Zuni Point Corridor** would remain the same as Alternative A.

22
23
24 The southwest corner of **Dragon Corridor** would be reduced in width to match the width of the rest of the corridor.
25 The southeastern boundary would be moved west to create a dogleg that would begin north of the Tower of Ra on
26 the east and south of Point Sublime on the west. This action would reduce the width of the southern part of this
27 corridor to *four nautical miles* (approximately 4.5 *statute* miles).

28
29 **Fossil Canyon Corridor** would be rotated 28 degrees to the southeast to move the corridor away from Great Thumb
30 Mesa and Supai Village.

31
32 **Tuckup Corridor** would remain the same as Alternative A.

33 **Air-tour Routes**

34
35
36 Except as noted in Table 2.4, air-tour routes would be the same as described in Table 2.1 for Alternative A.

Table 2.4 Modified NPS Preferred Alternative Changes from Current (Alternative A) Air-tour Routes

General Description	
Black Routes Fixed wing Aircraft Only	
Zuni Point Corridor Routes	Short-loop East End routes <i>plus the long-loop routes</i> would be available in Zuni Point Corridor <i>April 1-November 14</i> (closed remainder of year). <i>November 15- March 31 no flights allowed on Zuni Point Corridor routes or long-loop routes over North Rim</i>
Black-1/ Black-1A	Black-1 would be moved <i>west and</i> shortened. Aircraft traveling northbound along Zuni Point Corridor's east side would ascend from 8,000 feet MSL crossing South Rim to 9,000 feet MSL <i>at</i> Temple Butte, then remain at 9,000 feet MSL for turns to view the confluence. Aircraft would turn west at the north end of Chuar Butte (approximately one-mile west of the confluence), and climb to 9,500 feet MSL. At the intersection of Black-1 and Black-1A , which would move south to near Gunthers Castle, aircraft would either cross North Rim on Black-1A at the current location and altitude (9,500 feet MSL), or proceed southbound along Zuni Point Corridor's west side on Black-1 at 9,500 feet MSL, descending to cross South Rim at 8,500 feet MSL. Nankoweap loop described in Alternative A would be eliminated, and the loop confluence flyover moved west of the confluence. Route would continue to be flown counterclockwise, entering and exiting <i>the SFRA</i> near Grand Canyon <i>NP</i> Airport
Dragon Corridor Routes	A new short-loop route (Black-2A) would be available for air-tour fixed-wing aircraft <i>use</i> year-round
Black-2A	Black-2A would follow Dragon Corridor in a clockwise direction entering and exiting the Corridor from the south (<i>same route footprint as Green-2 but at a higher altitude</i>). Aircraft would enter route at 8,500 feet MSL crossing South Rim and traveling north along Dragon Corridor's west side climbing to 9,500 feet MSL at the dogleg north of Tower of Ra. Aircraft would loop over North Rim to safely merge with aircraft westbound on Black-1A from Zuni Point Corridor. Aircraft would travel southbound along Dragon Corridor's east side, descending after the turn in the dogleg from 9,500 feet to 8,500 feet MSL as the route crosses South Rim. Dragon Corridor entry and exit points would move west creating dogleg to reduce aircraft noise at Hermits Rest and Hermit Trail visitor use areas
Other East End Routes	As incentive for quiet-technology conversion, use of the long-loop tour route over North Rim between Zuni Point and Dragon Corridors by non-quiet-technology aircraft would be phased out over a four-year period; after the four-year period only quiet-technology aircraft could travel long-loop tour routes
Black-1E	Eliminated
Black-2	Eliminated
Black-3	Eliminated
Black-4	<i>Eliminated</i>
Black-4X	Eliminated
Black-5	Eliminated
Black-6	Eliminated
Green Routes Helicopter Routes	
Zuni Point Corridor Routes	<i>East End Short- and long-loop routes</i> would be available in Zuni Point Corridor <i>April 1-November 14</i> (closed remainder of year). <i>November 15-March 31 no flights allowed on Zuni Point Corridor routes or long-loop routes over North Rim</i>
Green-1/ Green-1A	Modified similar to Black-1 and Black-1A . Green-1 altitude would continue at 7,500 feet MSL northbound when crossing South Rim, climbing to 8,500 feet MSL <i>at</i> Temple Butte, then remaining at 8,500 feet MSL for turns to view the confluence. Aircraft would turn west at north end of Chuar Butte and climb to 9,000 feet MSL. At intersection of Green-1 and Green-1A , which would move south to near Gunthers Castle, aircraft could turn right to cross North Rim on Green-1A at 9,000 feet MSL, or turn left to continue south on Green-1 at 9,000 feet MSL along Zuni Point Corridor's west side, descending to cross South Rim at 7,500 feet MSL. Nankoweap loop described in Alternative A eliminated, and loop confluence flyover moved west of the confluence as for fixed-wing aircraft
Dragon Corridor Routes	A short-loop route (Green-2) would be available for <i>air-tour</i> helicopter use <i>year-round</i>
Green-2	Aircraft would enter Green-2 at 7,500 feet MSL crossing South Rim and travel north along Dragon Corridor's west side climbing to 8,500 feet MSL at the dogleg north of Tower of Ra. At Dragon Corridor's north end, helicopters would remain at 8,500 feet MSL and merge <i>safely</i> with helicopter traffic <i>westbound</i> on Green-1A from Zuni Point Corridor as route turns south along Dragon Corridor's east side, then descend from 8,500 feet MSL at the dogleg south of Tower of Ra to 7,500 feet MSL crossing South Rim. Green-2 entry and exit points would move west to create a dogleg to reduce aircraft noise at Hermits Rest and Hermit Trail visitor use areas
Other East End Routes	As incentive for quiet-technology conversion, use of long-loop tour routes over North Rim between Zuni Point and Dragon Corridors by non-quiet-technology aircraft would be phased out over a four-year period; after the four-year period only quiet-technology <i>aircraft</i> would be allowed to travel long-loop tour routes

Table 2.4 Modified NPS Preferred Alternative Changes from Current (Alternative A) Air-tour Routes

General Description	
Brown Routes Support Operations	
Brown-1	<i>Configuration and altitude same as Alternative A</i>
Brown-2	<i>Generally current route location and altitudes to intersect the Z-shaped Route (realigned Blue Direct North). Route configured to be two-way in consultation with FAA</i>
Brown-4	<i>Eliminated</i>
Brown-5	<i>Generally current route location and altitudes to intersect the Z-shaped Route (realigned Blue Direct North). Route configured to be two-way in consultation with FAA</i>
Brown-6	Realigned so aircraft from Grand Canyon NP Airport would travel predominantly west to Havasu Canyon then northwest directly over this canyon, same as Alternative E. Route would continue to allow two-way traffic at 300 feet AGL. Brown-6 would <i>continue to</i> be limited to operations in support of the Havasupai Tribe at Supai Village
Blue Routes Fixed-Wing Only	
<i>Z-shaped Route (realigned Blue Direct North)</i>	<i>Alignment changed to reduce length in SFRA and over GCNP, but distance/time over canyon increased from current Blue Direct North route. Route would cross Grand Canyon in a northwest-southeast direction near Twin Peaks, and then east to Grand Canyon NP Airport or west to Las Vegas. Anticipated route outside SFRA is depicted in Map 2.5. Route would be flown at same altitudes available on current Blue Direct North route: 7,500 or 9,500 feet MSL eastbound and 8,500 or 9,500 feet MSL westbound</i>
Blue Direct South	Eliminated

Allowable Times of Operation

For all East End routes, *April 1* through *November 14*, allowed air-tour flight time would be nine hours (8 a.m. to 5 p.m.); *November 15* through *March 31*, flight time would be seven hours (9:00 a.m. to 4:00 p.m.). *As clarification, no flights will be allowed on any routes north of the south boundary of Zuni Point and Dragon Corridors except during those hours (aircraft can be leaving the Corridor headed toward the airport when the evening curfew starts, but they cannot fly in East End except south of the Corridors before the morning curfew ends).* This modification would ensure at least one hour of flight-free time after sunrise and before sunset *almost all year*.

Numbers of Flights Allowed

The *Modified* NPS Preferred Alternative would implement a daily cap of 364 commercial air-tour operations in the SFRA, based on Peak Day use data for commercial air-tour operations 2004 to 2006. A new annual allocation of 65,000 air-tour and air-tour related operations in the SFRA would be implemented, based on the maximum annual number of operations reported for each operator 2004 to 2008.

The daily cap would apply to total commercial air-tour operations, not to individual air-tour operators and not to non-air-tour operations. *Although it is intended that air-tour operators would cooperate with each other to avoid exceeding the daily cap, NPS will monitor compliance with the daily cap as part of reporting requirements and adaptive management process outlined below.* Each *non-expected* operation in the SFRA would require use of an annual allocation.

West End Exception

As further defined in Chapter 2, Elements Common to All Alternatives, operations currently not subject to annual allocations will remain not subject to annual allocations and daily caps. However, flights currently not subject to annual allocations are growing and unlimited in number (for example, flights in support of Hualapai Tribe), and proposals exist to include additional flights as not subject to annual allocations (for example, flights in support of Navajo Nation).

1 *Additional flights may also result from actions outside the SFRA including: the proposed Southern Nevada*
 2 *Regional Heliport³³, the new Boulder City AeroCenter³⁴, the proposed Hualapai³⁵ and Tusayan Airport³⁶*
 3 *expansions, and potential development in the Navajo Nation adjacent to the park's eastern boundary.*
 4 *Considering these factors, aircraft noise impacts could increase virtually unrestricted and exponentially due to*
 5 *the unlimited nature of flights not subject to annual allocations.*

6
 7 *Unlimited numbers of flights could undo many gains realized by measures in this EIS. Also, the 2000 allocation*
 8 *limits were originally intended to temporarily limit commercial air tours, and be revisited at a later date. To*
 9 *address such issues, NPS intends to examine the entire allocation system parkwide, including flights currently*
 10 *not subject to annual allocations, in a subsequent planning effort building on this EIS process. This will likely*
 11 *require additional NEPA compliance and FAA rulemaking.*

12 13 **Adaptive Management**

14
 15 A key to successful **Modified** NPS Preferred Alternative implementation is appropriate and effective monitoring and
 16 reporting. The **Modified** NPS Preferred Alternative would require reporting of daily operations by air-tour operators
 17 on as close to a daily basis as is reasonable, **and would require deviations of any kind (into a Flight-free Zone or**
 18 **otherwise) be reported to both FAA and NPS to provide data necessary to ensure safety and monitor impacts.**
 19 This reporting would be enforceable by FAA as part of revised SFRA regulations. Reported and validated data are
 20 essential for verifying compliance with both the daily cap and annual allocation, and to provide data for ongoing
 21 GCNP noise modeling and monitoring.

22
 23 The **Modified** NPS Preferred Alternative would also involve a communication-based adaptive management process
 24 involving NPS, FAA, commercial air-tour operators, and other stakeholders to achieve the **Modified** NPS Preferred
 25 Alternative's goals and intents. This process would address any problems encountered in implementing the **Modified**
 26 NPS Preferred Alternative such as exceeding the daily cap and route deviations that become more than a rare
 27 occurrence. Using proactive communication among stakeholders and agencies, the intent of the process would be to
 28 search for solutions within the approved plan or with only minor changes. However, if the nature and severity of a
 29 problem requires changing the plan or regulations to solve the problem, a new NEPA process may be necessary. The
 30 adaptive management process would also identify and address potential opportunities if monitoring indicates the
 31 plan's objectives can be met in a less restrictive way (for example, increasing the daily cap for quiet-technology
 32 operations).

33 34 **Monitoring**

35
 36 *Monitoring and noise modeling will be conducted as part of an Adaptive Management approach to ensure noise*
 37 *provisions of section 804 of Public Law 106-181 will be met, to verify reporting data and compliance with the*
 38 *daily cap and annual allocations, and monitor noise in the field.*

33 *Ricondo and Associates, Inc. 2008. Final Environmental Assessment for Proposed Southern Nevada Regional Heliport, Clark County, Nevada. Prepared for: Clark County Department of Aviation; U.S. Department of Transportation, Federal Aviation Administration; U.S. Department of the Interior, Bureau of Land Management. Prepared by: Ricondo and Associates, Inc. in association with: Brown-Buntin Associates, Inc.; SWCA Environmental Consultants; The Louis Berger Group, Inc.; ASRC Aerospace Corporation; Granite Environmental, Inc. December. Accessed at <http://www.ricondoprojects.com/Heliport>*

34 *Papillon Grand Canyon Helicopters. Press Release dated March 29, 2009, "AeroCenter." Accessed at http://www.papillon.com/popris/show_article.aspx?article_id=342&lang=en-US*

35 *Arizona Department of Transportation, Five-Year Airport Capital Improvement Program, 2012-2016, Five-Year Transportation Facilities Construction Program. Accessed at <http://www.azdot.gov/5yearprogram/>*

36 *Arizona Department of Transportation. 2009. Terminal Area Plan for Grand Canyon National Park Airport. Prepared by Coffman Associates, Inc. in association with LEA-Associates, LLC and Z & H Engineering, Inc. Accessed at http://www.azdot.gov/MPD/Airport_Development/library/misc_doc_PDF/Grand_Cyn_TermPlan/GCN_Terminal_Area_Plan.pdf*

1 **Quiet-Technology Incentives and Conversion**

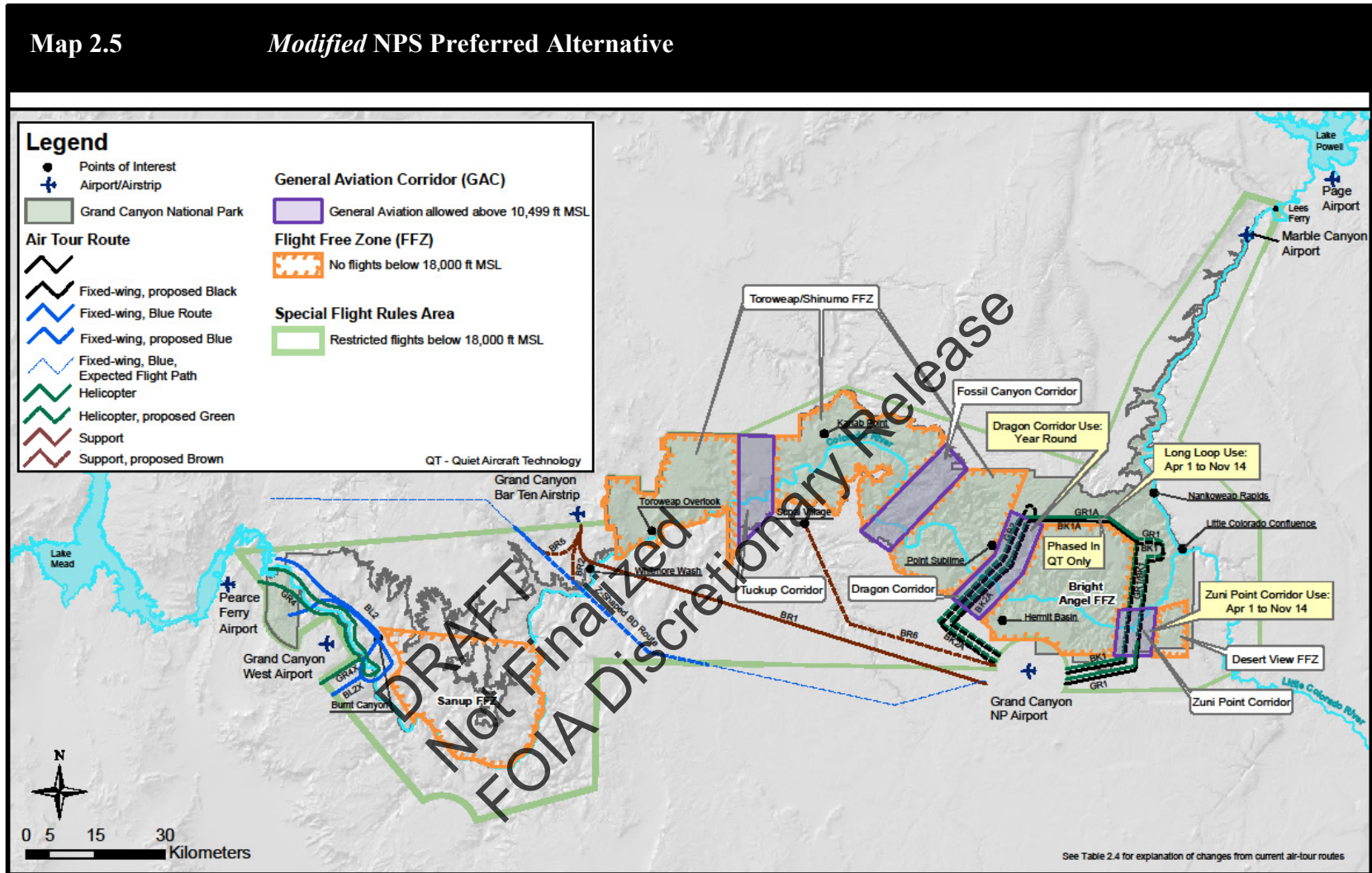
2
3 The *Modified* NPS Preferred Alternative would require all commercial aircraft flying on SFRA routes to be quiet-
4 technology aircraft within ten years of implementation.

5
6 *To provide an incentive to convert to quiet-technology aircraft prior to the ten-year deadline, within four years of*
7 *implementation* only quiet-technology aircraft (fixed-wing and helicopter) *would be allowed* to fly long-loop routes
8 between Zuni Point and Dragon Corridors via North Rim, *with use* of these long-loop routes by non-quiet-
9 technology aircraft phased out *during that four-year period*.

10
11 *Quiet-technology aircraft operations would not be required to use annual allocations three months each year*
12 *(January 1 to March 31)*.

13
14

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Not Finalized
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1 **MITIGATION PROVISIONS TO MANAGE AIRCRAFT NOISE AND REDUCE IMPACT TO RESOURCES UNDER ACTION**
 2 **ALTERNATIVES**

3
 4 Under any selected Action Alternative, the following measures would be taken to help avoid or minimize aircraft
 5 impacts

- 6 • Park staff would continue to work with applicable Military Airspace/Range Councils to minimize GCNP
 7 overflights
- 8 • Pilot education would be conducted to help prevent collisions with California condors and other birds. Incident
 9 reporting procedures are presently in place and would be refined as needed
- 10 • Compliance with terms and conditions of applicable Biological Opinions for protection of threatened,
 11 endangered, or sensitive listed species would be required for all commercial operations, and would include
 12 procedures for reporting any aircraft-animal collisions or near-collisions as well as airport safety incidents
- 13 • NPS would educate park visitors on Soundscape conditions to help them find the type of recreational
 14 opportunity and visitor experience they seek. Brochures, maps, and educational literature could show where
 15 aircraft noise is expected, areas and times of day expected to be dominated by natural sounds, and areas and
 16 times of day expected to experience the greatest amount of non-natural noise

17
 18 *The following conservation measures are a result of the Final Biological Opinion (received May 4, 2012) from*
 19 *the U.S. Fish and Wildlife Service.*

20
 21 **Conservation Measures for ESA Special Status Species**
 22 **Common to All**

- 23 • NPS shall develop and implement a soundscape monitoring plan for the California condor, Mexican
 24 spotted owl, and southwestern willow flycatcher to assess and monitor changes to sound levels in areas
 25 where noise level impacts are anticipated to increase or change in character (i.e., air-tour routes in
 26 Dragon Corridor). This may include monitoring areas where air tours will be restricted (i.e., Marble
 27 Canyon) to collect information on species' responses to improved soundscapes
- 28 • Depending on funding, NPS will develop a comprehensive research and monitoring plan that evaluates
 29 impacts of overflights on other species of management concern in GRCA that might be affected by the
 30 proposed action

31
 32 **Conservation Measures for ESA Special Status Species**
 33 **California Condor and Mexican Spotted Owl**

- 34 • NPS will continue to monitor populations of California condor and Mexican spotted owl within GRCA
 35 to assist with assessment of effects of the implemented action, and related actions, on those species. NPS
 36 will submit annual reports to USFWS on the results of monitoring activities
- 37 • NPS will monitor implementation of the proposed action on California condors and Mexican spotted
 38 owls:
 - 39 ○ Within six months after Rulemaking is completed, GRCA will develop a reporting/compliance
 40 process ensuring air-tour operators do not exceed the daily cap and other specific requirements
 41 of the proposed action
 - 42 ○ After four and ten years of project implementation, GRCA will provide a report to USFWS
 43 regarding progress made in converting all commercial aircraft flying on SFRA routes to quiet
 44 technology
 - 45 ○ By February 1 of each year, NPS will provide an overall annual report regarding compliance
 46 with conservation measures designed to reduce incidental take
 - 47 ○ NPS will continue to implement, and develop further as appropriate, the January 22, 2008,
 48 Management Plan (Management Plan for the Bald Eagle, California Condor, and Mexican
 49 Spotted Owl—To Address the 2000 Biological Opinion Requirements for Overflights of Grand
 50 Canyon National Park) that was developed and implemented as a term and condition of the
 51 2000 BO

1 **Conservation Measures for ESA Special Status Species**

2 **California Condor**

- 3 • GRCA will make condor information available to FAA for training air-tour (including helicopter) pilots
 4 at FAA-sponsored pilot safety meetings. Pilots will be asked to actively watch for condors and maintain
 5 safe distances between aircraft and condors. Incident reporting procedures are presently in place and
 6 will be refined as needed to include procedures for reporting any aircraft-animal collisions or near-
 7 collisions as well as airport safety incidents
- 8 • NPS will continue to assist FAA in developing appropriate bird avoidance measures (e.g., alarms or
 9 other hazing techniques) to minimize condor use of the airport vicinity, as necessary
- 10 • GRCA will work cooperatively with other condor recovery partners (e.g., Arizona Game and Fish
 11 Department, The Peregrine Fund, Hualapai Tribe) to monitor patterns of condor use (e.g., flight routes)
 12 throughout the project area. If changes to condor use patterns are observed, NPS will re-initiate
 13 consultation with FWS to determine whether new impacts to the species are occurring in the SFRA
 14

15 **Conservation Measures for ESA Special Status Species**

16 **Southwestern willow flycatcher**

- 17 • To promote southwestern willow flycatcher recovery and counter any potentially negative effects on
 18 breeding birds within GRCA, GRCA will pursue additional programs to reduce impacts on flycatchers
 19 and their habitat from recreationists by promoting stewardship, educating user groups to reduce noise
 20 and habitat disturbances, and surveying and managing habitat in historically and currently occupied
 21 territories
- 22 • GRCA will work with FAA and the Hualapai Tribe to control unauthorized flights and initiate another
 23 planning effort to address annual allocations, daily caps, and exceptions
 24

25 **Conservation Measures for Other Special Status Species**

26 **Bald and Golden Eagles**

- 27 • Bald and golden eagles both occur within GCNP and may also be affected by the proposed action.
 28 However, because these species are not listed under the Endangered Species Act, GRCA will work with
 29 USFWS to minimize effects to eagles through a process outside of section 7
 30

31 **ALTERNATIVES AND ACTIONS CONSIDERED AND DISMISSED FROM FURTHER CONSIDERATION**

32 Several Alternatives and Alternative elements were considered during the planning process but not included in this
 33 EIS for detailed study. These are described here, along with dismissal justification.
 34

35 **Eliminate All Air Tours or All Aircraft Flights from Entire Canyon**

36 *The 1986 Aircraft Management Plan Environmental Assessment prepared by Grand Canyon National Park*
 37 *considered and dismissed this Alternative in the section on Actions Which Were Considered Then Deleted from*
 38 *the Planning Process in “D. Eliminate All Aircraft Flights Over the Park” (NPS 1986, page 34). The rationale is*
 39 *still relevant, and states:*
 40

41 *“After detailed analysis of research data collected over the past 15 years, relevant laws, regulations, policies,*
 42 *and public input ... the NPS has determined that total elimination of aircraft flights over the park is not a*
 43 *reasonable alternative. While the NPS Organic Act established the priority of resource preservation over visitor*
 44 *use, it clearly provides for visitor use where consistent with the resource preservation goals. ...Congressional*
 45 *direction expressed through the GCNP Enlargement Act allows continuation of aircraft use provided there is*
 46 *no significant adverse effect to park resources. Had Congress considered total elimination as the appropriate*
 47 *remedy to address this issue, such a solution would have been identified prior to the passage of the Act since*
 48 *aircraft use was already well-established.*
 49

50 *“The NPS has determined that viewing the park from the air (and traveling to the park via aircraft) are*
 51 *important aspects of a park experience for many visitors which have continued for almost 60 years. This was*
 52 *confirmed during the 1985 public review process, when many persons expressed the positive impact of flying*
 53 *over the park on their appreciation for the park.”*
 54
 55

1 *The legislative history of the 1987 Overflights Act makes it very clear the intent was not to ban aircraft or air*
2 *tours above Grand Canyon or other national Parks. In the words of Senator John McCain when the Act was*
3 *passed (133 Cong Rec S 1592 February 3, 1987): "We must recognize that aircraft use of our national parks is*
4 *exactly that, use of the park. Just as we regulate other uses of our park system, it is appropriate that aircraft be*
5 *brought into the regulatory scheme in a fashion that will harmonize their use with other users. I emphasize*
6 *again, Mr. President, this legislation does not ban aircraft above the parks. What it does is regulate and manage*
7 *aircraft over the parks just as we regulate hikers, campers, dogs, water skiers and other individuals who use our*
8 *National Park System. Aircraft, in my opinion, are badly in need of regulation at this time. What this measure*
9 *does is propose a process whose end result will be to strike a balance among all those individuals and interests*
10 *who use our Nation's Park System."*

11 Lower Ceiling Elevation on All East End Green Routes to 6,500 Feet MSL

12 Eliminated from further consideration because *Section 3 (b)(1) of the 1987 Overflights Act states,*
13 *"recommendations shall contain provisions prohibiting the flight of aircraft below the rim of the Canyon," but*
14 *that FAA "shall define the rim of the Canyon."*

15
16
17
18 *FAA's definition of the rim currently allows helicopters to fly below North Rim in Dragon Corridor and near*
19 *Point Imperial, often very close to terrain features before climbing almost vertically near Canyon walls.*
20 *Therefore, to better meet all the Overflights Act mandates, NPS has included provisions in the Modified NPS*
21 *Preferred Alternative to raise route altitudes in Dragon and Zuni Point Corridors so aircraft will gradually climb*
22 *to altitudes needed to cross North Rim several miles before they near North Rim. See also Appendix H, Response*
23 *to Comments, Individual Alternative Elements, Flight Elevation.*

24 Reduce Overflight Numbers to Pre-1987 Levels

25
26
27 *Flight numbers have increased since 1974 and 1986, but NPS determined 2005 data the best available for the*
28 *EIS process (See Appendix H, Response, Analysis, Base Year for full explanation). In response to DEIS*
29 *comments and after further review of limited data available for earlier years, the NPS best estimate of air-tour*
30 *flight numbers in 1974 is 20,000 to 30,000, and in 1986 40,000 to 45,000. This compares to reported air-tour*
31 *numbers, 2001 to 2010, between a low of 42,453 in 2002 and a high of 56,920 in 2005 (current excepted flights*
32 *and those just outside the SFRA near Grand Canyon West raise the total number of flights to more than double*
33 *that of reported air-tour-and-related flights alone). However, it should be noted that 1974 and 1986 flight*
34 *numbers cannot be compared directly with more recent flight numbers in terms of impacts because there are*
35 *many factors now that reduce noise impacts in ways other than flight numbers, such as specified routes and*
36 *Flight-free Zones established by special regulations since 1988, and other factors that reduce impacts per flight*
37 *(e.g., most aircraft used today for GRCA air tours are quieter than those used in 1974 and 1986).*

38
39 *NPS uses five primary methods in combination to reduce aircraft noise at GCNP:*

- 40 • *Limit number of flights (annual allocation, daily cap)*
- 41 • *Reduce noise at the source (i.e., quiet technology)*
- 42 • *Move aircraft away from sensitive locations using a combination of vertical (altitude) and horizontal (slant*
43 *distance) increases in distance*
- 44 • *Reduce number of routes or areas where flights occur (Flight-free Zones and route locations)*
- 45 • *Reduce hours of operation or increase no-fly times (daily curfews, seasonal shifts, or closures)*

46
47 *Conversion to quiet technology (QT) can help reduce noise, but by itself it is not the answer, because QT aircraft*
48 *still produce considerable noise. They are quieter than non-QT aircraft but not completely quiet. Also, FAA's QT*
49 *definition is based on noise per passenger, not noise per flight. FAA's definition could actually allow more noise*
50 *per flight if a large aircraft carrying more passengers is used compared to a small aircraft (Response, Individual*
51 *Alternative Element, Quiet Technology, Quiet Technology Definition).*

52
53 *NPS included reduction to the 65,000 annual allocation in the DEIS NPS Preferred Alternative and retained it in*
54 *the Modified NPS Preferred Alternative after considering the range of Alternatives and the need to limit flights*
55 *so impacts would not keep growing and nullify benefits advanced by proposed actions. DEIS and FEIS analysis*
56 *showed significant reduction in noise impacts would occur with the NPS Preferred Alternative and Modified NPS*

1 *Preferred Alternative's combination of proposals without reducing annual allocations below 65,000. However,*
2 *those gains would be mostly undone if flight numbers were allowed to increase beyond 65,000, which could occur*
3 *if annual allocations were not limited, or if the number of flights excepted from annual allocations is allowed to*
4 *increase without limit.*

5
6 *NPS plans to examine exceptions and annual allocations in a separate compliance process initiated after*
7 *completion of this EIS. For more information, see Appendix H, Response to Comments, Annual Allocation.*

9 **Eliminate Helicopters from Entire Canyon**

10 *Eliminating helicopters* would have significant adverse effect on air-tour operators and variety of air-tour
11 experiences available to visitors. The EIS analysis demonstrates that laws, policies, and EIS objectives can be met
12 by Alternatives that include quiet-technology requirements and other elements without eliminating helicopters or
13 any other any specific aircraft type. Alternative D considered this element for the heart of the park (see Alternative
14 D discussion below).

17 **Move Whitmore Helicopter Exchange to a Location Across the River from Diamond Creek or to Nearby** 18 **Points Upstream Between Mile 220 and 224**

19
20 Whitmore helicopter pad is on Hualapai tribal land, *excepted* in PL 100-91 from prohibitions on helicopter flights
21 directly between a point on North Rim outside the park and locations on the reservation. Also, flights between Bar
22 Ten airstrip and the Diamond Creek area would be much longer with noise impacts over a much greater area.

24 **Require Flight-following**

25
26 Requiring flight-following (such as Capstone II) was considered but dismissed because it would not change the
27 noise footprint nor contribute to substantial restoration of natural quiet. Acquiring necessary radar capabilities to
28 conduct flight-following would involve significant costs for equipment, installation, maintenance, and land
29 acquisition, and costs for associated environmental studies for siting equipment. Impacts from equipment installation
30 throughout the park's remote areas, managed as Wilderness, might not be acceptable. Therefore, although NPS
31 conducts flight-following for administrative flights, and flight-following may be encouraged, requiring it as a
32 component of an Alternative in this EIS was considered infeasible and not necessary to accomplish EIS objectives.
33 Future technological advances may make flight-following more desirable to be considered through adaptive
34 management to enhance monitoring efforts.

36 **Exclude General Aviation from Analysis of How Each Alternative Meets the Substantial Restoration of** 37 **Natural Quiet Mandate**

38
39 PL 100-91 requires NPS and FAA consider all aircraft. Additionally, the August 16, 2002 court decision, relative to
40 the 2000 Final Supplemental EA stated "in the absence of any reasonable justification for excluding non-tour
41 aircraft from its noise model, we must conclude that this aspect of the FAA's methodology is arbitrary and
42 capricious and requires reconsideration by the agency." Therefore, noise from all aircraft, including general-aviation
43 aircraft, must be included in the Alternative analyses, and is considered in cumulative effects.

45 **Alternative B Unimplemented 2000 Environmental Assessment**

46
47 This Alternative included actions discussed in the FAA's Final Supplemental EA, February 2000, Special Flight
48 Rules in the Vicinity of Grand Canyon National Park. Some elements from that EA were modified to address safety
49 concerns raised in late 1999 and 2000, which resulted in not implementing most East End actions. Only West End
50 airspace changes were implemented. As much of the original proposal as possible was retained. To meet the 2000
51 National Parks Air Tour Management Act, incentives for quiet technology were incorporated as mitigation to further
52 reduce noise impacts.

53
54 Alternative B was dismissed from further evaluation primarily because other Alternatives receiving further
55 evaluation contained almost all Alternative B provisions with minor modifications that provide greater advantages in
56 meeting EIS objectives.

1 Alternative B, if implemented, would have restored 54% of the park to natural quiet Base Year, and 53% Ten-Year
2 Forecast. Compared to *progress toward* restoration *in* Alternative A (55% and 53% in Base Year and Ten-Year
3 Forecast, respectively), Alternative B did not provide a substantial improvement over current conditions. Alternative
4 B did not meet the EIS objective to improve natural quiet in the park and provide for enhanced visitor experience.
5 Due to these factors, Alternative B was dismissed from further study.

7 **Alternative C Consolidated Use**

9 Alternative C expanded Flight-free Zones, concentrated air-tour routes closer to park developed areas, and removed
10 annual allocation limits. The Alternative also changed allowable flight times, provided an incentive route for quiet
11 technology, and required eventual full conversion to quiet technology for all commercial air-tour aircraft flying in
12 the SFRA. This Alternative eliminated Dragon Corridor and associated air-tour routes, Black-1A and Green-2. It
13 created a new Developed Area Corridor across the canyon over popular visitor use-areas that, particularly on the
14 rim, often experience substantial levels of human-caused noise from other sources. These included South Rim's
15 Grand Canyon Village area, Phantom Ranch on the Colorado River, and North Rim's Grand Canyon Lodge.
16 Alternative C was developed to be most consistent with park management zoning, in that motorized visitation (i.e.,
17 air tours) would be routed over Developed Zones, roads, and other areas zoned for motorized visitation. Thus, it had
18 less impact on undeveloped and Wilderness areas where motorized use is not consistent with zoning and
19 management objectives.

21 In Alternative C, Dragon Corridor was replaced with a Developed Area Corridor, something very different from
22 remaining Alternatives. Even though the Developed Area Corridor seemed to be more consistent with park
23 management zoning by routing mechanized use and associated noise over developed areas, it impacted most park
24 visitors and was inconsistent with park administrative flight practices. (To the extent possible, administrative flights
25 are routed away from developed areas for noise abatement and to avoid the possibility of increased risk to visitors,
26 residents, facilities, and park resources including listed National Register historic buildings and districts).

28 Alternative C did not meet EIS objective 6 (limited aircraft intrusions for visitors at rim developed areas and major
29 frontcountry destination points), and objective 8 (minimize conflicts with other park visitors). Alternative C
30 maximized conflicts with other park visitors by routing air tours over the highest-use areas for ground visitors.

32 Because Alternative C routed air tours over developed areas (hotels, visitor centers, residences) and the highest
33 concentrations of ground-based visitors, it caused air-tour noise directly over the vast majority of park visitors,
34 facilities, National Register buildings, and National Historic Landmarks. This guaranteed the majority of park
35 visitors and facilities were exposed to the highest sound levels.

37 Alternative C also routed air tours directly over the Cross-Canyon Corridor, which includes heavily used
38 backcountry trails and campgrounds. Even though the Corridor is not Proposed Wilderness, it sees most of the
39 park's backcountry visitation (by design, visitation to the rest of backcountry is limited much more than in the
40 Corridor).

42 Alternative C had the greatest number of flight hours between curfews (11) of any Alternative, thereby providing the
43 least protection for visitors during sensitive morning and evening hours. The greatest remaining number of daily
44 flight hours after dismissing Alternative C is ten hours under Alternative A.

46 In Alternative C, Blue Direct North followed the Colorado River for 20 miles near Twin Peaks and Whitmore,
47 something no other Alternative does. This was not entirely consistent with objectives 1, 5, and 8. Due to the above
48 factors, Alternative C was dismissed from further study in this EIS.

50 **Alternative D Modified 1995 Report to Congress**

52 Alternative D was based primarily on recommendations provided in Chapter 10 of the NPS 1995 Report to
53 Congress, with some modifications. Under this Alternative, two of the four general-aviation corridors across Grand
54 Canyon and the easternmost Flight-free Zone would have been eliminated; the other three existing Flight-free Zones
55 would have been expanded; and air-tour flights on Marble Canyons west side would have been eliminated. The
56 Alternative included operational changes, such as curfews and quiet-technology incentives.

1 Recommendations were based on the general concepts of simplifying the commercial tour route structure, expanding
2 Flight-free Zones, accommodating air-tour industry forecast growth, and phasing in use of quiet-aircraft technology.
3

4 The Zuni Point Corridor was eliminated, with aircraft routed east of Desert View one-way northbound, and west of
5 Desert View one way southbound. This is very different from remaining Alternatives. On East End canyon routes,
6 flight time over the canyon was found to be less than the time over forest and sagebrush, which greatly reduced
7 quality of aerial viewing experience (EIS Objective 8) compared to other Alternatives. Alternative D also closed
8 Dragon Corridor, except for quiet-technology fixed-wing aircraft, 25% or less of the day. The combination of these
9 two features, although providing substantial noise reduction, greatly reduced time over the canyon, and thus the
10 quality aerial viewing experience. These factors contributed to Alternative D's dismissal.
11

12 D was the only Alternative with a noise budget. However, the agencies were not able to describe exactly how to
13 implement a noise budget; noise budgets have been implemented in very limited fashion at a few airports. A noise
14 budget appeared to be very complex and infeasible to address park noise concerns, with other, more practical
15 mechanisms available in remaining Alternatives. This feature contributed to dismissal of this Alternative.
16

17 The Navajo Nation, during government-to-government consultation, strongly objected to having a Marble Canyon
18 route on the east (i.e., Navajo) side of the river, and also objected to routes east of Desert View over Navajo lands.
19 In response to these concerns, the agencies agreed to dismiss proposed changes to the Marble Canyon route (as
20 contained in Alternative D) from further study.
21

22 In Alternative D, Fossil and Dragon General-Aviation Corridors were eliminated, the only alternative to do so. This
23 made it more difficult for general aviation to navigate Grand Canyon airspace, another factor contributing to
24 dismissal of this Alternative. Due to all above factors, Alternative D was dismissed from further study in this EIS.
25

26 **Alternative G**

27

28 Major features included two quiet-technology-only tour routes and lower air-tour operator fees to encourage quiet-
29 technology aircraft use, with full quiet-technology conversion within 15 years. The annual allocation limit would
30 have been modified to account for all air-tour and air-tour-related flights over the park while continuing to provide
31 opportunities for the peak number of operations per operator. Air-tour altitudes would have been raised and/or air-
32 tour routes moved away from sensitive resources and visitor-use areas. Quiet times would have been provided each
33 day, with no air-tour or air-tour-related flights occurring at least one hour before sunset to one hour after sunrise for
34 the entire East End all year. The current route structure would have been modified to add access and egress points to
35 air-tour routes in response to stakeholder requests for additional ways into and out of the SFRA. Alternative G
36 allowed potential growth in air-tour flight operations for quiet-technology aircraft if growth did not increase noise or
37 negatively impact substantial restoration of natural quiet.
38

39 Alternative G was dismissed primarily because it was superseded by the NPS Preferred Alternative *and now the*
40 *Modified NPS Preferred Alternative*, which improved Alternative G by adding features that increase *protection of*
41 *resources and* substantial restoration of natural quiet *and experience*, and by addressing several concerns (e.g.,
42 changes to annual allocation, Dragon Corridor short-loop tour options, altitudes, improved confluence views on both
43 sides of aircraft, and route adjustments over Navajo lands) raised in the Grand Canyon Working Group.
44

45 Alternative G's annual allocation system was not found in any other Alternative, due in large part to its complexity,
46 which goes to zero as aircraft convert to quiet technology. This system was considered impractical after discussion
47 with the Grand Canyon Working Group.
48

49 The Marble Canyon Minimum Sector Altitude for general-aviation aircraft would have been raised to keep air tours
50 separate from general aviation. The NPS Preferred Alternative *addressed* the issue by lowering tour-route altitude
51 but placing additional limits on Marble Canyon flights. *The Modified NPS Preferred Alternative eliminates air-*
52 *tour flights from Marble Canyon.* No remaining Alternative proposes raising a minimum sector altitude anywhere
53 to avoid potential airspace concerns with general-aviation traffic. This would not be entirely consistent with the
54 intent of EIS Objective 2. Due to the above factors, Alternative G was dismissed from further study in this EIS.
55

ENVIRONMENTALLY PREFERRED ALTERNATIVE

The Environmentally Preferred Alternative is defined as the Alternative that best meets the following criteria or objectives, as set out in Section 101(b) of the National Environmental Policy Act (42 USC 4331)

1. Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations
2. Assure for all Americans safe, healthful, productive, and esthetically and culturally pleasing surroundings
3. Attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences
4. Preserve important historical, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity and variety of individual choice
5. Achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities
6. Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources

Alternatives for managing air-tour overflights at GCNP differ in their abilities to meet these criteria. Aspects of the EIS that address each criteria are described below, and effects of Alternatives relative to these criteria are presented in Table 2.5. A more detailed evaluation of effects is provided in Chapter 4, Environmental Consequences.

Criteria

Fulfill the Responsibilities of Each Generation as Trustee of the Environment for Succeeding Generations

The primary concern for natural and cultural resources from aircraft overflights is the effect of noise generated during flights. As trustees of the environment for future generations, Federal government objectives include improving on and maintaining substantial restoration of natural quiet, enhancing visitor experience, protecting Wilderness Character in Wilderness, and protecting sensitive wildlife habitat and cultural resources.

Assure for All Americans Safe, Healthful, Productive, and Esthetically and Culturally Pleasing Surroundings

When this criterion is met, aircraft overflight sight and sound would be minimized, and primitive recreation opportunities would be provided without aircraft intrusions in most backcountry areas, most Colorado River locations, and destination points accessed by both backcountry and river users. Aircraft intrusions would also be limited for visitors at developed areas and major front-country destinations. Alternatives meeting or exceeding this criterion would provide large areas free of day-to-day experiences common to urban areas, such as aircraft sights and sounds, so visitors would have ample opportunities to experience resources and special qualities of Grand Canyon's environment, consistent with management zoning and the intent behind establishing Grand Canyon National Park.

Attain the Widest Range of Beneficial Uses of the Environment without Degradation, Risk to Health or Safety, or Other Undesirable and Unintended Consequences

To attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences, a wide range of opportunities must be provided for ground-based visitor experiences with limited aircraft intrusions, as well as a wide range of opportunities for quality aerial viewing experiences for air-tour visitors, while protecting and reducing impacts to park resources and minimizing conflicts with other park visitors. The range of beneficial uses without degradation is reduced when the range (variety and amount) of opportunities for ground-based and air-tour visitors are reduced, when conflicts between air-tour and ground-based visitation increase, and/or when resource impacts increase. In terms of risk to health and safety, a major reason for establishing the SFRA was to provide a safe environment for air-tours and other aviation.

Preserve Important Historical, Cultural, and Natural Aspects of our National Heritage, and Maintain, Wherever Possible, an Environment which Supports Diversity and Variety of Individual Choice

To preserve important aspects of our national heritage, and maintain diversity and variety of individual choice, impacts to these resources must be reduced while providing a diverse range of recreational opportunities to ground-based and air-tour visitors and minimizing conflicts among visitors. To meet this criterion, reductions in aircraft noise impacts must be balanced against diversity and variety of choices for air-tours, and ground-based visitor experiences without aircraft noise impacts.

1 **Achieve a Balance between Population and Resource Use which Will Permit High Standards of Living and a**
2 **Wide Sharing of Life's Amenities**

3 A balance would be achieved when park resources are protected, reasonable access to a variety of quality aerial
4 viewing and ground-based experiences is provided, and conflicts among different types of visitor use are minimized.
5 In doing so, a balance would be achieved for both ground-based and air-tour visitors, while minimizing aircraft
6 noise impacts on park resources.

7
8 **Enhance the Quality of Renewable Resources and Approach the Maximum Attainable Recycling of**
9 **Depletable Resources**

10 Alternatives that best enhance resources or best reduce impacts or energy/fuel use would contribute to meeting this
11 criterion.

12
13 **Conclusion**

14 Based on analysis presented in Table 2.5, the *Modified* NPS Preferred Alternative best achieves requirements of
15 NEPA Section 101(b) criteria and is the Environmentally Preferred Alternative

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Not Finalized
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Table 2.5 Analysis of Alternatives in Meeting Section 101(b) Criteria of the National Environmental Policy Act (42 USC 4331)*

Criteria	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations	Meets 53% of the park <i>progresses toward</i> SRNQ, barely more than the minimum to meet the law	Exceeds 84% of the park <i>progresses toward</i> SRNQ, greatly improving SRNQ	Exceeds 66% of the park <i>progresses toward</i> SRNQ, substantially improving SRNQ	Exceeds 75% of the park <i>progresses toward</i> SRNQ, substantially improving SRNQ
	Aircraft Percent Time Audible would be 50% or more in 33% of the park	Aircraft Percent Time Audible would be 50% or more in 6% of the park	Aircraft Percent Time Audible would be 50% or more in 16% of the park	Aircraft Percent Time Audible would be 50% or more in 10% of the park
	Aircraft Average Sound Level of 35 dBA or more in 22% of the park	Aircraft Average Sound Level of 35 dBA or more in 5% of the park	Aircraft Average Sound Level of 35 dBA or more in 13% of the park	Aircraft Average Sound Level of 35 dBA or more in 9% of the park
Assure for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings	Does not Meet Provides fewest opportunities for ground-based visitors to experience areas without air-tour aircraft sights and sounds	Exceeds Reduces aircraft sights and sounds, and provides greatest opportunities for enjoyment of surroundings for many ground-based visitors	Meets Reduces aircraft sights and sounds, and provides increased opportunities for enjoyment of surroundings for some ground-based visitors	Exceeds Reduces aircraft sights and sounds, and provides greater opportunities for enjoyment of surroundings for some ground-based visitors.
	No quiet-technology conversion requirement	Best available quiet technology required along with full quiet-technology conversion	Quiet-technology conversion incentives	Full quiet-technology conversion required
	Aircraft sights and sounds would increase with growth in aircraft operations, and no net change in flight-free zone area	Seasonal closures occur in Zuni Point and Dragon Corridors, and flight-free zone area would increase	Except for a reduction in Sanup Flight-free Zone size, there would be no net change in flight-free zone area	Raising Flight-free Zone ceilings provides greater resource protection and improves conditions for ground-based visitors. No net change in Flight-free Zone area. Seasonal closure of Zuni Point Corridor and long loop
	Aircraft would be audible less than 5% of the day in 37% of the park	Aircraft would be audible less than 5% of the day in 68% of the park	Aircraft would be audible less than 5% of the day in 46% of the park	Aircraft would be audible less than 5% of the day in 55% of the park

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Not Finalized
FOIA Discretionary Release

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Table 2.5 Analysis of Alternatives in Meeting Section 101(b) Criteria of the National Environmental Policy Act (42 USC 4331)

Criteria	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable and unintended consequences	Meets Provides wide range of opportunities for air-tour visitors, but fewest opportunities for ground-based visitors without aircraft impacts due to large number and distribution of air-tour routes and no quiet-technology conversion requirement. Generally has highest level of undesirable and unintended consequences	Meets Provides smallest range of opportunities for air-tour visitors, but largest range of opportunities for ground-based visitors without aircraft impacts. Air-tour routes reduced and vary by season, and quiet-technology conversion with best-available technology implemented	Meets Provides wide range of opportunities for air-tour visitors, and limited opportunities for ground-based visitors without aircraft impacts due to large number and distribution of air-tour routes, Dragon Corridor seasonal shift, and quiet-technology conversion requirement	Exceeds Provides widest range of beneficial uses, including wide range of opportunities for air-tour visitors due to number and distribution of air-tour routes, and a wide range of opportunities for ground-based visitors without aircraft impacts due to seasonal route <i>closure</i> , quiet-technology conversion requirement, <i>elimination of Marble Canyon tour flights</i> , and quiet-technology-only routes
	Flight-free Zone ceilings maintained at 14,500 feet except Sanup FFZ at 8,000 feet continuing levels of intrusion from other aircraft	Flight-free Zone ceilings increase to 18,000 feet reducing intrusions from other aircraft	Flight-free Zone ceilings remain at 14,500 feet except Sanup FFZ at 8,000 feet continuing intrusions from other aircraft	Flight-free Zone ceilings increase to 18,000 feet reducing intrusions from other aircraft
Preserve important historic, cultural and natural aspects of our national heritage and maintain, wherever possible, an environment which supports diversity and variety of individual choice	Meets Provides diversity and variety of air-tour route choices but provides fewest choices for ground-based visitors desiring experiences free of aircraft noise impacts	Meets Provides least diversity and variety of individual choice for air-tour visitors in flight route number and location. Provides greatest diversity and variety of individual choices for ground-based visitors desiring experiences free of aircraft noise impacts	Meets Provides same diversity and variety of air-tour route choices as Alternative A. Increases diversity and variety of choices for ground-based visitors desiring experiences free of aircraft noise impacts	Meets or Exceeds Provides a wide diversity and variety of air-tour route choices, but fewer than Alternatives A and F. However, provides a greater diversity and variety of choices than Alternatives A and F for ground-based visitors desiring experiences free of aircraft noise impacts
	Lowest protection of natural and cultural resources due to air-tour route number and distribution	Greatest protection of natural and cultural resources due to air-tour route number and distribution	Improvement from Alternative A in protection of natural and cultural resources due to air-tour route number and distribution	Better than Alternatives A and F in protection of natural and cultural resources due to air-tour route number and distribution

1

Table 2.5 Analysis of Alternatives in Meeting Section 101(b) Criteria of the National Environmental Policy Act (42 USC 4331)

Criteria	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities	Meets Four general-aviation corridors retained, providing general-aviation flexibility and opportunities	Meets Closes one general-aviation corridor reducing general-aviation flexibility	Meets Closes one general-aviation corridor reducing general-aviation flexibility	Exceeds Retains four general-aviation corridors maintaining general-aviation flexibility and opportunities
	Air-tour operations essentially unlimited although annual allocation of 93,971 flights; no daily cap	Implements daily flight cap (364) in addition to annual allocation of 93,971 flights	Retains same annual allocation as Alternative A (93,971); no daily cap	Implements both a daily cap (364 flights) and a lower annual allocation (65,000)
	No quiet-technology implementation required	Costs associated with required quiet-technology implementation	Costs associated with quiet-technology implementation	Costs associated with required quiet-technology implementation
Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources	Meets Greatest adverse impacts on Soundscape, Wildlife, Ethnographic Resources	Exceeds Least adverse impacts on Soundscape, Wildlife, Ethnographic Resources. <i>Same adverse impacts on areas around Nankoweap and Little Colorado River as Alternatives A and F</i>	Meets Less adverse impacts than Alternative A on Soundscape, Wildlife, Ethnographic Resources	Meets or Exceeds Less adverse impacts than Alternatives A or F <i>and similar impacts as Alternative E</i> on Soundscape, Wildlife, Ethnographic Resources. <i>Least adverse impacts on areas around Nankoweap and Little Colorado River</i>
	Minimally meets this criterion due to lack of change in route lengths and fuel use	Las Vegas-Grand Canyon routes slightly longer, requiring more fuel use	No change in route lengths, so no change in fuel use	Zuni Point Corridor short- and long-loop routes over North Rim shorter due so potentially less fuel use
	Quiet-technology conversion not required	Quiet-technology conversion requirement would also reduce energy usage as larger aircraft carry more passengers per flight	Quiet-technology conversion would also reduce energy usage as larger aircraft carry more passengers per flight	Quiet-technology conversion requirement would also reduce energy usage as larger aircraft carry more passengers per flight
	Does not enhance resources or reduce impacts or fuel use due to lack of quiet-technology conversion requirement	<i>Best</i> enhances resources, <i>best</i> reduces impacts and fuel use, in part due to quiet-technology conversion requirement	Enhances resources and reduces impacts and fuel use, in part due to quiet-technology conversion	<i>Better</i> enhances resources and reduces impacts and fuel use, in part due to quiet-technology conversion requirement <i>and reduced annual allocations</i>

*Table data is Ten-Year Forecast
SRNQ=Substantial Restoration of Natural Quiet

1
2
3
4

Table 2.6 Elements of the Alternatives

Elements	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Annual Allocations	Annual allocation for commercial air-tours of 93,971	Annual allocation for commercial air-tour and air-tour-related operations of 93,971	Annual allocation for commercial air-tours of 93,971	Annual allocation for commercial air-tour and air-tour-related operations of 65,000
Daily Cap	None	Air-tour and air-tour-related operations capped at 364	None	<i>Commercial air-tour operations</i> capped at 364
East End Seasonal Curfew	Curfew applies to aircraft in Zuni Point and Dragon Corridors	Curfew applies to aircraft in Zuni Point and Dragon Corridors Curfew times based on sunrise and sunset times, rather than the clock	Same as Alternative A	Curfews <i>will continue to apply to aircraft in Zuni Point and Dragon Corridors and the long loop</i>
	Allowable operation times May-September 8am-6pm October-April 9am-5pm	Tour day adjusted to provide 100 minutes of quiet time before sunset, and 150 minutes from sunrise until the tour day starts. There would also be a one hour mid-day curfew	Same as Alternative A	Allowable operation times <i>April 1- November 14</i> 8:00 am-5:00 pm <i>November 15 – March 31</i> 9:00 am-4:00 pm <i>No flights on any routes north of Zuni Point and Dragon Corridors’ south boundary except during those hours</i>
Seasonal Route Scheduling of East End Tours	None	September 16 to June 30, air tours permitted in Dragon Corridor only	December 1 to January 31, north end of Dragon Corridor, Black-1A, and Green-2 shifted seven-miles west	<i>April 1 to November 14</i> , short-loop routes in Zuni Point and Dragon Corridors, <i>plus the long-loop tour route over North Rim, open for air-tour operations</i>
		July 1 to September 15, air tours permitted in Zuni Point Corridor only		November 15 to March 31, <i>only Dragon Corridor short-loop routes open for use; no fixed-wing or helicopter air-tour operations east of Dragon Corridor</i>
				Zuni and Dragon long-loop tour route across North Rim open <i>April 1 to November 14</i> , but open only for quiet-technology aircraft after four years
Quiet-technology Routes and Incentives	None	Only best available quiet-technology aircraft allowed in the first 1.5 and last 2.5 hours of the tour day on East End routes	Forgiveness of overflight fees as incentive. Use of annual allocation not required for quiet-technology operations as long as no adverse impact to goal of Substantial Restoration of Natural Quiet and no noise increase. Green-4 westbound quiet-technology only route. Blue Direct North open only to quiet-technology aircraft	After four-year phase-in, routes across North Rim open only to quiet-technology aircraft. Use of an annual allocation not needed for quiet-technology operations January 1-March 31 (subject to monitoring to ensure noise provisions of law met)
Quiet-technology Conversion Requirements	None	All new aircraft are best-available quiet technology. Full conversion required by date to be determined	Over 10- to 12-year period, all commercial operations converted to quiet-technology aircraft	Over ten-year period, all commercial operations required to convert to quiet-technology aircraft

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Table 2.6 Elements of the Alternatives

Elements	Alternative A	Alternative E	Alternative F	<i>Modified NPS Preferred Alternative</i>
Black Routes (Fixed Wing)	Black-1 short-loop tour route in Zuni Point Corridor open year-round to all fixed-wing aircraft, includes loop around Little Colorado River confluence and Nankoweap, with altitude at 8,000 feet or 9,000 feet MSL unless climbing to join Black-1A route across North Rim at 9,500 feet MSL	Black-1 route in Zuni Point Corridor open July 1 to September 15. Nankoweap loop on Black-1 route eliminated. Altitude from 8,000 feet or 8,500 feet MSL. Entry/exit points modified to avoid popular visitor-use area near Hermit Basin	Black-1 same as Alternative A	Black-1 short-loop tour route open <i>April 1- November 14</i> . Nankoweap loop and Little Colorado River confluence flyover eliminated. Northbound Black-1 altitude starts at South Rim at 8,000 feet, climbs to 9,000 feet by Temple Butte, and to 9,500 feet past Gunthers Castle. Southbound Black-1 descends from 9,500 feet to cross South Rim at 8,500 feet MSL
	Black-1A across North Rim at 9,500 feet MSL then continues down Dragon Corridor's east side at 8,500 feet MSL	Black-1A route in Dragon Corridor open September 16 to June 30. Dogleg to southwest created. Black-1A altitude 8,000 feet to 8,500 feet MSL. Black-1A entry/exit points modified to avoid popular visitor-use areas near Hermit Basin. Black-1A along North Rim eliminated	Black-1A route across North Rim at 9,500 feet MSL. Dragon Corridor configuration same as Alternative A February 1 through November 30. December 1 through January 31, north end of route shifts seven-miles west. Altitude decreases from 9,500 feet MSL at Dragon Corridor north end to 8,500 feet MSL southbound through the corridor	Black-1A continues at 9,500 feet MSL across North Rim, open <i>April 1- November 14</i> , but, after four-year phase-in, open only to quiet-technology aircraft
	Black-1E allows entry to SFRA at south end of Zuni Point Corridor	Black-1E and Black-1X allow entry and exit to/from SFRA near Colorado River confluence	Black-1E same as Alternative A	Black-1E eliminated
	Black-2 entry route east of Desert View at 8,000 feet MSL. Long-loop tour route from Zuni Point Corridor to Dragon Corridor across North Rim using Black-1 to Black-1A open year-round to all fixed-wing aircraft	Black-2 eliminated	Black-2 same as Alternative A Long-loop Black-1 to Black-1A same as Alternative A	Black-2 eliminated Black-2A short loop route in Dragon Corridor open <i>year-round</i> to all fixed-wing aircraft. Long-loop Black-1 to Black-1A open <i>April 1-November 14</i> , but after four years only open to quiet-technology aircraft Black-2A dogleg created to southwest, with aircraft at 9,500 feet MSL north of dogleg, and 8,500 feet MSL south of dogleg

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TABLE 2.6 ELEMENTS OF THE ALTERNATIVES

Elements	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Black Routes (Fixed Wing)	Black-3 entry route along Little Colorado River at 8,500 feet MSL. Bad weather reverse Black-1R near Gunthers Castle	Black-3 and Black-1R eliminated	Black-3 and Black-1R same as Alternative A	Black-3 eliminated Black-1 changed to include current Black-1R
	Black-4 route northbound along Marble Canyon at 7,500 feet or 9,000 feet MSL to North Canyon, then 7,500 feet or 5,500 feet MSL to north end of SFRA	Black-4 eliminated	Black-4 same as Alternative A	Black-4 <i>eliminated</i>
	Black-5 southbound along Marble Canyon at 5,000 feet or 6,500 feet MSL to North Canyon, then 6,500 feet MSL to South Canyon, then climb to 8,500 feet to merge with Black-1 near Saddle Mountain	Black-5 eliminated	Black-5 same as Alternative A	Black-5 eliminated
	Black-6 entry and exit routes at South Canyon, eastbound at 8,500 feet MSL, westbound at 7,500 feet or 9,000 MSL	Black-6 eliminated	Black-6 same as Alternative A	Black-6 eliminated
Brown Routes (Support Operations)	Brown-1 continues as river support route to/from Bar Ten airstrip	Brown-1 same as Alternative A	Brown-1 same as Alternative A	Brown-1 same as Alternative A
	Brown-2 continues as river support route to/from Bar Ten airstrip	Brown-2 shortened and modified to accommodate modification of Blue Direct North route	Brown-2 route eliminated	Brown-2 <i>generally follows existing route south to intersect Z-shaped Route (realigned Blue Direct North), crosses Grand Canyon near Twin Peaks and Andrus Canyon. Route altitudes same as Alternative A</i> Brown-2 <i>eliminated</i>
	Brown-4 continues as river support route to/from Bar Ten airstrip	Brown-4 eliminated	Brown-4 same as Alternative A	Brown-4 <i>eliminated</i>
	Brown-5 continues as river support route to/from Bar Ten airstrip	Brown-5 shortened and modified to accommodate modification of Blue Direct North route	Brown-5 same as Alternative A	Brown-5 <i>generally current route and altitudes to intersect Z-shaped Route (realigned Blue Direct North). Route configured to be two-way in consultation with FAA</i>
	Brown-6 continues as support route to Supai Village	Brown-6 dogleg inserted into route to Supai Village	Brown-6 same as Alternative A	Brown-6 dogleg inserted into route to Supai Village

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Table 2.6 Elements of the Alternatives

Elements	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Green Routes (Helicopter)	Green-1 short-loop tour route in Zuni Point Corridor open year-round to helicopters, includes loop around confluence and Nankoweap, with altitude at 7,500 feet MSL unless climbing to join Green-1A route across North Rim at 9,000 feet MSL. No entry/exit routes to/from Navajo lands. Bad weather reverse Green-1R near Gunthers Castle	Green-1 route in Zuni Point Corridor open July 1 to September 15. Nankoweap loop on Green-1 route eliminated. Green-1 altitude 7,500 feet MSL. <i>Entry/exit routes to/from Navajo lands</i>	Green-1 same as Alternative A. Altitude continues at 7,500 feet MSL. <i>No entry/exit routes to/from Navajo lands</i>	Green-1 short-loop route open <i>April 1-November 14</i> . Nankoweap loop and Little Colorado River confluence flyover eliminated. Green-1 northbound altitude climbs from 7,500 feet at South Rim to 9,000 feet MSL by Temple Butte <i>and to 9,000 feet past Gunthers Castle</i> . <i>Southbound Green-1 descends from 9,000 feet to cross South Rim at 7,500 feet MSL</i> . <i>No entry/exit routes to/from Navajo lands</i>
	See above	Green-1A route along North Rim eliminated	Green-1A configuration same as Alternative A February 1 to November 1; however, December 1 to January 31 extended west to accommodate relocation of Green-2 . Altitude 9,000 feet MSL	<i>Long-loop Green-1 to Green-1A to Green 2 open April 1-November 14; after four years open to quiet-technology aircraft only</i> . Altitude 9,000 feet MSL across North Rim
	Green-2 short-loop tour route in Dragon Corridor open year-round to all helicopters at 7,500 feet MSL. Long-loop tour route from Zuni Point Corridor to Dragon Corridor using Green-1 to Green-1A to Green-2 open year-round to all helicopters	Green-2 route in Dragon Corridor open September 16 to June 30. Dogleg to the southwest created. Green-2 altitude 7,500 MSL	Green-2 Dragon Corridor same as Alternative A February 1 through November 30. December 1 through January 31, route shifts seven-miles west. Altitude ranges from 7,000 feet MSL at South Rim to 7,500 feet MSL over the canyon	Green-2 short-loop route <i>available for air-tour helicopter use year-round</i> . <i>Green 2 dogleg created to southwest with aircraft at 8,500 feet MSL north of dogleg, and 75,000 meet MSL south of dogleg</i>
	Green-4 route eastbound south of river at 5,000 feet MSL, reversing between Quartermaster and Horse Flat Canyons to westbound north of river at 5,000 feet MSL	Green-4 same as Alternative A	Green-4 route stays north of Colorado River with portions south of the river eliminated. Westbound route for quiet-technology helicopters only at 5,000 feet MSL, and eastbound altitudes for all helicopters at 4,000 feet MSL	Green-4 and Green-4R same as Alternative A
	Green-4X at 5,000 feet MSL at Quartermaster Canyon	Green-4X same as Alternative A	Green-4X near Horse Flat Canyon at 5,000 feet MSL	Green-4X same as Alternative A

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TABLE 2.6 ELEMENTS OF THE ALTERNATIVES

Elements	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Blue Routes	<p>Blue-2 current configuration flown at 5,500 feet or 7,500 feet MSL eastbound; 6,500 feet or 8,500 feet MSL westbound</p> <p>Blue-2X leaves Blue-2 south of river east of Quartermaster Canyon at 5,000 feet MSL or 7,500 feet MSL to exit SFRA</p>	<p>Blue-2 and Blue-2X same as Alternative A</p>	<p>Blue-2 route same as Alternative A</p>	<p>Blue-2 and Blue-2X same as Alternative A</p>
	<p>Blue Direct North current configuration flown at 7,500 or 9,500 feet MSL eastbound; 8,500 or 10,500 feet MSL westbound</p>	<p>Blue Direct North shortened to cross canyon near Twin Peaks, with north-west segment at 9,500 feet MSL southeast bound and 10,500 feet MSL northwest bound, and the segment south of the canyon eastbound at 9,500 feet or 7,500 feet MSL, and westbound at 8,500 feet or 10,500 feet MSL</p>	<p>Blue Direct North one way, eastbound, quiet-technology only. Configuration modified with junction at Burnt Springs Canyon allowing access from North or South Las Vegas. Crosses Shivwits Plateau at 7,500 feet MSL, turns along river toward Twin Peaks at 6,500 feet MSL, then resumes current route at Aubrey Cliffs at 7,500 feet MSL</p>	<p>Blue Direct North changed to Z-shaped Route) alignment changed to reduce length in SFRA and over GCNP, but distance/time over canyon increased from current Blue Direct North route. Route would cross Grand Canyon in a northwest-southeast direction near Twin Peaks, then proceed northwest out of SFRA, then east to Grand Canyon NP Airport or west to Las Vegas. Anticipated route outside SFRA is depicted in Map 2.5. Route would be flown at same altitudes available on current Blue Direct North route: 7,500 or 9,500 feet MSL eastbound, and 8,500 or 9,500 feet MSL westbound</p>
	<p>Blue Direct South current configuration at 9,500 feet MSL eastbound and 10,500 feet MSL westbound</p>	<p>Blue Direct South eliminated</p> <p>Any traffic displaced outside SFRA expected to travel on existing Victor airways as shown on Map 2.3</p>	<p>Blue Direct South modified to a non-quiet technology route moved south of Grand Canyon West Airport. Split at Burnt Springs Canyon allows access to/from Las Vegas area. Eastbound aircraft at 9,500 feet across Shivwits Plateau, descending to 7,500 feet MSL toward the airport. Westbound aircraft 10,500 feet MSL after climbing from airport area</p>	<p>Blue Direct South eliminated</p> <p>Any traffic displaced outside SFRA expected to travel on existing Victor airways as shown on Map 2.3</p>

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Table 2.6 Elements of the Alternatives

Elements	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
General-Aviation Corridors	Fossil Canyon Corridor in current configuration	Fossil Canyon Corridor closed. Three Corridors remain open with altitudes same as Alternative A	Fossil Canyon Corridor closed. Three Corridors remain open with altitude same as Alternative A	Fossil Canyon Corridor rotated 28 degrees southeast. Four Corridors remain open with altitudes same as Alternative A
	Dragon Corridor in current configuration	Dragon Corridor modified to include dogleg as proposed for air-tour routes and narrowed at south end	Dragon Corridor narrowed along southern boundary	Dragon Corridor modified to include dogleg as proposed for air-tour routes
	Zuni Point Corridor in current configuration	Zuni Point Corridor extended north and shifted east to accommodate expansion of Bright Angel Flight-Free Zone	Zuni Point Corridor same as Alternative A	Zuni Point Corridor same as Alternative A
	Tuckup Corridor in current configuration	Tuckup Corridor same as Alternative A	Tuckup Corridor same as Alternative A	Tuckup Corridor same as Alternative A
	All corridors 11,500 feet MSL or 13,500 feet MSL (northbound) and 10,500 or 12,500 feet MSL (southbound); all open year-round	Allow use above Zuni Point and Dragon Corridors year-round	Allow use above Zuni Point and Dragon Corridors year-round	In addition to Alternative A altitudes, also 15,500 feet and 17,500 feet northbound; 14,500 feet and 16,500 feet southbound
Flight-free Zones				
<i>Sanup Flight-free Zone</i>	Ceiling at 7,999 feet MSL Current configuration No flights under 8,000 feet except under written waiver	Ceiling raised to 17,999 feet MSL Configuration same as Alternative A No flights under 18,000 feet except under written waiver	Ceiling at 7,999 feet MSL Northern boundary moved south to accommodate modified Blue Direct routes No flights under 8,000 feet except under written waiver	Ceiling raised to 17,999 feet MSL Configuration same as Alternative A No flights below 18,000 feet except when under positive control of air-traffic control for safety or under a written waiver
<i>Toroweap/Shinumo Flight-free Zone</i>	Ceiling at 14,499 feet MSL Current configuration No flights under 14,500 feet except under written waiver	Ceiling raised to 17,999 feet MSL East of Tuckup Corridor adjust several miles to northern SFRA boundary, west of Tuckup Corridor extend boundary south to include some Hualapai tribal lands. Modify southeast edge of boundary to reflect inclusion of Dragon Corridor dogleg No flights under 18,000 feet except under written waiver	Ceiling at 14,499 feet MSL Eastern boundary moved west to accommodate modified Dragon Corridor No flights under 14,500 feet except under written waiver	Ceiling raised to 17,999 feet MSL Modify southeast edge of boundary to reflect inclusion of Dragon Corridor dogleg No flights below 18,000 feet except 1) on Victor airway V257 at or above 14,500 feet, 2) under positive control of air traffic control for safety, 3) under written waiver

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Table 2.6 Elements of the Alternatives

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
<i>Bright Angel Flight-free Zone</i>	Ceiling at 14,499 feet MSL Current configuration No flights under 14,500 feet MSL except under written waiver	Ceiling raised to 17,999 feet MSL Extend north to incorporate Marble Canyon Modify southwest edge to reflect Dragon Corridor dogleg No flights under 18,000 feet MSL except under written waiver	Same as Alternative A, except southwest corner extended to Dragon Corridor	Ceiling raised to 17,999 feet MSL Modify southwest edge to reflect Dragon Corridor dogleg No flights below 18,000 feet MSL except 1) on Victor airways (V257, V293, V210) at or above 14,500 feet MSL, 2) under positive control of air traffic control for safety, 3) under written waiver
<i>Desert View Flight-free Zone</i>	Ceiling at 14,499 feet MSL Current configuration No flights under 14,500 feet MSL except under written waiver	Raise ceiling to 17,999 feet MSL Extend north No flights under 18,000 feet MSL except under written waiver	Same as Alternative A	Raise ceiling to 17,999 feet MSL Configuration same as Alternative A No flights below 18,000 feet MSL except 1) on Victor airway V210 at or above 14,500 feet, 2) under positive control of air traffic control for safety, 3) under written waiver
Changes to SFRA	None	None	Modify notch around Grand Canyon West Airport to protect Eagle and Guano Points	None

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1 IMPACTS DETERMINATION COMPARISON OF ALL ALTERNATIVES TEN-YEAR FORECAST
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Table 2.7 Soundscape Impacts (Ten-Year Forecast)

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Substantial Restoration of Natural Quiet is Achieved in Percent of Park	53% of park	84% of park Major beneficial change from Alternative A	86% of park Major beneficial change from Alternative A	66% of park Moderate beneficial change from Alternative A	75% of park Moderate beneficial change from Alternative A	73% of park Moderate beneficial change from Alternative A	85% of park Major beneficial change from Alternative A
Percent of Management Zone Progressing Toward Substantial Restoration of Natural Quiet							
Developed Zone (2% of park)	Moderate to major adverse in 95-98% of Developed Zone	Moderate to major adverse in 12-58% of Developed Zone with major beneficial change from Alternative A	Moderate to major adverse in 5-49% of Developed Zone with moderate to major beneficial change from Alternative A	Moderate to major adverse in 24-55% of Developed Zone with major beneficial change from Alternative A	Moderate to major adverse in 9-39% of Developed Zone with major beneficial change from Alternative A	Moderate to major adverse in 16-66% of Developed Zone with Moderate to major beneficial change from Alternative A	Moderate to major adverse in 3-36% of Developed Zone with major beneficial change from Alternative A
Non-Wilderness Zone (4% of park)	Moderate to major adverse in 87-90% of Non-Wilderness Zone	Moderate to major adverse in 15-39% of Non-Wilderness Zone with major beneficial change from Alternative A	Moderate to major adverse in 11-32% of Non-Wilderness Zone with major beneficial change from Alternative A	Moderate to major adverse in 36-49% of Non-Wilderness Zone with major beneficial change from Alternative A	Moderate to major adverse in 18-28% of Non-Wilderness Zone with major beneficial change from Alternative A	Moderate to major adverse in 27-60% of Non-Wilderness Zone with moderate to major beneficial change from Alternative A	Moderate to major adverse in 8-28% of Non-Wilderness Zone with major beneficial change from Alternative A
Wilderness Zone (94% of park)	Moderate to major adverse in 48-55% of Wilderness Zone	Moderate to major adverse in 11-24% of Wilderness Zone with major beneficial change from Alternative A	Moderate to major adverse in 10-20% of Wilderness Zone with major beneficial change from Alternative A	Moderate to major adverse in 28-46% of Wilderness Zone with minor beneficial change from Alternative A	Moderate to major adverse in 25-42% of Wilderness Zone with minor to moderate beneficial change from Alternative A	Moderate to major adverse in 19-37% of Wilderness Zone with minor to moderate beneficial change from Alternative A	Moderate to major adverse in 12-23% of Wilderness Zone with moderate to major beneficial change from Alternative A
Percent of Park Area Progressing Toward Substantial Restoration of Natural							
Marble Canyon	Negligible to minor adverse	Negligible with negligible to minor beneficial change from Alternative A	Negligible with negligible to minor beneficial change from Alternative A	Negligible to minor adverse with negligible change from Alternative A	Negligible with negligible to minor beneficial change from Alternative A	Negligible with negligible to minor beneficial change from Alternative A	Negligible with negligible to minor beneficial change from Alternative A
East End	Major adverse under and near East End air-tour routes in Zuni Point and Dragon Corridors and across North Rim	Negligible to minor adverse under and near Dragon Corridor with major beneficial change from Alternative A	Major adverse under and near Dragon Corridors with negligible change from Alternative A	Moderate to major adverse under and near Zuni Point and Dragon Corridors and across North Rim with moderate to major beneficial	Moderate to major adverse under and near Zuni Point and Dragon Corridors and across North Rim with moderate to major beneficial	Minor to major adverse under and near Zuni Point and Dragon Corridors and across North Rim with major beneficial change from	Generally minor to major adverse impacts under and near open Dragon Corridor routes (negligible to minor beneficial change in

Table 2.7 Soundscape Impacts (Ten-Year Forecast)

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
East End (continued)		Major adverse under and near Zuni Point Corridor negligible change from Alternative A Negligible impacts across North Rim moderate to major beneficial change from Alternative A	Negligible to minor adverse under and near Zuni Point Corridor major beneficial change from Alternative A Negligible impacts across North Rim moderate to major beneficial change from Alternative A	change from A	change from Alternative A in areas Dragon Corridor shifted from; Moderate to Major Adverse change in areas Corridor shifted to	Alternative A	<i>impacts from Alternative A), and negligible to minor adverse impact in the eastern area away from open routes (a minor to major beneficial change in impacts from Alternative A)</i>
	Negligible to minor adverse away from routes and amid Bright Angel Flight-free Zone	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible change from Alternative A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone negligible with change from Alternative A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to moderate beneficial change from A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to moderate beneficial change from A	Negligible to minor adverse away from routes and amid Bright Angel Flight-free Zone with negligible to moderate beneficial change from Alternative A	Negligible to minor adverse away from routes and amid Bright Angel Flight-free Zone with negligible to major beneficial change from Alternative A
Central	Negligible to moderate adverse	Negligible to minor adverse with minor beneficial change from Alternative A	Negligible to moderate adverse with negligible change from Alternative A	Negligible to minor adverse with negligible to minor beneficial change from Alternative A	Negligible to minor adverse with negligible to minor beneficial change from Alternative A	Negligible to minor adverse with negligible to minor beneficial change from Alternative A	Negligible to minor adverse with negligible to minor beneficial change from Alternative A
West End	Major Adverse in northern area near air-tour routes	Moderate to major adverse in northern area near air-tour routes with minor beneficial change from Alternative A	Moderate to major adverse in northern area near air-tour routes with minor beneficial change from Alternative A	Moderate to major adverse in northern area near air-tour routes with minor beneficial change from Alternative A	Moderate to major adverse in northern area near air-tour routes with minor beneficial change from Alternative A	Moderate to major adverse in northern area near air-tour routes with negligible to minor beneficial change from A	Moderate to major adverse in northern area near air-tour routes with negligible to minor beneficial change from A
	Negligible to minor adverse in southern area away from routes	Negligible to minor adverse in southern area away from routes with negligible change from Alternative A	Negligible to minor adverse in southern area away from routes with negligible to moderate beneficial change from Alternative A	Negligible to minor adverse in southern area away from routes with negligible to minor beneficial change from Alternative A	Negligible to minor adverse in southern area away from routes with negligible to moderate beneficial change from A	Negligible in southern area away from routes with negligible to minor beneficial change from Alternative A	Negligible in southern area away from routes with negligible to minor beneficial change from Alternative A

Table 2.7 Soundscape Impacts (Ten-Year Forecast)

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Noise Outside GCNP but within SFRA	Moderate to major adverse under Blue Direct routes	Moderate to major adverse under shifted Blue Direct routes outside SFRA with moderate adverse change from Alternative A in areas where routes shift to, and moderate to major beneficial change in areas where routes shifted from	Moderate to major adverse under shifted Blue Direct routes outside SFRA with moderate adverse change from Alternative A in areas where routes shift to, and moderate beneficial change in areas where routes shifted from	Moderate to major adverse under shifted Blue Direct routes with moderate beneficial change from Alternative A	Moderate to major adverse under shifted Blue Direct routes with moderate beneficial change from Alternative A	Moderate to major adverse under shifted Blue Direct routes outside SFRA with moderate adverse change from Alternative A in areas where routes shift to, and moderate to major beneficial change in areas where routes shifted from	Moderate to major adverse under shifted Blue Direct routes outside SFRA with moderate adverse change from Alternative A in areas where routes shift to, and moderate beneficial change in areas where routes shifted from
	Negligible in Marble Canyon area	Negligible in Marble Canyon area with moderate beneficial change from Alternative A	Negligible in Marble Canyon area with moderate beneficial change from Alternative A	Negligible in Marble Canyon area with negligible to minor beneficial change from Alternative A	Negligible in Marble Canyon area with negligible to minor beneficial change from Alternative A	Negligible in Marble Canyon area with negligible to minor beneficial change from Alternative A	Negligible in Marble Canyon area with negligible to minor beneficial change from Alternative A

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Table 2.8 Wilderness Impacts (Ten-Year Forecast)

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Marble Canyon	Negligible to minor adverse in GCNP and Paria Canyon-Vermilion Cliffs Wilderness Area	In GCNP negligible with negligible to minor beneficial change from Alternative A	In GCNP negligible with negligible to minor beneficial change from Alternative A	In GCNP negligible to minor adverse with negligible change from Alternative A	In GCNP negligible to minor beneficial change from Alternative A	In GCNP negligible with negligible to minor beneficial change from Alternative A	In GCNP negligible with negligible to minor beneficial change from Alternative A
	Minor to major adverse in Saddle Mt. Wilderness Area	Negligible in Saddle Mt. and Paria-Vermilion Cliffs Wilderness Areas with moderate to major beneficial change from Alternative A	Negligible in Saddle Mt. and Paria-Vermilion Cliffs Wilderness Areas with moderate to major beneficial change from Alternative A	Moderate adverse at Saddle Mt. Wilderness Area with negligible to moderate beneficial change from Alternative A Negligible to minor adverse in Paria	Minor to moderate adverse at Saddle Mt. Wilderness Area with negligible to moderate beneficial change from Alternative A negligible to minor adverse in Paria	Negligible in Saddle Mt. and Paria Canyon-Vermilion Cliffs Wilderness Area with moderate to major beneficial change from Alternative A	Negligible in Saddle Mt. and Paria Canyon-Vermilion Cliffs Wilderness Area with moderate to major beneficial change from Alternative A

Table 2.8 Wilderness Impacts (Ten-Year Forecast)

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
				Canyon-Vermilion Cliffs Wilderness Area with negligible to minor beneficial change from A	Canyon-Vermilion Cliffs Wilderness with negligible to minor beneficial change from A		
East End	Moderate to major adverse under and near East End air-tour routes in Zuni Point and Dragon Corridors and across North Rim	Negligible to minor adverse under and near Dragon Corridor with moderate to major beneficial change from Alternative A	Moderate to major adverse under and near Dragon Corridor with minor to major beneficial change from Alternative A	Moderate to major adverse under and near East End air-tour routes in Zuni Point and Dragon Corridors and across North Rim with moderate to major beneficial change from Alternative A	Negligible to moderate adverse under and near Zuni Point and Dragon Corridor and across North Rim with moderate to major beneficial change from Alternative A in areas where Dragon Corridor shifted from, but moderate to major adverse change in areas Corridor shifted to	Minor to major adverse under and near East End air-tour routes in Zuni Point, long loop, and Dragon Corridors with minor to major beneficial change from Alternative A (depending on location with respect to active short-loop tour routes)	<i>Minor to Major adverse under and near open Dragon Corridor with minor to major beneficial change from Alternative A</i> <i>Areas away (Zuni Point closed, long loop closed, Little Colorado, Little Colorado River, Nankoweap) from Dragon Corridor route negligible with moderate to major change from Alternative A</i>
		Moderate to major adverse under and near Zuni Point Corridor with minor beneficial change from Alternative A	Negligible to minor adverse under and near Zuni Point Corridor with moderate beneficial to moderate adverse change from Alternative A			<i>Moderate adverse impacts across North Rim with moderate to major beneficial change from Alternative A</i>	<i>Minor to moderate adverse impacts across North Rim with moderate to major beneficial change from Alternative A</i>
	Negligible impacts across North Rim with moderate to major beneficial change from Alternative A	Negligible across North Rim with moderate to major beneficial change from Alternative A					
	Negligible to minor adverse away from routes and amid Bright Angel Flight-free Zone	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to major beneficial change from Alternative A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to major beneficial change from Alternative A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to major beneficial change from Alternative A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to major beneficial change from Alternative A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to major beneficial change from Alternative A	Negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone with negligible to major beneficial change from Alternative A

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Table 2.8 Wilderness Impacts (Ten-Year Forecast)

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Central	Mostly negligible but up to moderate adverse in a few locations	Negligible to minor adverse with negligible to moderate beneficial change from A	Negligible with minor <i>adverse</i> to moderate beneficial change from Alternative A	Negligible to minor adverse with negligible to moderate beneficial change from A	Negligible to minor adverse with negligible to moderate beneficial change from A	Negligible to minor adverse with negligible to moderate beneficial change from A	Negligible to minor adverse with negligible to <i>moderate</i> beneficial change from A
West End	Moderate to major adverse in northern area near air-tour routes	Moderate to major adverse in northern area near air-tour routes with minor adverse to moderate beneficial change from Alternative A depending on location	Moderate to major adverse in northern area near air-tour routes with minor adverse to moderate beneficial change from Alternative A depending on location	Moderate to major adverse in northern area near air-tour routes with moderate adverse to moderate beneficial change from Alternative A depending on location	Moderate to major adverse in northern area near air-tour routes with moderate adverse to moderate beneficial change from Alternative A depending on location	<i>Negligible to moderate</i> adverse in northern area near air-tour routes with <i>moderate to major</i> beneficial change from Alternative A	<i>Negligible to moderate</i> adverse in northern area near air-tour routes with <i>moderate to major</i> beneficial change from Alternative A
	Negligible to minor adverse in southern area away from routes	Negligible to minor adverse in southern area away from routes with negligible to moderate beneficial change from Alternative A	Negligible to minor adverse in southern area away from routes with negligible to moderate beneficial change from Alternative A	Negligible to minor adverse in southern area away from routes with moderate adverse to moderate beneficial change from Alternative A depending on location	Negligible to minor adverse in southern area away from routes with moderate adverse to moderate beneficial change from Alternative A depending on location	Negligible to minor adverse in southern area away from routes with negligible to moderate beneficial change from Alternative A	Negligible to minor adverse in southern area away from routes with negligible to moderate beneficial change from Alternative A
NPS Units in SFRA Outside GCNP	Moderate to major adverse under Blue Direct routes (LMNM & GCPNM)*	Moderate to major adverse under shifted Blue Direct routes (LMNM & GCPNM) with moderate adverse change from Alternative A where routes shift to, and moderate to major beneficial change where routes shifted from	Moderate to major adverse under shifted Blue Direct routes (LMNM & GCPNM) with moderate adverse change from Alternative A where routes shift to, and moderate to major beneficial change where routes shifted from	Moderate to major adverse under shifted Blue Direct routes (LMNM & GCPNM) with moderate adverse change from Alternative A where routes shift to, and moderate beneficial change where routes shifted from	Moderate to major adverse under shifted Blue Direct routes (LMNM & GCPNM) with moderate adverse change from Alternative A where routes shift to, and moderate beneficial change where routes shifted from	Moderate to major adverse <i>directly under and near the Z-shaped Route</i> (LMNM & GCPNM) with <i>moderate adverse change from Alternative A where routes shift to, and moderate to major beneficial change where routes shift from</i>	Moderate to major adverse <i>directly under and near the Z-shaped Route</i> (LMNM & GCPNM) with <i>moderate adverse change from Alternative A where routes shift to, and moderate to major beneficial change where routes shift from</i>

1 *Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument

Table 2.9 Ethnographic Resources Impacts (Ten-Year Forecast) by Park Area

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Marble Canyon	Negligible to minor adverse	Negligible impacts with minor long-term beneficial change from Alternative A		Negligible impacts with negligible change from Alternative A		Negligible impacts with minor <i>to moderate</i> long-term beneficial change from Alternative A	
East End	<p>Moderate adverse impacts in areas near the Little Colorado confluence</p> <p>Minor adverse impacts in areas represented by Little Colorado, Nankoweap River, and Pasture Wash Location Points</p> <p>Minor to moderate adverse impacts at Tusayan Museum and Bright Angel Point Location Points</p>	<p>Negligible impacts in Bright Angel Point, Little Colorado and Nankoweap River Location Points</p> <p>Minor adverse impacts at Pasture Wash Location Point</p> <p>Moderate adverse impacts at Temple Butte and Little Colorado River Location Points</p> <p>Negligible to moderate beneficial change from Alternative A all areas</p>	<p>Negligible impacts in all areas other than Pasture Wash Location Point where impacts would be minor to moderate adverse with minor to moderate beneficial change in all areas from Alternative A</p>	<p>Negligible impacts in areas represented by Little Colorado and Nankoweap Location Points with negligible to minor beneficial change from Alternative A</p> <p>Minor adverse impacts at Bright Angel Point and Pasture Wash Location Points with minor to moderate beneficial change from Alternative A</p> <p>Minor to moderate adverse impacts at Little Colorado River and Temple Butte Location Points with minor beneficial change from Alternative A</p>	<p>Minor adverse impacts at Pasture Wash Location Point with minor to moderate beneficial change from Alternative A</p> <p>Minor adverse impacts at Little Colorado River and Temple Butte Location Points with minor to moderate beneficial change from Alternative A</p> <p>Negligible impacts at Bright Angel Point Location Point with minor to moderate beneficial change from Alternative A</p>	<p>Negligible impacts at Little Colorado, and Nankoweap River Location Points with <i>minor</i> to moderate beneficial change from Alternative A</p> <p><i>Minor adverse impacts at Little Colorado River location point with minor to moderate beneficial change from Alternative A</i></p> <p>Minor to moderate adverse impacts near Temple Butte, Pasture Wash and Bright Angel Point Location Points with minor to moderate beneficial change from A</p>	<p>Minor <i>to moderate</i> adverse impacts at Pasture Wash Location Point with <i>minor</i> to moderate beneficial change from Alternative A</p> <p>Negligible impacts at Temple Butte, Little Colorado River and Bright Angel Point Location Points with moderate <i>to major</i> beneficial change from Alternative A</p>
Central	Negligible	Negligible impacts with negligible change from Alternative A		Negligible impacts with negligible change from Alternative A		Negligible impacts with negligible change from Alternative A	
West End	<p>Negligible impacts in areas away from air-tour routes (Meriwhitca and Granite Peak Location Points)</p> <p>Moderate adverse impacts under Green-4 and Black-2 routes</p>	Negligible impacts away from air-tour routes and moderate adverse impacts under air-tour routes with negligible to minor beneficial change in all areas from Alternative A		Negligible impacts except at Burnt Springs Canyon Location Point where impacts would be moderate adverse with negligible change from Alternative A		Negligible impacts except at Burnt Springs Canyon Location Point where impacts would be moderate adverse with negligible <i>to minor beneficial</i> change from Alternative A	

Table 2.10 Visitor Use and Experience Impacts (Ten-Year Forecast)

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Marble Canyon	Negligible to minor adverse impacts	Negligible impacts with negligible to minor beneficial change from Alternative A		Negligible impacts with negligible change from Alternative A	Negligible impacts with minor beneficial change from Alternative A	Negligible impacts with negligible to minor beneficial change from Alternative A	
	Negligible impacts Outside the Park within the SFRA	Negligible impacts Outside the Park within the SFRA with negligible change from Alternative A		Negligible impacts Outside the Park within the SFRA with negligible change from Alternative A	Negligible impacts Outside the Park within the SFRA with negligible change from Alternative A	Negligible impacts Outside the Park within the SFRA with negligible <i>to minor beneficial</i> change from Alternative A	
East End	Moderate adverse impacts in South Rim Developed Zone	Negligible to major adverse impacts in South Rim Developed Zone with negligible to major beneficial change from Alternative A	Minor adverse impacts in South Rim Developed Zone with moderate beneficial change from Alternative A	Minor to major adverse impacts in South Rim Developed Zone with negligible to moderate beneficial change from Alternative A	Negligible to moderate adverse impacts in South Rim Developed Zone with moderate beneficial change from Alternative A	Negligible to moderate adverse impacts in South Rim Developed Zone with minor to moderate beneficial change from A	Negligible impacts in South Rim Developed Zone with moderate <i>to major</i> beneficial change from Alternative A
	Negligible impacts in Phantom Ranch Developed Zone	Negligible impacts in Phantom Ranch Developed Zone with negligible change from Alternative A	Negligible impacts in Phantom Ranch Developed Zone with negligible change from Alternative A	Negligible impacts in Phantom Ranch Developed Zone with negligible change from Alternative A	Negligible impacts in Phantom Ranch Developed Zone with negligible change from Alternative A	Negligible impacts in Phantom Ranch Developed Zone with negligible change from Alternative A	Negligible impacts in Phantom Ranch Developed Zone with negligible change from Alternative A
	Moderate adverse impacts in North Rim Developed Zone	Negligible to Moderate adverse impacts in North Rim Developed Zone with minor to moderate beneficial change from A	Negligible to moderate adverse impacts in North Rim Developed Zone with minor to moderate beneficial change from A	Moderate adverse impacts in North Rim Developed Zone with minor beneficial change from Alternative A	Negligible to minor to adverse impacts in North Rim Developed Zone with minor to moderate beneficial change from Alternative A	Minor to moderate adverse impacts in North Rim Developed Zone with moderate <i>to major</i> beneficial change from Alternative A	<i>Negligible</i> impacts in North Rim Developed Zone with moderate <i>to major</i> beneficial change from Alternative A
	Moderate to major adverse impacts in Non-Wilderness Zone	Negligible impacts in Non-Wilderness Zone with minor to major beneficial change from Alternative A	Negligible impacts in Non-Wilderness Zone with minor to major beneficial change from Alternative A	Negligible impacts in Non-Wilderness Zone with moderate to major beneficial change from Alternative A	Negligible impacts in Non-Wilderness Zone with moderate to major beneficial change from Alternative A	Negligible to Minor adverse impacts in Non-Wilderness Zone with major beneficial change from Alternative A	<i>Negligible to</i> minor adverse impacts in Non-Wilderness Zone with major beneficial change from Alternative A
	Minor to major adverse impacts in the Wilderness Zone	Negligible to moderate adverse impacts in Wilderness Zone with negligible to major beneficial change from Alternative A	Wilderness Zone Negligible to major adverse impacts with minor to major beneficial change from Alternative A	Minor to major adverse impacts in Wilderness Zone with minor beneficial change from Alternative A	Negligible to moderate adverse impacts in Wilderness Zone with moderate to major beneficial change from Alternative A	Negligible to major adverse impacts in Wilderness Zone with negligible to major beneficial change from Alternative A	Negligible to major adverse impacts in Wilderness Zone with minor to major beneficial change from Alternative A

Table 2.10 Visitor Use and Experience Impacts (Ten-Year Forecast)

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
East End (continued)	Minor to moderate adverse impacts Outside the Park within the SFRA	Minor to moderate adverse impacts Outside the Park within the SFRA with minor to moderate adverse change from A	Negligible to moderate adverse impacts Outside the Park within the SFRA with negligible to moderate beneficial change from A	Minor to moderate adverse impacts Outside the Park within the SFRA with negligible change from Alternative A	Minor to moderate adverse impacts Outside the Park within the SFRA with negligible change from Alternative A	<i>Negligible to minor</i> adverse impacts Outside the Park within the SFRA with <i>moderate to major beneficial</i> change from Alternative A	<i>Negligible to minor</i> adverse impacts Outside the Park within the SFRA with <i>moderate to major beneficial</i> change from Alternative A
Central	Negligible impacts in most areas	Negligible impacts with negligible change in impacts from Alternative A in Wilderness Zone and Non-Wilderness Zones		Negligible impacts with change in impacts from Alternative A in Wilderness Zone and Non-Wilderness Zone	Negligible impacts with negligible change in impacts from Alternative A in Wilderness Zone and Non-Wilderness Zone	Negligible impacts with negligible change in impacts from Alternative A in Wilderness Zone and Non-Wilderness Zone	
	Negligible to moderate adverse impacts Outside the Park within the SFRA	Negligible to moderate adverse impacts Outside the Park within the SFRA with negligible change in impacts from A		Negligible to moderate impacts Outside the Park within the SFRA with Negligible to Minor adverse change in impacts from A	Negligible to moderate impacts Outside the Park within the SFRA with negligible to minor adverse change in impacts from A	Negligible to moderate adverse impacts Outside the Park within the SFRA with negligible change in impacts from Alternative A	
West End	Minor to major adverse impacts in the Wilderness Zone	Negligible to major adverse impacts in the Wilderness Zone with negligible change in impacts from Alternative A		Negligible to major adverse impacts in the Wilderness Zone with negligible change in impacts from Alternative A		Negligible to <i>moderate</i> adverse impacts Wilderness Zone except Bat Cave where impacts would be major adverse, with negligible changes in impacts from Alternative A, <i>except at Whitmore Rapids where changes would be negligible to minor beneficial</i>	Negligible to minor adverse impacts Wilderness Zone except at Bat Cave where impacts would be major adverse with negligible to minor beneficial change in impacts from Alternative A <i>except at Whitmore Rapids where changes would be negligible to minor beneficial</i>
	Negligible to moderate adverse impacts Outside the Park within the SFRA	Negligible to moderate adverse impacts Outside the Park within the SFRA with negligible change in impacts from Alternative A		Negligible to moderate adverse impacts Outside the Park within the SFRA with negligible change in impacts from Alternative A		<i>Minor</i> to moderate adverse impacts Outside the Park within the SFRA with negligible to minor beneficial change in impacts from Alternative A	

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Table 2.10 Visitor Use and Experience Impacts (Ten-Year Forecast)

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Air-tour Visitors	Provides a wide range of opportunities year-round. Scenic views from a variety of routes	Provides least variety of air-tour choices. Many current options eliminated (no long-loop or Marble Canyon tours)		Provides similar level of opportunities as Alternative A. Blue Direct routes provide different opportunities than other Alternatives		Provides similar level of opportunities as Alternative A. <i>Z-shaped Route provides different but equally scenic viewing opportunities.</i> Views of Little Colorado River confluence still available. <i>Although Marble Canyon routes have been eliminated there are still many air-tour view opportunities</i>	

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Table 2.11 Wildlife Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Marble Canyon	Negligible to minor adverse	Negligible impacts with negligible to minor beneficial change from Alternative A		Negligible to minor adverse impacts with negligible change from Alternative A	Negligible to minor adverse impacts with negligible to minor beneficial change from Alternative A	Negligible impacts with negligible to minor <i>to major</i> beneficial change in impacts from Alternative A, although at points close to the new route location minor adverse impacts with minor adverse change from Alternative A	
East End	Zuni Point and Dragon Corridors moderate to major adverse impacts under and near heavily used air-tour routes	Moderate to major adverse impacts under and near Zuni Point Corridor minor beneficial change from Alternative A	Negligible impacts under and near Zuni Point Corridor with major beneficial change from Alternative A	Zuni Point and Dragon Corridors moderate to major adverse impacts under and near heavily used air-tour routes with minor to major beneficial change from Alternative A	Zuni Point Corridor moderate adverse impacts with major beneficial change from Alternative A	Moderate to major adverse impacts under and near Zuni Point Corridor with <i>minor to moderate</i> beneficial change from Alternative A, negligible change at Grid Location Points 14 and 15	<i>Negligible</i> impacts under and near Zuni Point Corridor with moderate <i>to major</i> beneficial change from Alternative A
		Under and near Dragon Corridor negligible to minor adverse impacts with major beneficial change from Alternative A	Under and near Dragon Corridor moderate adverse impacts with moderate to major beneficial change from Alternative A		Dragon Corridor moderate to major adverse impacts with moderate to major beneficial change from Alternative A in areas where routes shift from, but up to major adverse changes in areas where routes shift to	Under and near Dragon Corridor <i>minor to major</i> adverse impacts with minor to <i>major</i> beneficial change from Alternative A	Under and near Dragon Corridor <i>minor to major</i> adverse impacts with minor to major beneficial change from Alternative A

Table 2.11 Wildlife Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
East End (continued)	Near routes in Bright Angel Flight Free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone moderate to major adverse	Near routes in western Bright Angel Flight-free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone negligible to minor adverse impacts with moderate to major beneficial change from Alternative A	Near routes in western Bright Angel Flight-Free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone moderate adverse impacts with moderate to major beneficial change from Alternative A	Near routes in western Bright Angel Flight-Free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone moderate adverse impacts with moderate to major beneficial change from Alternative A	Near routes in western Bright Angel Flight-free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone negligible to moderate adverse impacts with up to major beneficial change from Alternative A in areas where routes shift from A to moderate to major adverse impacts with moderate to major adverse change where routes shift to	Near routes in western Bright Angel Flight-free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone moderate adverse impacts with moderate to major beneficial change from Alternative A	Near routes in western Bright Angel Flight-free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone moderate adverse impacts with minor to major beneficial change from Alternative A
	Amid Bright Angel Flight-free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone negligible Outside park boundary along SFRA eastern boundary , east of Desert View Flight-free Zone , and areas south of Toroweap/Shinumo Flight-free Zone minor to moderate adverse	Amid Bright Angel Flight-free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone negligible impacts with negligible change from Alternative A	Amid Bright Angel Flight-free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone negligible to minor adverse impacts with negligible to major beneficial change from Alternative A	Amid Bright Angel Flight Free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone negligible to minor adverse impacts with negligible to major beneficial change from Alternative A	Amid Bright Angel Flight Free Zone and eastern portion of Toroweap/Shinumo Flight-free Zone negligible to minor adverse impacts with up to major beneficial change from Alternative A	Amid Bright Angel Flight-free Zone eastern portion of and Toroweap/Shinumo Flight-free Zone negligible impacts with negligible change from Alternative A	
Central	Negligible to minor adverse with impacts up to moderate adverse close to air-tour routes	Negligible impacts with negligible change from Alternative A	Negligible to minor adverse impacts with negligible change from Alternative A	Mostly negligible impacts with negligible change from Alternative A	Negligible to minor adverse impacts with negligible change from Alternative A		

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Table 2.11 Wildlife Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
West End	Under and near Green-4 and Blue-2 moderate to major adverse	Under and near Green-4 and Blue-2 , major adverse impacts with minor to major beneficial change from Alternative A		Under and near Green-4 and Blue-2 moderate to major adverse impacts with minor adverse to minor beneficial from Alternative A		Under and near Green-4 and Blue-2 major adverse impacts with minor beneficial change from Alternative A	
	Brown routes minor to moderate adverse impacts	Brown routes moderate adverse impacts with negligible to minor adverse change from Alternative A		Brown routes minor to moderate adverse impacts with negligible change from Alternative A		Brown routes minor to moderate adverse impacts with negligible change from Alternative A	
		At the SFRA's northern boundary, major adverse impacts with moderate to major adverse change from Alternative A					
West End	Near Blue Direct routes moderate to major adverse	Under and near new Blue Direct location major adverse impacts with moderate to major adverse change from Alternative A. Areas near where Blue Direct moved from major beneficial change from Alternative A		Moderate to major adverse impacts under Blue Direct routes with negligible to minor adverse change from Alternative A		Z-shaped Route moderate adverse impacts with negligible change from Alternative A	
	Under Sanup Flight-free Zone and south toward the SFRA boundary negligible impacts	Under Sanup Flight-free Zone negligible impacts with negligible change from Alternative A		In Sanup Flight-free Zone negligible impacts with negligible change from Alternative A		Under Sanup Flight-free Zone negligible impacts with negligible change from Alternative A	

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Table 2.12 Peregrine Falcon Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Marble Canyon	Short-term, negligible to minor adverse	Negligible to minor adverse impacts with short-term negligible to minor beneficial change from Alternative A		Negligible to minor adverse impacts with negligible change from Alternative A		No analysis due to species not present December through January	
East End	Short-term, negligible to minor adverse	Moderate to major adverse impacts under and near Zuni Point Corridor with short-term minor beneficial change from Alternative A	Negligible impacts under and near Zuni Point Corridor with short-term major beneficial change from Alternative A	Zuni Point Corridor moderate to major adverse impacts under air-tour routes with short-term moderate to major beneficial change from A		No analysis due to species not present December through January	
						Moderate to major adverse impacts under Zuni Point Corridor , with moderate to major beneficial change from Alternative A	Zuni Point Corridor , negligible to minor adverse impacts with short- and long-term moderate to major beneficial change from Alternative A

Table 2.12 Peregrine Falcon Impacts (Ten-Year Forecast) by Park Area

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
East End (continued)	Short- and long-term moderate to major adverse impacts in areas beneath air-tour routes	Dragon Corridor negligible to minor adverse impacts with short-term major beneficial change from Alternative A	Dragon Corridor moderate adverse impacts with a short-term moderate to major beneficial change from Alternative A	Dragon Corridor moderate to major adverse impacts under air-tour routes with short-term moderate to major beneficial change from A	Species not present	Minor to major adverse impacts under and near Dragon Corridor with short-term minor to major beneficial change from Alternative A	Minor to moderate adverse impacts under and near Dragon Corridor with short- and long-term minor to major beneficial change from A
		Negligible to minor adverse impacts with short-term moderate to major beneficial change from Alternative A in Bright Angel Flight-free Zone Middle of Bright Angel Flight-free Zone quiet with negligible impacts and negligible change from Alternative A	Bright Angel Flight-free Zone represent minor to moderate adverse impact with moderate beneficial change from Alternative A Middle of Bright Angel Flight-free Zone quiet with negligible change from Alternative A	Bright Angel Flight-free Zone minor to moderate adverse impacts with short-term negligible to major beneficial changes due to quiet-technology incentives and conversion requirements from Alternative A	Species not present	Bright Angel Flight-free Zone minor to moderate adverse impacts with moderate to major beneficial change from Alternative A in areas near air-tour routes Middle of Bright Angel Flight-free Zone quiet with negligible impacts and negligible change from Alternative A	Bright Angel Flight-free Zone negligible to minor adverse impacts with short- and long-term minor to major beneficial change from Alternative A
Central	Short-term, negligible to minor adverse	Negligible impacts with negligible change from Alternative A		Negligible impacts with short-term negligible to minor beneficial change from Alternative A	No analysis due to species not present December through January	Negligible to minor adverse impacts with negligible to minor beneficial change from Alternative A	
West End	Short- and long-term moderate to major adverse impacts due to noise persistence at high sound levels in areas close to Green-4 and Blue-2	Green-4 and Blue-2 major adverse impacts with generally minor to major beneficial change from Alternative A	Impacts major adverse under Green-4 and Blue-2 with negligible change from Alternative A	Green-4 and Blue-2 major adverse impacts with minor to moderate beneficial change from Alternative A	No analysis due to species not present December through January	Green-4 and Blue-2 short-term moderate to major adverse impacts with negligible to major beneficial change from Alternative A	

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Table 2.12 Peregrine Falcon Impacts (Ten-Year Forecast) by Park Area

Impact Category	A	Alternative					
		E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
West End (continued)	Blue Direct routes impacts in areas under and near air-tour routes short-term moderate adverse	Blue Direct routes Minor adverse impacts with short- and long-term moderate beneficial change from Alternative A	Blue Direct routes Minor adverse impacts with short- and long-term moderate beneficial change from Alternative A	Blue Direct routes Major adverse impacts with short-term negligible to minor adverse change from Alternative A		Z-shaped Route (realigned Blue Direct) minor adverse impacts with negligible to major beneficial change from Alternative A	Z-shaped Route (realigned Blue Direct) minor adverse impacts with negligible to major beneficial change from Alternative A
	Brown routes impacts short term minor to moderate adverse	Brown routes minor to moderate adverse impacts with short-term negligible to minor adverse change from Alternative A	Brown routes minor to moderate adverse impacts with short-term negligible to moderate adverse change from Alternative A	Brown routes negligible to minor adverse impacts with negligible change from Alternative A		Brown routes minor adverse impacts with negligible change from Alternative A	Brown routes minor adverse impacts with negligible change from Alternative A
	Negligible impact of air-tour aircraft in Sanup Flight-free Zone	Sanup Flight-free Zone negligible with negligible change from Alternative A	Sanup Flight-free Zone negligible with negligible change from Alternative A	Sanup Flight-free Zone negligible, with negligible change from Alternative A		Sanup Flight-free Zone negligible with negligible change from Alternative A	Sanup Flight-free Zone negligible with negligible change from Alternative A

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Table 2.13 Bald Eagle Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative	
	Modified NPS Preferred	
	Peak	Off Peak
Marble Canyon	Negligible with minor to major beneficial change from Alternative A	Negligible with minor to major beneficial change from Alternative A
East End	Moderate to major adverse impacts under and near Zuni Point Corridor with short-term minor adverse to moderate to major beneficial change from Alternative A	Zuni Point Corridor negligible impacts with short and long-term moderate to major beneficial change from Alternative A
	Minor to major adverse impacts under and near Dragon Corridor with long-term minor to major beneficial change from Alternative A	Minor to major adverse impacts under and near Dragon Corridor with short- and long-term moderate to major beneficial change from Alternative A
	Bright Angel Flight-free Zone minor to moderate adverse impacts with minor to moderate beneficial change from Alternative A in areas near air-tour routes	Bright Angel Flight-free Zone negligible impacts with short and long-term minor to major beneficial change from Alternative A
	Middle of Bright Angel Flight-free Zone quiet with negligible impacts and negligible change from Alternative A	
Little Colorado and Nankoweap area Location Points minor to moderate impacts with long-term moderate to major beneficial change from Alternative A	Little Colorado and Nankoweap Location Points negligible impacts with long-term moderate to major beneficial change from Alternative A	

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Table 2.14 Golden Eagle Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative	
	Modified NPS Preferred	
Marble Canyon	Negligible with minor to major beneficial change in impacts from Alternative A	
East End	Minor adverse impacts under and near Zuni Point Corridor with moderate to major beneficial change from Alternative A	Negligible to minor adverse impacts under and near Zuni Point Corridor with moderate to major beneficial change from Alternative A
	Minor to major adverse impacts under and near Dragon Corridor with long-term minor to major beneficial change from Alternative A	
	Bright Angel Flight-free Zone minor to moderate adverse impacts with moderate to major beneficial change from Alternative A in areas near air-tour routes	
	Middle of Bright Angel Flight-free Zone quiet with negligible impacts and negligible change from Alternative A	
	Location Points Point Imperial, Bright Angel Point, The Basin, and Grid Location Point 16 moderate adverse impacts with long-term minor to major beneficial change from Alternative A	Location Points Point Imperial, Bright Angel Point, The Basin, and Grid Location Point 16 minor to moderate adverse impacts with long-term minor to major beneficial change from Alternative A
Central	Negligible to minor adverse impacts with negligible to minor change from Alternative A	
West End	Green-4 and Blue-2: short-term moderate to major adverse impacts with negligible to major beneficial change from Alternative A	
	Z-shaped Route (realigned Blue Direct): Minor adverse impacts with negligible to major beneficial change from Alternative A	
	Brown routes: minor adverse impacts with negligible change from Alternative A	
	Sanup Flight-free Zone: negligible impacts with negligible change from Alternative A	

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Table 2.15 California Condor Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Marble Canyon	Short term negligible to minor adverse	Negligible effect, long-term negligible to minor beneficial change from Alternative A		Negligible to minor adverse impacts with negligible change from Alternative A	Negligible impacts with long-term negligible to minor beneficial change from Alternative A	Negligible impacts with generally short-term negligible to minor to major beneficial from A	<i>Negligible impacts with generally short-term minor to major beneficial from Alternative A</i>
East End	Under and near tour routes short term moderate to major adverse In areas away from air-tour routes negligible impacts	Moderate to major adverse impacts under and near Zuni Point Corridor with short-term minor beneficial change from A	Negligible impacts under and near Zuni Point Corridor with short-term major beneficial change from Alternative A	Zuni Point Corridor moderate to major adverse impacts with long-term moderate beneficial change from Alternative A	Dragon Corridor negligible to moderate adverse impacts with moderate to major beneficial change from Alternative A	Moderate to major adverse impacts under and near Zuni Point Corridor air-tour routes with mixed results, moderate to major beneficial change from A	Zuni Point Corridor, negligible impacts with moderate to major beneficial change from Alternative A

Table 2.15 California Condor Impacts (Ten-Year Forecast) by Park Area

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
East End (continued)		Dragon Corridor negligible to minor adverse impacts with short-term major beneficial change from Alternative A	Dragon Corridor moderate adverse impacts with short-term moderate to major beneficial change from Alternative A	Dragon Corridor moderate to major adverse impacts with long-term moderate beneficial change from Alternative A	Dragon Corridor route shift, negligible to moderate adverse impacts with short-term negligible to moderate adverse change from Alternative A	<i>Minor</i> to major adverse impacts under and near Dragon Corridor with short-term minor to major beneficial change from Alternative A	<i>Minor to major</i> adverse impacts under and near Dragon Corridor with short-term <i>minor to major</i> beneficial change from Alternative A
		Negligible impacts would continue and there would be a short-term moderate to major beneficial from Alternative A in Bright Angel Flight-free Zone in areas west of routes due to high reduction in time air-tour aircraft audible	Bright Angel Flight-free Zone minor to moderate adverse impacts with short-term moderate beneficial change from Alternative A	Bright Angel Flight-free Zone negligible impacts with negligible change from Alternative A	Bright Angel Flight-free Zone negligible impacts with negligible change from Alternative A	Bright Angel Flight-free Zone minor to moderate adverse impacts with short-term minor to major beneficial change from Alternative A	Bright Angel Flight-free Zone minor to moderate adverse impacts with short-term minor to major beneficial change from Alternative A
		Middle of Bright Angel Flight-free Zone quiet with negligible impacts and negligible change from Alternative A Cedar Ridge Location Point negligible impacts with major beneficial change from Alternative A				Middle of Bright Angel Flight-free Zone quiet with negligible impacts and negligible change from Alternative A	
Central	Negligible	Negligible to minor adverse impacts with negligible change from Alternative A		Negligible impacts with negligible change from Alternative A		Negligible to minor adverse impacts with negligible change from Alternative A	
West End	Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air-tours in this area. Thus, West End is not analyzed for impacts to California condor						

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Table 2.16 Mexican Spotted Owl Impacts (Ten-Year Forecast)

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
Marble Canyon	Short-term negligible to minor adverse	Negligible impact with negligible to minor long-term beneficial change from A		Negligible to minor adverse impacts with negligible change from Alternative A	Negligible impacts with long-term minor to moderate beneficial change from A	Negligible impacts with <i>long-term</i> minor to <i>major</i> beneficial change from Alternative A	<i>Negligible impacts with long-term minor to major beneficial change from A</i>
East End	Short-term moderate adverse impacts particularly in areas beneath and adjacent to air-tour routes In areas away from air-tour routes impacts short-term negligible to minor adverse	Moderate adverse impacts under and near Zuni Point Corridor air-tour routes with short-term minor beneficial change from Alternative A	Negligible to minor adverse impacts under and near Zuni Point Corridor air-tour routes with short-term moderate to major beneficial from Alternative A	Zuni Point Corridor moderate adverse impacts with long-term minor to moderate beneficial change from Alternative A		Moderate adverse impacts under and near Zuni Point Corridor with <i>long-term</i> minor to <i>major</i> beneficial change from Alternative A	Zuni Point Corridor <i>negligible</i> impacts and <i>long-term</i> moderate to <i>major</i> beneficial change from Alternative A
		Dragon Corridor negligible to minor adverse impacts with short-term moderate to major beneficial change from Alternative A	Dragon Corridor moderate adverse impacts with short-term moderate to major beneficial change in impacts from Alternative A	Dragon Corridor moderate adverse impacts with long-term minor to moderate beneficial change from Alternative A	Dragon Corridor minor to moderate adverse impacts with moderate to major beneficial change from Alternative A Dragon Corridor route shift, negligible to minor adverse impacts with minor to moderate adverse change from Alternative A	<i>Minor to major</i> adverse impacts under and near Dragon Corridor with short-term minor to moderate beneficial change from Alternative A	<i>Minor to major</i> adverse impacts under and near Dragon Corridor with short- <i>and long-term</i> <i>minor</i> to major beneficial change from Alternative A

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Table 2.16 Mexican Spotted Owl Impacts (Ten-Year Forecast)

Impact Category	Alternative						
	A	E		F		Modified NPS Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
East End (continued)		Negligible impacts with short-term moderate beneficial change in Bright Angel Flight-free Zone in areas away from active air-tour routes due to high reduction in air-tour aircraft Percent Time Audible	Bright Angel Flight-free Zone short-term minor to moderate adverse impacts with minor to moderate beneficial change from Alternative A	Bright Angel Flight-free Zone negligible to minor adverse impacts with negligible change from Alternative A		Bright Angel Flight-free Zone minor to moderate adverse impacts with <i>long-term</i> moderate beneficial change from A	Bright Angel Flight-free Zone minor to moderate adverse impacts with short- and <i>long-term</i> minor to <i>major</i> beneficial change from A
		Middle of Bright Angel Flight-free Zone would remain quiet with negligible impacts and negligible change from Alternative A	Middle of Bright Angel Flight-free Zone would remain quiet with negligible impacts and negligible change from Alternative A			<i>North Rim would improve at Location Points Point Imperial, The Basin, and Grid Location Point 16. Minor to moderate adverse impacts would occur with long-term minor to major beneficial change from Alternative A</i>	<i>North Rim would improve at Location Points Point Imperial, The Basin, and Grid Location Point 16. Minor to moderate adverse impacts would occur with long-term moderate beneficial change from Alternative A</i>
Central	Negligible	Negligible impacts with negligible change from Alternative A		Negligible impacts with short-term negligible to minor beneficial change from Alternative A		Negligible to minor adverse impacts with negligible change from Alternative A	
West End	Moderate adverse in areas near West End Blue Direct routes. In areas away from routes, impacts negligible to minor adverse	Minor adverse impacts with short-term minor to moderate beneficial change from Alternative A		Moderate adverse impacts with negligible to moderate adverse changes from Alternative A		<i>Negligible to minor</i> adverse impacts with negligible to <i>major</i> beneficial change from Alternative A	

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Table 2.17 Southwestern Willow Flycatcher Impacts (Ten-Year Forecast)

Impact Category	Alternative Modified NPS Preferred	
	Peak	Off Peak
Marble Canyon	Negligible impacts with minor to moderate beneficial change from Alternative A	SWFLs not found at GCNP Off-Peak Season
East End	All East End Location Points along the river negligible to minor adverse impacts with long-term negligible to moderate beneficial change from Alternative A, except 96 Mile Camp where moderate to major adverse impacts would continue under Dragon Corridor with long-term negligible to moderate beneficial change	
Central	No SWFL nest sites or suitable nesting habitat documented	
West End	Moderate to major adverse impacts at Location Points under and near Blue-2 and Green-4 with negligible to minor beneficial change from Alternative A Location Points amid West End (not including Burnt Springs, Bat Cave, West End, Whitmore Rapids, and Parashant Wash Location Points) similar to Alternative A. Negligible to minor adverse impacts West End with negligible beneficial change from Alternative A Near the Z-Shaped (realigned Blue Direct North) and Brown routes minor to moderate adverse impacts with negligible to minor beneficial change from Alternative A Under and near Sanup Flight-free Zone negligible impacts with negligible change in impacts from Alternative A	

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Table 2.18 Socioeconomic Environment Impacts (Ten Year Forecast)

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Air-tour Operators	Baseline for comparison	Long-term moderate to major adverse impacts compared to Alternative A	Long-term <i>negligible</i> impacts from Alternative A	Long-term minor adverse impacts from Alternative A
Indian Tribes				
Hualapai Tribe	Baseline for comparison	<i>Negligible impacts compared to Alternative A</i>		
Havasupai Tribe	Baseline for comparison	<i>Negligible impacts compared to Alternative A</i>		
Navajo Nation	Baseline for comparison	<i>Negligible impacts compared to Alternative A</i>		
General Aviation	Baseline for comparison	<i>Long-term negligible to minor adverse impacts compared to Alternative A</i>		
Regional Economy	Baseline for comparison	<i>Negligible impacts compared to Alternative A</i>		
Intrinsic Park Values	Baseline for comparison	<i>Negligible impacts compared to Alternative A</i>		

4

CHAPTER 3 AFFECTED ENVIRONMENT

INTRODUCTION

Chapter 3 describes conditions of those impact topics (Soundscape, Wilderness Character, Ethnographic Resources, Visitor Use and Experience, Wildlife, Special Status Species, and Socioeconomic Environment) potentially affected by Alternatives to manage air-tour flight operations and routes in the Grand Canyon National Park Special Flight Rules Area. The Affected Environment for this EIS includes the entire Special Flight Rules Area as described in Chapter 1's Scope of the Analysis. However for some topics, the Study Area is larger than the Special Flight Rules Area because impacts from air-tour management actions extend beyond the SFRA boundary. Discussion of each topic includes an overview of information and issues relevant to management of air-tour flight operations.

Impact topic descriptions provided in this Chapter serve as the baseline from which to compare potential effects of management actions considered in this EIS. Topics presented in this Chapter, and their organization, correspond to the impact analysis in Chapter 4, Environmental Consequences. Specific locations in the SFRA referred to in this Chapter are depicted in Map 2.1.

SOUNDSCAPE

This section provides an overview of Grand Canyon's affected Soundscape, *providing* a description of both natural and existing Soundscape as they form the *foundation for evaluating effects of Alternatives in FEIS Chapter 4*.

Soundscape Characteristics

Soundscape is defined by the NPS as the aggregate of all sounds in an area, both natural and human-made; the park's total acoustic environment. Contributing human-made sounds include cars traveling on roads, tourist buses idling, aircraft flying, visitors talking, hotel air conditioners humming, and so forth.

The natural Soundscape is the subset of the total Soundscape composed completely of natural sounds without human-made sounds (NPS 2006d). Physical and biological components such as wind, water, weather, birds, and insects create the natural Soundscape. The natural Soundscape can vary considerably among locations or times in a single location. At one end of the natural spectrum may be sounds associated with a severe thunderstorm; at the other, the absence of perceptible sound. Between these extremes an array of sound conditions varies moment to moment, season to season. These variations result from contributions of wind and its interaction with vegetation and irregular terrain; water as a result of movement in streams, rivers, rapids, and waterfalls; animals, whose sound can be nearly continuous, such as insects, or intermittent, such as birds and coyotes; and, more rarely, geological activity in the movement of earth and rock, such as landslides or rock falls.

Noise is *sound that is considered unwanted, unwarranted or unnecessary*. Noise can degrade or mask the natural Soundscape. Sound can be perceived as noise *because it occurs* at unwanted times or from an unwanted source, or because it interrupts, detracts from or interferes with a desired *visitor experience or sound source*. In a national park setting, noise is *usually* a subset of human-made sounds which is extraneous to the purpose, function or natural/cultural theme of a particular park area. Noise may adversely affect park resources or visitor experiences by modifying or intruding on the natural Soundscape or by impeding or masking natural sounds (NPS 2006d) *or by masking desired human sounds*. Noise may vary in character moment to moment, day to night, and season to season. Noise can distract visitors from enjoying park resources, purposes, and values; affect traditional cultural properties and the tranquility of historic park settings; and affect wildlife use patterns and daily life activities.

Sound is perceived by humans as an auditory sensation created by pressure variations that move through a medium such as water or air and is measured in terms of amplitude and frequency (Templeton and Sacre, 1997). Sound is usually measured in a logarithmic scale using units called decibels (dB). Sound is composed of various frequencies, but the human ear does not respond to all frequencies. The A-weighted decibel scale (dBA) takes this into account by emphasizing frequencies between 1 kilo Hertz (kHz) and 6.3 kHz to simulate the relative response of human hearing. As an example, Table 3.1 shows a range of A-weighted decibel levels for recognizable sounds. The Soundscape also includes many sounds humans cannot hear, some of which must be measured using metrics other than A-weighted decibels.

1 **Table 3.1 Common Sound Levels**

Sound Sources Measured in Parks	Other Common Sound Sources	dBa
Volcano crater, Haleakala National Park	Human breathing at 3m	10
Leaves rustling, Canyonlands National Park	Whispering	20
Crickets at five meters, Zion National Park	Residential area at night	40
Conversation at five meters, Whitman Missions National Historic Site	Busy restaurant	60
Snowcoach at thirty meters, Yellowstone National Park	Curbside of busy street	80
Thunder, Arches National Park	Jackhammer at 2m	100
Military jet at one hundred meters AGL, Yukon-Charley Rivers National Preserve	Automobile horn at 1m	120

Sound level of busy street (80 dBA), American Speech-Language Hearing Association, at

<http://www.asha.org/public/hearing/disorders/noise.htm>

Whisper/normal breathing (20 dBA/10 dBA), residential area at night (40 dBA), automobile horn (Berger and Kladden 2005)

Busy restaurant (60 dBA): http://www.engineeringtoolbox.com/sound-power-level-d_58.html, and

<http://www.hearingclearly.com/audiograms-sound/>; Jackhammer: <http://www.hearingclearly.com/audiograms-sound/>

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4 ***Two noise sources producing equal dBA levels at a given location would produce a combined Average Sound***
5 ***Level 3 dBA greater than either sound alone. Four noise sources would add to a 6 dBA increase, and ten noise***
6 ***sources would add to a 10 dBA increase. When two noise sources differ by 10 dBA, the combined Average Sound***
7 ***Level would be 0.4 dBA greater than the louder source alone (USFS 2007a).***
8

9 Many factors affect how an individual responds to noise. Primary acoustical factors include sound level, its
10 frequency and duration, whether the sound is steady or varying in frequency and sound level, and whether the sound
11 carries information of interest to the individual. Non-acoustical factors also play a role in how an individual
12 responds to sound. These factors vary from past experience and individual adaptability to the predictability of when
13 a noise may occur. The listener's activity also affects how he/she responds to noise (Mestre Greve Associates 2005).
14

15 **Natural Soundscape and Natural Quiet**

16
17 The concept of **natural quiet** as applied to Grand Canyon is discussed in Chapter 1. Natural quiet is synonymous
18 with the terms **Natural Soundscape** and the more technical **natural ambient sound**; natural ambient sound is the
19 more appropriate term because nature is often not quiet (i.e., thunderstorms, wind, etc.). Natural Soundscape
20 protection in national parks is required by law and policy.³⁷ Grand Canyon is noted for its rich sound environment
21 and unusual and noticeable natural quiet. A management objective in Grand Canyon National Park's 1995 General
22 Management Plan states, "Protect the natural quiet and solitude of the park, and mitigate or eliminate the effects of
23 activities causing excessive or unnecessary noise in, over, or adjacent to the park."
24

25 An important part of the NPS mission is preserving park resources and values unimpaired, including natural
26 Soundscapes (NPS 2006b Section 1.4.6). As defined by NPS Management Policies 2006, Section 4.9, park natural
27 Soundscape resources encompass all natural sounds that occur in parks, including the physical capacity for
28 transmitting natural sounds and the interrelationships among park natural sounds of different frequencies and
29 volumes. Natural sounds occur within and beyond the range of sounds humans can perceive, and they can be
30 transmitted through air, water, and solid materials. Management policies require NPS to preserve, to the greatest
31 extent possible, the natural Soundscapes of the national parks, and to restore to the natural condition wherever
32 possible those park Soundscapes that have become degraded by unnatural sounds (i.e., noise). The policy also
33 requires NPS to protect natural Soundscapes from unacceptable impacts. According to NPS Management Policies
34 2006, Section 1.4.7.1, these are impacts that, individually or collectively, would unreasonably interfere with the
35 atmosphere of peace and tranquility, or the natural Soundscape maintained in Wilderness and natural, historic, or
36 commemorative park locations.
37

38 In addition to being considered a park resource and value, natural sounds are also a key contributor to the visitor
39 experience (e.g., visitors listening to elk bugling or waterfalls or simply sitting quietly watching sunrise or sunset).

³⁷ The 1975 Grand Canyon National Park Enlargement Act, the 1987 National Parks Overflights Act, the 1995 Grand Canyon General Management Plan, the National Parks Air Tour Management Act of 2000, and NPS Management Policies 2006 (Sections 1.4.6, 1.4.7.1, 4.9, and 8.2.3)

1 Thus, Soundscape preservation and noise management are important components of achieving the NPS mission of
2 preserving park resources unimpaired for the enjoyment of future generations.
3

4 NPS Management Policies 2006, Section 4.9, requires the NPS identify what levels and types of unnatural sound
5 constitute acceptable impacts on park natural Soundscapes, and take action to prevent or minimize all noise that
6 through frequency, magnitude, or duration adversely affects natural Soundscape or other park resources or values, or
7 that exceeds levels identified through monitoring as being acceptable to or appropriate for visitor uses at monitored
8 sites (NPS 2006d). Grand Canyon offers a wide range of natural and human-influenced Soundscapes that vary
9 widely in a complex interaction of factors such as sound source, distance, park location, timing, and physical
10 conditions (such as weather and terrain). For example, sound conditions are very different between remote
11 backcountry locations and the visitor center parking lot.
12

13 **Natural Ambient Sound Levels**

14 **Natural ambient sound levels** include all natural sounds in a given area, excluding all mechanical, electrical and
15 other human-caused sounds.
16

17 **Existing ambient sound levels** include all natural and non-natural sounds.
18

19
20 To assess progress in substantial restoration of natural quiet, Grand Canyon National Park has been the subject of
21 numerous studies, investigations, and monitoring efforts to identify and characterize natural ambient and existing
22 sound levels throughout the park.³⁸ These studies show natural ambient sound levels vary considerably throughout
23 the SFRA by location and time, but there are areas with similar acoustic qualities (i.e., acoustic zones) that
24 correspond to major vegetation types in the area. Map 3.1 shows acoustic zones corresponding to major SFRA
25 vegetation types, along with natural ambient sound levels corresponding to these acoustic zones.
26

27 Maps 3.1 and 3.2 show the 127 SFRA Location Points³⁹ used in noise modeling referred to in Table 3.2 and Chapter
28 4's impact analysis.⁴⁰
29

30 Additionally, Map 3.1 shows natural ambient sound levels that form the basis of the Percent Time Audible
31 calculations performed in Chapter 4's noise modeling. dBA values shown are based on best available data in 2005
32 (the Base Year for data used in noise modeling (including aircraft operations) for this EIS).⁴¹ The 2005 natural
33 ambient data are shown for the four most common park vegetation types: piñon-juniper (33% of the park), cold
34 desert scrub (30% of the park), warm desert scrub (12% of the park), and ponderosa pine forests (10% of the park)

³⁸ Studies include Ambrose 2006, HMMH 1993, NPS 2007c, NPS 2007d, NPS 2008a

³⁹ As further described in Appendix D, 127 Location Points were selected by the NPS for EIS noise modeling. NPS selected 25 Location Points (GC008-GC033) corresponding to monitoring sites where acoustic data was collected. Other named points were selected as representative locations for visitor experience and/or park resources (e.g., Wilderness Character, Ethnographic Resources, and Wildlife). Additionally, Location Points GRID01 through GRID36 were selected based on a ten-kilometer grid to provide spatial coverage throughout the park

⁴⁰ Chapter 4's impact analysis is based, to large extent, on noise modeling results conducted for this EIS by the Department of Transportation, Volpe Volpe *National Transportation Systems* Center, using FAA's Integrated Noise Model (INM) 6.2a. See Appendix D for further discussion of the noise modeling performed by Volpe for this EIS. As part of noise modeling, both a Location Point analysis and a Contour Analysis were performed. Contour Analysis involved additional GIS analysis of modeling results to provide percentages of the entire park and SFRA within specified results for Percent Time Audible and Average Sound Level from the model. Location Point results were calculated directly in noise model software using geographical coordinates of the points, and represent specific points rather than broad areas (e.g., the point may be at the bottom of a narrow canyon which would probably not be similar to results from a point on a nearby ridge). Contour data represents broad areas rather than specific points (i.e., data for a specific point within a contour area may not show the same result as the contour area due to size and level of resolution of contour area). The analyses are used together in considering the complex noise environment in Grand Canyon

⁴¹ 2005 is the Base Year for noise modeling in this EIS. The best available data as of the end of 2005 is used as the base for noise modeling for the Alternatives. Since 2005, the 2005 database has been checked against data from subsequent years, and although there are some differences, given all factors contributing to those differences, the 2005 database has proven consistent enough to continue as a reasonable base for evaluating impacts of the Alternatives in this EIS

1 (NPS 2007d). A river/rapids acoustic zone is also shown in Map 3.1 with a range of sound levels related to the
2 Colorado River in GCNP (the river/rapids area shown is approximately 12% of the park). In addition, there are three
3 vegetation types shown on Map 3.1 outside GCNP (i.e., old piñon-juniper woodland, old desert scrub, and old
4 conifer forest).

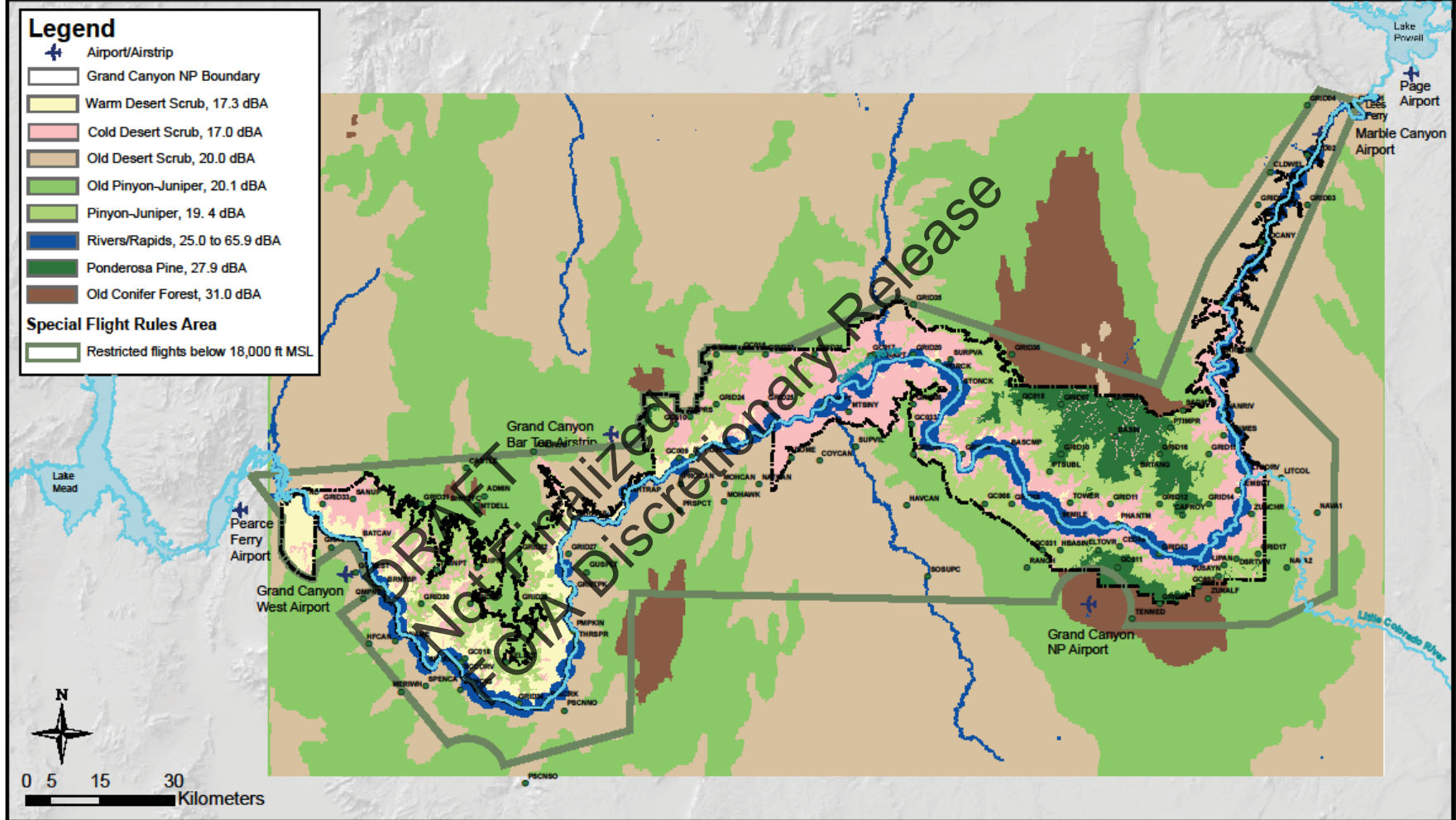
5
6 Table 3.2 shows, under the heading Natural Ambient Used in EIS Noise Modeling, natural ambient sound levels
7 from Map 3.1 were adjusted⁴² for use in EIS noise modeling. The 2005 database was used to ensure consistency and
8 avoid the very substantial time and expense needed to re-run noise modeling for already-modeled Alternatives as
9 new data accrued and new Alternatives were developed.

10
11 During EIS preparation, park staff collected additional data on natural ambient sound levels and human noise
12 sources in Grand Canyon's backcountry areas (NPS 2006a, 2007c and 2007d). Results of the backcountry sound
13 monitoring are shown in Table 3.2 under the heading Updated Natural Ambient. Chapter 4's noise modeling results
14 are interpreted with differences between 2005 and updated data sets in mind.
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⁴² As noted in Table 3.2, 10dB were added to natural ambient levels in approximately one-third of the park as explained further in Chapter 4, Methodology and 64 Federal Register 3969. Park Management Zones are an important part of context for some impact topics. As described in Chapter 3, Visitor Use and Experience, park Management Zones considered in this EIS are Wilderness, Non-Wilderness, and Developed. In general, impact analyses take into consideration that more noise sources are present and that more noise impact from all sources (including aircraft) is accepted in the Developed Zone (about 2% of the park) than other zones based on zone management objectives. Noise modeling for this EIS uses a Dual-zone System (Audibility and *Noticeability*) that generally addresses different management objectives for different park Management Zones. Specifically, for *Audibility* Zone areas (approximately 66% of the park), natural ambient sound levels were used directly in computing audibility in the noise model. For areas in the Noticeability Zone (approximately 34% of the park), 10 dB were added to natural ambient sound levels in the noise model to account for factors such as increased visitor activity and presence of non-natural sound sources. For reasons explained in the 1999 Federal Register Notice, when NPS and FAA agreed to use the Dual-zone System for modeling at GCNP, *most of* the Developed Zone (South and North Rim developed areas), GCNP's West End, and Marble Canyon are in the Noticeability Zone

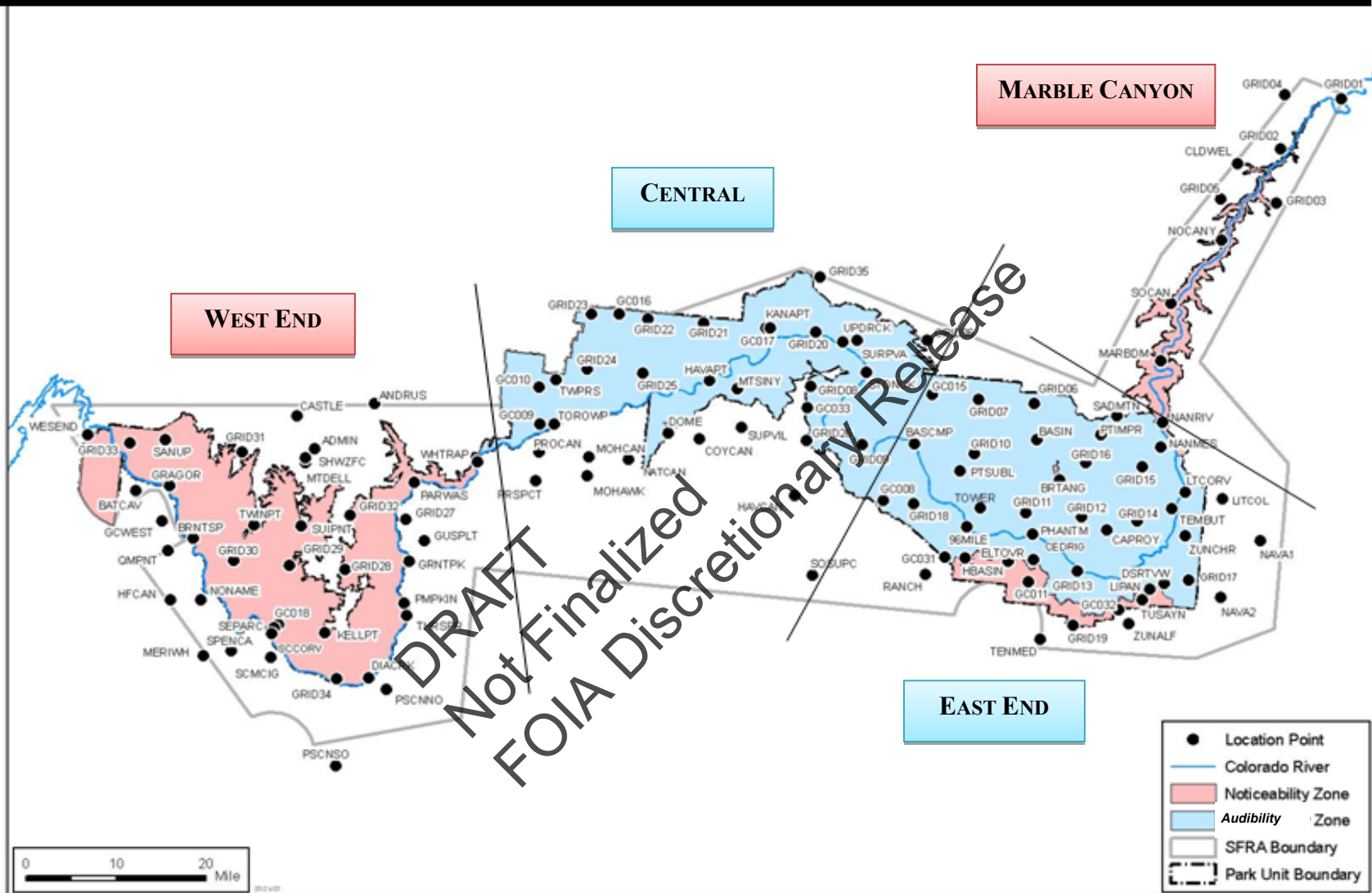
Map 3.1 Natural Ambient Sound Levels and Location Points



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Map 3.2 Location Points, EIS Areas, and Dual Noticeability



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Table 3.2 Natural Ambient Sound Levels by Location Point

Location Point Name	Point ID ^a	Vegetation/Ambient Type ^{bc}	Natural Ambient Used in EIS Noise Modeling (dBA) ^{de}	Updated Natural Ambient ^f (dBA)
96 Mile Camp	96MILE	River/rapids	25.0 to 65.9	Same
NPS Administration site*	ADMIN	Old PJ	20.1 (+ 10 dBA)*	20.0
Andrus Canyon*	ANDRUS	Old PJ	20.1 (+ 10 dBA)*	20.0
Bass Camp	BASCMP	River	25.0 to 65.9	Same
The Basin	BASIN	CDS	17.0	18.2
Bat Cave*	BATCAV	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Burnt Springs Canyon*	BRNTSP	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Bright Angel Point	BRTANG	Ponderosa	27.9	22.8
Cape Royal	CAPROY	Ponderosa	27.9	22.8
Castle Peak*	CASTLE	Old PJ	20.1 (+ 10 dBA)*	20.0
Cedar Ridge	CEDRIG	PJ	19.4	20.0
Cliff Dwellers Lodge	CLDWEL	WDS	17.3	18.5
Coyote Canyon	COYCAN	ODS	20.0	Same
Diamond Creek*	DIACRK	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Desert View*	DSRTVW	PJ	19.4 (+ 10 dBA)*	20.0
El Tovar*	ELTOVR	Ponderosa	27.9 (+ 10 dBA)*	22.8
Pasture Wash	GC008	CDS/PJ	17.0 to 19.6	18.2 to 20.0
Tuweep	GC009	WDS	17.3	18.5
Tuweep	GC010	CDS	17.0	18.2
South Rim*	GC011	Ponderosa	27.9 (+ 10 dBA)*	22.8
Rainbow Plateau	GC015	Ponderosa	27.9	22.8
Hancock Knolls	GC016	PJ	19.4	20.0
1 km W of Kanab Point	GC017	CDS	17.0	18.2
Separation Canyon*	GC018	WDS	17.3 (+ 10 dBA)*	18.5
Eremita Mesa	GC031	PJ	19.4	20.0
1.5 km SE of Moran Point*	GC032	PJ	19.4 (+ 10 dBA)*	20.0
Fossil Canyon	GC033	PJ	19.4	20.0
Grand Canyon West*	GCWEST	ODS	20.0 (+ 10 dBA)*	Same
Granite Gorge*	GRAGOR	ODS	20.0 (+ 10 dBA)*	Same
Grid Location Point 1*	GRID01	River/Rapids or ODS	25.0 to 65.9, or 20.0 (+ 10 dBA)*	Same
Grid Location Point 2*	GRID02	River/Rapids or ODS	25.0 to 65.9, or 20.0 (+ 10 dBA)*	Same
Grid Location Point 3*	GRID03	ODS	20.0 (+ 10 dBA)*	Same
Grid Location Point 4*	GRID04	ODS	20.0 (+ 10 dBA)*	Same
Grid Location Point 5*	GRID05	ODS	20.0 (+ 10 dBA)*	Same
Grid Location Point 6	GRID06	CDS/Ponderosa	17.0 to 27.9	18.2 to 22.8
Grid Location Point 7	GRID07	Ponderosa	27.9	22.8
Grid Location Point 8	GRID08	CDS	17.0	18.2
Grid Location Point 9	GRID09	CDS/WDS	17.0 to 17.3	18.2 to 18.5
Grid Location Point 10	GRID10	Ponderosa	27.9	22.8
Grid Location Point 11	GRID11	CDS	17.0	18.2
Grid Location Point 12	GRID12	PJ	19.4	20.0
Grid Location Point 13	GRID13	River/Rapids	25.0 to 65.9	Same
Grid Location Point 14	GRID14	PJ	19.4	20.0
Grid Location Point 15	GRID15	CDS/PJ	17.0 to 19.4	18.2 to 20.0
Grid Location Point 16	GRID16	PJ/Ponderosa/PJ	19.4 to 27.9	20.0 to 22.8
Grid Location Point 17	GRID17	PJ	19.4	20.0
Grid Location Point 18	GRID18	PJ	19.4	20.0
Grid Location Point 19*	GRID19	Ponderosa/Old Conifer Forest	27.9 or 31.0 (+ 10 dBA)*	22.8
Grid Location Point 20	GRID20	River/Rapids	25.0 to 65.9	Same
Grid Location Point 21	GRID21	CDS	17.0	18.2
Grid Location Point 22	GRID22	CDS	17.0	18.2
Grid Location Point 23	GRID23	CDS/PJ	17.0 to 19.4	18.2 to 20.0
Grid Location Point 24	GRID24	PJ	19.4	20.0

Table 3.2 Natural Ambient Sound Levels by Location Point

Location Point Name	Point ID ^a	Vegetation/Ambient Type ^{bc}	Natural Ambient Used in EIS Noise Modeling (dBA) ^{de}	Updated Natural Ambient ^f (dBA)
Grid Location Point 25	GRID25	CDS	17.0	18.2
Grid Location Point 26	GRID26	PJ/Old PJ	19.4 or 20.1	20.0
Grid Location Point 27*	GRID27	ODS	20.0 (+ 10 dBA)*	Same
Grid Location Point 28*	GRID28	Old PJ	20.1 (+ 10 dBA)*	20.0
Grid Location Point 29*	GRID29	CDS/PJ	17.0 to 19.4 (+ 10 dBA)*	18.2 to 20.0
Grid Location Point 30*	GRID30	PJ	19.4 (+ 10 dBA)*	20.0
Grid Location Point 31*	GRID31	Old PJ	20.1 (+ 10 dBA)*	20.0
Grid Location Point 32*	GRID32	Old PJ	20.1 (+ 10 dBA)*	20.0
Grid Location Point 33*	GRID33	CDS	17.0 (+ 10 dBA)*	18.2
Grid Location Point 34*	GRID34	River	25.0 to 65.9 (+ 10 dBA)*	Same
Grid Location Point 35	GRID35	ODS	20.0	Same
Granite Peak*	GRNTPK	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Gus Plateau*	GUSPLT	Old PJ	20.1 (+ 10 dBA)*	20.0
Havasupai Point	HAVAPT	River/Rapids	25.0 to 65.9	Same
Havatagvitch Canyon	HAVCAN	ODS	20.0	Same
Hermit Basin*	HBASIN	PJ	19.4 (+ 10 dBA)*	20.0
Horse Flat Canyon*	HFCAN	ODS	20.0 (+ 10 dBA)*	Same
Kanab Point	KANAPT	CDS/PJ	17.0 to 19.4	18.2 to 20.0
Kelly Point*	KELLPT	Old PJ	20.1 (+ 10 dBA)*	20.0
Lipan Point*	LIPAN	PJ	19.4 (+ 10 dBA)*	20.0
Little Colorado	LITCOL	ODS	17.0	18.2
Little Colorado River	LTCORV	River/Rapids	25.0 to 65.9	Same
Marble Canyon Dam Site*	MARBDM	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Meriwhitca*	MERIWH	ODS	17.0 (+ 10 dBA)*	Same
Mohawk Canyon	MOHAWK	ODS	17.0	Same
Mohawk Canyon	MOHCAN	ODS	17.0	Same
Mt. Dellenbaugh*	MTDELL	Old Conifer Forest	31.0 (+ 10 dBA)*	22.8
Mt. Sinyala	MTSINY	CDS	17.0	18.2
Nankoweap Mesa	NANMES	CDS	17.0	18.2
Nankoweap River	NANKRV	River/Rapids	25.0 to 65.9	Same
National Canyon	NATCAN	ODS	17.0	Same
Navajo 1	NAVA1	ODS	17.0	Same
Navajo 2	NAVA2	Old PJ	20.1	20.0
North Canyon*	NOCANY	CDS	17.0 (+ 10 dBA)*	18.2
Jackson Canyon*	NOJAME	ODS	20.0 (+ 10 dBA)*	Same
Parashant Wash*	PARWAS	River	25.0 to 65.9 (+ 10 dBA)*	Same
Phantom Ranch	PHANTM	WDS	17.3	18.2
Pumpkin Springs*	PMPKIN	River/rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Prospect Canyon	PROCAN	ODS	20.0	Same
Prospect Canyon	PRSPCT	ODS	20.0	Same
Peach Spring Canyon N*	PSCNNO	ODS	20.0 (+ 10 dBA)*	Same
Peach Spring Canyon S*	PSCNSO	ODS/Old PJ	20.0 or 20.1 (+ 10 dBA)*	20.0
Point Imperial	PTIMPR	Ponderosa	27.9	22.8
Point Sublime	PTSUBL	PJ	19.4	20.0
Quartermaster Point*	QMPNT	ODS	17.0 (+ 10 dBA)*	Same
The Ranch	RANCH	Old PJ	20.1	20.0
Saddle Mountain*	SADMTN	Old Conifer Forest	31.0 (+ 10 dBA)*	22.8
Sanup*	SANUP	CDS	17.0 (+ 10 dBA)*	18.2
Separation Canyon 1km N of Colorado River*	SCCORV	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Spencer/Meriwhitca Canyons*	SCMCIG	ODS	20.0 (+ 10 dBA)*	Same
Separation Canyon at Colorado River*	SEPARC	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same

Table 3.2 Natural Ambient Sound Levels by Location Point

Location Point Name	Point ID ^a	Vegetation/Ambient Type ^{bc}	Natural Ambient Used in EIS Noise Modeling (dBA) ^{de}	Updated Natural Ambient ^f (dBA)
Shivwits Fire Camp*	SHWZFC	Old Conifer Forest	31.0 (+ 10 dBA)*	22.8
South Canyon*	SOCAN	CDS	17.0 (+ 10 dBA)*	18.2
South Supai Canyon	SOSUPC	ODS	20.0	Same
Spencer Canyon*	SPENCA	ODS	20.0 (+ 10 dBA)*	Same
Stone Creek	STONCK	River/Rapids	25.0 to 65.9	Same
Suicide Point*	SUIPNT	Old PJ	20.1 (+ 10 dBA)*	20.0
Supai Village	SUPVIL	ODS	20.0	Same
Surprise Valley	SURPVA	CDS	17.0	18.2
Temple Butte	TEMBUT	CDS	17.0	18.2
Three Springs*	THRSRPR	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Toroweap Overlook	TOROWP	WDS	17.3	18.5
Tower of Ra	TOWER	PJ	19.4	20.0
Tusayan Museum *	TUSAYN	PJ	19.4 (+ 10 dBA)*	20.0
Twin Point*	TWINPT	ODS	20.0 (+ 10 dBA)*	Same
Tuweep Ranger Station	TWPRS	CDS	17.0	18.2
Upper Deer Creek	UPDRCK	WDS	17.3	18.5
West End*	WESEND	WDS	17.3 (+ 10 dBA)*	18.5
Whitmore Rapids*	WHTRAP	River/Rapids	25.0 to 65.9 (+ 10 dBA)*	Same
Zuni Alpha	ZUNALF	Old Conifer Forest	31.0	22.8
Zuni Charlie	ZUNCHR	CDS	17.0	18.2

^aPoint ID shows identification codes for Location Points, and are the same codes shown in Map 3.1. The codes were also used in EIS noise modeling

^bAs shown also in Map 3.1, River/Rapids Location Points have a dBA range because the database used for River/Rapids did not identify which points are close to large noisy rapids and which are near quieter running water. Some other Location Points show a range because the point is on the edge of two vegetation/ambient types

^cCodes used for vegetation/ambient types are ponderosa pine forest (Ponderosa); piñon-juniper woodland (PJ); old piñon-juniper woodland (Old PJ); warm desert scrub (WDS); cold desert scrub (CDS); old desert scrub (ODS); old conifer forest (Old Conifer Forest); River/Rapids

^dIn the column Natural Ambient Used in EIS Noise Modeling, the values shown were used in EIS audibility calculations in the integrated noise model (INM), and are based on best available data in 2005, with the following exception: points identified with an asterisk (*) had 10 dBA added in the noise model calculation as shown in the table and as explained in Footnote 20 and Chapter 4, Methodology

^edBA is A-weighted decibels. A-weighting is commonly used where human hearing is important as it emphasizes the same portions of the sound frequency spectrum as does the human ear

^fUpdated values are from 2007 monitoring reports (NPS 2007c, NPS 2007d), except for River/Rapids which those studies did not update. Also, ODS was not updated since the vegetation map outside the park was not split into cold and warm desert scrub, and there was no new data to update ambient for those areas. However, Old Conifer Forest and Old PJ vegetation types were known to the NPS EIS team to be essentially the same vegetation respectively as Ponderosa and PJ inside the park. So natural ambient values for Old Conifer Forest and Old PJ were updated to the same as the Ponderosa and PJ vegetation types inside the park

For noise modeling purposes, 10 dBA was added to 2005 natural ambient sound levels for Location Points marked with an asterisk (), as part of dual-zone modeling explained in Footnote 29 and Chapter 4, Methodology

Existing Noise Environment (Existing Ambient Soundscape)

As mentioned above, Soundscape can include both natural and non-natural (i.e., human) components. The above discussion described natural Soundscape, which NPS policy considers the baseline condition against which current conditions in a Soundscape will be measured and evaluated (NPS 2006b, 8.2.3). However, NPS policy (NPS Director's Order 2, Park Planning) also requires NPS to divide the park into Management Zones, and to define zone management objectives in such a way that different types and levels of impact are considered acceptable in different zones. In the case of Soundscape, the zone definition for the Developed Zone (approximately 2% of the park) allows many more human noise sources, and considers much more noise impact acceptable than in the Wilderness Zone (approximately 94% of the park), with the Non-Wilderness Zone (approximately 4% of the park) in between the other two but closer to Wilderness Zone than Developed Zone objectives.

1 During summer and winter 2007 to 2008, NPS monitored sound in GCNP frontcountry areas (NPS 2008a). Existing
 2 ambient sound levels in Table 3.3 are L_{50} (median)⁴³ sound levels at those sites, and include natural sounds plus non-
 3 natural sounds (i.e., human-caused noise), including aircraft overflights.

4
 5 **Table 3.3 Existing Ambient Sound Levels (Natural plus Non-Natural) Summer and Winter at Selected**
 6 **GCNP Frontcountry Locations 2007–2008^a**

Location ^b	L_{50} (Median) Sound Levels (dBA) ^c		L_{50} (Median) Sound Levels (dBA) ^c		Activity Type
	7a.m	7p.m.	Midnight	Midnight	
	Summer	Winter	Summer	Winter	
Mather Campground	41.3	37.9	39.7	34.1	Campground
Village Loop Rd, West End	56.6	55.8	51.6	51.2	High-use Area
Yaki Point	31.8	29.0	31.4	26.8	Overlook
South Kaibab Trailhead	35.4	32.3	36.7	30.4	Overlook/Trailhead
Mather Point Parking Lot	52.3	52.9	48.1	46.5	Overlook
Desert View Drive, Mile 251	41.3	32.6	36.9	28.7	Road
Bright Angel Trail, 3.7 Mile	23.7	22.3	27.3	21.3	Corridor Trail
Desert View, Parking Lot	47.3	40.2	41.9	36.1	High-use Area
South Rim, Residential Area (NPS)	36.7	36.3	35.2	34.7	Residential
North Kaibab Trailhead	42.7	NA	50.5	NA	Trailhead
North Rim Campground	35.9	NA	34.8	NA	Campground
Cape Royal	27.3	NA	27.9	NA	Overlook
Point Imperial	31.4	NA	32.0	NA	Overlook
North Rim Entrance Road	37.3	25.5	33.2	24.1	Road
Tuweep Campground/ Overlook	28.3	22.7	30.7	21.6	Campground

Source: NPS 2008a

^aWith exception of the Bright Angel Trail, 3.7 Mile location, all frontcountry locations in this table are in the Developed Zone as defined for this EIS

^bLocations shown in these tables are not necessarily the same location as any Location Points with similar name in Table 3.2 due to different times Location Points (Map 3.2) were selected and studies conducted

^c L_{50} dBA values represent sound pressure level, in A-weighted decibels, of all sounds (L) (natural plus non-natural) exceeded 50% of the time during the studied time period (i.e., the median)

7
 8
 9 During busy visitation periods in Developed Zones, it can be difficult to find times and places when and where
 10 natural Soundscape is not affected by human noise sources to some extent, even if aircraft are excluded as a human
 11 noise source. However, even the Developed Zone is diverse enough that natural Soundscape can be experienced
 12 unaffected by human noise sources some times in some places. The studies cited above (NPS 2007 c,d) along with a
 13 later study (NPS 2008a) determined natural ambient sound levels when human noise sources were not present, and
 14 when they were. Study results, in terms of both natural and human sounds, are shown in Tables 3.3 to 3.6. Results
 15 show types of human noise sources and times when human noise sources were present were generally much more
 16 numerous in the Developed Zone than in the Wilderness Zone. Results also show there are probably no places, even
 17 in the most remote portions of the Wilderness Zone, where aircraft noise does not affect natural Soundscape at least
 18 some of the time.

19
 20 In the GCNP frontcountry study (NPS 2008a), non-natural sounds (vehicles, buildings operations, construction, and
 21 maintenance) were audible nearly all the time during the day at high-use frontcountry sites, and about half the day at
 22 low-use frontcountry sites. It should be noted that frontcountry sites are less than 6% of the park. Sound levels were
 23 loudest in high-use areas such as Village Loop Road, near the popular Bright Angel Lodge and Hermit Road
 24 interchange. Sound levels were lowest in less visited areas, such as below the rim 3.7-miles down Bright Angel
 25 Trail. Winter sound levels were lower than summer levels in park frontcountry and backcountry areas. In

⁴³ In acoustics, L_x values are called exceedence values because they are values exceeded x percent of the time of interest. L_{50} values in these tables are values exceeded 50% of the time during the measurement period(s) at the site. As such, L_{50} values are also the median value of the data

1 frontcountry areas, vehicles were the single sound source contributing most to higher sound levels and higher
 2 percent time non-natural sounds were audible (Table 3.4). At low-use frontcountry sites, aircraft were the single
 3 source contributing the most non-natural sounds to the Soundscape (Table 3.5). At backcountry sites, aircraft
 4 contributed almost all non-natural sounds (Table 3.6).

5
 6 In high-use frontcountry areas, non-natural sounds were audible 79.5% of the 24-hour day in summer, and 72.9% in
 7 winter. In low-use frontcountry areas, non-natural sounds were audible 42.1% of the 24-hour day in summer, and
 8 31.2% in winter. At locations with the highest number of visitors and activities, human-caused sounds were audible
 9 nearly 100% of the time summer and winter. The most common audible human-caused sounds were vehicle-related
 10 (driving, idling, horns, and alarm systems). Other audible human-caused sounds were aircraft, people (talking,
 11 walking), buildings (doors, air conditioners, and heating units), ground-care activities (trash can lids), other
 12 mechanized sounds (generators), and domestic animals. The most common natural sounds in both high-use and low-
 13 use frontcountry areas were wind-related (wind through vegetation) and birds and insects (primarily in summer).
 14 Other audible natural sounds included mammals, water (rain, snow), and thunder.

15
 16 Outside GCNP within the SFRA, sound sources in NPS, USFS, BLM, and tribal lands are expected to be similar to
 17 ambient conditions presented in Tables 3.3 to 3.6 for similar frontcountry and backcountry sites in the park.

18
 19 **Table 3.4 Average Percent Time Audible of Sound Sources High-Use Frontcountry Areas**

Audible Sound Sources	Percent Time Audible 7a.m. 7p.m.		Percent Time Audible Midnight Midnight	
	Summer	Winter	Summer	Winter
	No Sound Audible	0.1	1.2	0.5
Total Non-Natural	92.1	88.2	79.5	72.9
Total Aircraft	14.1	22.1	11.7	19.6
Aircraft (<i>type unknown</i>)	0.9	1.2	0.5	0.8
Jet Aircraft	9.0	17.7	8.7	17.0
Propeller Aircraft	2.1	1.2	1.2	0.8
Helicopter	2.3	1.9	1.3	1.0
Total Road Vehicles	77.1	66.3	58.5	46.1
Other Non-Natural				
People	40.5	18.7	28.3	10.9
Building Sounds	2.9	0.6	10.4	4.6
Total Natural	81.4	65.8	82.4	63.1
Wind	36.3	41.6	45.3	48.0
Water (rain, snow)	2.0	15.5	2.6	12.6
Thunder	1.4	0.0	0.8	0.0
Bird	70.2	28.5	46.9	16.9
Insect	7.3	5.3	17.9	7.2

20 Source: NPS 2008a

21 22 23 **Noise Effects Associated with Aircraft Overflights**

24
 25 Although GCNP includes a wide variety of human noise sources, aircraft sound is the **most prevalent** human noise
 26 source present in the park because, unlike any other noise source, aircraft **create noise** over the entire park while
 27 most other noise sources are confined to limited areas such as developed areas or roads. **Aircraft produce more**
 28 **noise energy than most other park noise sources, and their position in the sky allows this noise to spread across**
 29 **wide areas.** Natural Soundscapes throughout GCNP are affected by aircraft noise from a variety of overflight
 30 sources. These include high-altitude, commercial jet traffic; military aircraft traffic; general aviation; NPS
 31 administrative operations, such as emergency response and facility maintenance; and commercial air tours. In the
 32 1987 Overflights Act (Public Law 100-91), Section 3(a), Congress found that “[n]oise associated with aircraft
 33 overflights at the Grand Canyon National Park is causing a significant adverse effect on the natural quiet and
 34 experience of the park.”

Table 3.5 Average Percent Time Audible of Sound Sources at Two Low-Use Frontcountry Areas (Bright Angel Trail and Tuweep Campground)

Audible Sound Sources	Percent Time Audible 7a.m. - 7p.m.		Percent Time Audible Midnight - Midnight	
	Summer	Winter	Summer	Winter
	No Sound Audible	0.3	13.4	0.3
Total Non-Natural	53.5	47.5	42.1	31.2
Total Aircraft	30.3	36.9	23.3	25.7
Aircraft (<i>type unknown</i>)	4.4	0.8	2.8	0.5
Jet Aircraft	19.7	32.2	16.5	23.3
Propeller Aircraft	5.8	2.6	3.8	1.3
Helicopter	0.3	1.5	0.2	0.7
Total Road Vehicles	4.5	1.3	3.3	0.6
Other Non-Natural				
People	29.3	13.1	21.6	6.5
Building Sounds	1.1	0.2	1.6	0.1
Total Natural	94.1	57.8	96.6	59.0
Wind	74.7	45.0	62.9	51.3
Water (rain, snow)	1.9	0.0	0.9	0.0
Thunder	0.0	0.0	0.0	0.0
Bird	52.6	29.1	42.3	16.5
Insect	28.0	3.4	5.2	1.9

Source: NPS 2008a

Table 3.6 Percent Time Audible for Non-Natural and Natural Sounds, Daytime Hours (7a.m.-7p.m.), for Summer 2006 Replicate and 2005 Original Sites

Site	Non Natural Sounds	All Aircraft	Jets	Propeller and/or Helicopter	Natural Sounds
	2006 (2005)	2006 (2005)	2006 (2005)	2006 (2005)	2006 (2005)
Ponderosa Pine	34.7 (47.7)	34.7 (36.7)	30.5 (21.8)	3.3 (11.9)	99.6 (99.8)
Piñon-Juniper*	NA (51.9)	NA (49.4)	NA (43.0)	NA (4.9)	NA (95.1)
Cold Desert Scrub	43.2 (40.0)	43.0 (39.4)	39.2 (33.6)	2.8 (4.2)	89.6 (95.0)
Warm Desert Scrub	38.5 (33.4)	38.4 (33.1)	32.7 (22.2)	3.5 (9.7)	99.8 (92.9)

*No recordings were available for the 2006 piñon-juniper site due to monitoring equipment problems

Source: NPS 2007d

As shown in Table 3.4, at high-use frontcountry sites road vehicles were the greatest audible non-natural sound source, followed by aircraft (jets, propeller planes, and helicopters). At low-use frontcountry sites (Table 3.5), total aircraft noise were by far the most frequent non-natural sound source (NPS 2008a).

While aircraft are still audible in most frontcountry areas (high commercial jet traffic at all locations plus air tour aircraft in some locations), at many frontcountry locations aircraft noise were often masked by the higher sound levels of road vehicles and other sources. Many aircraft noise occur in the same frequency bands as motor and vehicle sounds, which tend to add to the masking effect. In addition, while aircraft were more audible in winter than summer, this is not due to a higher number of flights, but rather due to lower existing ambient sound levels in winter allowing aircraft to be audible more often (NPS 2008a).

At all of the backcountry sites (Table 3.6), almost all non-natural sounds were caused by aircraft during daytime hours (NPS 2007d). At all sites, natural sounds were heard a majority of the time (89.6% to 99.8% of daytime

1 hours), despite non-natural sounds audible 33.4% to 51.9% of daytime hours.⁴⁴ Aircraft (specifically jets and
2 propeller planes) were the only non-natural sounds heard at all backcountry sites. Commercial high altitude jet
3 aircraft were audible at all frontcountry and backcountry locations in all three Management Zones (Developed, Non-
4 Wilderness, and Wilderness). Even at locations in Flight-free Zones, air tour aircraft are often audible due to the
5 distances aircraft noise can travel in the Grand Canyon environment.
6

7 See Chapter 4 for a discussion of current impacts from aircraft overflights in Alternative A, No Action.
8

9 WILDERNESS CHARACTER

10 Introduction

11 The 1964 Wilderness Act defines Wilderness as

12
13 *A Wilderness, in contrast with those areas where man and his own works dominate the landscape, is*
14 *hereby recognized as an area where the earth and its community of life are untrammelled by man, where*
15 *man himself is a visitor who does not remain. An area of Wilderness is further defined to mean in this Act*
16 *an area of undeveloped Federal land retaining its primeval character and influence, without permanent*
17 *improvements or human habitation, which is protected and managed so as to preserve its natural*
18 *conditions and which (1) generally appears to have been affected primarily by the forces of nature, with*
19 *the imprint of man's work substantially unnoticeable; (2) has outstanding opportunities for solitude or a*
20 *primitive and unconfined type of recreation; (3) has at least five thousand acres of land or is of sufficient*
21 *size as to make practicable its preservation and use in an unimpaired condition; and (4) may also contain*
22 *ecological, geological, or other features of scientific, educational, scenic, or historical value.*
23
24

25 The 1964 Wilderness Act does not set expectations for Soundscape conditions in Wilderness areas. However,
26 Wilderness Character is expressed through suitability criteria in section 6.2.M of Management Policies (NPS
27 2006b) used by the NPS to determine whether lands are eligible for Wilderness designation.
28

29 Management Policies also directs that

30 *The National Park Service will take no action that would diminish the Wilderness suitability of an area*
31 *possessing Wilderness Characteristics until the legislative process of Wilderness designation has been*
32 *completed. Until that time, management decisions pertaining to lands qualifying as Wilderness will be*
33 *made in expectation of eventual Wilderness designation.*
34

35 Grand Canyon National Park Wilderness

36
37 Ninety-four percent of GCNP has been proposed for inclusion in the National Wilderness Preservation System (NPS
38 1993). The GCNP Proposed Wilderness is primarily inner canyon and rim areas, and does not include developed
39 areas or the Cross-Canyon (trail) Corridor. Map 3.3 shows areas proposed for Wilderness designation in relation to
40 current air-tour routes.
41

42 The 1993 Final GCNP Wilderness Recommendation included two units totaling 1,139,077 acres. Of this, 1,109,257
43 acres were proposed for immediate Wilderness designation; and 29,820 acres were proposed for designation as
44 Potential Wilderness. Potential Wilderness areas include places that do not qualify for immediate designation as
45 Wilderness due to temporary, nonconforming, or incompatible conditions. GCNP Proposed Wilderness are in the
46 park's GMP-defined Natural Zone, managed to conserve natural resources and ecological processes and to provide
47 for their use and enjoyment by the public in ways that do not adversely affect these resources and processes (NPS
48 Management Policies).
49
50
51

⁴⁴ Percent Time Audible in Tables 3.3 to 3.6 often adds to more than 100%, because more than one sound source was audible at the same time during measurement periods. However, although natural sounds can often be heard in the presence of non-natural sounds (e.g., aircraft), the natural Soundscape is adversely impacted whenever a non-natural sound is present

- GCNP Proposed Wilderness is defined by the following qualities consistent with the 1964 Wilderness Act
- **Untrammeled** Ecological systems unhindered and free from modern human control or manipulation
 - **Natural** Ecological systems are substantially free from effects of modern civilization
 - **Undeveloped** Without permanent improvements or modern human occupation. This quality pertains to the presence and development level of trails, structures, and facilities in the park's backcountry areas
 - **Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation** People can experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge. This quality pertains to visitor opportunities to experience a primitive setting that may include solitude and sights and sounds of nature on its own terms

Designated and Proposed Wilderness Outside the Park

There are six Designated Wilderness areas in the Study Area, and seven Proposed Wilderness areas adjacent to GCNP and/or in the SFRA. These areas are included in the Study Area, as depicted on Map 3.3. For example, Mount Logan and Mount Trumbull are outside the SFRA, and several others are mostly outside the SFRA, but within the Study Area.

Proposed Wilderness Areas

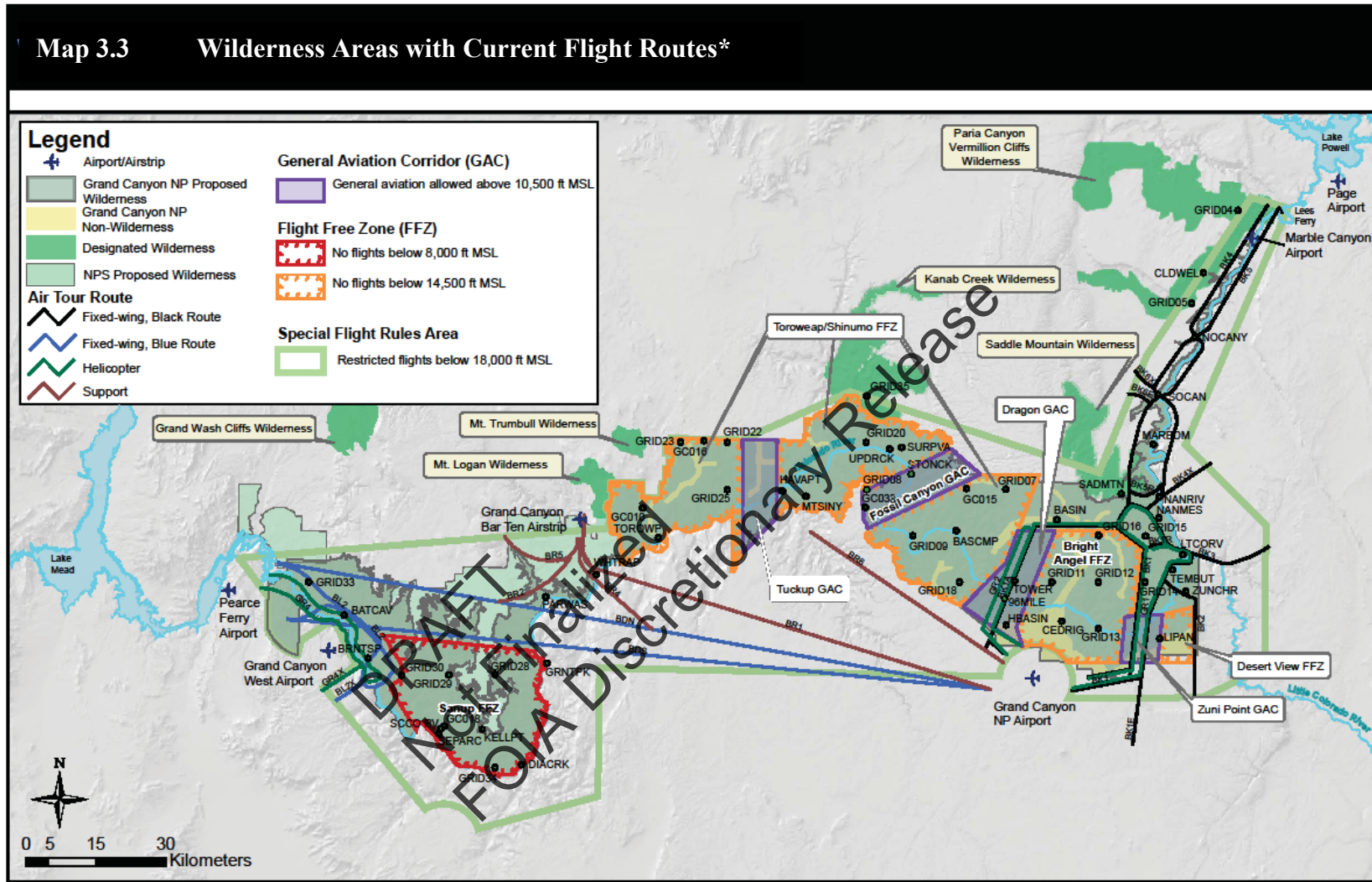
Grand Canyon-Parashant National Monument Wilderness Areas	GCPNM NPS-managed portion contains seven Proposed Wilderness areas totaling 190,475 acres. GCPNM's BLM-managed portion contains Designated wilderness of 93,109 acres. Total BLM and NPS Designated and Proposed Wilderness Areas total 283,584 acres
	These proposed lands would continue to be managed as Wilderness as required by NPS Management Policies and Director's Order 41, Wilderness Preservation and Management. No actions would be taken by the NPS that diminish Wilderness eligibility of these areas until the legislative process of Wilderness designation has been completed

Designated Wilderness Areas

Paria Canyon-Vermilion Cliffs Wilderness	This 112,500-acre Wilderness is managed by the BLM, and is located at the northeast section of the SFRA, predominantly west of Marble Canyon
Saddle Mountain Wilderness	This 40,539-acre Wilderness is located in the Kaibab National Forest managed by the USFS, and is located west of Marble Canyon, abutting the Kaibab Plateau's eastern edge. The Nankoweap Rim forms the southern boundary (USFS 2007b)
Kanab Creek Wilderness	This Wilderness is also located in the Kaibab National Forest, totals 75,300 acres, and is jointly managed by the BLM, which administers 6,700 acres, and the USFS, which manages 68,600 acres. The entire Wilderness is located north of the canyon rim above Kanab Canyon and abuts Kaibab Plateau's western edge. The Wilderness contains Kanab Creek, the largest tributary canyon system on Grand Canyon's north side (BLM 2006)
Mount Trumbull Wilderness	This BLM-managed 7,880-acre Wilderness is located in the Grand Canyon-Parashant National Monument just north of Grand Canyon (BLM 2006)
Mount Logan Wilderness	This BLM-managed 14,650-acre Wilderness lies in the Grand Canyon-Parashant National Monument north of Grand Canyon and east of Whitmore Canyon
Grand Wash Cliffs Wilderness Area	This remote, BLM-managed 37,030-acre Wilderness is a 12-mile long stretch of Grand Wash Cliffs in Grand Canyon-Parashant National Monument north of Grand Canyon

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*Current flight routes correspond to Alternative A

1 ETHNOGRAPHIC RESOURCES

3 Introduction

5 In this document, Ethnographic Resources include traditional cultural properties, tribal concerns, and various
6 intangible and tangible resources valued by GCNP-associated native people.

8 Ethnographic Resources may include traditional arts and native languages, structures with historic associations,
9 natural materials, sacred or ceremonial places, and spiritual concepts and subsistence activities supported by special
10 places in the natural world. Ethnographic Resources may also include archeological sites and other physical
11 evidence of human activity considered important to a culture for historic, traditional, religious, or other reasons.
12 Ethnographic Resources are the foundation of traditional societies, and form the basis for their cultural continuity.

14 Traditional cultural properties are defined as a property associated with cultural practices or beliefs of a living
15 community rooted in that community's history or important in maintaining its cultural identity. American Indian
16 groups in the Grand Canyon region recognize certain tangible properties as important in their traditional tribal
17 histories. These traditional cultural properties may or may not correspond to archeological sites. Traditional cultural
18 properties are Ethnographic Resources eligible for listing in the National Register of Historic Places (NPS 2006b).

20 The term *historic properties* refers to cultural resources listed in, or eligible for listing in, the National Register of
21 Historic Places. For this EIS, potentially eligible and unevaluated resources (that is, Ethnographic Resources that
22 have not been evaluated for National Register of Historic Places eligibility) would be afforded the same level of
23 protection as listed or eligible historic properties.

25 Sacred places are natural and cultural resources having established religious meaning and as locales of private
26 ceremonial activities (Management Policies 5.3.5.3.2).

28 Because American Indians have a strong concern for privacy and protection of traditional cultural properties, site-
29 specific descriptions of cultural sites or details of traditional practices are not included in this EIS.

31 Some native people believe that the Grand Canyon region was their place of origin or that they have occupied this
32 area from time immemorial. As recorded by archeological research, human history in the Colorado Plateau Region
33 extends back nearly 12,000 years, a time that has been divided into four broad periods: Paleoindian, Archaic,
34 Formative, and Historic. All periods are represented in Grand Canyon. The presence of Paleoindian peoples is
35 suggested by very limited evidence, while later Archaic occupations are sparse but include campsites, rock art, and
36 diagnostic artifacts such as split-twig figurines dating to 3,000 to 4,000 years before present.

38 Most prehistoric sites in the eastern Grand Canyon are associated with the Formative period (circa AD 500-1200)
39 and typically include Puebloan characteristics: an economy based on farming and trading and villages with similar
40 architectural styles. Populations diminished after the early 1200s as some prehistoric peoples moved eastward.
41 These prehistoric peoples are believed to be ancestors of modern Puebloan peoples. The ancestors of the Pai
42 (Havasupai, Hualapai, and Yavapai), Paiute, and Puebloan peoples occupied the Grand Canyon area as far back as
43 AD 1300 (Euler 1979), and Pai peoples are thought to have occupied downstream areas along the Colorado River as
44 early as AD 700 (Gilpin and Phillips 1998).

46 Status of Ethnographic Resources Information

48 The topic of archeological resources has been dismissed from discussion in this EIS (see Chapter 1). However,
49 because of the role archeological sites play in the cultural history and traditional cultural practices of the American
50 Indian groups associated with GCNP, they are briefly discussed as part of the area's Ethnographic Resources.

52 Numerous archeological investigations and ethnographic studies have been completed in GCNP, but only about 5%
53 of the park has been formally surveyed for cultural sites. Areas that receive heavy visitor use or management that
54 have been surveyed include the Colorado River corridor, the southern extension of the Walhalla Plateau on North
55 Rim (Walhalla Glades), portions of Grand Canyon Village, the Cross-Canyon Corridor, and segments of Desert
56 View Drive.

1 Most archeological work has been project-specific, but an archeological overview of the park was completed by
2 Ahlstrom et al. in 1993. Coder (2000) prepared an introduction to the park's prehistory. Other recent publications
3 include Fairley et al. (1994) which documents sites along the Colorado River between Glen Canyon Dam and
4 Separation Canyon. A synthesis of cultural resources data was conducted in 2000 (Neal and Gilpin 2000).

5
6 Ethnographic studies include Euler's 1979 publication on 4,000 years of human history in the Grand Canyon, T.J.
7 Ferguson's ethnohistory of the Hopi people (1998), and Richard E. Hart's 1995 publication on the Zuni and Grand
8 Canyon.

9
10 The Hualapai Tribe, *which has a Tribal Historic Preservation Officer*, inventoried historic properties in the
11 Hualapai Reservation, and produced three reports that identified and evaluated traditional cultural properties,
12 including a Draft preliminary report dated November 2, 1998, and two final ethnographic study reports dated March
13 31 and December 3, 1999. These ethnographic studies focused on major canyons, critical and sensitive areas, and
14 the most accessible areas closest to proposed flight patterns over Hualapai tribal lands.

15
16 Summaries of Hualapai traditional cultural properties along the Colorado River include Jackson (1997), Jackson et
17 al. (2001, 2002), Glassco (2003a and 2003b), and Stevens (1996).

18
19 Roberts et al. (1995) described Navajo history and cultural resources of Grand Canyon.

20
21 An ethnographic resource inventory and assessment for the Colorado River corridor was conducted for the Paiute by
22 Stoffle et al. (1994).

23
24 Plants play an important role in traditional cultural practices and ceremonies. Several reports document
25 ethnobotanical resources in the Study Area and include a report on monitoring of Hualapai ethnobotanical resources
26 by Phillips and Jackson (1997). To help protect culturally sensitive plants, several tribes, including the Hopi Tribe,
27 Hualapai Tribe, Navajo Nation, Pueblo of Zuni, and Southern Paiute Consortium, conducted ethnobotanical studies
28 along the Colorado River in Grand Canyon to determine where such plants are located. A list of the plants identified
29 by these groups except the Pueblo of Zuni is on file at the park; the Pueblo of Zuni list is confidential (NPS 2005a).

30 31 **Tribal History and Ethnographic Resources and Concerns**

32
33 A number of Federally recognized American Indian tribes in the region attach cultural significance to historic
34 properties located in GCNP, and have expressed or claimed cultural affiliation and/or ancestral ties to the park.
35 Tribes with close cultural ties to Grand Canyon include

- 36 • Havasupai Tribe
- 37 • Hopi Tribe
- 38 • Hualapai Tribe
- 39 • Kaibab Band of Paiute Indians
- 40 • Las Vegas Tribe of Paiute Indians
- 41 • Moapa Band of Paiute Indians
- 42 • Navajo Nation
- 43 • Pueblo of Zuni
- 44 • Paiute Indian Tribe of Utah (representing the Shivwits Band of Paiutes)
- 45 • San Juan Southern Paiute Tribe
- 46 • Yavapai-Apache Nation

47 48 **Havasupai Tribe**

49 The Yuman-speaking Havasupai Indians (the *Havasu 'Baaja'* or people of the blue-green waters) are one of 14
50 bands of Pai Indians, and the only tribe that resides in Grand Canyon. The Havasupai share a common language and
51 ancestry with two other local Pai tribes, the Hualapai and Yavapai-Apache. Once, Yuman speakers occupied the
52 lower Colorado River valley and adjacent areas in western Arizona, as well as southern California, northern Baja
53 California, and northwestern Sonora. Yuman speaking groups who inhabited the area along the Colorado River from
54 the Bill Williams River in northwestern Arizona to Grand Canyon were known as Upland Yumans, or Pai (the

1 people). When these peoples were first encountered by Euroamericans, there were three major Pai groups, made up
2 of 14 bands. Each band occupied distinct but overlapping ranges.

3
4 An 1880 Executive Order restricted the Havasupai Tribe to 38,000 acres; this was further reduced to around 500
5 acres in 1882. At the time of establishment of GCNP in 1919, the Havasupai Tribe was restricted to a 518-acre, 5-
6 mile-wide, 12-mile-long corridor in a side canyon (Havasu Canyon). Congress reallocated 185,000 acres of the
7 original hunting grounds to the Tribe in 1975 as part of the Grand Canyon Enlargement Act. Havasu Canyon and
8 areas to the east and west lie in the Tribe's reservation, which also includes land on the Coconino Plateau from the
9 Little Colorado River west to the Aubrey Cliffs, and from the vicinity of Bill Williams Mountain northward to the
10 Colorado River. The Havasupai Reservation borders the park on the west and south. Today, there are approximately
11 700 enrolled tribal members living in the village of Supai at the bottom of the canyon.

12
13 The native flora and fauna of the canyon and the adjacent Coconino Plateau are traditionally important to the
14 Havasupai for both economic and traditional cultural purposes. Historically, the Havasupai hunted and gathered wild
15 foods over a large area, at a great altitudinal range, from the bottom of the canyon to more than 7,000 feet MSL.
16 During the winter, the Havasupai subsisted by using plateau regions, dividing into bands, extended family, or family
17 units, and returning to areas belonging to these groups. They hunted all over the Coconino Plateau, and collected
18 mescal (*Fabaceae*) and edible wild plants such as agave (*Agavaceae*) on canyon benches.

19
20 In summer, they moved into brush and mud-covered wicki-ups (small structures or shelters constructed of wood
21 poles) in Havasu Canyon where they irrigated crops of squash, beans, and corn. In the late summer, the Havasupai
22 gathered to collect piñon nuts. Bright Angel Trail, Hermit Basin Trail, Mystic Springs Trail, and other long-
23 established trails used by the Havasupai and other native people to access the plateau were rebuilt during the 1890s
24 by Anglos. Moqui Trail was a trade route between the Hopi mesas and Havasupai Canyon, but had been almost
25 completely abandoned by 1910 (FAA 2000b). Many of these trails led to water sources, including Rain Tank (now
26 part of Grand Canyon National Park Airport), used as a subsistence camp and water stop during long-distance travel.
27 A route east from Rain Tank passes through Long Jim Canyon. An area near Hance Trailhead is known to be sacred
28 to the Havasupai people (FAA 2000b). Indian Garden was the home of several Havasupai families until well into the
29 20th century, and remains important to the native people. The Havasupai creation story tells that "this region is the
30 place where they began, and has always been home to their ancestors" (FAA 2000b). The Havasupai consider
31 themselves traditional guardians of Grand Canyon, and revere the Colorado River as the backbone of their lifeline
32 (NPS 2005a).

33
34 In the 1930s the National Park Service constructed residences at the area known as Supai Camp west of Grand
35 Canyon Village on South Rim and relocated Havasupai tribal members who had been living at Indian Garden and
36 around Grand Canyon Village to those residences. The NPS, in developing the camp, established a residential area
37 for use of the Havasupai people living and working on South Rim. The total number of residences originally
38 constructed at Supai Camp is unclear, but currently four historic cabins, one community building-turned-residence,
39 and one community bathroom and laundry facility exist in this location. Many updates to Supai Camp were
40 completed in 2010, including connecting facilities to the park's wastewater treatment plant, installation of overhead
41 utilities including electricity and telephone, and construction of three duplexes with additional units to be
42 constructed as funding becomes available. Existing housing units are being rehabilitated to meet health and safety
43 codes, including connections to water and sewer. Road expansion and improvements will occur to allow safe, year-
44 round access to Supai Camp. The Havasupai Tribe and NPS have a general agreement to recognize historic use and
45 occupancy of Supai Camp by tribal members. Under terms of this agreement, the Tribe is allowed to use and occupy
46 the Camp for 50 years, from June 2, 2008, the date of signature, to June 2, 2058. Upon expiration of this term, the
47 general agreement will automatically renew for an additional 50 years.

48 49 **Hopi Tribe**

50 Hopi traditions tell their place of origin was through the *Sipapuni*, a travertine dome located in the Little Colorado
51 River gorge, outside GCNP. According to Hopi tradition, some of their clans migrated into Grand Canyon, a claim
52 supported by archeological investigations that found Hopi use of the canyon since about AD 700. These early
53 peoples (*Hisatsinom* or people of long ago) lived in small pit-house settlements where they cultivated crops such as
54 corn, beans, and cotton. They occupied a large area that extended roughly from Grand Canyon to Navajo Mountain.
55 The first substantial settlement in the Hopi Mesa area came about AD 700.

56

1 Eventually, masonry structures replaced pit houses, small clusters of families consolidated into larger villages in the
2 Black Mesa area of Arizona, and by the AD 1500s, the Hopi had developed a complex social organization, elaborate
3 ceremonial cycles, and advanced agricultural systems that used mesa runoff to irrigate crops. In 1540, the Hopi were
4 encountered by part of the Coronado Entrada, and later, by Spanish explorers and missionaries. Over the next four
5 centuries the Hopi strove to retain their traditions and lands.

6
7 Contact with the U.S. Government began during the mid-1800s, and the first Hopi Indian agent was appointed in
8 1870. A 2.5-million-acre Hopi Reservation was established by Executive Order in 1882. Today, the Hopi
9 Reservation is surrounded by the Navajo Reservation, and is bisected by Dinnebito and Polacca Washes as they
10 drain toward the Little Colorado River. Population on the reservation is about 6,946 people, and its economy is
11 based largely on small-scale farms and livestock raising (Tiller 2005).

12
13 Grand Canyon is very significant to the cultural and traditional life of the Hopi people, and they continue to use the
14 canyon for important ceremonial and ritual purposes. Some of their most sacred sites are inside and adjacent to the
15 park, such as the Hopi Salt Mines (by the Colorado River, but closed to public use). The Hopi people consider
16 Grand Canyon to be their place of emergence into the present world, and the source of their life.

17
18 The canyon's archeological sites, shrines, springs, places where medicinal herbs are found, and other sacred places
19 are significant because they help perpetuate Hopi life and culture by providing a vital physical and spiritual link
20 between the past, present, and future. Springs have spiritual importance, and may have provided holy water used by
21 Spanish priests at Oraibi and Awatovi Catholic missions. Traditional cultural properties also include elements of art
22 appearing on rocks, the Mount Trumbull area near Tuweep, archeological sites, shrines, and pilgrimage routes. The
23 Hopi also believe Grand Canyon is dangerous, requiring proper spiritual preparation and respectful demeanor (NPS
24 1995). Unintentional disrespect of visitors to these various cultural sites is believed to have the potential to erode the
25 spiritual well-being of all people.

26 27 **Hualapai Tribe**

28 Hualapai Tribe ancestral lands covered millions of acres in and around Grand Canyon, with the Colorado River's
29 rugged canyons marking the northern boundary. Origin stories link the Hualapai to a place on the west bank of the
30 Colorado River (McGuire 1983). Archeological evidence suggests the Hualapai are related to the Cerbat branch of
31 the prehistoric Upland Patayan tradition, found in the Grand Canyon area as early as AD 655.

32
33 Franciscan missionary Francisco Garcés met the Hualapai during his 1776 expedition, who apparently remained
34 isolated from Euroamerican incursions for another three quarters of a century until encountered by U.S. Army
35 explorations seeking a railroad route through Arizona. Conflict between the Hualapai and Anglo road builders,
36 settlers, and miners resulted in internment of the Hualapai during the 1870s. When the Hualapai returned to their
37 homeland, they found much of the area occupied by non-Indians. The land had been overgrazed during Hualapai
38 absence, destroying many of the native plants and making the land unproductive (McGuire 1983).

39
40 A 900,000-acre reservation was established in 1883 along South Rim of Grand Canyon and the Colorado River on a
41 portion of ancestral lands. One third of the reservation is on the Coconino Plateau, and two-thirds is at a lower
42 elevation of the Hualapai Plateau. The terrain covers a wide elevation span, from 7,000 feet MSL on the plateaus to
43 2,000 feet at the base of Grand Canyon. The reservation extends along 108 miles of the Colorado River, from River
44 Mile (RM) 165 to RM 273. Most of the Hualapai Reservation is undeveloped. By tribal law, development of any
45 kind is prohibited in canyons considered sacred to the Hualapai people. Non-Hualapai may not enter these canyons.
46 *Hualapai* means People of the Tall Pines, and this vegetative cover is found on the central and eastern portions of
47 the reservation near the canyon rim.

48
49 The Hualapai Tribe manages its lands for wildlife protection, cultural resources preservation, and forestry. The Tribe
50 has set aside an area along the southern rim of Grand Canyon for tourism and recreation such as sightseeing,
51 hunting, and river rafting, etc. This area includes Grand Canyon West Airport (FAA 2000b).

52
53 Approximately 1,800 people reside on the Hualapai Reservation, including about 1,000 enrolled tribal members out
54 of the 2,200 total enrolled tribal memberships. Most live in the tribal capital, Peach Springs, situated on Highway 66
55 on the southern edge of the reservation.

56

1 The Hualapai people also revere the Colorado River, considering it “the backbone of their lifeline” (NPS 2005a).
2 The river (*Ha'yitad*) is a significant physical and spiritual landmark, and some canyons (such as Meriwhitica
3 Canyon) along the river are also considered sacred. Names of sacred canyons in Grand Canyon are derived from
4 important historical events recounted through oral traditions (NPS 1995).

5
6 Like the Havasupai, the Hualapai traditionally moved seasonally between canyon and plateau, and hunted game,
7 gathered seeds, and cultivated gardens wherever water was available. Their major wild vegetation foods were
8 derived from cactus fruit and seeds of grasses. Desert bighorn (*Ovis canadensis*) were one of the Hualapai's prime
9 sources of survival, along with other animals such as mule deer (*Odocoileus hemionus*), chuckwallas (*Sauromalus*
10 spp.), elk (*Cervus elaphus*), cottontail rabbits (*Sylvilagus spp.*), and pronghorn (*Antilocapra americana*). They
11 captured eagles, hawks, and, falcons. Significance is accorded to these and other species because of their historically
12 great importance to the Hualapai for food and use in ceremonies.

13
14 The Hualapai also identified plants of special concern traditionally used for food, medicinal purposes, and
15 ceremonies. These include ponderosa pine (*Pinus ponderosa*), piñon pine (*Pinus edulis*), Gooding's willow (*Salix*
16 *gooddingii*), sage brush (*Artemisia tridentata*), agave (*Agave spp.*), mesquite (*Prosopis spp.*), and other species
17 known only to the Hualapai. Minerals of importance are also used for several purposes, and include hematite, used
18 for ceremonial activities (FAA 2000b).

19
20 The Hualapai continue to use traditional ceremonial sites, and regularly monitor the condition of six traditional
21 cultural properties located near heavily visited areas. These include Diamond Creek, Bridge Canyon, Spencer
22 Canyon, Travertine Canyon, Travertine Falls, and Burnt Springs Canyon. The Hualapai Tribe has documented
23 numerous traditional cultural properties within the Lower Colorado River gorge (Glassco 2003b; NPS 1995). Based
24 on ethnographic studies documenting archeological and ethnographic sites, the Hualapai identified about 40
25 traditional cultural properties they feel are especially critical and sensitive (FAA 2000b).

26 27 **Navajo Nation**

28 There is no clear agreement on when the Athabaskan-speaking ancestors of the people now known as the Navajo
29 migrated into the American southwest. However, archeological and linguistic evidence suggests Navajo ancestors
30 came into this area between AD1000 and AD1525 (Brugge 1983). Their traditional homeland is symbolized by four
31 sacred mountains: Blanca Peak and La Plata Mountains in Colorado, Mount Taylor in New Mexico, and San
32 Francisco Peaks in Arizona. However, their use area extended beyond these landmarks.

33
34 Navajo views of the origin of their people and their world begin with a journey upward through a subterranean
35 domain, encountering world after world, before emerging onto the surface of a fifth world at a place centered in
36 Navajo sacred geography and history, and bounded by the four sacred mountains. This is a created world that is the
37 responsibility of Navajo people to care for by means of careful stewardship and ceremonies (Gill 1983).

38
39 Historic records document Navajo peoples presence in the Grand Canyon area by at least AD 1600. When first
40 encountered by Spanish explorers, the large and powerful Athabaskan-speaking group in the Grand Canyon vicinity
41 was called *Apache de Nabajó*. These semi-nomadic people planted maize and other crops but also moved to other,
42 more distant areas for hunting, trading, and mineral procurement. Over the next three centuries, the Navajo came to
43 occupy the region east of the Colorado River and north of the Little Colorado River, farming, grazing livestock,
44 gathering plants, hunting, and performing traditional cultural activities in the canyon vicinity.

45
46 After AD 1600, a number of factors affected Navajo culture, including European influences such as introduction of
47 sheep and metalworking, the arrival of Puebloan refugees during and after the Pueblo Revolt of 1680, and conflict
48 with New Mexicans and other groups. U.S. military decisions led to what is known as the Long Walk to Bosque
49 Redondo (Fort Sumner) in the winter of 1864, in which thousands of Navajo were forcibly removed from their land.
50 After their return in 1868, the Navajo found that the reservation decreed by treaty contained no more than ten
51 percent of the land they had occupied earlier. Over the more than 150 years since that time, numerous changes have
52 been made in the reservation boundaries, so that today it occupies more than 17 million acres (Tiller 2005).

53
54 The Navajo Nation borders GCNP on the east, stretching from Lees Ferry to the park's southern boundary, south of
55 Desert View. The Cameron and Gap-Bodaway Chapters (local government divisions) are adjacent to the park. As of

1 2005, the Navajo Reservation population was estimated at 180,462 (Tiller 2005), with greater than 255,000 enrolled
2 members of the Navajo Nation.

3
4 The Navajo view the Colorado and Little Colorado Rivers as sacred female and male entities, respectively, and these
5 rivers and their engulfing canyons provide protection to the Navajo people. These sacred beings are inseparable
6 from the larger sacred landscape of which they are an integral part. Canyon visits must be preceded by ceremonial
7 rituals. Secret sacred places must be visited and rituals performed whenever one goes into the canyon. Salt mined
8 from the canyon is sacred, and proper ceremonies must be observed to obtain it (NPS 2005a).

9
10 Sacred sites and traditional use areas include ancestral village sites, shrines, plant collection areas, and places where
11 prayers are offered or herbs gathered. The Navajo have a tradition of using park resources for sacred purposes such
12 as the gathering of medicinal herbs and rock salt. Nuts and berries are routinely harvested from the park. Many areas
13 of traditional cultural and economic significance to the Navajo are in the park, and the many trails used to access the
14 canyons are used for both sacred and secular uses (NPS 1995).

15 16 **Southern Paiute**

17 The Southern Paiute include the San Juan Southern Paiute Tribe, the Kaibab Band of Paiute Indians, the Paiute
18 Indian Tribe of Utah (representing the Shivwits Band of Paiutes), the Las Vegas Tribe of Paiute Indians, and the
19 Moapa Band of Paiutes (Nuwuvi). These are separate tribes; however, their beliefs, ties to Grand Canyon, and
20 concerns are similar. Therefore, they are discussed as one people, the Southern Paiute (FAA 2000b).

21
22 Archeological evidence of Southern Paiute use of the area indicates they have lived in northern Arizona, Nevada,
23 and southern Utah for hundreds of years, from as early as AD 1150. Their language, Uto-Aztecan, is related to
24 languages spoken by peoples living in Great Basin and southward to Mexico, and the Southern Paiute share a
25 common heritage with Paiute tribes in the surrounding states.

26
27 For the last several hundred years, the San Juan Southern Paiute Tribe has lived in an area east of the Grand Canyon
28 bounded by the San Juan and Colorado Rivers, and were recorded in the area when John Wesley Powell boated the
29 Colorado in 1869. A traditional boundary for the Southern Paiute in Grand Canyon extends from the junction of the
30 Paria and Colorado Rivers downstream to Kanab Creek (FAA 2000b). This area is part of *Puaxant Tuvip*, a larger
31 sacred land that the Southern Paiute believe was given to them with the “supernatural mandate to protect and
32 manage...” (NPS 1995). The Paiute practiced limited agriculture and horticulture, leaving evidence of irrigated
33 gardens of maize, beans, and squash near permanent water sources.

34
35 The first European contact with the Southern Paiute occurred when Fathers Escalante and Dominguez came across
36 the people during the Spaniards’ failed attempt in 1776 to locate an overland route to the California missions. Over
37 the next 75 years, numerous Southern Paiute women and children were taken and sold as slaves. The Old Spanish
38 Trail, cut through Southern Paiute territory during the 1830s and 1840s, contributed to loss of Southern Paiute
39 lifeways and territory. In the mid-1800s, Mormon settlers occupied Paiute water sources, creating a dependency
40 relationship with the Tribe. By the early part of the 20th century, most of the Southern Paiute ancestral territory had
41 been lost to incoming settlers. The Kaibab-Paiute Reservation is located in northwestern Arizona, about 23 miles
42 northwest of Grand Canyon, in rolling grasslands and mesa country. Tribal enrollment is 212 members. The
43 Shivwits Paiute, with about 233 enrolled members, have a reservation near St. George, Utah. The San Juan Southern
44 Paiute Tribe, a newly recognized tribe of approximately 265 members, does not occupy a land base, and most
45 members live in two separate communities, Willow Springs near Tuba City and a second community near Paiute
46 Canyon/Navajo Mountain. Subsistence farming of a small number of crops and livestock husbandry, along with sale
47 of hand-woven traditional baskets, help support tribal economy. The Moapa Band of Paiutes (population 295)
48 resides on the Moapa River Reservation, situated in the upper Muddy Valley in northeast Clark County, Nevada,
49 55 miles northeast of Las Vegas (Tiller 2005).

50
51 To the Paiute people, Grand Canyon’s symbolic landscape is filled with places to farm, hunt, gather, live, and
52 worship. The Colorado River and Grand Canyon are seen as a homeland where their people have lived and died for
53 over a thousand years. This sacred land for the Paiute, *Puaxant Tuvip*, is full of culturally meaningful human
54 artifacts and natural elements such as water, minerals, animals, plants, artifacts, and burials, each having their own
55 human-like life force (NPS 1995).

56

1 The living natural environment is perceived as liking certain types of human interactions and disliking other
2 behaviors. In return for proper human behavior, the Colorado River and canyon feed, protect, and support Southern
3 Paiute (and other human) life and culture. Grand Canyon itself is a source of great power and has a powerful
4 spiritual aspect. For example, those wishing to become medicine men go to high places along the rim to learn to
5 sing, a form of prayer. Seeps, springs, falls, and rock formations may be sacred to the Southern Paiute, and often are
6 part of Southern Paiute Pilgrimage routes (NPS 1995; Stoffle and Van Vlack 2006).

7
8 Modern Southern Paiute continue to use canyon resources in traditional ways. In particular, because of overgrazing
9 in other areas, some plants and herbs necessary for medicine and food are only available in Grand Canyon. Native
10 flora used by the Paiute include 32 families encompassing at least 96 species of edible plants, including cacti,
11 grasses, berries, piñon, and juniper. Many more plants are used for medicinal purposes.

12 **Yavapai-Apache Nation**

13 The Yavapai-Apache Indian Nation reflects the amalgamation of these two historically and linguistically distinct
14 tribes. The Yavapai-Apache Reservation is located south of Grand Canyon in Yavapai County, Arizona. Today the
15 tribe has about 159 members occupying a little less than 1,500 acres.

16
17
18 The term Yavapai-Apache includes the White Mountain Tribe, San Carlos Tribe, Yavapai-Apache Nation, and
19 Tonto Apache Tribe. The Yavapai and Apache have lived in central and western Arizona for many centuries, using a
20 migratory hunting and gathering subsistence pattern that may have included lands now occupied by the park.
21 Traditionally, the Western or Tonto Apache (Dilzhe'e) used lands south, east, and north of the Upper Verde River,
22 while the Yavapai (Wipukyipaya) used country south, west, and north of the river (their traditional areas
23 overlapped).

24
25 Until the discovery of gold in central Arizona in the 1860s, the Yavapais had little contact with Euroamericans. As
26 settlers and gold seekers began to encroach onto their lands, conflicts increased. Eventually, in 1871, General
27 George Crook ordered all the "roving Apaches" to a reservation or be considered hostile. To enforce this order, a
28 large band of Yavapais was killed by the military in the Salt River Canyon (Tiller 2005). Warfare with the U.S.
29 military ended with establishment of a 900-mile square military reserve in 1871. However, a presidential order in
30 1875 rescinded the reserve, and all the people (both Yavapai and Apache) were forcibly marched to the San Carlos
31 agency near Phoenix. Beginning in the early 1900s, small family groups, survivors of the removal effort, drifted back
32 to their traditional home country. A tiny reservation was established in 1909 at Camp Verde, followed by later
33 designation of additional parcels that make up the present reservation.

34
35 Praying for one another, especially to encourage good health, is a crucial feature of Yavapai religion.
36 Individuals also may call on various forces of nature for help, and they feel the land that sustains them is sacred.

37 **Pueblo of Zuni**

38 Although they do not currently reside in or near Grand Canyon, the Zuni retain ancestral ties to Grand Canyon.
39 Their area of traditional use lies between the San Francisco Peaks on the south and portions of the Little Colorado
40 River on the north. Like the Hopi, the Zuni believe they entered this world through Grand Canyon before beginning
41 their journey through the canyons of Arizona and New Mexico, finally settling at Zuni. Written accounts suggest the
42 origin place is near the main Colorado River, south of its confluence with the Little Colorado at Ribbon Falls (NPS
43 2005a). Archeological sites, traditional cultural properties, and other sacred locations along the Colorado River
44 corridor and Little Colorado River are important to Zuni traditional and cultural values, providing important spiritual
45 linkages to the place of emergence for the Zuni people (NPS 1995).

46
47
48 The Zuni and their ancestors occupied the Colorado and Little Colorado River valleys for more than 2,000 years.
49 They first encountered Europeans when Francisco de Coronado stopped at Zuni in 1540; the first Spanish mission
50 was established at Zuni in 1629. Following the 1848 Treaty of Guadalupe Hidalgo, the U.S. assumed control of New
51 Mexico, including the 15.2 million-acre Zuni aboriginal territory (Tiller 2005).

52
53 The U.S. Government policy of encouraging non-Indian settlement of the West led to Zuni loss of control of about
54 nine million acres. Additional losses resulted when the Atlantic Pacific Railroad bisected Zuni territory, and when
55 tens of millions of board feet of timber were cut from the Zuni Mountains, resulting in severe environmental

1 damage. Eventually, the Zuni received some compensation, both for land and land rehabilitation. Presently, more
2 than 9,500 tribal members occupy the 463,271-acre Zuni Reservation (Tiller 2005).

3
4 Archeological sites, traditional cultural properties, and other sacred locations along the Little Colorado River and
5 Colorado River corridors are important to Zuni traditional and cultural values, providing important spiritual linkages
6 to the place of emergence for the Zuni people. The Pueblo of Zuni considers Grand Canyon the place of emergence
7 into the present world. Soil, rocks, water, plants, and other materials are gathered for ceremonies conducted to
8 ensure rainfall for crops and a balanced universe. They pray and leave offerings at various locations. Water from the
9 bottom of Grand Canyon carried in sacred gourds has special significance to Zuni ceremonies and special meaning
10 to the Zuni people. The Zuni pray not only for their own lands but for all people and all lands (NPS 1995). Trails
11 used by the Zuni for traditional cultural purposes also carry special meaning and are cared for by means of particular
12 blessings and prayers. Thus, the Zuni people have important concerns about the ancient Zuni Trail from their village
13 to the bottom of Grand Canyon (NPS 1995).

14 **Aircraft Overflights Concerns for Traditional Cultural Practices and Properties**

15
16 American Indian groups usually do not make a distinction between secular and sacred. Their religion is an
17 inextricable part of their lives, integrated into all other traditional aspects of their culture. Places of worship and
18 veneration may be natural features such as mountains, springs, rivers, and canyons. Grand Canyon and the river
19 within are valued by the native people as a type of reference point in their beliefs, and the natural features form a
20 crucial part of their world view.

21
22 In most cases, it is difficult to separate traditional cultural properties and their uses from subsistence activities
23 because to most native people, the physical world and spiritual world are tightly interrelated and cannot be
24 separated. Traditional cultural properties and traditional activities potentially affected by actions proposed by
25 Alternatives for managing aircraft overflights may include sacred sites (sometimes with an archeological
26 component); ancestral habitations; shrines; burials; ceremonial plant gathering; healing ceremonies; sites where
27 prayers are offered; hunting; trails; traditional cultural activities that include prayer, song, vision quest, and
28 pilgrimages by foot and through dreams; and even the husbandry of livestock and other subsistence uses. For tribal
29 practices to be successful, the site, habitat, or particular resource and its context must remain undisturbed.

30
31 Human burials are also of special concern to American Indians, and burial areas are considered sacred places.

32
33 In addition to specific locations and resources, American Indians in the area feel many broader attributes such as the
34 canyons, water, minerals, plants, and animals of Grand Canyon are of traditional sacred importance. Tribal oral
35 traditions reveal a strong spiritual relationship to Grand Canyon as a whole.

36
37 The following excerpt from the Colorado River Management Plan (NPS 2005a) aptly illustrates this broad view of
38 Ethnographic Resources in the Grand Canyon area

39 *On a broader scale, the whole river corridor can be viewed as an ethnographic landscape in which*
40 *American Indians have for millennia farmed, hunted, gathered plants and minerals, and performed rituals.*
41 *Ancient trails, remnants of stone structures, traces of fields, and prayer objects enshrined in travertine and*
42 *salt are enduring evidence of a subtly altered landscape. Integral to this landscape are the animals,*
43 *plants, and minerals traditionally used and valued by American Indians.*

44
45 During a Bureau of Reclamation project related to Glen Canyon Dam operations, five tribes identified cultural
46 resources of importance in the river corridor. A total of 324 known archeological sites were identified as traditional
47 cultural properties by one or more tribal groups (NPS 1995; Glassco 2003a). Of these 324 sites and traditional
48 cultural properties, the Hopi Tribe identify with 256 sites, the Hualapai Tribe with 118, the Pueblo of Zuni with 99,
49 the Navajo Nation with 31, and the Southern Paiute Consortium with two.

50
51 Tribal members have strong expectations of quiet at traditional cultural sites. When practitioners are engaged in
52 ceremonies at traditional cultural sites, quiet is needed for proper performance of traditional activities. For example,
53 lengthy prayers are memorized and passed down orally from one spiritual leader or practitioner to another,
54 generation by generation. Remembering the correct words, song, or prayer sequence is crucial to success of the
55 prayers, and any interruption can have negative results.

1 Many prayers are tied to a specific time and place, and special ceremonies may mark special times of year such as
2 the solstice. Ceremonies may accompany the coming of age of children. Traditional hunting and plant gathering
3 often incorporate prayer and quiet contemplation. Prayers may be offered for healing while gathering medicinal
4 herbs from special places. Traditional cultural activities are believed essential to restoration or maintenance of the
5 health of individuals and the well-being of the tribal community. If such ceremonies are interrupted visually or by
6 intrusive sound, the activities may be unsuccessful. If practitioners are unable to conduct their ceremonies or pray at
7 a particular time and in a particular place, the prayers may not have the desired effect.
8

9 For the Hualapai, traditional cultural and ceremonial activities undertaken at traditional cultural properties depend
10 on an uninterrupted viewshed and a clear line of sight for prayers to travel uninterrupted from one site to another. If
11 aircraft flights are too low to the ground, flights may block prayers. Practitioners feel that failure to complete these
12 traditional cultural obligations appropriately can lead to dire consequences.
13

14 **Privacy for Traditional Cultural Practitioners**

15
16 Flights visible from the ground during ceremonies or prayers can be highly disruptive of traditional cultural
17 practices by introducing an intrusive visual element.
18

19 Tribal members have strong expectations of privacy from outsiders, and are concerned about passengers viewing or
20 photographing private ceremonies from the air. The Hualapai have stated that disclosure of the location or character
21 of the traditional cultural properties and associated archeological sites would likely result in vandalism, theft,
22 desecration, and unauthorized public visitation of these sites.
23

24 Many practitioners worship at personal shrines or other places in private, and require solitude to successfully
25 complete their worship. Often tribal traditional cultural practices are the secret, exclusive province of a practitioner,
26 and are shared only in prescribed ways with specified individuals having particular relationships with the
27 practitioner. Holders of traditional American Indian beliefs may even feel misfortune may come to those who share
28 this information with inappropriate parties. Even knowledge not considered secret is likely to be private to the native
29 community. Noise from helicopters or other aircraft can intrude on these communications with holy beings,
30 interrupting prayers, invading privacy, and causing distress to the practitioners.
31

32 The Hualapai indicate quiet, privacy, and natural viewscape of traditional cultural properties on the Hualapai
33 Reservation are important characteristics of these sites, and are considered to contribute to their eligibility for listing
34 in the National Register of Historic Places (FAA 2000b). Members of other tribes have expressed similar concerns.
35

36 **Overflights and Areas of Traditional Cultural Significance**

37
38 Some park areas carry great traditional cultural importance to several tribes. In these areas, overflights could be
39 considered sacrilegious. One area of particular concern to multiple tribes is the confluence of the Colorado and Little
40 Colorado Rivers.
41

42 **Special Circumstances by Tribe**

43
44 The FAA's 2000 EA for Special Flight Rules contains an extensive discussion of the tribal consultation process and
45 documentation of consultation with tribes (see Section 3.6.4 and Appendix H of that document). In 1996, the
46 Hualapai Tribal Historic Preservation Officer assumed responsibilities of the State Historic Preservation Officer,
47 including those for Section 106 of the National Historic Preservation Act, for the Hualapai Reservation.
48

49 In March 1998, the Hualapai entered into an agreement whereby the Hualapai Department of Cultural Resources
50 would conduct ethnographic and archeological studies to identify traditional cultural properties on the Hualapai
51 Reservation in areas potentially affected by the proposed special flight rules. Over the next two years, these
52 resources were recorded, and the data used to provide FAA with information on sensitive sites. Data from those
53 studies are still relevant and are considered in this EIS.
54
55

1 National Register of Historic Places

2
3 As described above, the Colorado River, Grand Canyon, the landscape within which these occur, and numerous park
4 resources are considered sacred by many American Indian communities. Within this larger landscape are sites,
5 resources, and locations that are, in some cases, of traditional significance to all tribes, and to only some tribes in
6 other cases. These traditional cultural properties are important in maintaining the cultural identity of American
7 Indian communities (FAA 2000b).

8
9 These traditional cultural properties are tangible properties potentially eligible for listing on the National Register of
10 Historic Places due to their association with beliefs and cultural practices rooted in history. In this EIS, all traditional
11 cultural properties identified by tribes are considered potentially eligible for the National Register pending
12 completion of Section 106 consultation.

14 VISITOR USE AND EXPERIENCE

16 Introduction

17
18 GCNP receives approximately 4.5 million visitors annually, and annual visitation has remained relatively unchanged
19 for more than a decade (NPS 2006c). Visitor experience is directly related to park significance statements presented
20 in the General Management Plan (NPS 1995). That is, visitors come to GCNP to enjoy resources the park was
21 established to protect and preserve. Visitor experience can be summarized by

- 22 • Scenic qualities and scientific values represented by vistas of internationally significant geological forms, a
23 variety of ecosystems, night-sky viewing, and Class I air quality that allows appreciation of these resources
- 24 • Natural quiet and solitude available in a place with unusual and noticeable natural quiet, along with access to
25 numerous sites for solitude
- 26 • Spiritual/inspirational qualities of the canyon's natural, cultural, and scenic resources coupled with the
27 landscape's vastness
- 28 • Recreational opportunities offered by the diversity of park resources and settings in the park's undeveloped and
29 developed areas

30
31 Most visitors come in summer (39%) followed by spring (27%) and fall (23%). Only 11% visit in winter. Visitors
32 come from all 50 U.S. states, the District of Columbia (D.C.) Puerto Rico, and 41 foreign countries. A total 83%
33 originate in the U.S. while 17% are international visitors. Among U.S. residents, California is the source of the most
34 visitors at 12.2%, followed by residents of Arizona at 9%. Over 58% of Grand Canyon visitors are visiting for the
35 first time (Northern Arizona University 2005).

36
37 Most visitors view the park along South and North Rims in developed areas and access corridors. Of the 4.5 million
38 GNCP annual visitors, approximately 90,000 stay overnight in the backcountry, while approximately 25,000 run the
39 river (NPS 2005b, NPS 2005a).

40
41 For most visitors, visiting Grand Canyon is the primary reason for their trip (Northern Arizona University 2005).
42 Visitors to developed areas most often sight-see, take scenic drives, take a guided walk to the rim, and shop
43 (University of Idaho 2003). For some visitor categories, specifically river users and fall backcountry visitors, natural
44 quiet is almost as important a reason for visiting Grand Canyon as viewing the scenery. Enjoying natural quiet is
45 extremely important to many visitors (Baumgartner et al. 1994).

47 Management Zones

48
49 Three Management Zones modified from the GCNP General Management Plan (NPS 1995) are used in this EIS to
50 discuss a range of visitor experiences. These include the 1) Wilderness Zone, 2) Non-Wilderness Zone, and 3)
51 Developed Zone (see Map 3.4).

52
53 In the Wilderness Zone, visitors can expect a remote experience with little or no infrastructure, amenities, or
54 services, and opportunities for solitude and primitive, unconfined recreation. The Non-Wilderness Zone offers
55 access to less crowded park areas where an infrastructure level higher than the Wilderness Zone provides basic

1 services and wayfinding. Corridor trails are often considered transitional areas between developed and
2 nondeveloped areas. The Developed Zone includes visitor centers, major roads, and most visitor services. The
3 frontcountry, while not a formally designated zone, provides a common description for the park's developed areas
4 and transition to Non-Wilderness or Wilderness Zones including main developed areas, viewpoints, and trailheads.
5 Descriptions of the three park zones follow.

6 7 **Wilderness Zone**

8 Includes remote backcountry areas and the Colorado River Corridor. Backcountry use areas fall in three subzones:
9 Threshold, Primitive, or Wild. These backcountry Management Zones are based on type and amount of use, current
10 resource conditions, and opportunities for solitude. Threshold subzones are backcountry areas with designated
11 camping, compared to more remote Primitive and Wild subzones with at-large camping and fewer encounters with
12 other visitors. The Colorado River experience varies by season. During summer months, there may be up to 60 trips
13 on the river at one time with visitors traveling on motorized and oar-powered rafts. During non-summer use periods,
14 there are as few as ten trips on the river at one time, and motors are prohibited to enhance opportunities for a
15 Wilderness experience. Backcountry and river use are managed through permit systems and are limited by season
16 and backcountry use area (subzone).

17 18 **Non-Wilderness Zone**

19 Includes the Cross-Canyon Corridor, the Tuweep area, and forested areas on North and South Rims. The Cross-
20 Canyon Corridor consists of Bright Angel, South Kaibab, and North Kaibab Trails. There are developed
21 campgrounds, ranger stations, water, and composting toilets in the Non-Wilderness Zone. Unpaved road corridors in
22 the Non-Wilderness Zone provide access to scenic overlooks, dispersed camping areas, and Wilderness trailheads.
23 The Tuweep area is in a remote section of western Grand Canyon. Facilities are limited to a ranger station,
24 undeveloped campground, and composting toilets. Day use in the Non-Wilderness Zone is unlimited. Overnight use
25 is managed by permit.

26 27 **Developed Zone**

28 Developed areas on South Rim include Grand Canyon Village, scenic roads west to Hermits Rest and east to Desert
29 View, and a number of scenic overlooks, visitor services, and amenities. On North Rim, the Developed Zone
30 includes the highway corridor to North Rim Village, roads to Cape Royal and Point Imperial, camper services,
31 lodging, and other visitor amenities. Tuweep ranger station, its water catchment system, out-buildings, and the area
32 between these facilities, the campground, and the unpaved road into Tuweep are considered Developed Zone. Also
33 included in the Developed Zone is Phantom Ranch bounded on the east and west by canyon walls, on the north by
34 the hiker dorm, and south by the Colorado River.

35 36 **Ground-Based Visitors**

37 38 **Frontcountry Use**

39
40 Map 3.5a-c and Table 3.8 presents distribution of visitor days. The majority of visitors experience GCNP from the
41 frontcountry. Frontcountry generally includes the Developed Zone and transitions at overlooks and trailheads
42 between Developed and Non-Wilderness Zones. Frontcountry visitors experience highest densities of, and
43 encounters with, other visitors, including sights and sounds of vehicles such as buses, trucks, and automobiles.

44 45 **Backcountry Use**

46
47 **Day Hikers** While most visitors view the canyon from rim overlooks, a considerable portion (303,958) day-
48 hike into the backcountry. The visitor experience for the day hiker unfolds in two phases. The first phase is the sense
49 of arrival and viewing the canyon, and all visitors participate in this experience. The second phase is exploring the
50 canyon below the rim. Visitors below the rim on a short or long day-hike experience different canyon views, come
51 in closer contact with the canyon's natural resources, and move away from the rim's developed setting and
52 associated sounds and crowds.

53
54 Day-use accounts for a large portion of backcountry use along trails accessible from South and North Rim
55 developed areas (NPS 2006a). Seven primary trails used by day hikers are shown in Table 3.7.

56

Table 3.7 Primary Trails Used by Day Hikers

South Rim	North Rim
Grandview	Widfors
Hermit	Ken Patrick
Bright Angel Trail	North Kaibab Trail
South Kaibab Trail	

The three corridor trails are most used by day hikers. The busiest trail is Bright Angel, with number of day hikers averaging 464 to 787 per day. South Kaibab is the next most used, with 302 to 567 hikers per day, and North Kaibab receives 146 to 208 hikers daily. The other trails received one to 76 visitors per day. The busiest day is Saturday, and mid-day sees the most traffic on the trails.

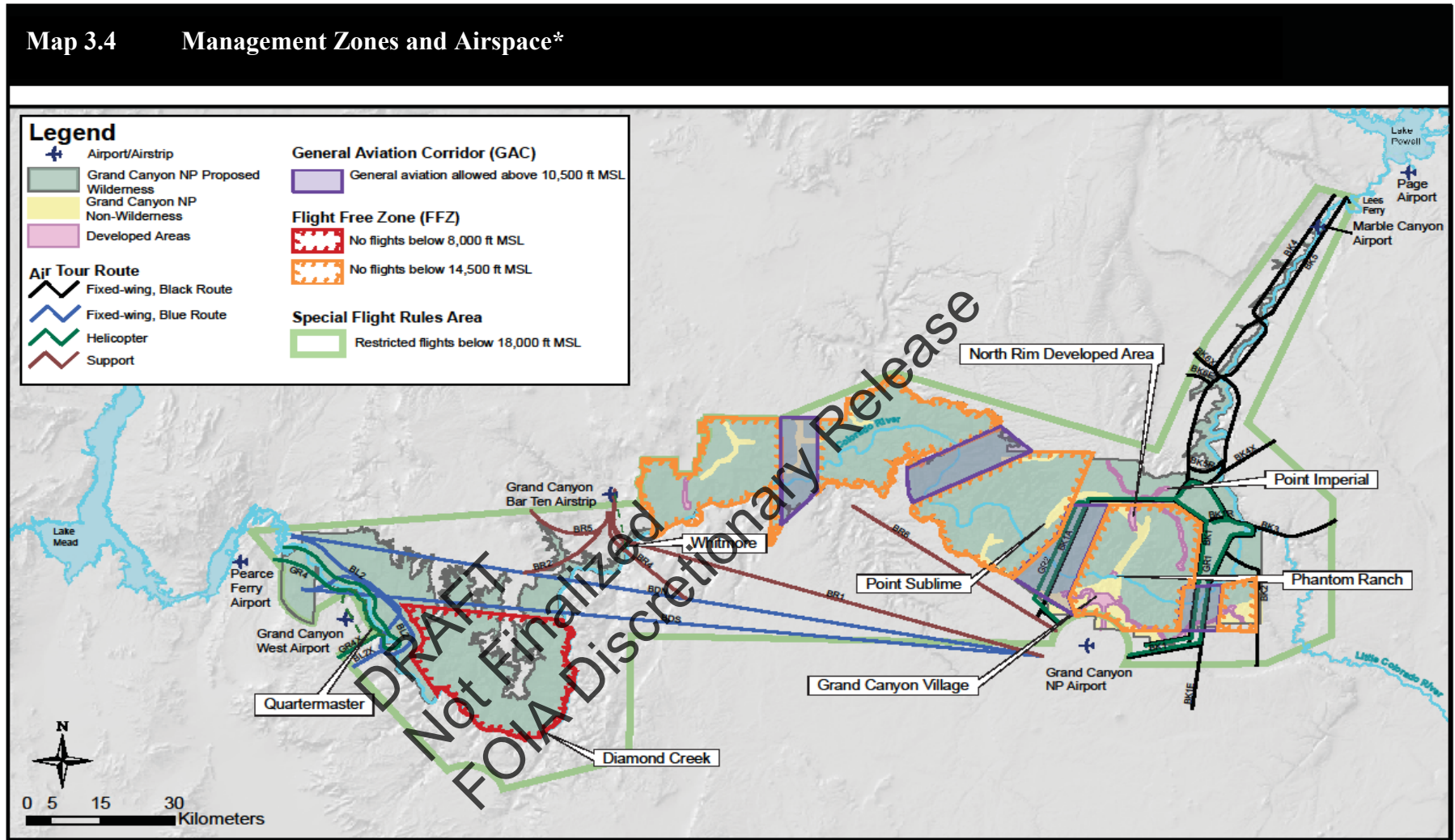
Overnight Hikers NPS visitation statistics show Grand Canyon visitors spent about 90,000 person-days in the backcountry (each person multiplied by number of days in the backcountry), with about 51,000 of those in the Cross-Canyon Corridor campgrounds and about 39,000 in proposed Wilderness (Map 3.5a-c and Table 3.8). This represents 20% of the total 1.2 million overnight stays reported (including concession lodging and campgrounds, and NPS campgrounds) (NPS 2006c). Going on a hike deep into the canyon is wonderful way to experience some of the park's rich natural beauty and immense size. Even for avid hikers, hiking Grand Canyon is very different from, and more demanding than, most other hiking experiences. Hiking beyond the canyon rim into the backcountry offers hikers a powerful and inspiring landscape that, through its immense size, can overwhelm the senses.

River Runners (Motorized and Non-Motorized) A river trip through Grand Canyon is one of the most sought-after backcountry experiences in the country, and nearly 25,000 visitors run the river annually between Lees Ferry and Diamond Creek, for a total 228,986 person-days (i.e., each person multiplied by number of days on the river), plus an estimated additional 300,000 or more user-days between Diamond Creek and Lake Mead National Recreation Area⁴⁵ (Map 3.5a-c and Table 3.8) (NPS 2005a). The 277-mile Colorado River section in the park provides a unique combination of thrilling whitewater adventure and magnificent vistas of remarkable geologic landscape. Most visitors begin their trips at Lees Ferry, below Glen Canyon Dam, and most trips end at Diamond Creek or on Lake Mead National Recreation Area. Visitors participate on an outfitter-guided (commercial) trip or a self-guided (noncommercial) trip. River trips are both motorized (40%) and non-motorized (60%). Noncommercial trips are 90% non-motorized and 10% motorized. Commercial service providers offer river trips to private groups and individuals, both motorized (72%) and non-motorized (28%). River trips vary from one day to several weeks.

Whitmore Helicopter Exchanges Some commercial outfitters offer river trips that include helicopter transport in or out of the canyon near RM187. The Whitmore helicopter pad is on Hualapai tribal lands adjacent to the river. This use is allowed under the 1987 Overflights Act (P.L. 100-91).

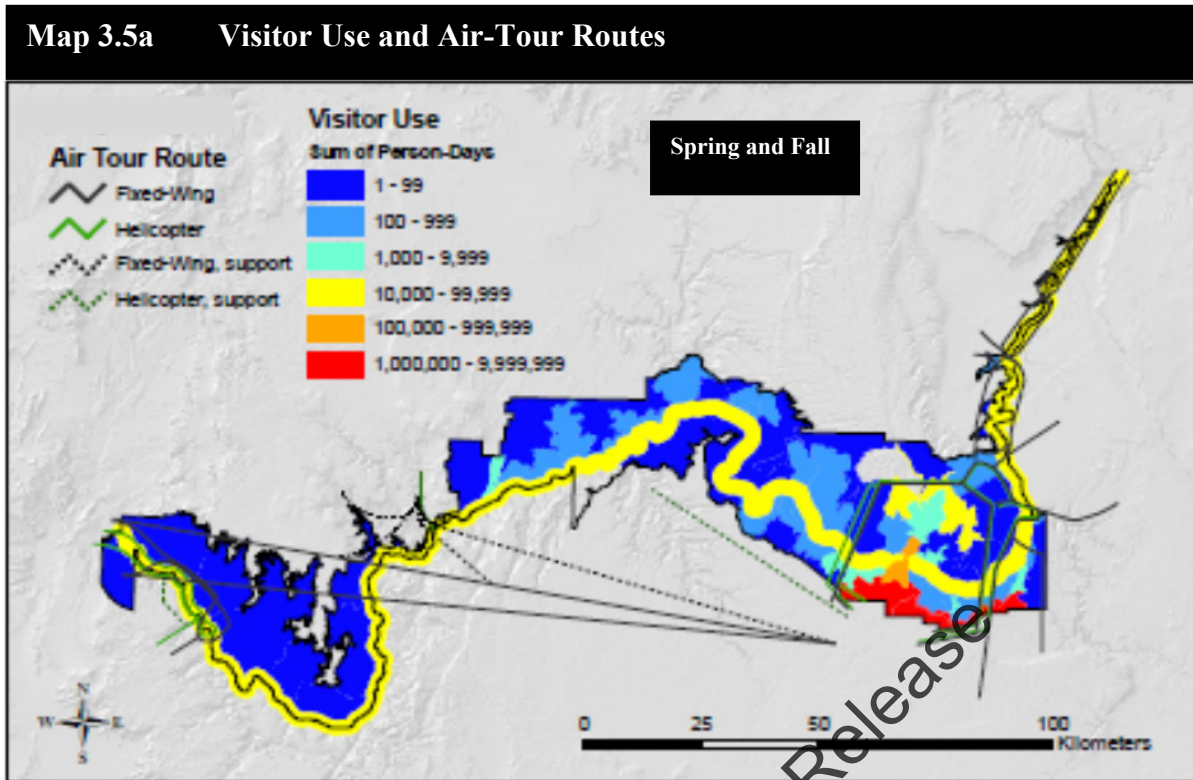
Hualapai Tribe One-Day River Tours The NPS and Hualapai Tribe share an approximate 108-mile boundary along the river corridor. The Hualapai Tribe provides commercial river tours beginning at Diamond Creek and ending near the Quartermaster use area where visitors helicopter from tribal lands. Overnight tours continue to Lake Mead National Recreation Area.

⁴⁵ Many river users between Diamond Creek and Lake Mead are not required to obtain permits, so only estimates of user-days in that section are available



1
2 * Routes shown correspond to current air tour routes (Alternative A)

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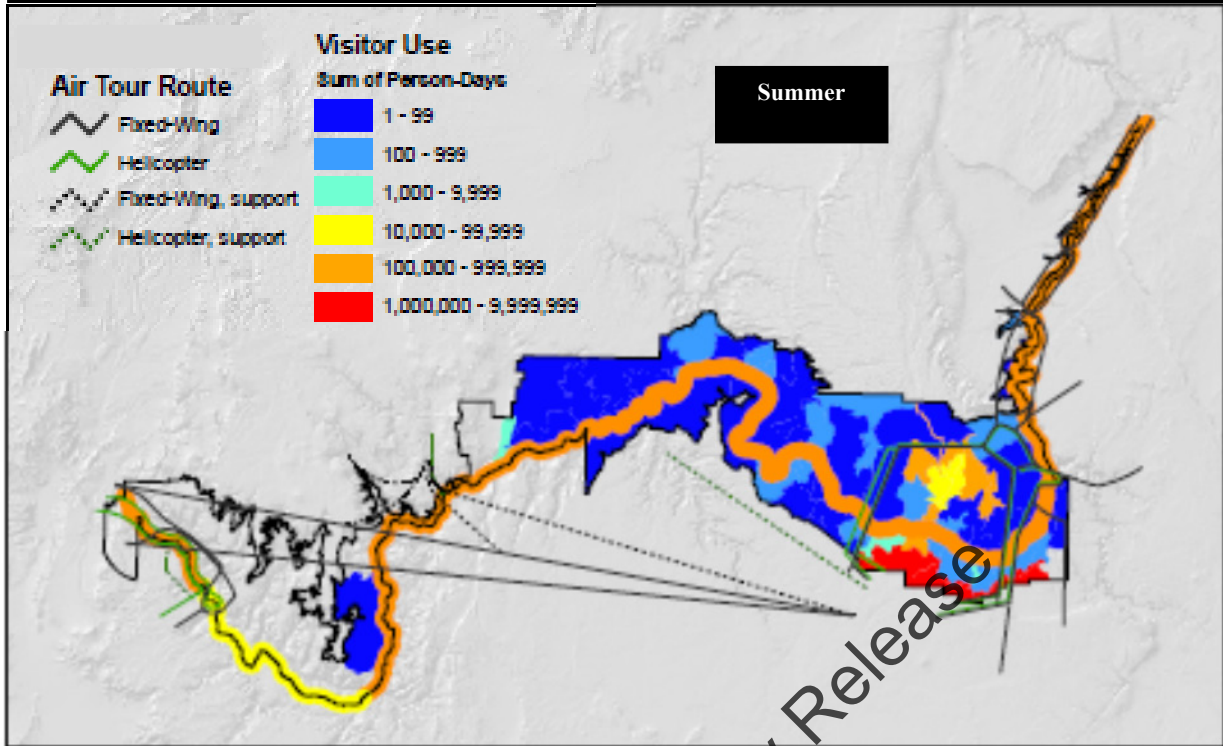


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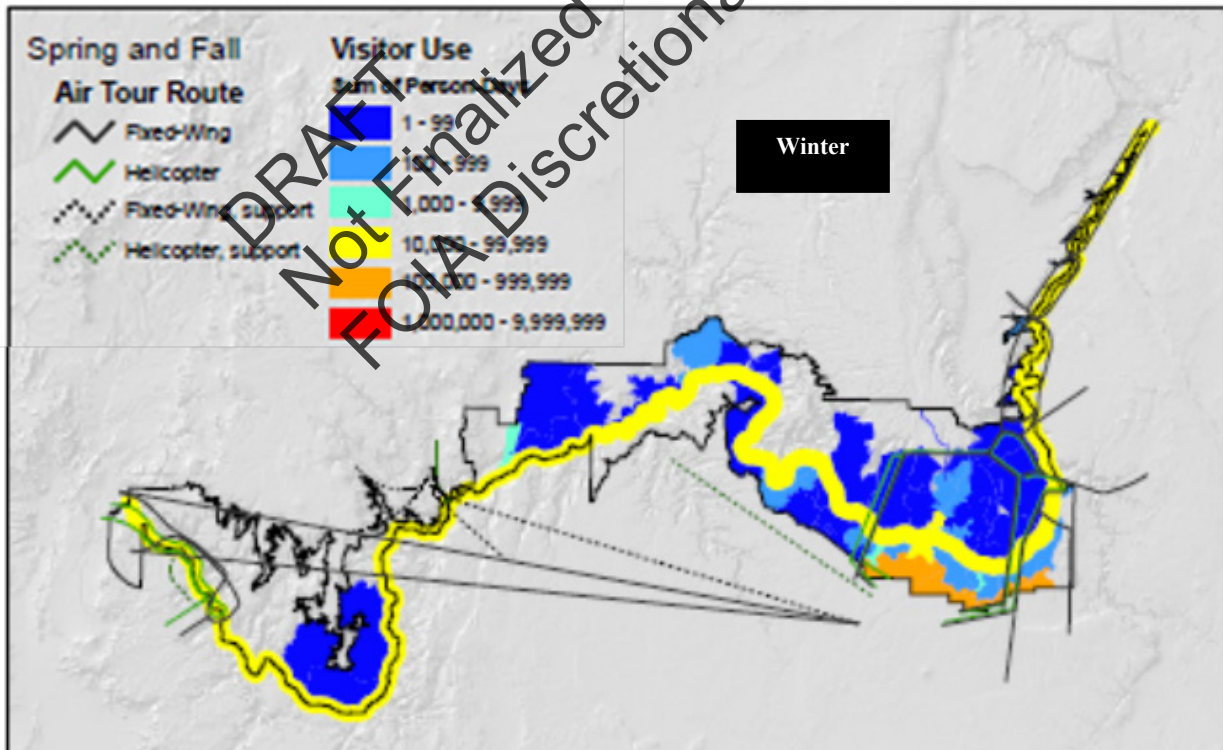
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Map 3.5b and c Visitor Use and Air-Tour Routes, continued



3



1 **Table 3.8 Seasonal Person-Days**

Seasonal Person Days	Front country ^a South Rim	Front country ^a North Rim	Colorado River			Back country ^d	Day hikers ^e
			Lees Ferry to Diamond Creek ^b	Diamond Creek to Quartermaster ^c	Quartermaster to Lake Mead ^c		
Spring and Fall March/April & September/October	1,700,723	94,973	70,583	28,832	98,388	43,953	92,369
Summer May-August	2,373,967	352,918	124,316	39,168	104,040	30,237	164,612
Winter November-February	830,051	0	34,087	14,416	49,184	15,366	46,977
Annual Total	4,904,741	447,891	228,986	82,416	251,592	89,556	303,958

^aFrontcountry numbers are based on 2005 entrance gate data adjusted to exclude local traffic and business deliveries. Overnight guest counts from lodges and campgrounds are included

^bEstimated user-days based on the 2006 Colorado River Management Plan EIS Alternative H (pg. 60) for calendar year 2007 and later

^cMaximum allowable user-days based on the 2006 Colorado River Management Plan EIS Alternative 4 (pg. 89); does not include continuation river trips from Lees Ferry past Diamond Creek or Grand Canyon West Elevator Flight river trips

^dUser-nights based on 2005 backcountry permit data; use without permits is not reflected

^eEstimates based on data collected for the NPS in 2004 by the University of Illinois

2 3 4 **Other Federal Lands in the Study Area**

5 Grand Canyon-Parashant National Monument

6 1,048,316 acres in Mohave County

7 808,744 acres BLM-administered lands

8 208,447 acres NPS-administered lands

9 23,205 acres Arizona State Trust lands

10 7,920 acres private lands (BLM 2008c)

11 Vermilion Cliffs National Monument

12 279,566 acres BLM-administered lands

13 13,438 acres Arizona State Trust lands

14 683 acres private lands (BLM 2008b)

15 BLM Arizona Strip Field Office

16 Encompasses roughly 1.98 million acres located in both Coconino and Mohave Counties, including

17 1,679,896 acres BLM-administered lands

18 170,165 acres Arizona State Trust lands

19 130,962 acres private lands (BLM 2008a)

20
21
22
23
24 These public lands provide a wide range of recreation opportunities including vehicular exploration, sightseeing, backcountry hiking, and backpacking. Exploring or sightseeing constitutes the primary activity for many visitors, and can involve various modes of transportation, such as sports-utility vehicle, equestrian, small aircraft, walking, off-highway vehicle, hiking, motorcycle, bicycle, sedan, or motor home.

25
26
27
28
29 These areas, as well as the Kaibab National Forest discussed below, contain existing and proposed Wilderness in or adjacent to the SFRA. Wilderness activities and experiences include hiking, backpacking, and outstanding opportunities for solitude and primitive, unconfined recreation.

30
31
32
33 Due to the remote nature of the area and dispersed nature of most recreation activities, it is difficult for managing agencies to obtain actual numbers of visits. Estimated visitation to the three areas is presented in Table 3.9.

1 **Table 3.9 Recreation Visits by Year, Nearby Areas**

Year	Arizona Strip BLM	Parashant BLM	Parashant NPS	Vermilion BLM
1999	114,252	13,093	---	39,704
2000	120,150	12,058	---	39,702
2001	125,472	12,949	---	41,884
2002	118,745	14,280	---	39,934
2003	112,475	25,298	8,880	45,329
2004	112,846	44,233	9,180	39,093

Source: BLM, Arizona Strip Field Office Resource Management Plan

2
3
4 While visitor use has typically peaked during spring and fall months, improved navigation technologies, outdoor
5 gear, transportation modes, and attraction site promotion have contributed to visitation increases in winter and
6 summer months (BLM 2008a).

7
8 The Kaibab National Forest is administered by the U.S. Forest Service and, overall, receives over 600,000 visits a
9 year (USFS 2010). Recreational activities include mountain biking, camping and cabin use, hiking, horse riding,
10 hunting, target shooting, outdoor learning, picnicking, boating, fishing, snowshoeing, and skiing.

11
12 The North Kaibab Ranger District is adjacent to, and a portion contained in, the SFRA. Recreational visitors to the
13 district are generally of two categories: visitors whose primary destination is Grand Canyon National Park, but who
14 stop in the district for some period of time, and those who visit the district to hunt game or gather fuel wood. Other
15 activities, most notably mountain biking, are popular in the district, but visitors participating in these activities are
16 not as common as those visiting Grand Canyon, hunting game, or gathering fuel wood. Visitation fluctuates widely
17 with the seasons, as North Rim and Highway 67 close for the winter (USFS 2010).

18 19 **Air-tour Visitors**

20
21 Based on **2005** flight data, aircraft capacity data, and load factors specific to location and aircraft type, an estimated
22 423,000 passengers took air tours in the SFRA. About half flew fixed-wing and half helicopter tours. Over 58% of
23 all air-tour passengers took East End tours, and the remaining 42% flew West End routes.

24
25 The following information was provided in interviews with Grand Canyon air-tour operators conducted as part of
26 this EIS (Harvey 2007a). On GCNP's West End, air-tour visitors tend to be international, with many coming from
27 Asia and the Pacific Basin. These visitors tend to travel in larger groups and generally participate in day trips over
28 Grand Canyon and to the Hualapai Reservation as part of a longer Las Vegas area trip. These groups come to Las
29 Vegas year-round and do not have seasonal travel patterns East End visitors do. Asian travelers make up 60 to 90%
30 of passengers for Las Vegas-based operators.

31
32 Comparatively, on GCNP's East End, air-tour visitors tend to come from the U.S., other North American and
33 European countries, especially England and Germany. At Tusayan-based operators, 35 to 50% of air-tour passengers
34 are international. East End visitors are more likely to be couples or families and include a large percentage of small
35 groups that arrive by car or camper and spend at least one night in the local area. The bulk of visitation to the East
36 End occurs during summer months and school vacations when U.S. families have time to travel with children. Also
37 visiting East End are Asian visitors that have taken a flight from Las Vegas through the SFRA as part of a day trip.

38
39 Several operators reported serving customers of all ages, including young families; however, the majority of
40 operators fly tours mainly made up of adults 40 to 65 years of age. The elderly do not make up a large portion of
41 business for any tour operator. Only a small percentage of air-tour visitors are disabled; operators reported not more
42 than 1 to 2% of all passengers were handicapped. Air-tour customers can generally be described as having higher-
43 end incomes, although those in middle-income ranges also take air tours.

44
45 ***Air tours continue to be popular and all indications are that the vast majority of air tour visitors are very satisfied***
46 ***with their experience.*** According to tour operators, key air-tour selling points include canyon views/other scenery
47 and amount of time spent flying over Grand Canyon. Customers appear to enjoy that they can see a large Grand

1 Canyon area, including special features, in a short period. Other selling points are the variety of accompanying tours
 2 packaged with flights, quality of customer service and, for some, Las Vegas proximity.
 3

4 **Importance of Natural Quiet**
 5

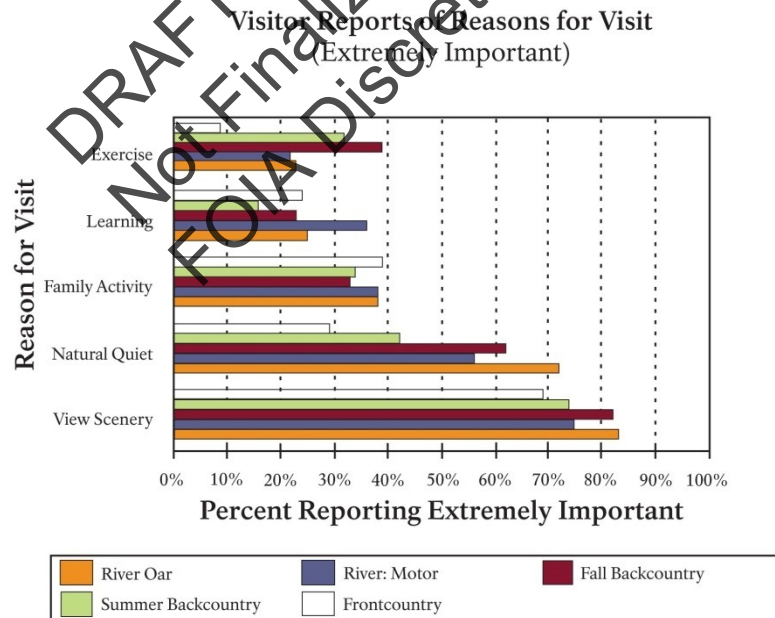
6 National park visitors often indicate an important reason for visiting is to enjoy the relative quiet parks can offer.
 7 Americans surveyed in 1998 (NPS 2003) were asked to identify some of the most important reasons for having
 8 national parks. Seventy-two percent said, “Providing opportunities to experience natural peace and the sounds of
 9 nature.” This ranked as the fifth most common response. *A 2008-2009 national survey showed similar results with*
 10 *74% of park visitors saying “hearing the sounds of nature” was “very important” to their park visit (NPS and*
 11 *University of Wyoming 2011).* In studies of visitor preferences, respondents consistently rate many natural sounds,
 12 such as birds, animals, wind, and water, as very pleasing. As a result, presence of unwanted, uncharacteristic, or
 13 inappropriate sounds can interfere with or alter the Soundscape resource and degrade visitor experience.
 14

15 Experiencing natural quiet and associated events such as solitude are part of the park’s purpose and significance, and
 16 Grand Canyon is recognized as a place with unusual and noticeable natural quiet. Many surveys have shown natural
 17 quiet an important part of the recreational experience, and recreational users have stated in numerous research
 18 reports that escaping noise and enjoying nature’s sounds are among the most important reasons for visiting natural
 19 environments (Driver et al. 1991).
 20

21 A mail survey was conducted of randomly sampled Grand Canyon visitors. These visitors were categorized as
 22 frontcountry visitors, summer backcountry visitors, fall backcountry visitors, river users in motorized boats, and
 23 river users in oar-powered boats (Baumgartner et al. 1994). Figure 3.1 shows how these visitors ranked various
 24 reasons for their canyon trip. Five of these categories, representing the response range are shown for those who
 25 rated their reasons as extremely important.
 26

27 For some visitor categories, specifically river users and fall backcountry visitors, natural quiet is almost as important
 28 a reason for visiting Grand Canyon as viewing scenery. Enjoying natural quiet is extremely important to many
 29 Grand Canyon visitors.
 30

31 **Figure 3.1 Visitor Reports of Extremely Important Reasons for Visiting Grand Canyon**



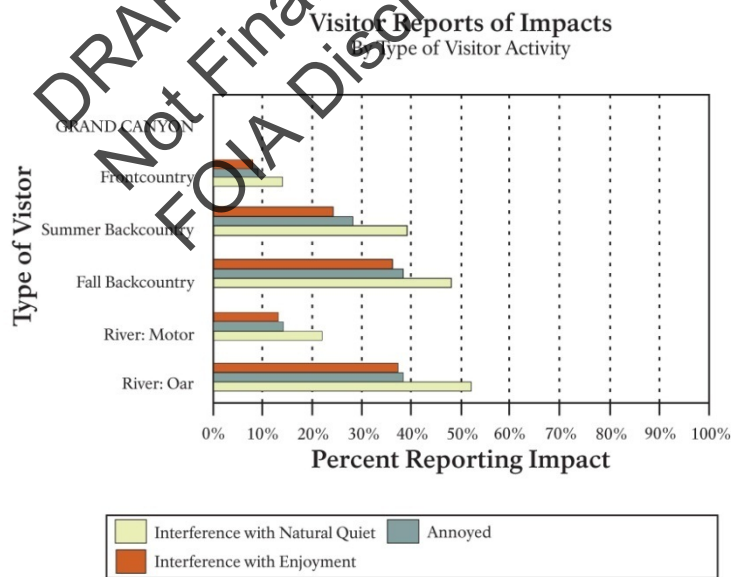
32 Source: NPS 1994

1 **Visitor Responses to Air-tour Noise**

2
 3 NPS and FAA *collected* data *on* dose-response measurements to characterize how visitors *react to the* sound of
 4 aircraft overflights. Dose-response studies *quantify* visitor reactions *to noise by means of a mathematical*
 5 *relationship between amount of noise* visitors were exposed to (dose) with *their response to noise exposure*
 6 expressed by *the* degree they were annoyed or that noise interfered with *natural quiet or their appreciation of*
 7 *natural quiet and sounds of nature*. The research measured park aircraft sound levels and asked visitors, “Were you
 8 bothered or annoyed by aircraft noise during your visit to the site,” and “How much did the sound from aircraft
 9 interfere with your *appreciation of natural quiet and sounds of nature at the site?*” Simultaneous measurement of
 10 aircraft sound levels and visitor *response* permitted an improved understanding of *the relationship between noise*
 11 *dose and visitor response, and allowed estimation of the percentage* of people affected by a given *exposure to*
 12 aircraft overflight sound (Anderson et al. 1993). For tour-aircraft overflights, the sound measure *judged of greatest*
 13 *potential use was* percent of time aircraft were audible. Even when aircraft are audible for relatively low
 14 percentages of time, some visitors notice the aircraft, and believe the sound has interfered with their appreciation of
 15 natural quiet *and the sounds of nature* (NPS 1994). *Aircraft Leq can also provide useful information for judging*
 16 *impact mitigation. (Anderson 1993 Executive Summary).*

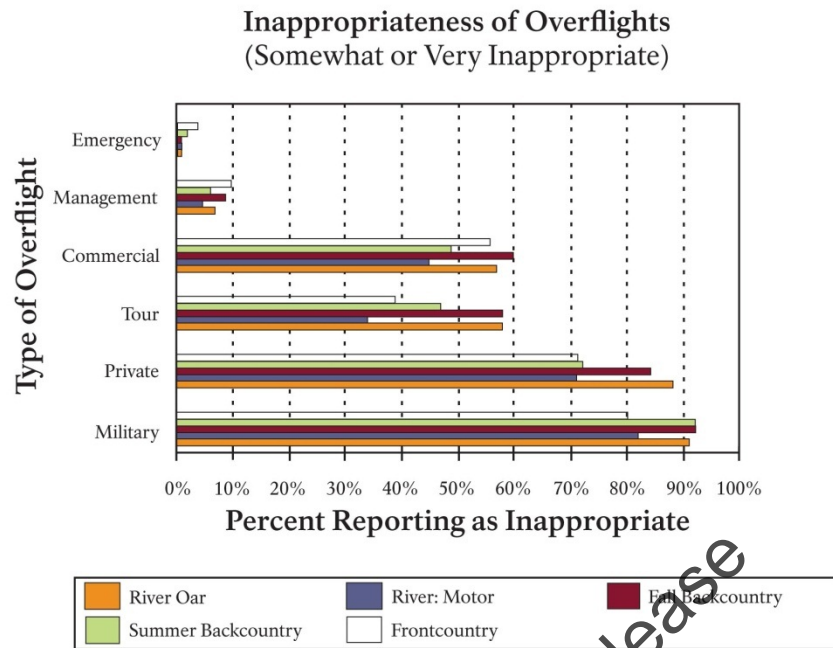
17
 18 Results, summarized on Figures 3.2 and 3.3, show visitors have very different sensitivity to aircraft noise depending
 19 on their park location. Backcountry hikers and oar-powered river users reported greatest sensitivity. As presented in
 20 the 1995 Report to Congress, for a given aircraft-sound level, considerably fewer visitors at frontcountry overlook
 21 sites reported annoyance or interference with natural quiet than backcountry or oar-powered river visitors. For
 22 visitors to short-hike sites, 30 to 40% can be expected to report moderate to extreme interference with their
 23 appreciation of natural quiet when aircraft are audible 10% of the time (NPS 1994). Backlund et al (2008) found in
 24 2005 that 32% of overnight backcountry visitors felt there were too many aircraft flying over the backcountry.
 25 Though many factors likely influence sensitivity, it is likely that as visitors pursue activities that take them away
 26 from their cars and other visitor activities, they are likely to be more sensitive to mechanized sounds, including the
 27 sound of overflights from tour aircraft. *A more recent paper provides formulae for predicting responses to aircraft*
 28 *noise incorporating several aspects of visit context for visitors at overlooks or taking short hikes in parks*
 29 *(Anderson et al 2011).*

30
 31
 32 **Figure 3.2 Visitor Reports of Impact**



33 Source: NPS 1994

1 **Figure 3.3** Visitors Reporting Inappropriateness of Overflights
 2



Source: NPS 1994

3
 4
 5
 6
 7 In 2005, the U.S. Department of Transportation’s Volpe Center⁴⁶ conducted a noise/visitor response study and
 8 combined this with results of all known aircraft noise response data previously collected in national parks (Volpe
 9 2005). This effort revealed perception differences between overlook users and those on short hikes. The study found
 10 those on hikes in the four national park units studied were much more likely to hear and be annoyed by presence of
 11 aircraft noise (Table 3.10). In comparing respondents at overlooks to those on short hikes, a substantial difference
 12 existed in percentage who reported hearing aircraft when they were present, 37% and 66%, respectively, and a
 13 greater percentage of short-hike visitors expressed some level of annoyance (Volpe 2005). *While these particular*
 14 *figures are not correlated with average noise exposure (i.e., there is no indication of whether visitors on short*
 15 *hikes were, on average, exposed to more aircraft noise than visitors at overlooks), they do indicate a greater*
 16 *sensitivity by those on short hikes to noise exposure.* This is consistent with findings of differing perceptions
 17 between backcountry and frontcountry park users (Baumgartner and McDonald, 1994). *Mathematical dose-*
 18 *response relationships derived from this same data set indicate that, at these four park units, including GCNP, at*
 19 *short-hike sites, about 20% of visitors were annoyed when aircraft were audible 20% of the time. Similarly, about*
 20 *3% were annoyed at overlooks when aircraft were audible 20% of the time. These results are nearly identical to*
 21 *those obtained by Anderson, et al. (1993) using a subset of this data.*
 22
 23

Table 3.10 Overview of Responses to Aircraft Noise Dose

Percentage of Respondents who	Overlook	Short Hike
Were exposed to aircraft noise	94%	89%
Reported hearing aircraft when exposed to aircraft noise	37%	66%
Reported moderate to extreme annoyance when exposed to aircraft noise	9%	26%
Reported very or extreme annoyance when exposed to aircraft noise	2%	12%

Source: Volpe 2005

⁴⁶ Volpe National Transportation Systems Center 2005, U.S. Department of Transportation, online at <http://www.volpe.dot.gov>

1 Table 3.11 also presents visitor responses to both air-tour aircraft and high-altitude jets. Forty-five percent of
 2 overlook visitors and 77% of hikers reported hearing aircraft noise that included tour aircraft and high-altitude jets.
 3 While visitors on short hikes expressed greater annoyance to aircraft noise, both groups appear to be more sensitive
 4 to air-tour aircraft than to high-altitude jets.

5
 6 Overall, research results consistently conclude that increased exposure to aircraft noise resulted in an increased
 7 diminishment of visitor enjoyment, and that visitors farther from park development (e.g. on short hikes or in the
 8 backcountry) have an increased sensitivity to equivalent noise doses compared with visitors in developed park
 9 settings (e.g. at overlooks).

10
 11 **Table 3.11 Overview of Responses to Tour Aircraft and Jets by Visitors to GCNP**

	Overlook Visitors		Short Hike Visitors	
	Tour Aircraft plus Jet	Jet Only	Tour Aircraft plus Jet	Jet Only
Number of respondents	785	150	1,122	50
Percent who reported hearing aircraft	45	17	77	55
Percent who reported moderate to extreme annoyance from noise	11	4	30	10
Percent who reported very or extreme annoyance from noise	3	1	14	6

12 Source: Volpe 2005

13 WILDLIFE

14 Introduction

15
 16 Grand Canyon is a valuable wildlife resource due to the park's size, elevation range, and associated habitat variety.
 17 The park wildlife database lists 90 mammals, 355 birds, and 56 amphibian and reptile species. GCNP's diverse
 18 vegetation associations provide suitable conditions for both habitat generalists and specialists. Wildlife occurrence
 19 can generally be grouped in habitats defined by vegetation: mixed-conifer (spruce-fir and mixed-conifer types),
 20 ponderosa pine, piñon-juniper, shrub-grass, and riparian. Many wildlife species are habitat generalists, using
 21 ecosystems from desert scrub through coniferous forest to meet basic requirements. Some species are habitat
 22 specialists, requiring specific vegetation composition and structural components to supply their needs. Appendix E
 23 provides a habitat list with common species found in the park. The following focuses on information regarding park
 24 wildlife; however, the information also pertains to areas outside the park in the SFRA that support the same habitats.
 25 Information presented below is predominantly based on park documents and references cited therein (NPS 2010b,
 26 NPS 2005a).

27
 28 Analysis focuses on those wildlife groups most likely to be affected by commercial air-tour operations. As discussed
 29 in Chapter 2, it is unlikely invertebrates would be detectably affected by air-tour operations, thus, they are not
 30 considered for further analysis in this EIS. In addition, bats are not considered for further analysis as they are not
 31 active during air-tour flight times, and thus would not be affected. Special-status species are considered separately as
 32 the next impact topic.

33 Reptiles and Amphibians

34
 35 Approximately 56 reptile and amphibian species reside in GCNP, the majority along the river corridor or in upland
 36 desert and riparian sites. Highest densities and diversity occur in riparian areas due to abundant vegetation and
 37 invertebrate food sources. Sixteen reptiles species have been identified along the Colorado River (Carpenter 2003).
 38 Reptiles commonly associated with the river corridor include Western whiptail lizards (*Cnemidophorus spp.*), tree
 39 lizards (*Urosaurus ornatus*), desert spiny lizards (*Sceloporus magister*), and Grand Canyon pink rattlesnakes
 40 (*Crotalus atrox*). Little is known about herpetofauna that inhabit the park's forested communities. A variety of
 41 lizards and snakes inhabit plateau coniferous forests especially in piñon-juniper woodlands and ponderosa pine
 42 forests. Common lizard species found on the plateau area include the greater short-horned lizard (*Phrynosoma*
 43 *hernandesi*), northern plateau lizard (*Sceloporus undulatus elongatus*), and northern sagebrush lizard (*Sceloporus*
 44 *graciosus graciosus*). Great Basin gopher snake (*Pituophis catenifer deserticola*) is common in ponderosa pine
 45
 46
 47

1 forests, piñon-juniper woodlands, and desert scrub. Primarily found on South Rim, the Sonoran gopher snake
 2 (*Pituophis catenifer affinis*) occurs in predominantly scrub to piñon-juniper woodlands.
 3

4 Amphibians are not well-represented in the park generally due to arid conditions; few amphibians inhabit plateaus.
 5 Tiger salamanders (*Ambystoma tigrinum*) inhabit areas around pools, marshes, and water tanks in meadows in North
 6 Rim ponderosa pine to spruce-fir forests. Great Plains toad (*Bufo cognatus*) and Great Basin spadefoot toad (*Spea*
 7 *intermontana*) can be found in riparian areas or in ponderosa pine forests. Rocky Mountain (*Bufo woodhousii*) and
 8 red-spotted toads (*Bufo punctatus*) are found in inner canyon riparian areas along the river and perennial tributaries.
 9

10 **Birds**

11
 12 Grand Canyon's striking elevational and topographic diversity creates complex mosaics of vegetation types,
 13 providing diverse habitat for bird species. Riparian habitats along the river in the park provide breeding habitat,
 14 migratory stopover sites, and wintering areas for birds throughout the year. Over 370 bird species have been
 15 recorded in the Grand Canyon region, approximately 250 of which are from the river corridor (NPS 2010a). Some
 16 species are year-round residents such as canyon wren (*Catherpes mexicanus*), wild turkey (*Meleagris gallapavo*),
 17 and American dipper (*Cinclus mexicanus*), but most are migrants that use the river seasonally for breeding or as a
 18 travel corridor, or are from other canyon habitats and use the river corridor during nonbreeding or migratory
 19 seasons. Other species that breed in the canyon and are present through most of the summer include song sparrow
 20 (*Melospiza melodia*), house finch (*Carpodacus Mexicanus*), and Bell's vireo (*Vireo bellii*). Waterfowl have been
 21 found to be more abundant in winter than in other seasons and are particularly abundant in the canyon's upper
 22 reaches between Lees Ferry and the Colorado/Little Colorado River confluence.
 23

24 In plateau areas, a number of bird species are generalists and occupy a variety of habitats (ponderosa pine,
 25 ponderosa-mixed-conifer transition, mixed-conifer, and meadow). Generalist forest species such as broad-tailed
 26 hummingbird (*Selasphorus platycercus*), plumbeous vireo (*Vireo plumbeus*), brown creeper (*Certhia americana*),
 27 and evening grosbeak (*Coccothraustes vespertinus*) have been found in all forest types from ponderosa pine to
 28 spruce-fir forests. Breeding warbler diversity in ponderosa pine is second only to the Colorado River corridor, which
 29 has four breeding species. Secondary cavity nesters (e.g., violet-green swallow (*Tachycineta thalassina*), pygmy
 30 nuthatch (*Sitta pygmaea*), western bluebird (*Sialia mexicana*), brown creeper, and white-breasted nuthatch (*Sitta*
 31 *carolinensis*) are also an important component of the ponderosa pine forest bird community.
 32

33 Several raptors are closely associated with ponderosa pine, including the rare northern goshawk (*Accipiter gentilis*),
 34 red-tailed hawk (*Buteo jamaicensis*), Cooper's hawk (*Accipiter cooperii*), great horned owl (*Bubo virginianus*), and
 35 northern pygmy owl (*Glaucidium californicum*). The northern goshawk breeds in high, forested mountains and
 36 plateaus across Arizona (usually above 6,000 feet); primary potential goshawk habitat in the park is in North Rim
 37 mixed-conifer and ponderosa pine habitats. As of 2007, 18 northern goshawk territories are identified in North Rim
 38 forests, and four in South Rim forests. The northern pygmy owl also occurs in ponderosa pine, but hunts during the
 39 day or at dusk (Brown, et al. 1987). Flammulated owls (*Otus flammeolus*) are migratory and occur in dry, montane
 40 coniferous forests in central and western North America.
 41

42 Golden eagles (*Aquila chrysaetos*) are usually found in open country, prairies, arctic and alpine tundra, open wooded
 43 country and barren areas, especially in hilly or mountainous regions. They nest on rock ledges, cliffs, or in large
 44 trees; however, nesting golden eagles are very rare in Grand Canyon (Ward 2009). They commonly hunt in early
 45 morning and early evening.
 46

47 **Small Mammals**

48
 49 A number of small mammals are habitat generalists using ecosystems including desert scrub, coniferous forests, and
 50 riparian areas. Deer mice (*Peromyscus maniculatus*) and western harvest mice (*Reithrodontomys megalotis*) are
 51 common throughout the park, and serve as important prey species for many predators. The deer mouse is the only
 52 rodent that depends directly on the riparian zone for its existence. Botta's pocket gopher (*Thomomys bottae*) inhabits
 53 South Rim and North Rim's warmer West End. They use desert scrub, piñon-juniper and ponderosa pine forests
 54 wherever suitable soil exists for digging. The brush mouse (*Peromyscus boylii*) uses a variety of park habitats,
 55 preferring piñon-juniper forests, riparian areas, rocky slopes, and shrublands, and sometimes spruce-fir forests.
 56 Mexican woodrat (*Neotoma mexicana*), bushy-tailed woodrat (*Neotoma cinerea*), and Mexican vole (*Microtus*

1 *mexicanus*) occur only on South Rim. The bushy-tailed woodrat occurs in piñon-juniper woodlands or ponderosa
 2 pine forests, but is restricted to suitable rocky areas. The Mexican woodrat inhabits rocky areas in ponderosa pine,
 3 frequently along rim edges and sometimes into the piñon-juniper belt. They often use the same habitat as rock
 4 squirrels (*Spermophilus variegates*). Mexican voles prefer areas that tend to be drier with sparse grass. The Uinta
 5 chipmunk (*Tamias umbrinus*), least chipmunk (*Tamias minimus*), golden-mantled ground squirrel (*Spermophilus*
 6 *lateralis*), and Nuttall's cottontail (*Sylvilagus nuttallii*) are found only on North Rim. Shrews and voles occur in
 7 most habitats on the plateau ranging from rocky slopes to grassy meadows.

9 **Carnivores**

11 Most predators are highly mobile, hunting in habitats throughout GCNP. Eleven terrestrial mammalian carnivore
 12 species occur in the park. These include mountain lion (*Puma concolor*), black bear (*Ursus americanus*), coyote
 13 (*Canis latrans*), bobcat (*Lynx rufus*), gray fox (*Urocyon cinereoargenteus*), badger (*Taxidae taxus*), raccoon
 14 (*Procyon lotor*), striped skunk (*Mephitis mephitis*), spotted skunk (*Spilogale gracilis*), ringtail (*Bassariscus astutus*),
 15 and long-tailed weasel (*Mustela frenata*). Mountain lions occur throughout Arizona and can be found in any habitat,
 16 including riparian areas. Black bears are thought to exist in very low densities on North and South Rims, and are
 17 reported sporadically on South Rim. Raccoons are likely restricted to lower elevations along the river and in more
 18 developed South Rim areas. Ringtails are primarily found along canyon rims and in developed areas. Skunks are
 19 found in South Rim piñon-juniper and ponderosa pine forests and are probably present on North Rim; striped skunks
 20 occur in the canyon below 4,400 feet.

22 Coyotes are common throughout the park and appear particularly common on South Rim. Bobcats are commonly
 23 found throughout the park in desert and wooded areas, especially along the piñon-juniper belt. Badgers uncommonly
 24 occur in grasslands, piñon-juniper, and ponderosa pine forests on both rims. In Arizona, long-tailed weasels occur
 25 from the Kaibab Plateau south along the Mogollon Rim and in scattered mountain ranges in eastern Arizona. Long-
 26 tailed weasels are active year-round and are primarily nocturnal.

28 **Ungulates**

30 Ungulates such as mule deer and elk occupy zones seasonally. Both elk (*Cervus elaphus*) and mule deer (*Odocoileus*
 31 *hemionus*) are found on South Rim and use piñon-juniper and ponderosa pine forests for food and shelter. Mule deer
 32 occupy a variety of habitats from ponderosa pine forests to chaparral scrub, but tend to avoid large openings and
 33 mature forest with closed canopy. Mule deer occur on both North and South Rims and along the river corridor. On
 34 North Rim, mule deer depend on the piñon-juniper zone for essential winter forage, and move into ponderosa pine,
 35 mixed-conifer, and spruce-fir during spring, summer, and fall. Deer begin migrating into mixed-conifer forest in
 36 early May and remain there and in spruce-fir until late September. Desert bighorn (*Ovis Canadensis*) prefer rough,
 37 rocky, sparsely vegetated habitat characterized by steep slopes, canyons, and washes. They descend to the river for
 38 forage. Bighorn are commonly seen on rocky cliffs along the Colorado River, and occasionally seen on plateaus near
 39 rims.

41 **Ambient Soundscape, Aircraft Overflights, and Wildlife**

43 Wildlife both create and are affected by sound in their environment. Soundscape is an integral part of an animal's
 44 habitat. Wind, weather and storm activity, water, mammals, birds, insects, and occasional geologic events all
 45 contribute to the natural ambient Soundscape. Natural ambient sound levels are substantially affected by vegetation
 46 and topography, which greatly vary throughout Grand Canyon. Non-natural sounds, such as those created by low-
 47 level air-tour overflights, high-elevation aircraft noise, miscellaneous motor sounds, and other human-caused
 48 sounds, have become a regular part of the park's Soundscape.

50 All habitats that support park wildlife are subject to aircraft noise. Higher elevations generally experience more
 51 aircraft noise because they are closer to the source (i.e., aircraft). Where West End helicopter tours travel below the
 52 canyon rim or into side canyons, lower elevations could experience more aircraft noise. Low frequency wind sounds
 53 have potential to mask aircraft noise in some situations, especially in ponderosa pine forests (Ambrose 2006).

55 Altitudes and areas where air tours most often occur are such that potential for noise or visibility effects on wildlife
 56 are increased, and thus, indicate areas where existing conditions may present noise and visual impacts to wildlife. In

1 the 1995 Report to Congress, the complexity of determining effects on wildlife due to various factors that influence
2 an individual's response was presented. The report discusses differences in stimuli perception based on physical
3 environment and psychological attributes of the animal at the time of its exposure. The report states: "Some habitats
4 enhance stimuli associated with aircraft overflights. The sound and visual stimuli associated with aircraft have
5 different effects in an open desert than in a forest where trees can obscure the sight and may reduce the sound of
6 aircraft." In addition, the report surmised that "...the relationship between aircraft and animals is clear in that the
7 closer an aircraft is, the greater the probability that an animal will respond...."

8
9 The 1995 Report to Congress discussed physiological and behavioral responses to overflights including accidental
10 injury, reproductive and energy losses, and habitat avoidance and abandonment. Physiological responses to aircraft
11 overflights would vary depending on noise characteristic and species, with reactions ranging from mild annoyance
12 to panic. Behavioral responses similarly vary between and within a species due to age, sex, prior exposure, etc.

13
14 ***More recent studies have also demonstrated noise inhibits perception of sounds (known as masking). Researchers***
15 ***have observed birds, primates, and other animals shift their vocalizations to reduce masking effects of noise***
16 ***(Barber et al 2009, 2010, 2011). Auditory cues are critical in predator-prey relationships and reproductive***
17 ***behaviors. When these cues are masked, the ability of a given species to succeed is at risk. Masking caused by***
18 ***anthropogenic noise could have negative and unpredictable results (Barber et al 2009).***

19
20 Some research has been conducted in the park focusing on effects of aircraft on wildlife. Bighorn were shown to be
21 sensitive to helicopter noise during winter resulting in reduced foraging efficiency. The effect from helicopter noise
22 decreased in spring when sheep migrated to lower elevations, creating greater distance between them and the
23 helicopters (Stockwell and Bateman 1987, Stockwell et al. 1991). ***Additional ungulate studies have shown that***
24 ***while researchers may observe minimal behavioral responses to noise, landscape-scale analyses reveal***
25 ***noteworthy preference for quiet and avoidance of noise (Barber and Frisrup 2009-2010; Krausman et al. 2004).***

26
27 ***The impact of extrinsic noise on visitor experience has been studied extensively (Lynch et al. 2011; Mace et al.***
28 ***1999, 2003; Miller 1999, 2008). However, effects of anthropogenic noise on wildlife can be difficult to measure***
29 ***and interpret and can take many forms (Barber et al. 2009; Francis et al. 2009; Kempf and Hueppop 1996; Kight***
30 ***and Swaddle 2011; Mockford and Marshall 2009; Pater et al. 2009; Pepper et al. 2003; Radle 1997; Swarthout***
31 ***and Steidl 2001). Analysis of soundscape impacts on human hearing and experience may serve as proxy for***
32 ***potential impacts to other vertebrates because humans have more sensitive hearing at low frequencies than most***
33 ***species (Dooling and Popper 2007). However, it is important to consider that the hearing range of most species,***
34 ***including owls, differs from humans (Delaney et al. 1999).***

35
36 ***Most researchers agree noise can affect an animal's physiology and behavior, and if it becomes a chronic stress,***
37 ***can be injurious to an animal's energy budget, reproductive success, and long-term survival (Bayne et al. 2008;***
38 ***Radle 1997). Prolonged exposure to noise has been shown to cause wildlife to avoid certain areas, reducing***
39 ***already limited potential habitat (Lynch et al. 2011). Studies of songbird behavior and ecology near oil and gas***
40 ***development found a significant reduction in pairing success, bird density, and bird species diversity caused by***
41 ***noise (Habib et al. 2007; Bayne et al. 2008). Research on red-tailed hawk exposure to helicopter overflights***
42 ***suggests habituation to noise levels can lead to a decrease in flush response (Andersen et al. 1993).***

43
44 ***Research on potential for human disturbance on raptors is varied and includes multiple species including***
45 ***ospreys, eagles, goshawks, peregrine falcons, and kestrels, and to a limited extent, owls. Recommendations for***
46 ***protecting raptors from human disturbance has been reviewed by Richardson and Miller (1997), and indicates a***
47 ***common spatial buffer zone used for many raptor species to mitigate potential adverse noise impacts is 2,625 ft***
48 ***(800 m or approximately 0.50 miles). This distance was primarily the result of a 1979 compilation of studies (Call***
49 ***1979) that suggested buffers surrounding raptor nests between .25 and 1 mile. Olendorff et al. (1980)***
50 ***recommended 0.25 mile buffers around known bald eagle nests during breeding season. As indicated by recent***
51 ***guidance from USFWS (2007), this 0.50 buffer zone is still in use, and represents a conservative approach to***
52 ***minimizing potential for noise impacts to MSO, in absence of specific research results on the topic.***

53
54 Air tours are not conducted to specifically afford viewing opportunities of any particular wildlife species or habitat.
55 Aircraft striking wildlife is a relatively uncommon event. Direct conflict between wildlife and aircraft overflights is
56 most often associated with bird strikes. FAA's Airports Division has wildlife hazard records dating to 1990. Since

1 that time there have been four wildlife incidents recorded for Grand Canyon Airport: in 1990, 1998, and 2000
2 aircraft struck sparrows, crows, and a common raven, respectively. In 1992 an aircraft struck an elk (NPS 2008a).

4 SPECIAL-STATUS SPECIES

6 Introduction

8 Special-status species and their critical habitats include the following categories

- 9 • Federally listed, proposed, or candidate
- 10 • State-listed, proposed, or candidate
- 11 • Tribally listed, proposed, or candidate

13 The U.S. Fish and Wildlife Service only formally considers Federally listed species in Biological Assessments and
14 subsequent Biological Opinions. However, NPS uses a broader approach that considers all species with listing status
15 at Federal, state, and tribal levels. As a result, some species not addressed in previous Biological Assessments and
16 Opinions, such as American peregrine falcon, are included in this analysis.

18 Several threatened and endangered species in the SFRA would not be affected by the Alternatives, and are not
19 analyzed; see Chapter 1, Impact Topics Considered and Dismissed from Detailed Analysis. Table 3.12 provides a
20 list of *six* special-status bird species evaluated in this EIS.

21 **Table 3.12 Special Status Species with Potential to Be Affected by Aircraft Overflights**

Common Name	Scientific Name	Listing Status				Designated Critical Habitat in GRCA
		Federal ^a	State ^b	Navajo ^c	Other ^c	
American peregrine falcon	<i>Falco peregrinus anatum</i>		WSC	--	SSC	No
Bald eagle	<i>Haliaeetus leucocephalus</i>	D	WSC	G2	BGEPA	No
Golden eagle	<i>Aquila chrysaetos</i>	--		G3	BGEPA	No
California condor ^d	<i>Gymnogyps californianus</i>	E, XN	WSC			No
Mexican spotted owl	<i>Strix occidentalis lucida</i>	T	WSC	G3		Yes
Southwestern willow flycatcher	<i>Empidonax traillii extimus</i>	E	WSC	G2		No

^aFederal status: E = Endangered; T = Threatened; C = Candidate; XN = Experimental, non-essential; **D = Delisted**

^bState status: WSC = Wildlife of special concern in Arizona

^cNavajo endangered species list: G1 = No longer occurs on Navajo Nation lands; G2 = Prospect of survival or recruitment is in jeopardy; G3 = Prospect of survival or recruitment is likely to be in jeopardy in the foreseeable future. Navajo status determination is not used by any other *traditionally associated* Grand Canyon tribes

^dCondors are managed as Federally *threatened* in the park

^ePeregrine falcons are managed as a Species of Special Concern (SSC) as they were formerly listed as Threatened; see Appendix E; **Eagles receive protection under the Bald and Golden Eagle Protection Act (BGEPA)**

23 Species Profiles

26 American Peregrine Falcon

27 After 29 years on the U.S. Fish and Wildlife Service List of Endangered and Threatened Wildlife Species, peregrine
28 falcon (*Falco peregrinus anatum*) was removed from the list August 25, 1999. This, however, does not end NPS
29 concern for the species. Arizona lists peregrine falcon as Wildlife of Special Concern. Peregrine falcons are known
30 to tolerate noise and disturbance more than other avian species (Palmer et al. 2003, Ellis 1991 in NPS 1999).
31 However, as a conservative approach, the peregrine was retained for full evaluation to analyze potential for aircraft
32 overflights to affect this species in Grand Canyon.

1 Peregrine falcons often nest high on cliff faces that afford them access to an open sky to pursue their primary prey:
2 birds and bats (White et al. 2002).

3
4 Importance of the Grand Canyon peregrine population was first documented in 1991 with submission of a final
5 report to the NPS covering an extensive survey conducted during the 1988 and 1989 field season by Bryan T. Brown
6 (Brown 1990). This survey documented 58 peregrine pairs in the park, and speculated there may be upwards of 100
7 pairs. This study was duplicated in 1998 and 1999 with similar results (Ward 2000).

8
9 A USFWS monitoring plan must consider the Arizona peregrine population, and the population portion in the SFRA
10 has received particular attention, as the Arizona population contributes more to recovery goals than any other state
11 in the Recovery Plan (USFWS 1984).

12 **Bald Eagle**

13 ***Once abundant in North America, the bald eagle (*Haliaeetus leucocephalus*) became rare in the mid-1900s. This***
14 ***decline is the result of trapping, shooting, poisoning, and pesticide-caused reproductive failures. The bald eagle***
15 ***was listed as an endangered species in 1978 in the lower 48 states under protection of the Endangered Species***
16 ***Act. With this protection and banning of the pesticide DDT, bald eagle populations increased, and by the late***
17 ***1990s breeding populations could be found throughout most of North America. Bald eagle populations recovered***
18 ***sufficiently, and as a result were removed from the Endangered Species List in June 2007. The Sonoran Desert***
19 ***bald eagle population maintained the status of a threatened species until it was determined that this population***
20 ***did not qualify as a distinct population segment and were, therefore, not a listable entity under the Endangered***
21 ***Species Act. The Final Rule to remove the species from the list was effective on publication in the Federal***
22 ***Register on September 2, 2011 (50 CFR Part 17, Vol. 76, No. 171, Docket No. FWS-R-ES-2011-0069). While***
23 ***no longer a Federally listed species, bald eagles are protected under the Bald and Golden Eagle Protection act of***
24 ***1940 (16 U.S.C. 668-668d, 54 Stat. 250).***

25
26
27 ***Bald eagles often breed and nest in forested areas usually near a large water source. While they most often nest***
28 ***in large trees, on rare occasions they will nest on cliffs (Sherrod et al. 1976). Their primary diet consists of fish,***
29 ***but they will also feed on carrion. Eagles are a long-lived species, reaching sexual maturity at four or five years***
30 ***of age, and may live up to 28 years in the wild (Buehler 2000). Spring and fall stopover sites usually have***
31 ***traditional roost sites such as mature deciduous trees proximate to foraging opportunities. Bald eagles will***
32 ***primarily migrate to temperate zones in winter, generally less than 500 meters elevation (Bailey 1989).***

33
34 ***At GCNP bald eagles are considered rare winter residents (generally November-March) along the Colorado River***
35 ***(Gloss et. al. 2005). Three locations in particular have been repeatedly used for many years: Phantom Ranch,***
36 ***Nankoweap Creek, and Twin Overlooks. Nankoweap Creek flashed in 1995 altering the spawning habitat of trout***
37 ***and, since then, bald eagles have not been reported in numbers as before (personal comm. Elaine Leslie, GRCA).***
38 ***However, eagles are known to use the Colorado River corridor even when numbers at Nankoweap Creek are low***
39 ***(Sogge et. al. 1995). Bald eagles have also been observed throughout winter months in the region's wooded areas.***

40
41 ***As winter residents, bald eagles are present in the park for a limited time and can move to avoid disturbances as***
42 ***they are not committed to reproductive activities. While GCNP is still concerned about the bald eagle, proposed***
43 ***changes in the Modified NPS Preferred Alternative will provide beneficial changes for eagles. In general, the***
44 ***following changes will benefit eagles in GCNP***

- 45 • ***moving routes away from historic bald eagle winter roost areas***
- 46 • ***raising air-tour flight altitudes***
- 47 • ***elimination of some air-tour routes***
- 48 • ***reduction of current annual allocation***
- 49 • ***instituting a daily cap on air-tour flights***
- 50 • ***quiet-technology incentives***
- 51 • ***seasonal route closures***

52
53 ***Under the Bald and Golden Eagle Act, "take" is defined as "pursue, shoot, shoot at, poison, wound, kill, capture,***
54 ***trap, collect, destroy, molest or disturb." When speaking of overflights, the most likely impact would be***
55 ***disturbance. "Disturb" is defined in regulations as "to agitate or bother a bald or golden eagle to a degree that***

1 *causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle, 2) a decrease*
 2 *in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest*
 3 *abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”(72 FR 31132)*
 4

5 *After analyzing impacts of these proposed changes to eagles, and combining that knowledge with current*
 6 *population status and distance of roosting and foraging eagles from air-tour operations, GCNP has concluded an*
 7 *Incidental Take Permit for bald eagles is not necessary. GCNP will continue to coordinate with U.S. Fish and*
 8 *Wildlife Service.*
 9

10 **Golden Eagle**

11 *Golden eagles are most common in western North America near open spaces that provide nesting cliffs and*
 12 *foraging habitat. Golden eagles have never been Federally listed as threatened or endangered, but do receive*
 13 *protection under the Bald and Golden Eagle Protection Act. Golden eagles commonly hunt small- and medium-*
 14 *sized mammals, but will also feed on carrion (Kalmbach et al. 1964, Watson 1997).*
 15

16 *Golden eagles are primarily found in mountainous canyon land, rimrock terrain of open desert and grassland*
 17 *areas of the western U.S. They tend to avoid heavily forested areas, and prefer open and semi-open habitats from*
 18 *near sea level to 3,630 m (Poole and Bromley 1988) for breeding. These habitats include tundra, shrublands,*
 19 *coniferous forests, grasslands, and woodland-brushlands (Kochert 1986). Golden eagles usually nest on cliffs*
 20 *(Menkens and Anderson 1987), often on prominent escarpments (Bates and Moretti 1994).*
 21

22 *Nesting golden eagles are very rare in Grand Canyon (Ward 2009); however, recent data is lacking. Golden*
 23 *eagles are year-round park residents; however, with numerous, remote side canyons estimating numbers of*
 24 *breeding pairs is very difficult. According to Brown’s annotated checklist of Birds of the Grand Canyon Region,*
 25 *golden eagles are “uncommon permanent residents throughout the [Grand Canyon] region. Scattered nesting*
 26 *occurs in areas with suitable cliffs” (Brown 1984).*
 27

28 *As stated above with bald eagles, GCNP is concerned about the golden eagle, and believes proposed changes in*
 29 *the Modified NPS Preferred Alternative will provide beneficial changes for golden eagles. In general, the*
 30 *following changes will benefit eagles in GCNP*

- 31 • *raising air-tours flight altitudes*
- 32 • *elimination of some air-tour routes*
- 33 • *reduction of current annual allocation*
- 34 • *instituting a daily cap on air-tour flights*
- 35 • *quiet-technology incentives*
- 36 • *seasonal route closures*
 37

38 *Under the Bald and Golden Eagle Act, “take” is defined as “pursue, shoot, shoot at, poison, wound, kill, capture,*
 39 *trap, collect, destroy, molest or disturb.” When speaking of overflights, the most likely impact would be that of*
 40 *disturbance. “Disturb” is defined in regulations as “to agitate or bother a bald or golden eagle to a degree that*
 41 *causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle, 2) a decrease*
 42 *in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest*
 43 *abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”(72 FR 31132)*
 44

45 *After analyzing impacts of proposed actions to golden eagles, and combining that knowledge with current*
 46 *population status, GCNP has determined an Incidental Take Permit for bald eagles is not necessary. GCNP will*
 47 *continue to coordinate with U.S. Fish and Wildlife Service.*
 48

49 **California Condor**

50 *Condors are members of the New World vulture family, feeding exclusively on carrion such as deer, cattle, rabbits,*
 51 *and large rodents. Using thermal updrafts, condors can soar and glide at up to 50 miles per hour and travel 100 miles*
 52 *or more per day seeking food while expending little energy. When not foraging, condors spend most of their time*

1 perched at a roost. Cliffs, tall conifers, and snags serve as roost sites (NPS 2007b). An experimental, nonessential⁴⁷
2 California condor population was introduced into northern Arizona December 1996, and the Arizona Game and Fish
3 Department (AZGFD) now lists the California condor as a Species of Special Concern. In GCNP, the experimental
4 population is managed as threatened.

5
6 As of June 30, 2010 there are 74 California condors in the southern Utah/northern Arizona area, including six
7 breeding pairs in the northern Arizona area that includes Grand Canyon. The first wild-reared chick in the program's
8 history, and likely the first chick in Arizona in 100 years, fledged November 2003. Since then, five chicks have
9 fledged in the park.

10
11 Condors create nesting sites in rock formations such as caves, crevices, and potholes (USFWS 2002a in NPS
12 2005a). Courtship begins in December, and breeding pairs lay a single egg between late January and early April.
13 Eggs hatch after approximately 56 days, and young condors take their first flight at approximately six months.
14 Young condors may be dependent on parents through the following breeding season (USFWS 1996). Their preferred
15 roosting habitat consists of rock cliffs, snags, and live conifer stands where they can rest, preen, and socialize.
16 Condors prefer the river corridor in winter.

17
18 All northern Arizona condors are fitted with radio transmitters allowing field biologists to monitor their movements.
19 Monitoring data indicate condors are using habitat throughout the park, concentrating in Marble Canyon, Desert
20 View to Grand Canyon Village, the Village to Hermits Rest, and North Rim's Bright Angel Point. A growing
21 number of condors typically begin visiting the Marble Canyon portion of the Colorado River corridor in February,
22 March, and April (Peregrine Fund 2003 in NPS 2005a). Condors have been observed at Phantom Ranch.

23 24 **Mexican Spotted Owl (MSO)**

25 The Mexican spotted owl was listed as threatened in 1993 (58 FR 14248), and a recovery plan was issued in 1995
26 (USFWS 1995). It also is listed as a Species of Concern by Arizona and the Navajo Nation. Critical habitat for the
27 owl, designated February 2001 (66 FR 8530–8553), includes over 75,000 acres of mixed-conifer habitat on North
28 Rim and over 31,000 additional acres of designated Protected Activity Centers (PAC) in the park's canyon habitat.

29
30 Presence of MSO in the park was confirmed in 1992 field surveys. Additional survey results in subsequent years
31 suggest owls occupy rugged canyonland terrain. Owl detections indicate they use side canyons and small Douglas fir
32 stringers below the rim. Currently, 41 Draft PACs have been designated in the park, for a total of 31,000 acres. No
33 nests are known to occur on Grand Canyon plateaus, but owls have infrequently been found to forage on North and
34 South Rim plateaus in close proximity to the rim (Bowden et al. 2008).

35
36 MSO breed sporadically and do not nest every year. Eggs are laid in late March or, more typically, early April.
37 Incubation begins shortly after the first egg is laid and is performed entirely by the female. MSO incubation is
38 assumed to be 30 days. Eggs usually hatch in early May, with nestlings fledging four to five weeks later, and then
39 dispersing late August to mid-September (Ganey 1988).

40
41 MSO monitoring as a condition of the USFWS permit since 2001 reported 18 PACs adjacent to or directly under
42 current air-tour routes (NPS 2008d). Currently, East End flight routes traverse seven PACs. In addition, the majority
43 of air-tour flights occur during the MSO breeding period March 15 to August 30 (NPS 2008d).

⁴⁷ Under the Endangered Species Act section 10(j), California condors released into northern Arizona are designated a nonessential experimental population, meaning condors will be treated as a threatened population for section 9 purposes (protection from take). For the purposes of section 7 (interagency consultation), the birds will be treated as a species *proposed* for listing--except on NPS and National Wildlife Refuge System lands, where the birds will be treated as if threatened. Nonessential experimental designation enables the USFWS to develop special management regulations more flexible than rules applying to endangered species, which helps ensure such land uses as forest management, agriculture, mining, livestock grazing, sport hunting, and non-consumptive outdoor recreation will not be restricted. The proposal to reintroduce condors in the Vermilion Cliffs area as an experimental population appeared in the January 2, 1996, Federal Register. After notices were published in local newspapers, the USFWS held 59 meetings (including 2 public hearings) in the vicinity to further explain the proposal and gather public comments. The comment period was extended several times until April 1, 1996.
<http://www.fws.gov/endangered/bulletin/96/condors.html>

1 *Information on the effects of low-flying commercial air-tour operations on Mexican spotted owls is lacking, and*
2 *few studies have addressed effects of noise disturbance on spotted owls (Wasser et al. 1997; Delaney et al. 1999;*
3 *Temple and Gutierrez 2003). Delaney et al. (1999) evaluated nesting and non-nesting MSO responses to*
4 *helicopter noise to evaluate if (military) helicopter overflights affected spotted owl reproductive success. This*
5 *study discovered that an alert response (i.e., head movement) was solicited when helicopters were an average of*
6 *1,322 ± 486 ft (403 ± 148 m) away (n = 34), and no response was detected when helicopters were > 2,165 ft (660*
7 *m) away. It is difficult to extrapolate results from spotted owl studies in other locations due to variations in*
8 *weather, terrain, and vegetation between sites, and how topography can affect transmission of sounds. While*
9 *limited, previous studies indicate spotted owl response to noise events is influenced by proximity, decibel level,*
10 *and duration of disturbance, and suggest helicopter noise greater than 1,312 ft (400 m) from owls may have*
11 *limited effect on owl behavior (Bowden et al. 2010).*

12 *Southwestern Willow Flycatcher (SWFL)*

13 *The southwestern willow flycatcher is one of four currently recognized willow flycatcher subspecies (Phillips*
14 *1948, Unitt 1987; Browning 1993). It is a neotropical migrant that breeds in the southwestern U.S. and migrates*
15 *to Mexico, Central America, and possibly northern South America during the non-breeding season (Phillips,*
16 *1948; Stiles and Skutch 1989; Peterson 1990; Ridgely and Tudor 1994; Howell and Webb 1995). On March 29,*
17 *1995, the southwestern willow flycatcher was designated as endangered (FR 60:10694) in its entire range, known*
18 *to include Arizona, California, Colorado, New Mexico, Texas, Utah, and Mexico.*

19
20
21 *In August 2002, USFWS released the “Final Recovery Plan for the Southwestern Willow Flycatcher.” The*
22 *Recovery Plan establishes six recovery units further subdivided into management units. These Recovery and*
23 *Management Units are based on watershed and hydrologic units within the flycatcher’s breeding range (USFWS*
24 *2002). Grand Canyon National Park falls in the Lower Colorado Recovery Unit. This Recovery Unit*
25 *encompasses the Colorado River and its tributaries from Glen Canyon Dam downstream to the Mexican border.*
26 *Despite the large size of this Recovery Unit, the unit contains only 146 known territories (15% of the range-wide*
27 *total) (USFWS 2002).*

28
29 *The southwestern willow flycatcher breeds in dense riparian habitats from sea level in California to*
30 *approximately 8,500 feet in Arizona and southwestern Colorado. Throughout its range the southwestern willow*
31 *flycatcher arrives on breeding grounds in late April and May (Sogge and Tibbitts 1992; Sogge et al. 1993; Sogge*
32 *and Tibbitts 1994; Muiznieks et al. 1994; Maynard 1995; Spera et al. 1995, 1997). Nesting begins in late May*
33 *and early June, and young fledge late June through mid-August (Willard 1912; Ligon 1961; Brown 1988a,b;*
34 *Whitfield 1990; Sogge and Tibbitts 1992; Sogge et al. 1993; Muiznieks et al. 1994; Whitfield 1994; Maynard*
35 *1995). The entire breeding cycle, egg laying to fledging, is approximately 28 days. Nesting occurs during spring*
36 *and early summer months (May 1st through August 31st) in Grand Canyon National Park.*

37
38 *Historical egg/nest collections and species descriptions throughout its range identify the southwestern willow*
39 *flycatcher’s widespread use of willow (Salix spp.) for nesting (Phillips 1948, Phillips et al. 1964, Hubbard 1987,*
40 *Unitt 1987, San Diego Natural History Museum 1995). Other habitats are also used, including non-native species*
41 *such as tamarisk (Tamarix ramosissima), and Russian olive (Eleagnus angustifolia). Throughout the SWFL’s*
42 *current range, suitable riparian habitats tend to be rare, widely separated, small and/or linear locales, separated*
43 *by vast expanses of arid lands.*

44
45 *Seventeen flycatcher sites in Grand Canyon National Park were identified in the 1992 Recovery Plan. Flycatcher*
46 *territories in Grand Canyon National Park are generally located in tamarisk-dominated riparian vegetation*
47 *along the river corridor, but not in the mesquite-acacia and hackberry-dominated habitats higher on the slopes*
48 *(Sogge et al. 1997). The flycatcher’s nesting habitat is dynamic in that it varies in occupancy, suitability, and*
49 *location over time. Because river channels, river flows, and floodplains are varied and change over time, location*
50 *and quality of nesting habitat may also change over time.*

51
52 *Numbers of southwestern willow flycatcher detections in Grand Canyon National Park have declined since the*
53 *1980s. There is little information on number of willow flycatchers along the river before Glen Canyon Dam*
54 *construction. However, what data are available suggest southwestern willow flycatchers were not common*
55 *breeders along the Colorado River in Grand Canyon (Brown 1988a; Brown 1991; Sogge et al. 1997).*

56

Bird Strikes

Since 2000, there have been no reported bird strikes of California condor or Mexican spotted owl species in the vicinity of Grand Canyon National Park Airport. The FAA's Air Traffic Control and Airports Divisions have both confirmed this data. Since 1990, when the FAA began recording wildlife hazard incidents at Grand Canyon Airport, there have been no recorded strikes of special-status species birds (NPS 2008d). Bird strikes associated with SFRA air-tours are known to occur; one recent example having occurred in August 2009 (<http://www.nationalparkstraveler.com/2009/08/tour-helicopter-en-route-grand-canyon-makes-emergency-landing-after-bird-strike>).

Existing Noise Conditions and Special-Status Species

Concerns regarding effects of commercial air-tour operations on special-status species relate to noise, in-flight collisions, and visual disturbance from aircraft. Based on previous Biological Opinions; consultation with Federal, state, and tribal agencies; scoping comments; and a preliminary assessment of potential for species to be affected by air-tour overflights, special-status species fully evaluated in this EIS include the American peregrine falcon, California condor, and Mexican spotted owl.

SOCIOECONOMIC ENVIRONMENT

Since release of the DEIS, the following socioeconomic discussion has been enhanced to provide additional perspectives on the air-tour industry and communities most likely to be affected by EIS Alternatives. Where possible, data was updated using the most recent data source available. Additional context has been provided regarding long-term trends in the air-tour industry and growth of Hualapai exempted flights.

Introduction

Four major socioeconomic issues are addressed in this affected environment section and subsequently analyzed in the environmental consequences section of this EIS. Selection and identification of these issues was based on agency and public scoping results *and DEIS public comments* along with NPS guidelines for addressing socioeconomic issues as part of NEPA compliance. Each of the four major socioeconomic issues are defined and described below.

- 1. Air-tour Industry** This EIS addresses existing conditions and *potential* economic impacts *from* changes in the air-tour industry that operates over *GCNP*. This industry would be affected by flight rules and regulations changes such as *alternate* routes, operation hours, or quiet-technology equipment. Effects to industry were raised during scoping *and in DEIS public comments*. Most air-tour flights occur in East End, although there are *an increasing number of* trans canyon flights and air tours operating on West End. Tribal-related air tours are discussed separately below.
- 2. Affected Tribes and Tribal-related Air Operations** *Three* tribes are currently directly affected by air-tour activity. The Hualapai Reservation facilitates air tours on the park's West End as part of its tourism industry, and experiences aircraft noise in certain areas. The Havasupai receive visitors via helicopter, and also experience other aircraft noise according to scoping *and DEIS public comments*. A third tribe, the Navajo Nation, *has Grand Canyon air-tour routes located over tribal lands in the Marble Canyon and Little Colorado River confluence areas. The Navajo Nation is also* considering entering the air-tour business on the park's East End. Federally recognized tribes are afforded special consideration under government-to-government requirements, government trust responsibilities, and environmental justice considerations based on ethnic and income qualifications described in the subsequent affected environment section
- 3. General-aviation Operations** General-aviation aircraft currently fly over the park according to existing rules and regulations governing non-tour flight operations. Effects of EIS Alternatives on general-aviation operations were raised during agency scoping, *DEIS public comments*, and by the Grand Canyon Working Group. General-aviation operators could be affected by closures or other changes to existing general-aviation corridors or minimum-flight altitudes over Flight-free Zones

4. Regional Economics and Park Values

This topic responds to dollar-denominated economic and fiscal effects stemming from changes in air-tour and ground-based park visitor patterns and visitor experience. The affected environment describes economic and fiscal conditions in communities *most likely to be affected by EIS Alternatives*, and current effects of the park and air-tour activities on the region using the most up-to-date data available at time of analysis. Intrinsic, non-dollar effects related to park values expressed by visitors and non-visitors are also addressed under this topic. Regional impacts and intrinsic park values were evident among scoping *and DEIS public* comments. Also, regional business, local tax base, and economic effects must be addressed according to NPS guidelines for NEPA compliance

Air-tour Industry

Data and information on air-tour operators and operations provided in the following sections were obtained from a variety of sources and reflect several different time periods. FAA provided a full year of data on operations May 1, 1997 to April 30, 1998, *daily flight totals for 2003*, and data on peak-period operations from July and August 2005. *Additional long-term data was gathered from GCNP and the Grand Canyon National Park Airport (GCN) Terminal Area Plan completed in 2009.* In addition, each operator provided substantial information on its existing conditions and operations during interviews with Harvey Economics in spring 2007 and fall 2008. The most current information available at the time of analysis was used for this discussion whenever possible; however, 2005 baseline information is included for several components for consistency with other impact topics.

Historical Trends in Air Tour Flights

In February 1919 – six months before Grand Canyon was granted National Park status – the first Grand Canyon air-tour overflight was recorded. The first air-tour company began operations in 1927. Air-tour activity continued throughout the following decades. In June 1986, a mid-air collision between two air-tour flights focused national attention on the air-tour industry. The first regulation of overflights in the vicinity of GCNP was established the following year. Figure 3.4 displays a long-term view of Grand Canyon air-tour activity by depicting the number of air-tour enplanements⁴⁸ from GCN 1980 to 2008. Significant regulations affecting air-tour operations are also included. Each regulation included is described below Figure 3.4. (For a comprehensive review of overflight laws, policies, and regulations in the vicinity of GCNP, see Appendix A).

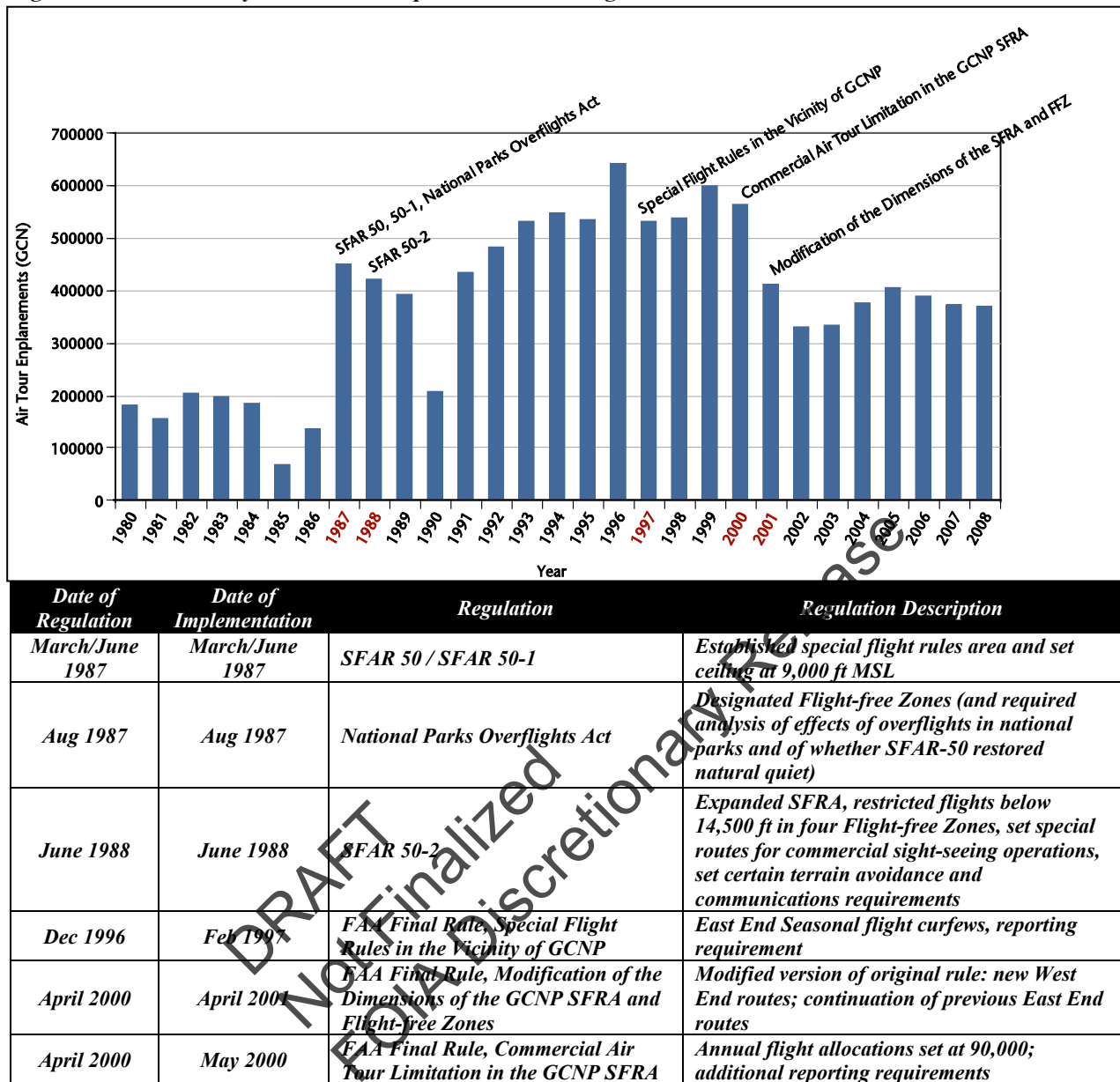
As displayed in Figure 3.4, East End air-tour enplanements (from GCN) remained around or below 200,000 through the mid-1980s, then increased dramatically in the late 1980s. Despite some fluctuation, enplanements remained high throughout the 1990s, peaking in 1996. Air-tour enplanements from GCN declined in the early years of the following decade, but began to level off between 350,000 and 400,000 annual enplanements.

The greatest regulatory change in the history of the Grand Canyon air-tour industry was enactment of SFAR 50 in 1987/1988 which established the special flight rules area (SFRA). At the beginning of 1987, there were no specific regulatory constraints on air tours over Grand Canyon but, by the end of 1988, flights were restricted below 14,500 feet, there were four Flight-free Zones, air tours were required to follow specific flight routes designated for commercial sight-seeing operations, and tours were required to avoid certain terrain in the SFRA. Following these new regulations, there was a decrease in air tours, especially notable in 1990. It is not known to what degree this decrease can be attributed to the new regulations. However, the market adjusted to the new regulations, the air-tour industry recovered, and GCN air-tour enplanements surpassed the number of pre-regulation enplanements within just five years. At the industry peak in 1996, air-tour enplanements reached 642,000, a 43% increase over the peak number of enplanements prior to enactment of SFAR 50.

The next significant decline in air-tour enplanements occurred in 2001 and 2002. This decrease was likely related to events of September 11, 2001 and the economic recession of the early 2000s. Overall U.S. enplanements, and GCNP ground visitation, also declined during this period. In 2003, air-tour enplanements began to increase once again.

⁴⁸ *Enplanements describes the number of passengers taking flights*

1 **Figure 3.4 History of Air-Tour Enplanements and Regulations 1980-2008**

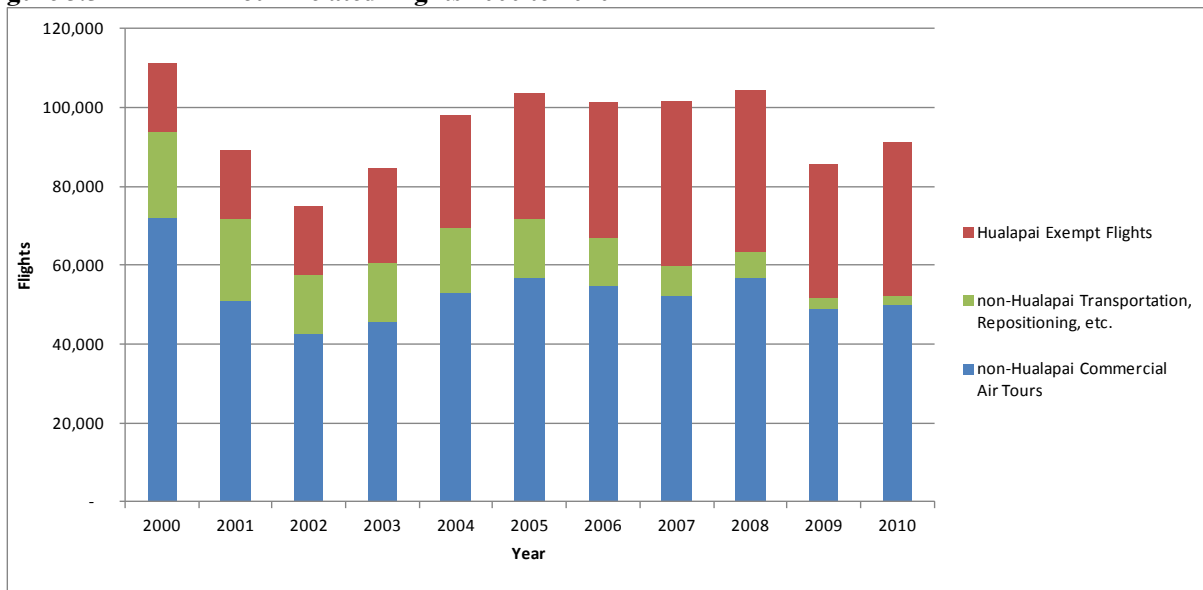


Source: GCN Enplanements data from Tusayan GCN Terminal Airport Plan, ADOT 2009 Appendix A provides a more detailed description of overflight laws, policies, and regulations

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Figure 3.5 provides additional detail on air-tour industry trends 2000 to 2010. Instead of enplanements, Figure 3.5 depicts annual numbers of flights⁴⁹. The figure also provides a more complete view of air-tour industry operations, including Hualapai excepted flights (air tours that do not require annual allocations) and air-tour industry support flights (generally transportation, repositioning, and training) as well as commercial air tours requiring annual allocations.

⁴⁹ Numbers of flights and numbers of passenger enplanements are generally correlated with one another over short periods of time. However, the increasing predominance of helicopter tours (and decline in tours using fixed-wing aircraft) likely results in fewer enplanements per flight, on average. The ongoing conversion to more quiet-technology aircraft, which are usually larger, tends to result in more enplanements per flight

1 **Figure 3.5 Air-Tour-Related Flights 2000 to 2010**

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Source: FAA 2012

Hualapai exempt flights are those that land on the Hualapai Reservation and are therefore not subject to annual allocations and some regulations that apply to other commercial air tours over Grand Canyon. This exception is the result of concerns regarding potential impacts flight limitations would have on the Tribe's economic development (Federal Register, Vol. 65, No. 65). These flights typically depart from the Las Vegas area and land at Grand Canyon West Airport using Green-4X and Blue-2X routes to exit the SFRA. A small number of fixed-wing flights also depart from Grand Canyon National Park Airport and land at Grand Canyon West. **Non-Hualapai commercial air tours include all other commercial air tours (which do not land on the Hualapai Reservation) and which are subject to annual allocations and other regulations.** Aircraft operations in the SFRA are also conducted for purposes other than air tours. **Air-tour-related operations include transportation of people and/or equipment, aircraft repositioning, maintenance, and training flights with the majority being transportation or repositioning flights⁵⁰.** Non-air-tour operations are not restricted by annual allocations regulating air tours; however, noise from these operations is considered in the noise analyses conducted for this EIS.

As indicated by Figure 3.5, the number of air tours requiring annual allocations has remained well below the 93,971 available annual allocations. Even in 2005, which had the most non-excepted air tours since 2000, the annual number of air tours requiring annual allocations was 56,920.

Between 2000 and 2010, the reported number of air tours requiring annual allocations declined from approximately 72,000 flights per year to about 50,000 flights. However, much of that decline evidently stems from a shift in the industry and market from East End (where annual allocations are required) to West End Hualapai exempted flights. Over the past decade, there has been rapid expansion of exempted air tours licensed by the Hualapai Tribe. Since 2000, the number of air tours landing on the Hualapai reservation have more than doubled (from 17,200 to 38,900). Hualapai exempted flights accounted for 44% of all air tours in 2010, compared to only 19% in 2000.

⁵⁰ Transportation flights typically include the return leg of a round-trip flight between the Las Vegas area and Grand Canyon National Park Airport. Repositioning flights are movement of empty aircraft from one airport or airstrip to another to meet operational needs. Additionally, administrative flights are conducted in support of NPS and other agencies, and support flights are conducted for Havasupai Tribal operations. Currently, non-tour transportation and repositioning flights may occur on any designated Black, Blue, or Green flight route over Grand Canyon. They may also occur on Brown routes (support routes used for transporting people, equipment, or other supplies to various points in or near the park). Brown routes are used for flights between Grand Canyon National Park Airport and Supai Village, and flights between Bar Ten airstrip and the Las Vegas area, Grand Canyon National Park Airport, or other places outside the park

1 *Hualapai Reservation operations include flights that landed at Grand Canyon West Airport and those that landed*
 2 *at the multiple landing pads near Quartermaster Canyon. Helicopter and fixed-wing tours that land on the*
 3 *Hualapai Reservation often include options for additional land or river-based activities. In addition to tours*
 4 *shown in Figure 3.5, between 25,000 and 50,000 Over the Edge flights, which move visitors to the canyon bottom*
 5 *for boat tours, are provided each year. The majority of commercial air tours and related flights that land at*
 6 *Grand Canyon West Airport or at Quartermaster Canyon fly the Green-4 (helicopter) route or the Blue-2 (fixed-*
 7 *wing) routes in the SFRA (aircraft can also access Grand Canyon West Airport from outside the SFRA). The*
 8 *impact of the air-tour industry on the Hualapai tribe is discussed in more detail in the Affected Tribes and Tribal-*
 9 *related Air Operations.*

10 Profile of the Grand Canyon Air-tour Industry

13 **Air-tour Operators** As of June 2010, 13 commercial air-tour operators provided scenic air tours over Grand
 14 Canyon, with most air-tour operators based in *either the* Tusayan, Arizona *area or in the* Las Vegas, Nevada *area*.
 15 *Some larger operators have a base of operations in both northern Arizona* and the Las Vegas *area*. Other
 16 operators base in Santa Fe, New Mexico, and Deer Valley, Arizona. In addition to flying tours from those places,
 17 some air-tour operators also offer flights from Page and Sedona, Arizona, and Boulder City, Nevada. Table 3.13
 18 shows air-tour operators that made up the Grand Canyon air-tour industry in 2010, and their locations. These air-tour
 19 companies run the gamut from small operators offering a few basic flight options to large operators offering
 20 varieties of helicopter and fixed-wing tours.

21 **Table 3.13 Grand Canyon Air-tour Operators 2010**

Operator*	Primary Location
Air Grand Canyon, Inc.	Tusayan, AZ
Aviation Ventures, Inc. / Vision Air	North Las Vegas, NV
Southwest Safaris	Santa Fe, NM
Grand Canyon Airlines/ <i>Scenic Airlines</i>	Tusayan, AZ/Las Vegas, NV
Heli USA	Las Vegas, NV
King Airlines, Inc.	Henderson, NV
Las Vegas Helicopters	Las Vegas, NV
Maverick Airstar, LLC	Tusayan, AZ
Maverick Helicopters	Las Vegas, NV
Papillon Airways, Inc.	Tusayan, AZ
Serenity Helicopters	Las Vegas, NV
Sundance Helicopters	Las Vegas, NV
Westwind Aviation	Deer Valley, AZ

Source: Norman Elrod, Federal Aviation Administration 2010

*Air-tour operators with annual allocations to fly in the SFRA *as of 2010*

23
 24
 25 **Air Tours Offered by Operators** Tour operators offer a variety of tours over the park on both fixed-wing
 26 aircraft and helicopters. Tours range from short, air-only excursions to longer trips that include flights and ground-
 27 based activities such as river trips, meals, horseback riding, and other tours. Air tours provide views of the Colorado
 28 River and a variety of other natural features.

29
 30 In addition to Grand Canyon air tours, many operators conduct tours over other national parks, monuments,
 31 recreation areas, and/or other attractions. Therefore, in many cases, an operator's resources (planes, employees) are
 32 devoted to providing tours over several locations, not only Grand Canyon. For operators conducting air tours over
 33 several locations, business and revenues are generated from a larger number of operations than just Grand Canyon
 34 tours. The socioeconomic discussion of commercial operations included in this EIS pertains only to air-tour
 35 operations conducted over Grand Canyon, in the SFRA *and at Grand Canyon West*.

1 According to tour operators, key air-tour selling points include canyon views/other scenery and amount of time
 2 flying over the canyon. Customers appear to enjoy seeing a large canyon area, including special features, in a short
 3 period. Other selling points are variety of accompanying tours packaged with flights, quality of customer service
 4 and, for some, proximity to Las Vegas. As with some of the passenger demographic information, these passenger-
 5 use insights were obtained from air-tour operators. Operators are assumed to be generally familiar with their
 6 passengers through conversations that occur throughout the tour experience.

7
 8 **Air-tour Routes** Current air-tour routes over GCNP include designated fixed-wing and helicopter routes
 9 over East and West Ends, and two trans-canyon routes that allow operations between the Las Vegas area and Grand
 10 Canyon National Park Airport. Map 2.2 and Table 2.1 show current designated air-tour routes over the park. Current
 11 routes are described in detail in Chapter 2, Alternative A.

12
 13 Many fixed-wing aircraft and helicopter routes on the park's East End are routed around Bright Angel and Desert
 14 View Flight-free Zones through Zuni Point and Dragon Corridors. Fixed-wing air tours also operate in the Marble
 15 Canyon area on the SFRA's East End. West End air-tour routes include fixed-wing and helicopter routes generally
 16 located west-northwest of Sanup Flight-free Zone, but within the SFRA. Trans-canyon routes are north of the Sanup
 17 Flight-free Zone. Current route locations are shown on Map 2.2.

18
 19 No air-tour routes exist through Fossil Canyon or Tuckup General Aviation Corridors.

20
 21 As of 2007, most Las Vegas-based operators used West End air-tour routes, and several fixed-wing operators used
 22 Blue Direct trans-canyon routes. Operators based in Tusayan or other Arizona locations generally used air-tour
 23 routes in Zuni Point and Dragon Corridors.

24
 25 **Air-tour Prices** A wide variety of air-tours are offered by operators ranging from short flights lasting less
 26 than an hour to all day trips that include one or more flights, meals, and other activities. Several operators also offer
 27 multi-day trips in which scenic flights make up only a small portion of the overall trip.

28
 29 Air-tours prices cover a wide range. Factors affecting tour price include departure point (generally the Las Vegas
 30 area or Grand Canyon National Park Airport), flight length, and addition of other activities to the tour package.
 31 Tours leaving Las Vegas are more expensive and generally include round-trip transportation to and from local
 32 hotels. Flight-only tours range about \$100 to about \$400, depending on where the flight originates. More common
 33 are tour packages including land-based activities in addition to a flight or flights. These tours cover a wide price
 34 range depending on included activities and can cost up to several hundred dollars. Following is a sample of air-tour
 35 prices based on information gathered in 2008.

Operator Location	Tour	Flight time	Price
Tusayan	air-only fixed-wing tours	40 to 60 minutes	\$109 to \$120 per person
Tusayan	air-only helicopter tours	25 to 50 minutes	\$130 to \$235 per person
Las Vegas	air-only fixed-wing tours	several hours (door to door)	\$150 to \$200 range per person
Las Vegas	air-only helicopter tours	several hours (door to door)	\$200 and \$400 per person
Other Locales (example Sedona)		2-½ to 3 hours	\$500 to \$600 per person

36
 37
 38 **Seasonality and Curfews** Air tours take place year-round, although spring and summer experience more
 39 air visitors than fall or winter. *About 68% of air tours using annual allocations in the SFRA occur April through*
 40 *September (FAA 2012). Hualapai excepted flights at Grand Canyon West are more popular during the fall and*
 41 *winter, with about 45% of these flights occurring October through March (FAA 2012).*

42
 43 East End air-tour overflights are subject to *daily* curfews (designated times of day when air-tour aircraft are legally
 44 restricted from flying). *Currently, curfews change seasonally with* the East End curfew 6 p.m. to 8 a.m. May
 45 through September, and 5 p.m. to 9 a.m. October to April. Trans-canyon flights may leave the Las Vegas area as
 46 early as 7 a.m. to get to the park airport when the East End curfew lifts at 8 a.m. in summer. There are no curfew
 47 restrictions for flights on the park's West End.

48
 49 On East End, outside of curfew, air tours operate throughout the day in summer unless grounded due to inclement
 50 weather. In winter, operators may choose not to conduct tours during all allowed hours due to limited demand or

1 poor weather. On West End, winter weather is not as much a concern as on East End, and there is greater year-round
2 demand. West End flights fly throughout summer, and according to demand through winter.

3
4 **Aircraft Used for Overflights** Air-tour operations use a wide range of aircraft. Fixed-wing aircraft
5 used by air-tour operators include single-engine Cessna's that hold three passengers, and larger deHavilland Twin
6 Otters that hold 19 passengers. Helicopters used by air-tour operators include models that hold four to six
7 passengers. Table 3.14 shows types and numbers of different aircraft used for air tours over Grand Canyon in 2005,
8 and their maximum passenger capacity. *Although more recent data is not available, this 2005 information is*
9 *illustrative of the variety and types of aircraft used for air-tour flights.*

10
11 Air-tour operators used 133 different aircraft for commercial flights in 2005. Fixed-wing aircraft accounted for
12 about 40% of the total air-tour fleet, and helicopters accounted for the remaining 60%. Although some changes
13 occur in aircraft types and number used for tours and other operations over time, information provided in Table 3.14
14 *was generally consistent with information gathered from air-tour operators in 2007 as well* (Harvey Economics
15 2007).

16
17 **Table 3.14 Aircraft Used for Air Tours 2005**

Type of Aircraft		Number of Aircraft	Maximum Capacity
Beechcraft 1900	Fixed Wing	2	19 passengers
Cessna 182	Fixed Wing	2	3 passengers
Cessna 206	Fixed Wing	2	5 passengers
Cessna 207	Fixed Wing	10	6 passengers
Cessna 208	Fixed Wing	5	9 passengers
Cessna 402	Fixed Wing	8	9 passengers
De Havilland Twin Otter (DHC-6) or Vistaliner (DHC-6-QP) ^a	Fixed Wing	18	19 passengers
Dornier 228	Fixed Wing	5	19 passengers
Piper 31-350	Fixed Wing	1	9 passengers
Aerospatiale 350	Helicopter	36	6 passengers
Bell 206-B	Helicopter	3	4 passengers
Bell 206-L	Helicopter	18	6 passengers
Bell 407	Helicopter	4	6 passengers
Eco-Star 130 (EC-130) ^b	Helicopter	19	6 passengers
Total		133	

Source: Federal Aviation Administration, Peak Day JulAug-Dat05.xls; Norman Elrod, March 14, 2007; Harvey Economics 2007

^aVistaliner (DHC-6-QP) is a Twin Otter aircraft modified to meet quiet-technology standards

^bEco-Star 130 helicopter is a quiet-technology aircraft

18
19
20 **Quiet-technology Aircraft** Some aircraft used for commercial air tours have incorporated technology to
21 reduce noise emitted during flight calculated on a per passenger basis. Procedures for determining Grand Canyon
22 National Park quiet-technology aircraft designation status for different aircraft are defined in Chapter I, Title 14,
23 Code of Federal Regulations *Appendix A to Subpart U of Part 93*, and a Final Rule published by FAA in the Federal
24 Register on March 29, 2008. Designation of GCNP quiet-technology aircraft is generally based on measured flyover
25 sound level of an aircraft and seating configuration. Table 3.15 shows aircraft types designated GCNP quiet-
26 technology aircraft.

1 **Table 3.15 Designated GCNP Quiet-technology Aircraft Models**

		Aircraft Type
Piper PA-18-150	Cessna 208	Fixed Wing
Vistaliner (DHC - 6QP)	Cessna 425	
Dornier 228	Cessna TR 182	
McDonnell-Douglas 900	Bell 407 (with Quiet Cruise Kit)	Helicopter
Whisper Jet S-55QT	ECO-Star 130	

Source: FAA Advisory Circular AC-93-2, June 2006, with appendices updated December 2008; some of these aircraft may not be currently used for air tours at GCNP

2
3
4 Although used extensively by the NPS for administrative flights such as search and rescue, the MD 900 model is not
5 used for air tours. Examples of quiet-aircraft technology include addition of a fourth blade to propellers and turbine-
6 driven engines (compared to piston-driven) for the Vistaliner. ECO-Star helicopters are quieter than other models
7 since tail rotors are enclosed in a shell. Of the six helicopter operators offering tours over the park, two operate a full
8 fleet of EC-130s, three have fleets partially made of EC-130s, and one operator does not use any quiet-technology
9 aircraft. Of the seven fixed-wing operators, one operator flies only quiet-technology aircraft, three do not use any
10 quiet-technology aircraft, and remaining operators have mixed fleets including quiet technology and non-quiet-
11 technology.

12
13 *Although there is limited data available to assess the adoption of quiet-technology aircraft over time, both Peak*
14 *Day data on individual flights and aircraft in 2005 and 2008, and comments provided by the air-tour industry in*
15 *response to the Draft EIS indicate quiet-technology conversion is ongoing among air-tour operators. Data on*
16 *individual flights suggests that approximately 39% of air tours flown on the Peak Day in 2008 used quiet-*
17 *technology aircraft, compared to approximately 28% of tours flown on Peak Day 2005. At this conversion rate, it*
18 *is possible that up to 50% of the tours flown in 2011-12 may be using quiet-technology aircraft.*

19
20 **Flight Allocations** Total number of non-tribal air tours allowed in the SFRA has an annual allocation of
21 93,971 flights per year. This annual allocation applies to air tours only, not to transportation or repositioning flights
22 by tour operators. Each air-tour operator is allocated a set number of flights through Zuni Point and Dragon
23 Corridors, and a set number of flights in the SFRA outside Zuni Point and Dragon Corridors. Each operator's annual
24 flight allocations in these areas are based on total number of air tours they reported to the FAA May 1, 1997 to April
25 30, 1998. Currently, air-tour operators can use their annual flight allocation throughout the year, without any cap on
26 maximum number of tours flown per day. *Two operators, Papillon Airways, Inc. and Eagle Canyon*
27 *Airlines/Scenic Airlines) accounted for 60% of the total annual allocations in 2006. More recent data on the*
28 *distribution of annual allocations was not available.* Table 3.16 shows annual allocation held by each air-tour
29 operator as of March 2006.

31 **Table 3.16 Total Annual Allocations Held by Grand Canyon Air-tour Operators 2006**

Operator	Total Annual Allocation	Operator	Total Annual Allocation
Air Grand Canyon, Inc.	3,135	Maverick Helicopters	7,680
Aviation Ventures, Inc./Vision Air	3,471	Papillon Airways, Inc.	34,690
Southwest Safaris	13	Sundance Helicopters	2,587
Eagle Canyon Airlines/Scenic Airlines	21,355	Vista Helicopters/Silver State Helicopters	1,220
Grand Canyon Airlines	3,168	Westwind Aviation	2,985
Heli USA	2,556	Subtotal	91,250
King Airlines, Inc.	1,924	FAA Held Allocations	2,721
Las Vegas Helicopters	1,026	Total	93,971
Maverick Airstar, LLC	5,440		

Source: Gene Kirkendall, Federal Aviation Administration, 2006

32
33

Number of Air Tours Flown By Route

Table 3.17 shows estimated number of air tours by route for 2005, *the most recent available data on annual numbers of air tours using specific, individual routes*. On the park's west side, each air-tour operation flew only one of the air-tour routes (Blue-2 or Blue Direct routes) during each tour. However, on the east side many air-tour flights flew more than one route during the same tour. For example, all east side fixed-wing flights used Black-1, but a large portion of those flights also used Black-1A during the same air tour. Therefore, number of air tours by route shown in Table 3.17 does not reflect number of complete air tours flown in 2005.

Table 3.17 Estimated Number of Air Tours by Route 2005^a

Route	Number of Air Tours	Type of Aircraft	Location
Blue-2	4,078	Fixed Wing	West side
Blue-2X ^b	0	Fixed Wing	West side
Blue Direct North	6,411	Fixed Wing	Trans-canyon
Blue Direct South	16	Fixed Wing	Trans-canyon
Black-1	7,800	Fixed Wing	East side
Black-1A	6,127	Fixed Wing	East side
Black-2	336	Fixed Wing	East side
Black-3	280	Fixed Wing	East side
Black-4	747	Fixed Wing	East side
Black-4X	303	Fixed Wing	East side
Black-5	104	Fixed Wing	East side
Black-6E	0	Fixed Wing	East side
Black-6W	0	Fixed Wing	East side
Green-1	9,232	Helicopter	East side
Green-1A	8,559	Helicopter	East side
Green-1R	673	Helicopter	East side
Green-2	30,558	Helicopter	East side
Green-4	7,379	Helicopter	West side
Green-4X ^b	0	Helicopter	West side

Source: Federal Aviation Administration, Peak Day Jul-Aug-Dat05.xls; Federal Aviation Administration, Quarterly Tables-PF.xls; Harvey Economics, 2007

^aActual number of tours flown by route was not available for the full 2005 year. Estimates in this table were created using flight data from July and August 2005, and total flight numbers by quarter for 2005 exit routes to Grand Canyon West Airport and the Hualapai Reservation

^bFlights using these routes are Hualapai supported tours and not a designated commercial tour

Historical Operator Trends

Both number of air-tour operators and number of air tours flown over Grand Canyon have decreased since detailed data collection began in 1997-1998. Number of operators flying over Grand Canyon decreased from 40 in 1987 to 24 in 1997-1998 to 13 operators in 2007. Consolidation of the Grand Canyon air-tour industry may be the result of several factors (FAA 2007):

- Regulations to the Grand Canyon air-tour industry over recent years and uncertainty created by the prospect of additional regulation may have caused some operators to leave the industry. Marginal operators, whose main business focus may not have been Grand Canyon flights or who flew a very limited number of air tours over Grand Canyon, may have been deterred from continuing operations in the face of regulations. For example, SFRA creation required air-tour businesses to operate under Part 135 of Federal Aviation Regulations, rather than Part 91 as several small operators had previously
- The Grand Canyon air-tour industry might have become a mature industry. Operators may have seen demand for services reach its peak, and are seeing a more stable demand. As shown by Tables 3.16 and 3.17, total number of air tours flown each year has been less than the annual allocation allowed by the FAA in every year since 2000. If additional air tours were in demand, it is expected operators would accommodate additional customers. Therefore, it appears the market for non-tribal-related air tours over the park is in balance with operations. Although total number of commercial air tours flown has increased since 2002, operators have not reached the level flown 1997 to 1998 based on the most current data available at the time of analysis

- 1 • Additionally, there are several barriers to entry to this industry, making it difficult for any new operators to
- 2 begin air-tour operations over Grand Canyon
- 3 ○ Start-up costs of air-tour operations are high since aircraft and other equipment required to provide tours are
- 4 expensive
- 5 ○ The annual flight allocation system does not allow additional air tours over Grand Canyon above a set limit.
- 6 Almost all annual allocations have been assigned to existing operators, although the FAA does hold some
- 7 additional annual allocations
- 8

9 **Employment and Income Generated from the Grand Canyon Air-tour Industry** The air-tour industry
 10 employs pilots, mechanics, office administrators, and other types of jobs to conduct business. In addition to people
 11 directly employed by air-tour operators, others are indirectly involved with the industry including hotels tour-
 12 booking agents, and advertising and marketing professionals. Table 3.18 shows total number of people directly
 13 employed by air-tour operators, by location, in 2007.

14
 15 Wages for those directly employed by air-tour operators generally range about \$30,000 to \$50,000 annually,
 16 including full-time and part-time employees. Employment supported by the air-tour industry provides income to
 17 workers and indirectly provides revenue to local businesses as a result of employee and operator spending.

18
 19 **Table 3.18 Employees of the Grand Canyon Air-tour Industry by Location 2007**

Location	Employees
<i>Clark County, NV</i>	<i>900</i>
<i>Coconino County, AZ</i>	<i>298</i>
Grand Canyon West, Hualapai Reservation, AZ	24
<i>Maricopa County, AZ</i>	<i>20</i>
<i>Yavapai County, Arizona</i>	<i>5</i>
<i>Other (Santa Fe, NM and San Diego, CA)</i>	<i>4</i>
Total	1,251

Source: Harvey Economics 2007

Employee information was not provided for one operator

Several operators have employees at more than one location

Table was consolidated by County as compared to the DEIS

20
 21
 22 **Financial Characteristics of Air-tour Operators Revenues**

23 FAA reports between May 1, 1997 and April 30, 1998, air tours over Grand Canyon generated almost \$100 million
 24 in gross revenue (\$99.3 million). Tours in fixed-wing aircraft accounted for over 70% of all revenue generated by air
 25 tours, with helicopter tours accounting for just under 30% (FAA 2000c).

26
 27 Revenues varied widely for air-tour operators flying over the park in 2006. Revenue data was collected from most
 28 operators during individual interviews conducted by Harvey Economics in April 2007. For operators that did not
 29 provide financial data, Harvey Economics estimated gross revenues based on passenger data, operations by aircraft
 30 type, and available price information. As discussed previously, tour operators differ from one another with respect to
 31 fleet size and type, operations number, tours types, customer types flown, and other factors. These differences
 32 resulted in a wide range of reported and estimated revenues for 2006. Gross revenues resulting from tours over the
 33 park, including those that landed at Grand Canyon West, ranged about \$45,000 to about \$64.5 million for individual
 34 operators in 2006. According to operator interviews with Harvey Economics (April 2007), total gross revenue of air-
 35 tour operators from tours flown over the park in 2006 was \$203,123,000.

36
 37 Substantial air-tour price increases *and the rapid expansion of excepted air tours licensed by the Hualapai Tribe*
 38 explain total revenue increases *over 1997-1998 figures. In 1997-1998, there were approximately 90,000 air tours,*
 39 *and industry revenue was \$99.3 million, or \$123 million in 2006 dollars. In 2006, industry revenue totaled \$203*
 40 *million from approximately 55,000 non-Hualapai flights and 34,000 Hualapai excepted flights.*
 41

1 Total net revenue, defined as gross revenues less gross operating costs, for 2006 was not provided for several
2 operators and could not be estimated from available data. Net revenue for other operators, resulting only from Grand
3 Canyon-related operations, ranged about \$1.3 million in profit to about \$700,000 loss in 2006. The differences in net
4 revenues are due to specific operating characteristics of individual operators.
5

6 Marketing of Grand Canyon air tours is an industry of its own and operator revenues are affected by the amount of
7 money dedicated to marketing of tours. For example, a portion of each tour price for some operators goes to other
8 companies or groups involved in selling tours. Commissions to booking agents or other tour sellers generally run 10
9 to 20% of gross revenues.
10

11 **Operating Costs** FAA developed estimates of variable operating costs including crew, fuel, oil, and
12 maintenance costs for air-tour operators May 1, 1997 to April 30, 1998. Operating costs were estimated for each
13 aircraft type along each air-tour route separately, with estimates of total operating costs for the industry of \$29.2
14 million (FAA 2000c). Estimates of operating costs May 1997 through April 1998 are presented in 1998 dollars and
15 have not been adjusted to reflect current dollars.
16

17 Only about half the 2007 air-tour operators provided information on various operating costs. Of operators that
18 provided these financial data, total operating costs resulting from Grand Canyon-related operations ranged about \$1
19 million to about \$24 million per operator in 2006. These reported costs include wages, aircraft rental, insurance,
20 fuel, maintenance, commissions to booking agents, advertising, landing fees, and other miscellaneous expenses. The
21 percentage of operating costs that fall into each of these categories varies based on specific operations of individual
22 tour providers.
23

24 **Debt Service** Total debt and annual debt service also varies for these tour operators. For reporting operators,
25 total debt ranged \$4.5 million to over \$35 million, and annual debt service ranged about \$230,000 to about \$2.2
26 million in 2006 (Harvey Economics 2007) (These figures are based on a small number of air-tour operators. The
27 majority of operators chose not to provide this information and therefore the actual range of total debt and annual
28 debt service may differ from what is reported here). Difference in debt among operators results from a number of
29 factors, from purchases of new aircraft to purchases of competing air-tour companies. Most operators obtain short-
30 term loans (seven to ten years) for purchase of new aircraft, although several operators are able to finance these
31 purchases themselves.
32

33 **Fleet Replacement and Expansion** As a result of hours flown, aircraft require periodic maintenance or
34 replacement. Operators generally reported conducting scheduled aircraft overhauls and replacement of key parts
35 rather than purchasing new aircraft to replace older ones. However, many of these same operators also reported
36 plans to purchase additional aircraft within the next year or two to expand their fleet (Harvey Economics 2007).
37 These operators generally plan to acquire one or two new aircraft at a time. Several of these operators plan on
38 purchasing quiet-technology aircraft; these are generally operators that already have some quiet-technology aircraft
39 in their fleet. Other operators may purchase non-quiet-technology aircraft similar to their fleet. Helicopter operators
40 reported plans to purchase a greater number of aircraft in the near future than fixed-wing operators. This is
41 consistent with the increasing number of helicopter tours flown over the park since 2002, and the large percentage of
42 total tours that are helicopter operations, as shown in Table 3.20
43

44 *The indication from some operators that they plan to purchase aircraft within the next several years, despite the*
45 *decline in number of air tours over the past decade (and particularly the number of air tours subject to annual*
46 *allocations), suggests that at least some operators anticipate the air-tour market is improving.*
47

48 **Overall Financial Condition of Air-tour Operators** Overall financial condition of air-tour operators can
49 generally be described as adequate. Most operators have experienced positive net revenues in recent years, although
50 one operator reported a net loss, and other operators reported losses for specific portions of their tour operations in
51 2006. The majority of operators do have some amount of overall debt; however, they seem able to manage that debt.
52 As discussed above, some operators are planning to purchase additional aircraft in the future, which will be debt-
53 financed.
54

1 **Profile of Airports Serving Grand Canyon Air-tour Operators**

2 Nine airports provide services and support to air-tour companies flying over Grand Canyon. These facilities range
3 from small, local airports to major international airports and are owned by various public entities including cities,
4 counties, and the state of Arizona. Table 3.19 lists airports (and ownership) from which non-tribal-related fixed-
5 wing and helicopter tours took-off or landed in 2006.

6
7 Several operators moved their base of operations from one airport or airstrip to another over the years for a variety
8 of reasons. Other operators plan a future move. Location changes are expensive, requiring a considerable amount of
9 planning and preparation, and generally occur only if absolutely necessary. For example, McCarran International
10 Airport will soon require all air-tour operations leave that location to find another base of operations. These changes
11 do occur from time to time, affecting use of various airports and airstrips. A large portion of flights taking off or
12 landing at Grand Canyon National Park Airport are related to the Grand Canyon air-tour industry, while at other
13 airports, such as McCarran International Airport and Santa Fe Municipal Airport, percentage of total flights related
14 to the air-tour industry is quite small. Following is a description of primary airports used by air-tour operators in
15 2006, including air-tour industry impacts on each.

16
17 **Table 3.19 Airports Used by the Grand Canyon Air-tour Industry 2006**

Airport	Owner
Grand Canyon National Park Airport, AZ	State of Arizona
McCarran International Airport, NV	Clark County, NV
North Las Vegas Airport, NV	Clark County, NV
Henderson Executive Airport, NV	Clark County, NV
Boulder City Municipal Airport, NV	Boulder City, NV
Page Municipal Airport, AZ	City of Page, AZ
Deer Valley Airport, Phoenix, AZ	City of Phoenix, AZ
Sedona Airport, AZ	Yavapai County, AZ
Santa Fe Municipal Airport, NM	City of Santa Fe, NM

Source: Air-tour operators 2007

18
19
20 **Grand Canyon National Park Airport** Owned and operated by the Arizona Department of Transportation,
21 Grand Canyon National Park Airport is located *two* miles south of *the boundary of* Grand Canyon National Park,
22 *in the town of* Tusayan. This airport is the fourth⁵¹ most active commercial-service airport in Arizona. The air-tour
23 industry makes up *most* of Grand Canyon National Park Airport operations, with air-tour operators conducting
24 tours over Grand Canyon and other nearby sites. In **2008**, commercial air *tour operators* made up *almost 93%* of
25 Grand Canyon National Park Airport's total operations (*GCN Terminal Area Plan, page 2-22, ADOT 2009*). Six
26 operators offer tours from Grand Canyon National Park Airport. *The 2009 Terminal Area Plan for GCN,*
27 *however, anticipates a greater role for destination airline arrivals and departures in the future. Annual*
28 *enplanements of destination airline passengers are projected to grow from approximately 17,000 in 2008 to*
29 *about 270,000 by 2030.*

30 **McCarran International Airport, North Las Vegas Airport, and Henderson Executive Airport**

31 Clark County Department of Aviation operates the Clark County Airport System, made up of these three airports
32 plus two additional airports and an airfield. The Clark County Department of Aviation operates as an enterprise
33 fund, separate from the county. Where data are available, the three airports are discussed separately; however,
34 revenue and expenditure information is only available at the department level. Air tours make up a much smaller
35 operations portion of these airports than Grand Canyon National Park Airport. A large portion of operations at
36 North Las Vegas Airport and Henderson Executive Airport are non-commercial, private-operator flights. Seven
37 operators offer tours from these three airports
38

⁵¹ According to the March 2010 Arizona Office of Tourism Airport Passenger Volume Report accessed at
<http://www.azot.gov/documents/Airports%20March%202010.pdf>, Arizona's busiest airports are 1) Phoenix Sky Harbor, 2)
Tucson International, 3) Phoenix-Mesa Gateway, 4) Grand Canyon NP Airport and 5) Laughlin-Bullhead City International

Boulder City Municipal Airport Three air-tour operators (one fixed-wing and two helicopter-tour operators) fly tours out of Boulder City Municipal Airport. This airport has only been in operation since the early 1990s and has a much smaller number of total operations than Grand Canyon National Park Airport or Clark County airports. Grand Canyon air tours make up only a small portion of flights at this airport

Page Municipal Airport One Grand Canyon air-tour operator offers flights out of Page Municipal Airport. In addition to air tours, operations at Page Airport include other commercial air service, general-aviation and military flights, and cargo transport. Grand Canyon air tours make up only a small portion of flights

Deer Valley Airport Deer Valley Airport is a reliever airport for Phoenix's Sky Harbor International Airport and the busiest general-aviation airport in the United States (City of Phoenix 2010). These airports are part of the City of Phoenix's Department of Aviation, an enterprise fund that does not receive funding from the city. The same operator that offers flights out of Page Municipal Airport also offers flights out of Deer Valley Airport. This is the only Grand Canyon operator offering flights from Deer Valley. Air tours over Grand Canyon are a small part of total operations at Deer Valley Airport

Sedona Airport One Grand Canyon helicopter-tour operator offers flights out of Sedona Airport. The majority of this operator's tours are offered from other airports; only a few are offered from Sedona Airport

Santa Fe Airport One Grand Canyon air-tour operator offers flights out of Santa Fe Airport. This operator holds only a few annual allocations for Zuni Point and Dragon Corridors and these operations made up less than 0.1% of the airport's total operations in 2005-2006

Takeoffs and Landings Table 3.20 shows number of air-tour take-offs and landings at each airport serving Grand Canyon air-tour operators in 2005, *other than Grand Canyon West which serves Hualapai excepted flights. About 80% of air tours requiring annual allocations used Grand Canyon National Park Airport in Tusayan for take-offs and landings in 2005. More recent data on air-tour take-offs and landings by airport and type of aircraft were not available.*

Table 3.20 Air-tour Take-offs and Landings 2005

	GCNP Air tour Take offs		GCNP Air tour Landings	
	Fixed Wing	Helicopter	Fixed Wing	Helicopter
Grand Canyon National Park Airport, AZ	9,861	33,652	14,318	33,212
McCarran International Airport, NV	0	3,477	0	3,477
North Las Vegas Airport, NV	6,667	0	2,202	0
Henderson Executive Airport, NV	1,268	0	1,268	0
Boulder City Municipal Airport, NV	0	1,341	0	1,341
Page Municipal Airport, AZ	109	0	8	0
Phoenix Deer Valley Airport, AZ	79	0	389	0
Sedona Airport, AZ	4	0	0	0
Valle Airport, private, AZ	13	0	0	0
Kayenta Airport, Navajo Nation, AZ	13	0	0	0
Scottsdale Airport, AZ	50	0	0	0
Monument Valley Airport, AZ	239	0	8	0
Las Vegas Strip, NV	0	142	0	142
Peach Springs Airstrip (Hualapai), AZ	4	0	113	0
Whitmore Helipad (Hualapai), AZ	0	0	0	439
Total	18,307	38,613	18,307	38,613

Source: Federal Aviation Administration, Peak Day JulAug-Dat05.xls; Federal Aviation Administration, Quarterly Tables-PP.xls; Harvey Economics 2007

Data do not include Hualapai *excepted* flights. Air-tour operations landing at Grand Canyon West Airport or at Hualapai helicopter landing pads along the Colorado River are discussed as part of the earlier Hualapai *excepted* flights discussion

Take-offs and landings at Bar-10 are not included here since they are not air tours

Data for the full year 2005 was extrapolated using flight data from July and August 2005 and total flight numbers by quarter

1 Passenger Demographics

2 May 1, 1997 to April 30, 1998 about 642,000 passengers took air tours over Grand Canyon. Just over 70% of all
3 passengers took tours in fixed-wing aircraft, with just under 30% of all passengers taking helicopter tours (FAA
4 2000c) In 2005, an estimated 423,000 passengers took air tours (*excluding Hualapai excepted flights*). About half
5 of these passengers flew on fixed-wing tours and half flew helicopter tours. Over 58% of all air-tour passengers *on*
6 *flights requiring annual allocations (excluding Hualapai excepted flights)* took tours over East End; the remaining
7 42% of passengers flew on West End routes.

8
9 Air-tour visitors are further characterized in *Chapter 3*, Visitor Use and Experience.

10 Affected Tribes and Tribal-related Air Operations

11 Hualapai Reservation

12 The Hualapai Reservation is located along 108 miles of the southern banks of the Colorado River and the park, to
13 the west of the Havasupai Reservation down to Peach Springs, Arizona, which serves as the Hualapai Tribal Capital.
14 The unincorporated town of Peach Springs is located in Mohave County along Route 66. The reservation
15 encompasses about one million acres in Mohave and Coconino Counties and a very small portion of Yavapai
16 County. Map 1.1 includes the reservation.

17 Community facilities on the reservation include elementary, middle and high schools, general store, service station,
18 senior citizens center, gift shops, hunting lodge, training center, gymnasium, community center, rodeo arena, ball
19 fields, laundromat, dialysis treatment center, emergency fire station, health clinic, and juvenile detention center
20 (Arizona Department of Commerce 2005b). The nearest bank is in Kingman, about 50 miles from Peach Springs.
21 Law enforcement is provided by a tribal police force that employs 12 officers (Hualapai Police Department 2006).

22 Hualapai Demographic Profile

23 **Hualapai Population** As of 2010, there were an estimated 2,100 enrolled members of the Hualapai Tribe, 1,335
24 of whom were living on the reservation (*Hualapai Tourism 2010 and US Census Bureau 2010*). 82% of the
25 reservation population lived in Peach Springs (up from an estimated 44% in 2005). Between 1990 and 2000,
26 reservation population increased about 65%, but then declined by 1% between 2000 and 2010. Table 3.21 provides
27 population data for the Hualapai Reservation, Mohave and Coconino Counties, and the state of Arizona. Trust lands,
28 small parcels outside the Reservation, are included in the Census Data.

29 **Table 3.21 Population of Hualapai Reservation, Coconino and Mohave Counties 1990, 2000, and 2010**

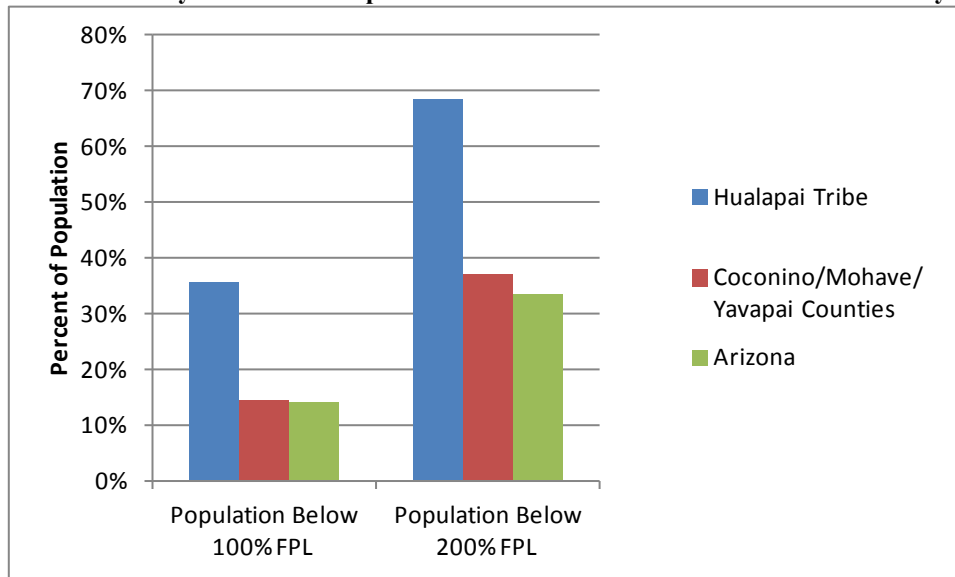
Population	1990	2000	1990 2000 Change	2010	2000 2010 Change
Hualapai Reservation	822	1,353	65%	1,335	-1%
Coconino County	96,591	116,320	20%	134,421	16%
Mohave County	91,497	188,032	101%	200,186	6%
Arizona	3,665,228	5,130,632	40%	6,392,017	25%

30 Source: 1990 and 2000 data from 2000 Census population finder, accessed at www.census.gov
31 2010 Data from 2010 Census, American Factfinder accessed at factfinder2.census.gov

32 Hualapai Economic Profile

33 Principal economic activities on the Hualapai Reservation are cattle ranching, governmental activities, tourism, and
34 traditional and modern folk arts (Arizona Department of Commerce 2005b).

35 **Hualapai Income** According to the 2006-2010 American Community Survey (ACS), per capita income for
36 Hualapai Reservation residents was \$12,209, up from \$8,147 in 2000. Median annual household income for the 178
37 households averaged \$34,375 from 2006-2010, compared to \$24,999 in 2000. Approximately 45% of households
38 had income of less than \$24,999. Almost 6% of households had income of more than \$100,000 (U.S. Census Bureau
39 2006-2010 ACS). Figure 3.6 provides the percent of Hualapai and Coconino and Mohave County residents below
40 the Federal Poverty Level (FPL) and below 200% of the FPL in 2009.

1 **Figure 3.6 Poverty Level of Hualapai Reservation and Coconino and Mohave County Residents**

Source: Arizona Department of Health Service, Division of Public Health Services. Hualapai Tribe Primary Care Area Statistical Profile, 2009

2 Hualapai Employment

3 *The majority of Hualapai residents work on the reservation. Based on*
 4 *commuting statistics in the 2006-2010 ACS, approximately 14% of employed residents presumably work outside*
 5 *the reservation. The Hualapai Reservation population 16 years or older grew slightly from 867 to 878 between*
 6 *2000 and 2010. According to the 2006-2010 ACS, approximately 78% of the population 16 years or older was in*
 7 *the labor force. This represents a substantial increase from 2000, when the labor participation rate was only 45%.*

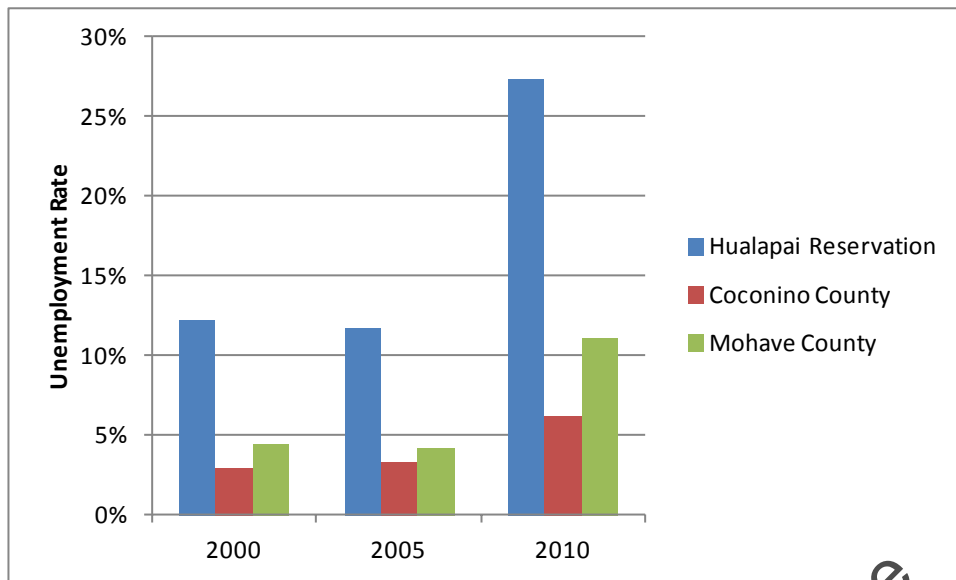
8
 9
 10 Figure 3.7 provides unemployment percentages for the Hualapai Tribe, and Coconino and Mohave Counties, 2000
 11 through 2010. *Despite an increase in employed residents from 2000 to 2010, the reservation unemployment rate*
 12 *rose from 12% in 2000 to 27% in 2010, due to the increased participation in the labor force.*

14 Hualapai Employment by Occupation and Industry

15 Distribution of workers by occupation on the
 16 reservation was similar to Coconino County in 2006-2010; however, there were fewer Hualapai in management,
 17 business, science, and arts occupations and more in the service industry. About 73% of Hualapai Reservation
 18 workers were employed by government as compared to 25% and 14% for Coconino and Mohave Counties,
 19 respectively (U.S. Census Bureau 2010). Consistent with the percentage of government workers on the reservation,
 20 more than one third of employees work in educational, health and social services, and public administration
 21 industries.

22 Tourism-related employment is extensive on the reservation. Industries associated with tourism, such as retail trade,
 23 accommodation, and food services account for 28% of all employment. These activities are mostly within the Grand
 24 Canyon Resort Corporation.

1 **Figure 3.7 Unemployment Rates for Hualapai Tribe, Coconino and Mohave Counties, 2000 through**
 2 **2010**



Source: Arizona Department of Economic Security, Research Administration, CES/LAUS Unit, Arizona Unemployment Statistics Program, Special Unemployment Report Average of monthly numbers, County data does not include reservations

5 **Hualapai Tourism Sector**

6 Development of tourism on tribal land is important to the Hualapai. Their location in Grand Canyon along the banks
 7 of the Colorado River is a natural resource that provides an economic advantage that helps off-set other
 8 disadvantages, such as lack of larger population centers near the reservation.

9
 10 The Hualapai Tribe owns and operates several tourist-oriented ventures, mostly under the organization of the Grand
 11 Canyon Resort Corporation. Opened in February 1988, Grand Canyon West is a large tourist-oriented facility
 12 located on the Hualapai Reservation about 120 miles east of Las Vegas and almost 250 miles from Grand Canyon
 13 National Park's Visitor Center at South Rim. Grand Canyon West encompasses about 9,000 acres and is 60 miles
 14 from Peach Springs. Grand Canyon West offers one and two-day rafting trips, Hummer vehicle tours, all inclusive
 15 trips from Las Vegas, the Hualapai Market, an Indian Village, the Hualapai Ranch, and horseback riding. Tour
 16 prices vary from about \$30 per person up to \$500 or more per person, depending on activity. As a part of a
 17 contractual agreement, Grand Canyon Resort Corporation is required to provide 15% of its revenues to the Tribe, or
 18 a minimum of \$600,000 annually to the Tribe's general fund (FAA 2000a).

19
 20 Admission to Grand Canyon West is \$49.95 per person, with additional charges for various activities. In March
 21 2007, Grand Canyon West opened the Grand Canyon Skywalk, a horseshoe-shaped glass-bottom walkway more
 22 than 4,000 feet above the canyon floor that extends 70 feet into the canyon. The cost was initially \$25 per person. In
 23 addition, construction of a 6,000-square-foot visitor center, which will include a museum, movie theater, gift shop,
 24 restaurants and lounges, and event facilities, is underway. The Tribe hopes Grand Canyon West will eventually draw
 25 many visitors each year. Plans include an RV park, gas station, small grocery store, and a tram to the Canyon floor
 26 (Grand Canyon Resort Corporation 2007). The Hualapai River Runners offer one and two-day river rafting trips
 27 down the Colorado River on motorized river rafts. The GCNP Colorado River Management Plan regulates the
 28 number of people on these rafting trips to 156 passengers per day. The Hualapai also offer short (15 to 20-minute)
 29 pontoon boat tours in the Quartermaster Canyon area. The Colorado River Management Plan limits these river
 30 passengers to 600 per day.
 31

1 Hualapai Lodge, which opened in 1997, is also owned by the Tribe. The lodge has 60 rooms, a restaurant and gift
2 shop. The Tribe also sells hunting permits through Wild Life Hunting and produces and sells t-shirts, hats, and mugs
3 through the Hualapai Arts and Crafts Enterprise (Northern Arizona University 2007b).

4
5 Tourism provides about \$5 million in income and almost half the jobs on the reservation each year. Tourism
6 contributes about 90% of the Tribe's budget each year.

7 8 **Hualapai Tribal-related Air Tours**

9 Air-tour operations are an important piece of the overall tourism economy for the Hualapai. Tribal officials estimate
10 as much as 87% of total reservation visitors are air-tour related. Besides moving visitors onto the reservation, air
11 tours land at Quartermaster Canyon, and other flights move visitors to the bottom of the canyon for boat tours (these
12 are known as Elevator Flights or Over the Edge tours). Four helicopter companies operated on the reservation in
13 2007, providing air tours as arranged through the Hualapai Tribe.

14
15 Air tours land at both Grand Canyon West Airport and along the Colorado River. In 1997, along with conversion
16 from a private-use to a public-use airport, a Federally funded airport renovation and runway resurfacing were
17 completed. After that time, air tours to the reservation increased significantly. Like most air-tour operations, events
18 of September 11, 2001 resulted in a decrease in flights, but operations gradually returned and then surpassed pre
19 9/11 levels. Between May 1, 1998 and April 30, 1999, five airplane and four helicopter operators conducted 10,700
20 air tours with 55,700 passengers to the reservation. These air-tour operations at Grand Canyon West provide income
21 to the Tribe from landing fees, ground tours, and meals provided to passengers, trespass fees, and lease payments.
22 More than 60% of the tribal budget can be attributed to air tours.

23
24 *As discussed previously, the* number of air tours in support of the Hualapai has *significantly* increased in recent
25 years, *partially* due to additional attractions on the reservation and increased marketing by the Hualapai. The
26 Hualapai collect about \$3 million per year in charges and fees from various operators that land on the reservation.
27 (These charges and fees are only a portion of total Hualapai revenues.)

28 29 **Hualapai Fixed-Base Operations**

30 The Hualapai own four fixed-base operations: Grand Canyon West Airport, Grand Canyon West 1 Heliport, Grand
31 Canyon West 2 Heliport, and 183 Mile Heliport. This does not include their numerous helipads near the Colorado
32 River used for transporting river passengers in and out of the canyon and for helicopter tours based out of Grand
33 Canyon West or the Las Vegas area.

34 35 **Havasupai Reservation**

36
37 The Havasupai Reservation encompasses about 188,000 acres at the western edge of Grand Canyon's South Rim in
38 Coconino County. Most reservation residents live in Supai Village, and are governed by a seven-member tribal
39 council. Peach Springs, on the Hualapai Reservation, is the nearest town. The Havasupai Reservation is quite remote
40 and can be reached only by foot, horseback, or helicopter. If not traveling by helicopter, tourists park at Hualapai
41 Hilltop and take an eight-mile trail to the village. Map 1.1 includes the Havasupai Reservation.

42
43 The isolated nature of this reservation makes it quite different from most communities and other reservations. For
44 example, according to the *2006-2010 ACS*, no workers used a car, truck, or van to get to work. About *91%* walked,
45 *5% worked at home* and the balance used other means, possibly a horse *or mule*. Ninety percent of households did
46 not have a vehicle available to them. No owner-occupied housing units had a mortgage (U.S. Census Bureau *2006-*
47 *2010 ACS*).

48
49 Community facilities on the reservation include a school (kindergarten through eighth grade), community building
50 and tribal offices, library, senior center, a community playing field, basketball court, rodeo grounds, museum and
51 cultural center, silkscreen studio, campground, lodge, café, and the Havasupai Trading Company (Arizona
52 Department of Commerce 2005a). Law enforcement is provided by the Bureau of Indian Affairs.

1 **Havasupai Demographic Profile**

2 **Havasupai Population** *As of 2007*, there *were* roughly 650 enrolled members of the Havasupai Tribe
 3 (*Havasupai Tribe 2007*). In *2010*, the Havasupai Reservation population was *465, down 8% from 503 in 2000*.
 4 Table 3.22 provides population data for the Havasupai Reservation, Coconino County, and the state of Arizona.

5
 6 **Table 3.22 Population Havasupai Reservation, Coconino County, and Arizona, 1990, 2000, and 2010**

Population	1990	2000	1990 2000 Change	2010	2000 2010 Change
Havasupai Reservation	N/A	503	N/A	<i>465</i>	<i>-8%</i>
Coconino County	96,591	116,320	20%	<i>134,421</i>	<i>16%</i>
Arizona	3,665,228	5,130,632	40%	<i>6,392,017</i>	<i>25%</i>

Source: 1990 and 2000 *data from 2000* Census population finder, accessed at www.census.gov
 2010 *Data from 2010 Census, American Factfinder* accessed at factfinder2.census.gov
 1990 Census data for the Havasupai Reservation was not available

7
 8
 9 Reservation residents are relatively young in relation to Coconino County residents. In *2010, the median age* of
 10 reservation residents *was 27* years compared to *31* for Coconino County.

11 **Havasupai Economic Profile**

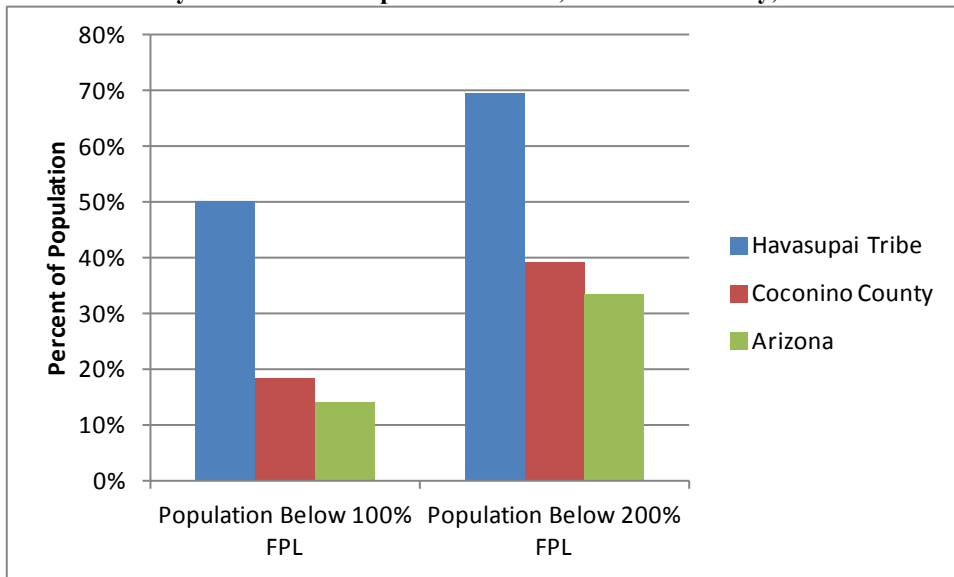
12 The principal economic activity on the Havasupai Reservation is tourism; more than 12,000 guests visit the
 13 reservation each year (Arizona Department of Commerce 2005a). The dramatic nature of the landscape with its deep
 14 canyons and beautiful waterfalls make it very attractive to certain tourists.

15
 16
 17 **Havasupai Income** According to the *2006-2010 ACS*, per capita income for Havasupai Reservation
 18 residents was *\$12,707*; median annual household income for the *120* households was *\$32,000*. *Approximately 28%*
 19 *of households had income of less than \$24,999; in Coconino County only 17%* of households had income of less
 20 than \$24,999. Public assistance income or Supplemental Security Income was received by about *6%* of households.
 21 *Six percent* of households had income of more than \$100,000 *between 2006 and 2010* (U.S. Census Bureau *2006-*
 22 *2010 ACS*).

23
 24 Figure 3.8 provides the percent of Havasupai and Coconino County residents below the Federal poverty level and
 25 below 200% of the Federal Poverty Level in *2009*.

26
 27 **Havasupai Employment** In *2010*, the Havasupai Reservation population 16 years or older was *335*. *The*
 28 *average* labor participation rate *between 2006 and 2010 was 63%, up from 36% in 2000*. The labor force
 29 participation rate for Coconino County was almost *67%*. *Oftentimes, a* reservation's isolation and resulting limited
 30 employment opportunities may result in an understatement of unemployment numbers; *however, the high labor*
 31 *participation rate of the Havasupai reservation suggests otherwise*. Figure 3.9 provides unemployment
 32 *percentages for the Havasupai Tribe and Coconino County, 2000 through 2010*.

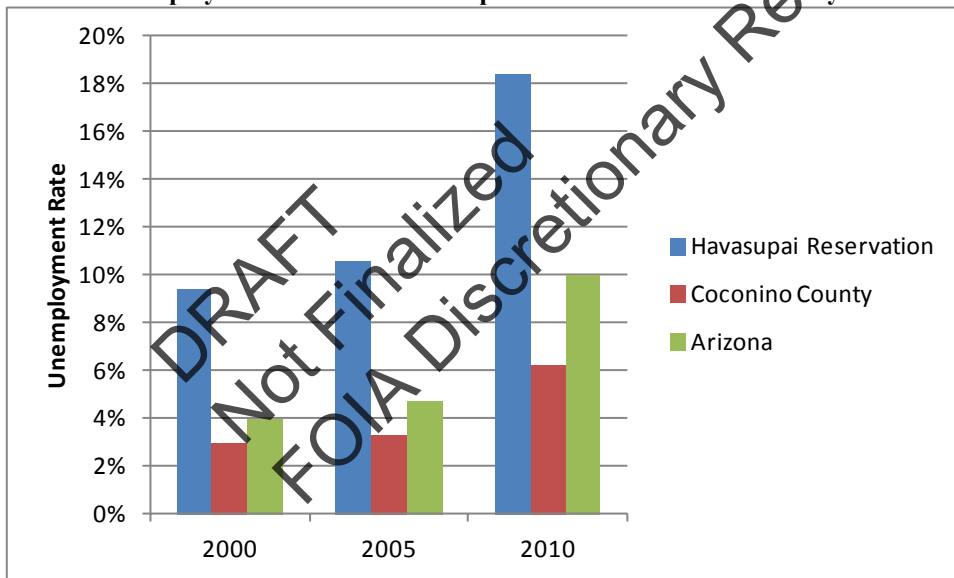
1 **Figure 3.8 Poverty Level of Havasupai Reservation, Coconino County, and Arizona**



Source: Arizona Department of Health Service, Division of Public Health Services. *Havasupai Tribe Primary Care Area Statistical Profile 2009*

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Figure 3.9 Unemployment Rates for Havasupai Tribe and Coconino County 2000-2010



Source: Arizona Department of Economic Security, Research Administration, CES/LAUS Unit, *Arizona Unemployment Statistics Program, Special Unemployment Report Average of monthly numbers. County data does not include reservations*

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Havasupai Employment by Occupation and Industry

According to the 2006-2010 ACS, employment in service occupations on the Havasupai reservation was about 13 percentage points higher than in Coconino County. Half of reservation employment and the majority of Coconino County employment was in traditionally white-collar occupations. About 90% of Havasupai Reservation workers were employed by government as compared to 25% in Coconino County (U.S. Census Bureau 2006-2010 ACS). The largest employer on the reservation is the Tribe itself (Inter Tribal Council of Arizona, Inc. 2007). Consistent

1 with a tourism-driven economy, tourism-related industries provide another **17%** of employment. Other industries,
2 such as manufacturing and transportation, may also be indirectly related to the tourism industry.

4 **Havasupai Tourism Sector**

6 Tourism development on tribal land is crucial to the Havasupai Tribe as its remote location makes industries
7 impractical. The reservation's spectacular scenery is appealing to certain tourists undeterred by the difficulty getting
8 there. The entrance fee is \$35 per adult and \$17.50 for children under 12.

10 In addition to the natural beauty of the reservation's canyons and waterfalls, the Tribe has invested in several
11 ventures designed to attract tourist dollars. The Tribe owns a lodge with 24 guest rooms near Havasu Falls. It also
12 owns and operates a cafe, post office, grocery store, tourist office, museum and cultural center, silk-screening studio
13 (Northern Arizona University 2007a), primitive campground, and horseback tours.

15 By arrangement with the Tribe, air-tour operators offer two helicopter trips per day to the reservation. Besides
16 transportation, visitors use these flights in conjunction with hiking and other activities.

18 **Havasupai Tribal-related Air Tours**

20 The Havasupai do not currently conduct air-tour operations.

22 **Navajo Reservation**

23 The Navajo Nation (see Map 1.1) covers roughly 27,000 square miles in Arizona, Utah, and New Mexico. There are
24 110 Chapters within the Nation, which is governed by three branches of government: Executive, Legislative, and
25 Judicial headquartered in Window Rock, Arizona. The Cameron Chapter of the Navajo Nation is elaborated in this
26 section as the Chapter may develop air tours and air-tour-related fixed-based operations.

28 The Cameron Chapter was certified as an entity of the Navajo Nation in 1955 and occupies about 240,000 acres in
29 Coconino County. This Chapter is part of the Bennett Freeze Area, a region disputed between the Navajo Nation and
30 Hopi Tribe. The Bennett Freeze law (section 10(f) of Public Law 93-531, commonly known as the Bennett Freeze)
31 prohibited construction, development, and repair on these lands. In early 2007, the Freeze was lifted, but the impacts
32 of the Freeze still affect Chapter residents.

34 Community facilities include a pre-school and elementary school, several churches, and 11 businesses. Law
35 enforcement is provided by the Tuba City Chapter. The nearest medical facility is Tuba City Indian Medical Center
36 about 26 miles away (Cameron Chapter 2007).

38 **Navajo Demographic Profile**

39
40 **Navajo Population** In 2011, there were **more than 300,000** total enrolled members in the Navajo Nation,
41 making it the **second** largest **Indian Nation in the U.S. behind the Cherokee Nation (Donovan 2011)**. Requirements
42 for enrollment vary tribe to tribe, and enrolled members are not necessarily residents of Navajo Nation lands. Table
43 3.23 provides population data for the entire Navajo Reservation, Cameron Chapter, Coconino County, and the state
44 of Arizona.

46 **Table 3.23 Population Navajo Reservation, Cameron Chapter and Arizona 1990, 2000, and 2010**

Population	1990	2000	1990 2000 Change	2010	2000 2010 Change
Navajo Nation	148,451	180,462	22%	173,667	-4%
Cameron Chapter	N/A	1,231	N/A	1,122	-9%
Coconino County	96,591	116,320	20%	134,421	16%
Arizona	3,665,228	5,130,632	40%	6,392,017	25%

Source: 1990 data from 2000 Census population finder, at www.census.gov

The estimated population of the Arizona portion of the Nation in 2005 was 113,056 residents (Arizona Department of Health Services 2006c)

1 Navajo Economic Profile

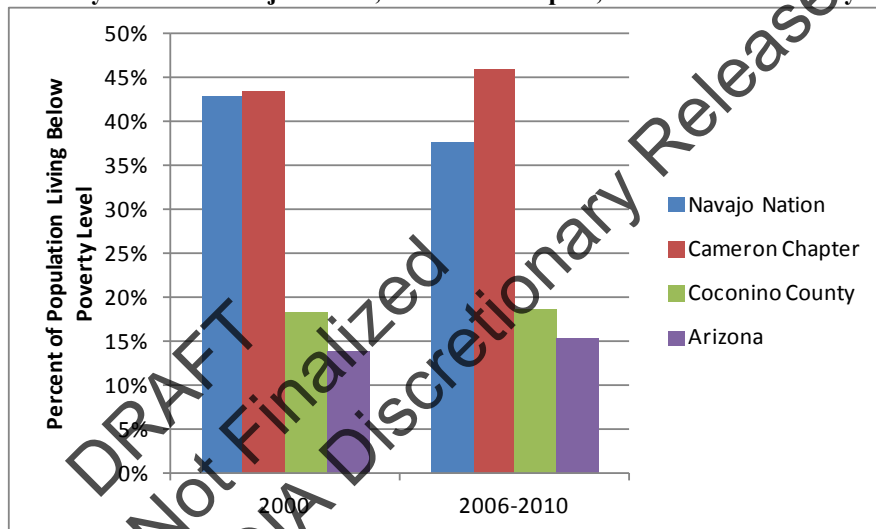
2
3 Principal economic activities on the Navajo Nation are sheep and cattle ranching, coal and uranium mining,
4 weaving, jewelry making, and traditional arts. Tourism is also very important. Many parks, monuments, and
5 museums attract tourists each year (Arizona Department of Commerce 2005c).

6
7 **Navajo Income** According to the *2006-2010 ACS*, per capita income for Navajo Nation residents was
8 **\$10,547**; median annual household income for the **43,398** households was \$26,232. Almost **50%** of households had
9 income less than \$24,999. Public assistance income or Supplemental Security Income was received by **24%** of
10 households. *Approximately* 6% of households had income of more than \$100,000 (U.S. Census Bureau *2006-2010*
11 *ACS*).

12
13 Per capita income for Cameron Chapter residents was **\$10,121**; median annual household income for the **367**
14 households was **\$20,795**. *Over half (55%) of households had income less than \$24,999*. About **19%** of households
15 received public assistance or Supplemental Security Income. *Seven percent* of households had income over
16 \$100,000.

17
18 Figure 3.10 provides the percent of Navajo Nation, Cameron Chapter and Coconino County residents who were
19 below the Federal Poverty Level in **2000 and 2006-2010**.

20
21 **Figure 3.10 Poverty Level of Navajo Nation, Cameron Chapter, and Coconino County Residents**

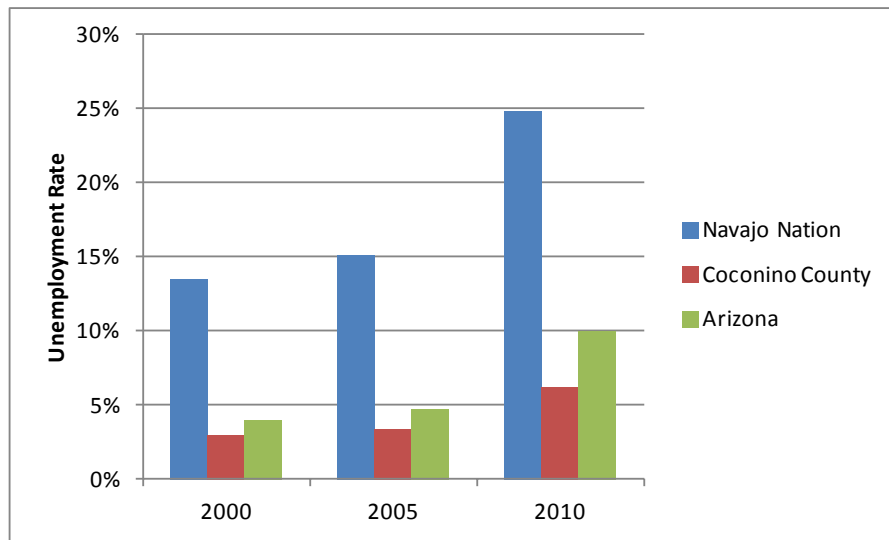


22
23 *Source: Arizona Department of Health Service, Division of Public Health Services.*
24 *Navajo Tribe Primary Care Area Statistical Profile 2009*

25
26
27 **Navajo Employment** *Between 2006-2010*, the civilian labor force on the Navajo Nation *averaged 53,056*
28 persons, *or about 44% of residents aged 16 and over*. In the Cameron Chapter, about **48%** of the **960** residents over
29 16 were in the labor force, a relatively low figure. In Coconino County, **67%** of residents over age 16 were in the
30 labor force (*US Census Bureau 2006 -2010 ACS*).

31
32 Although reservation unemployment may be understated, it is still high compared to Coconino County. Figure 3.11
33 provides unemployment percentages for the Navajo Nation, and Coconino *County* and *the State of Arizona* 2000
34 through **2010**.

1 **Figure 3.11 Unemployment Rates for Navajo Nation, Coconino County and Arizona 2000-2010**
2



3 *Source: Arizona Department of Economic Security, Research Administration, CES/LAUS Unit, Arizona Unemployment Statistics Program, Special Unemployment Report*

4 *Navajo Nation data includes only Arizona data. Average of monthly numbers. County data does not include reservations*

11 Navajo Employment by Occupation And Industry

12 *Sales and office occupations, followed by service*
13 *occupations provided the largest percent of employment for workers in the Cameron Chapter. In the Navajo Nation*
14 *and Coconino County, management and professional occupations provided the largest employment percentage. In*
15 *Coconino County, traditionally white-collar occupations provided 57% of all jobs as compared to about 44% for the*
16 *Navajo Nation as a whole and 34% for the Cameron Chapter. Only 14% of Cameron Chapter workers were*
17 *employed by government as compared to 44% on the Navajo Nation and 25% in Coconino County (U.S. Census*
18 *Bureau 2006-2010 ACS).*

19 Retail trade and arts, entertainment, recreation, accommodation, and food services accounted for 46% of all
20 employment for the Cameron Chapter, indicating a reliance on tourism. *The same industries accounted for 20% of*
21 *employment for the Navajo Nation as a whole and 27% for Coconino County. As of 2007, the largest employers*
22 *within the Cameron Chapter were the Cameron Trading Post with approximately 50 employees and the Cameron*
23 *Chapter House with approximately 11 workers.*

25 Navajo Tourism Sector

26 The Little Colorado River Gorge Tribal Park is located in the Cameron Chapter. No fees are charged for park
27 entrance; however, a visitor center is available that provides information and permits for various activities. The park
28 includes two overlooks with picnic tables and native vendors selling handmade crafts, as well as numerous hiking
29 and backpacking trails. The Cameron Chapter does not operate any formal tourist attractions.

32 Navajo Tribal-related Air Tours

33 The Navajo Nation, including the Cameron Chapter, does not currently conduct air-tour operations.

36 General Aviation Operations

38 General Aviation Corridors

39 Four general-aviation corridors currently exist in the SFRA. These are: Zuni Point Corridor, Dragon Corridor, Fossil
40 Canyon Corridor, and Tuckay Corridor. General-aviation corridors allow aircraft to fly across Grand Canyon

1 between various Flight-free Zones. Required altitudes in corridors are lower than required to fly over Flight-free
 2 Zones. Current flight altitudes are the same for all four general-aviation corridors. Northbound flights may occur at
 3 11,500 feet MSL or 13,500 feet MSL. Southbound flights may occur at 10,500 feet MSL or 12,500 feet MSL. Each
 4 corridor is described in Chapter 2, Alternative A, and shown on Map 2.2.

6 **Flight-free Zones**

7 Four Flight-free Zones exist in the SFRA: Sanup, Toroweap/Shinumo, Bright Angel and Desert View. Flight-free
 8 Zones are described in Chapter 2, Alternative A, and shown on Map 2.2. Flights may currently occur over the Sanup
 9 Flight-free Zone at altitudes greater than 7,999 feet MSL and over the Toroweap/Shinumo, Bright Angel, and Desert
 10 View Flight-free Zones at altitudes greater than 14,499 feet MSL.

12 **General Aviation Aircraft**

13 A variety of types of general-aviation aircraft fly over GCNP at different locations and altitudes based on points of
 14 take-off and destination, as well as on mechanical aircraft capabilities. For example, single-engine piston aircraft can
 15 fly at altitudes up to 14,500 feet MSL and turbo-charged engines up to 21,000 feet MSL (Harvey Economics 2006).
 16 Examples of general-aviation single-engine piston aircraft types are shown in Table 3.24.

18 **Table 3.24 Examples of Single-Engine Piston Aircraft**

Aircraft Manufacturer	Model Types
Beech	A23; A45; B19; C24R; D35; F33A
Cessna	C120; C150L; C170A; C182E
Maule Air Inc.	MX-7-160; MXT-7-180A
Mooney	M20C; M20J; M20M Bravo; M20R
Piper	PA-12; PA22-135; PA-24-160B

19 Source: www.planequest.com

20 Only a small portion of all single engine piston aircraft types that could be used for
 21 general aviation purposes are shown

24 **General Aviation Operations**

25 On the Peak Day of the Base Year (August 8, 2005), there were a total of four general-aviation flights flying within
 26 the SFRA. These flights occurred on a Beech Baron, a Cessna Conquest, and on other unidentified general-aviation
 27 single-engine aircraft. The Peak Day for total SFRA flights may or may not represent Peak Day operations for
 28 general-aviation flights. No information is available on annual number of general-aviation flights in the SFRA.

30 *According to the 2009 Grand Canyon National Park Airport Terminal Area Plan, of the 46 aircraft based at
 31 GCN, only 2 were general aviation aircraft; 44 were associated with air-tour operators.*

33 **Regional Economics and Park Values**

34 This section discusses local and regional communities affected by park operations and park-related tourist activities.
 35 Current economic and demographic conditions of local communities and the relevant region are presented and the
 36 role of tourism in these economies is discussed. The value of the park to visitors and non-visitors is also discussed.

39 **Regional Economics**

40 **Local Communities and Region Influenced by Air-tour Activity in Grand Canyon National Park**

41 Visitors to Grand Canyon, including those participating in air tours over Grand Canyon, also spend time and money
 42 in local communities outside the park, dining in restaurants, purchasing souvenirs in local shops, and staying
 43 overnight in hotels, motels, and other accommodations. These local communities, also known as gateway
 44 communities, are made up of businesses that rely on tourism as a source of income and employment for residents
 45 and local governments. Economies of many of these small communities are based on tourism and may be affected
 46 by any visitation changes *in GCNP*.

48 *The air-tour industry is a geographically concentrated portion of tourist activity with 94% of air-tour operations
 49 and employees in Tusayan, Arizona and Las Vegas, Nevada. This concentration is even more dramatic at the*

1 *county level: 99% of all air-tour takeoffs and landings occur in Coconino County, Arizona or Clark County,*
 2 *Nevada and 96% of all air-tour employees work in one of these two counties. Any changes to local overflight*
 3 *activity and the air-tour industry are likely to primarily affect these communities. Therefore, the following*
 4 *regional economics discussion is focused on Tusayan, Las Vegas, Coconino County, and Clark County.*

6 Demographic and Economic Characteristics

7 **Population** Population of *the affected* communities are presented in Table 3.25 with growth rates since 2000.
 8 *In 2010, Clark County had approximately 2 million residents and Las Vegas had about 584,000 residents. The*
 9 *populations of Coconino County (134,421) and Tusayan (558) were much smaller.*

11 **Table 3.25 Population of Affected Communities, 1990–2010**

	1990 Population	2000 Population	2010 Population	Total Growth, 2000–2010	Compound Annual Growth 2000–2010
<i>Tusayan, Arizona</i>	555	562	558	-1%	-0.1%
<i>Coconino County, Arizona</i>	96,591	116,320	134,421	16%	1.5%
<i>Las Vegas, Nevada</i>	258,295	478,434	583,756	22%	2.0%
<i>Clark County, Nevada</i>	797,142	1,375,765	1,951,269	42%	3.6%

12 *Source: U.S. Census Bureau, American Factfinder, Census 1990, 2000 and 2010*

15 *Both Las Vegas and Clark County experienced substantial growth over the past decade with total growth rates of*
 16 *22% and 42% respectively. The population of Coconino County also grew (16%), but the population in Tusayan*
 17 *declined from 562 residents to 558 residents. Some possible explanations for the population decline in Tusayan*
 18 *are that the tourism base of Tusayan is largely stable but not expanding, the remoteness of the community, and*
 19 *limited room for expansion since Tusayan is surrounded by Federal land.*

21 **Income** Median household income for *Las Vegas* and *Tusayan* in both 2000 and 2010 are presented in
 22 Table 3.26 in 2010 dollars. After adjustment for inflation, *only Tusayan experienced an increase* in median
 23 household income from 2000 to 2010. Median household income *decreased in Coconino County (-1%), Clark*
 24 *County (-4%) and most substantially in Las Vegas (-6%). Between 2006 and 2010, the median income in Tusayan*
 25 *was slightly higher than in Coconino County as a whole, but still below that of both Las Vegas and Clark County.*

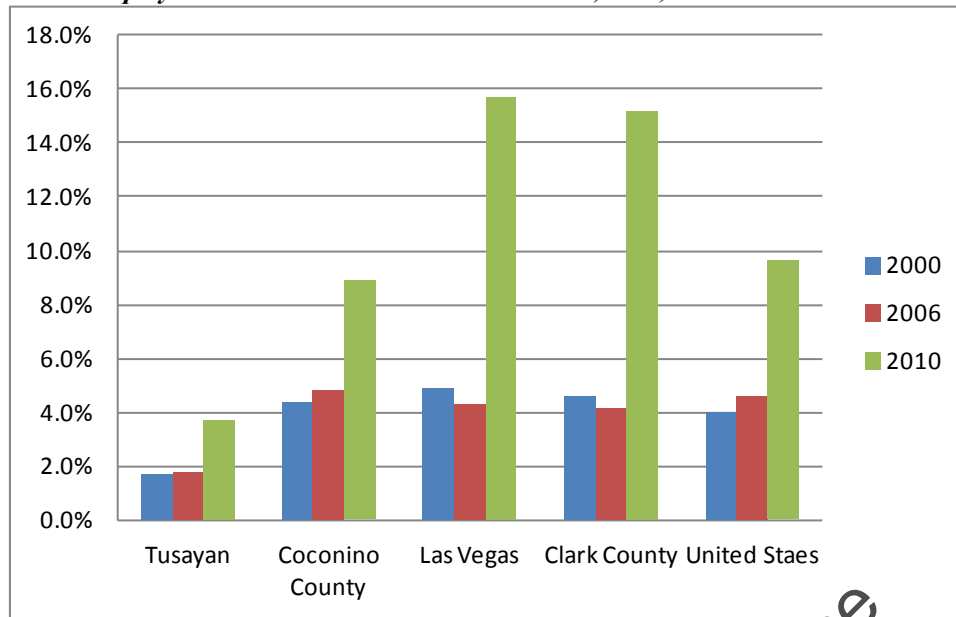
27 **Table 3.26 Median Household Income for Affected Communities 2000 and 2010**

	2000	2006–2010	Real Change (net of inflation)
<i>Tusayan, Arizona</i>	\$45,701	\$50,048	10%
<i>Coconino County, Arizona</i>	\$50,072	\$49,510	-1%
<i>Las Vegas, Nevada</i>	\$57,680	\$54,334	-6%
<i>Clark County, Nevada</i>	\$58,396	\$56,258	-4%

Source: U.S. Census Bureau, American Factfinder, Census 2000, Table P053 and ACS
 2006-2010, Table B19013 www.census.gov

30 **Employment** *The annual unemployment rate in 2000, 2006, and 2010 for affected communities and the*
 31 *United States as a whole is presented in Figure 3.12. Both Las Vegas and Clark County have unemployment rates*
 32 *above the national average, whereas unemployment in Tusayan and Coconino County remains below the*
 33 *national average.*

1 **Figure 3.12 Unemployment for Affected Communities 2000, 2006, and 2010**



Sources: Arizona Department of Economic Security, *Special Unemployment Report, 2000-2010* www.workforce.az.gov. Bureau of Labor Statistics, *Local Area Unemployment Statistics (LAUS)* www.bls.gov

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Table 3.27 shows 2006-2010 average employment by industry for Tusayan and Coconino County and comparisons of industry percentages of total employment with Arizona as a whole. A large percent of regional residents are employed in tourism-related industries. About 26% of Tusayan residents, and 15% of all Coconino County residents are employed in the arts, entertainment, recreation, accommodation, and food service industries compared to just 11% of Arizona residents statewide. In Tusayan, transportation, warehousing, and utilities account for another 39% of local employment. This sector, which averaged 58 employees from 2006-2010, includes individuals employed by the air-tour industry as well as other workers involved in tourist-related transportation (such as bus tours).

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1 **Table 3.27 Employment by Industry for Tusayan and Coconino County 2006-2010**

Industry	Tusayan		Coconino County		Arizona
	Emp.	%	Emp.	%	%
Agriculture, forestry, fishing, hunting	14	10%	703	1%	1%
Mining	-	-	192	0%	0%
Construction	-	-	5,370	8%	7%
Manufacturing	-	-	4,494	7%	7%
Wholesale trade	-	-	1,101	2%	2%
Retail trade	12	8%	7,658	12%	13%
Transportation, warehousing, utilities	58	39%	3,655	6%	5%
Information	-	-	649	1%	2%
Finance and insurance	-	-	1,325	2%	5%
Real estate, rental, and leasing	-	-	1,147	2%	2%
Professional, scientific, and related services	14	10%	4,170	6%	11%
Education, health, and social services	11	7%	16,928	26%	23%
Arts, entertainment, and recreation	-	-	2,317	4%	3%
Accommodation and food services	38	26%	7,367	11%	8%
Other services	-	-	2,918	5%	5%
Public administration	-	-	4,416	7%	6%
Total	147	100%	64,410	100%	100%

2 *Source: U.S. Census Bureau, American Factfinder, American Community Survey 2006-2010, Table DP03,*
3 *www.census.gov.*

4
5
6 Table 3.28 shows **2006-2010 average** employment by industry for *Las Vegas and Clark County* and *comparisons of industry percentages of total employment with Nevada as a whole*. *Not surprisingly, a large percent of regional residents are employed in tourism-related industries. About 26% of Las Vegas residents (and all Clark County residents) are employed in the arts, entertainment, recreation, accommodation, and food service industries. Clark County accounts for over 70% of Nevada's population, so this percentage is not substantially different from the overall state average. In Las Vegas, the largest industry in terms of employment is accommodation and food services (18%) followed by education, health, and social services (14%).*

14 **Table 3.28 Employment by Industry for Las Vegas and Clark County 2006-2010**

Industry	Las Vegas		Clark County		Nevada
	Emp.	%	Emp.	%	%
Agriculture, forestry, fishing, hunting	260	0%	260	0%	0%
Mining	438	0%	438	0%	1%
Construction	27,394	10%	27,394	10%	9%
Manufacturing	8,805	3%	8,805	3%	4%
Wholesale trade	5,363	2%	5,363	2%	2%
Retail trade	29,817	11%	29,817	11%	11%
Transportation, warehousing, utilities	10,741	4%	10,741	4%	5%
Information	4,809	2%	4,809	2%	2%
Finance and insurance	10,674	4%	10,674	4%	4%
Real estate, rental, and leasing	8,212	3%	8,212	3%	3%
Professional, scientific, and related services	30,976	12%	30,976	12%	10%
Education, health, and social services	38,700	14%	38,700	14%	15%
Arts, entertainment, and recreation	20,905	8%	20,905	8%	9%
Accommodation and food services	47,445	18%	47,445	18%	16%
Other services	11,544	4%	11,544	4%	4%
Public administration	11,139	4%	11,139	4%	5%
Total	267,222	100%	267,222	100%	100%

15 *Source: U.S. Census Bureau, American Factfinder, American Community Survey 2006-2010, Table DP03,*
16 *www.census.gov.*

Projected Regional Economic and Demographic Growth

The potentially affected communities of Tusayan, Coconino County, Las Vegas, and Clark County are all projected to grow in terms of population and employment over the next five to ten years.

Table 3.29 shows the projected population for each community in 2015, 2020, and 2025. The projections were calculated by applying projected growth rates to 2010 Census populations for each community. The populations of Coconino County and Clark County are projected to increase by about 18% between 2010 and 2025. Tusayan's projected growth is slightly lower at 10%.

Table 3.29 Population Projections for Affected Communities

	Actual		Projections		
	2010	2015	2020	2025	Total Growth
Tusayan	558	580	599	616	10%
Coconino County	134,421	143,632	151,419	158,437	18%
Arizona	6,392,017	7,228,316	8,017,238	8,756,155	37%
Las Vegas*	583,756	620,244	655,122	686,792	18%
Clark County	1,951,269	2,073,235	2,189,817	2,295,677	18%
Nevada	2,700,551	2,875,875	3,042,139	3,183,331	18%

* The Nevada State Demographer does not provide projections at the city level. Las Vegas was assumed to have the same growth rate as Clark County

Note: Projected growth rates were applied to 2010 Census populations for each community

Sources: 2010 Census, Arizona Department of Administration: Office of Employment and Population Statistics, and Nevada State Demographer

Long-term employment projections for Arizona predict a compound annual growth rate of 0.6% from 2008 to 2018. Arizona's employment is projected to grow faster in the short term at a compound annual rate of 1.1% between 2010 and 2012. Although projections are not provided specifically for Tusayan and Coconino County, the portions of the state excluding Tucson and Phoenix are expected to grow by 1.0% per year in the short term (2010-2012) and 0.4% per year in the long term (2008-2018) (Arizona Department of Administration: Office of Employment and Population Statistics).

Employment in Nevada is projected to grow at a compound annual rate of 0.6% from 2010 to 2012, and 0.7% between 2008 and 2018. Similar growth is projected in Clark County with a compound annual growth rate of 0.7% in the short term and 0.6% long term (Nevada Department of Employment, Training and Rehabilitation). It is assumed Las Vegas employment will grow at the same rate as Clark County.

Role of Tourism in the Regional Economy

Tourism plays a major role in the economy of Coconino County, Arizona and Las Vegas, Nevada. The tourism "sector" is not a clearly defined, specific industry within a local economy, but rather reflects the portions of the economic activity of multiple sectors (such as retail trade; accommodation and food services; and arts, entertainment and recreation) that can be attributed to expenditures by tourist visitors. Consequently, standardized data on the tourism-related economy are not typically available. The following discussion uses available data to characterize the nature and impact of tourism in the regional economy.

Role of Tourism in the Coconino County Economy A substantial portion of tourism in Coconino County is due to nature-based travel to public lands. Grand Canyon and many other northern Arizona tourist attractions including Oak Creek Canyon, Glen Canyon and Lake Powell, Walnut Canyon, Sunset Crater, Wupatki, Navajo National Monument and several reservations (discussed separately), attract millions each year. These visitors often spend several days or more in the area, injecting money into local economies. Spending by park visitors and visitors to other attractions in the area has a noticeable impact on the regional economy.

Table 3.30 displays visitation and estimated economic impacts for national parks and monuments located in Coconino County. The jobs, labor income, and value added include direct and secondary (multiplier) effects from visitor spending and national park payroll.

1 **Table 3.30** *Visitation and Estimated Economic Impacts, National Parks and Monuments in*
 2 *Coconino County*

	<i>Recreation Visits</i>	<i>Non local Visitor Spending (\$000's)</i>	<i>Total Jobs*</i>	<i>Total Labor Income* (\$000's)</i>	<i>Total Value Added* (\$000's)</i>
<i>Grand Canyon NP **</i>	3,642,360	\$345,112	5,665	\$170,300	\$253,987
<i>Glen Canyon NRA</i>	2,124,467	\$181,609	2,487	\$80,010	\$112,826
<i>Sunset Crater Volcano NM</i>	158,819	\$7,353	97	\$2,691	\$4,338
<i>Walnut Canyon NM</i>	126,552	\$5,859	79	\$2,190	\$3,507
<i>Wupatki NM</i>	221,083	\$10,235	194	\$7,072	\$9,648
TOTAL	6,273,281	\$550,168	8,522	\$262,263	\$384,306

* Total Jobs, Total Labor Income and Total Value Added include both visitor impacts and NPS payroll impacts

Source: Stynes 2011

** Based on results of the 2005 NAU tourism study of GCNP, 83% of the visitation, visitor spending, and economic impacts of the park was allocated to Coconino County (corresponding to South Rim share of total visitation)

3
4
5 *As demonstrated in Table 3.30, facilities managed by NPS, including national parks, monuments, and recreation*
6 *areas, generated over six million recreational visits to Coconino County in 2010. These visits supported 8,500*
7 *jobs (approximately 13% of total jobs in the county) and contributed \$384 million dollars to GRP in 2010. Not*
8 *surprisingly, GCNP creates the largest economic impact supporting 5,700 jobs and generating \$254 million in*
9 *value added. Average labor income from tourism-based jobs was relatively low at \$30,776 per year.*

10
11 *Table 3.31 data from the Arizona Office of Tourism on direct travel spending, broken down by segment, by all*
12 *visitors – not just national park visitors – in Coconino County 2000 through 2010. Travel-related spending in*
13 *Coconino County by visitors totaled \$946 million in 2010. An additional \$2.2 million travel spending was due to*
14 *resident air travel and travel arrangements.*

15
16 **Table 3.31** *Total Direct Travel Spending in Coconino County 2000 to 2010 in Millions*

	2000	2002	2004	2006	2008	2010
<i>Accommodations</i>	\$ 251	\$ 219	\$ 234	\$ 254	\$ 274	\$ 268
<i>Food Service</i>	\$ 239	\$ 220	\$ 240	\$ 245	\$ 255	\$ 263
<i>Food Stores</i>	\$ 51	\$ 48	\$ 49	\$ 47	\$ 49	\$ 47
<i>Local Tran. & Gas</i>	\$ 60	\$ 49	\$ 71	\$ 93	\$ 96	\$ 79
<i>Arts, Entertainment, and Recreation</i>	\$ 143	\$ 133	\$ 146	\$ 141	\$ 137	\$ 133
<i>Retail Sales</i>	\$ 189	\$ 163	\$ 163	\$ 157	\$ 153	\$ 153
<i>Visitor Air Tran.</i>	\$ -	\$ 3.8	\$ 2.1	\$ 3.4	\$ 1.8	\$ 3.2
Total Visitor Spending	\$ 933	\$ 837	\$ 906	\$ 940	\$ 965	\$ 946
Other Travel^a	\$ 4.7	\$ 0.8	\$ 3.1	\$ 1.5	\$ 2.5	\$ 2.2
Total Direct Travel Spending	\$ 938	\$ 838	\$ 909	\$ 941	\$ 967	\$ 948

Source: Arizona Office of Tourism, *Arizona Travel Impacts, 1998-2010*, prepared by Dean Runyan Associates, June 2011

^aIncludes resident air travel and travel arrangement

At the time of study completion, 2010 data was preliminary

All data adjusted for inflation and reported in constant 2010 dollars

17
18
19
20 Visitors spent the most money on lodging and food services. Spending on ground transportation and gas was *also a significant*
21 *part of overall visitor spending, but decreased as a percentage of total visitor spending 2000 to 2010. Visitors staying overnight in*
22 *hotels or motels accounted for 72% of all visitor spending in Coconino County. Day travelers accounted for another*

1 **13%**. Travelers staying in private homes (visiting county residents), campgrounds, or vacation homes accounted for
2 **the remainder** of overall visitor spending (*Arizona Office of Tourism 2011*).

3
4 In **2010**, travel spending in Coconino County generated over **\$256** million in total direct industry earnings, two
5 thirds of which was in the accommodation and food services industries. Coconino County travel spending generated
6 about **10,500** jobs, most in the accommodation and food services industries and the arts, entertainment, and
7 recreation industries (*Arizona Office of Tourism 2011*).

8
9 In addition to providing revenue to local businesses and income to employees, travel spending also provides revenue
10 to local governments through a variety of tax sources including sales taxes, lodging taxes, and other tourism-related
11 taxes. In **2010**, travel spending in Coconino County resulted in generation of about **\$29** million local taxes, and **\$38**
12 million dollars in state taxes (*Arizona Office of Tourism 2011*). The state imposes a 5.6% sales tax on most business
13 activities, and Coconino County has a 0.925% general sales tax. Incorporated cities in the county impose additional
14 sales taxes and many also have lodging taxes of 2.0 to 4.5% (*Arizona Department of Commerce 2007d*).

15
16 **Role of Tourism in the Las Vegas Economy** A large part of the Las Vegas economy is *also* based on
17 tourism (*University of Nevada Las Vegas 2010*).

- 18 • Over **37** million people visited Las Vegas in **2010**, spending **\$36.9** billion. In **2011**, visitation increased to
19 almost 39 million people
- 20 • Occupancy rate of hotel rooms in Las Vegas was about **80%** in **2010**, and the city had over 43 million occupied
21 room nights
- 22 • Las Vegas gross gaming revenue exceeded **\$8.9** billion in **2010**

23
24 **About 51%** of visitors reported going to Las Vegas for vacation or pleasure, **9%** for **gambling** and about 17% for
25 conventions, corporate meetings, or other business events. Other reasons for visiting Las Vegas included:
26 friends/relatives, gambling, special events, or other (*Las Vegas Convention and Visitors Authority 2010*).

27
28 Las Vegas is located in Clark County, which collects a **8.10%** sales and use tax. As of November **2011**, **2011** year-
29 to-date taxable sales in Clark County amounted to **\$12.4** billion (*Nevada Department of Taxation 2012*). Several Las
30 Vegas revenue sources, such as room taxes and gaming taxes, are dependent on visitors. Las Vegas collected about
31 **\$3.4** million in room taxes in **2009**, out of **\$398** million of total taxes collected (*City of Las Vegas 2009*).

32
33 Seven of the 14 air-tour operators that offer air tours over Grand Canyon base in Las Vegas. Operations of these
34 businesses (flights offered, employment opportunities, financial conditions) have been discussed as part of the
35 profile of the air-tour industry. Operators based in Las Vegas rely on tourists visiting Las Vegas for a large portion
36 of their business.

37
38 Grand Canyon is one attraction that lures visitors to the Las Vegas area; however, air tours over Grand Canyon are
39 only a small part of the overall Las Vegas tourist draw and are a small portion of the overall tourist economy.

40 41 **Grand Canyon Air-tour Industry Impacts on the Regional Economy and Las Vegas**

42
43 **The economic impact of the air-tour industry was estimated using IMPLAN v3.0, an input/output (I/O) modeling**
44 **system originally developed for the U.S. Forest Service. IMPLAN is widely used by both private sector and public**
45 **sector economists for impact analyses throughout the United States. An input-output analysis estimates the**
46 **overall economic impact on all industrial sectors that results from direct economic activity in one or more specific**
47 **sectors. Table 3.32 summarizes the overall economic impact – including direct, indirect, and induced effects – of**
48 **the Grand Canyon Air-tour industry in Coconino and Clark Counties, according to 2009 IMPLAN data.**

1 **Table 3.32** *Economic Impact of the Grand Canyon Air-tour Industry*

	<i>Coconino County</i>	<i>Clark County</i>	<i>Total</i>
<i>Direct and Indirect Employment</i>	529	1,752	2,281
<i>Percent of Total County Employment</i>	0.8%	0.2%	0.2%
<i>Employee Compensation</i>	\$20,145,218	\$83,909,312	\$104,054,530
<i>Output</i>	\$66,172,596	\$257,852,048	\$324,024,644

*Note: Estimates include both direct and indirect (multiplier) effects
Source: IMPLAN 2009*

2
3
4 *In Coconino County, the air-tour industry directly employs an estimated 298 people and indirectly supports an*
5 *additional 231 employees in other industries such as food and beverage, retail, etc. The overall employment*
6 *impact of the existing air-tour industry in Coconino County is 529 jobs, which represents less than 1% of total*
7 *county employment. The Clark County air-tour industry, which directly employs 900 employees, generates an*
8 *economic impact of an additional 852 jobs for a total impact of 1,752 jobs, or about 0.2% of total Clark County*
9 *employment.*

10
11 *Industry output, or revenue, generated directly and indirectly by the Coconino County air-tour industry is \$66*
12 *million. In Clark County, total output related to the air-tour industry and associated multipliers equal \$258*
13 *million.*

14 **Park Values**

15
16
17 As a unique feature, Grand Canyon has both non-monetary and monetary values to people who visit and to those
18 who appreciate its existence, but may never see it in person. Grand Canyon's intrinsic and existence (non-use)
19 values are discussed below. Intrinsic value includes values park visitors ascribe to their park visit beyond actual
20 expenditures. This is also referred to as consumer surplus, use benefits, or visitor day values. In general, intrinsic
21 values are easier to estimate as they are at least partially based on existing visitor data and survey information
22 collected as part of various studies. Non-use values are more difficult to estimate, although *previous surveys* have
23 *developed estimates relevant to Grand Canyon.*

24 **Intrinsic Value of Grand Canyon National Park**

25
26 GCNP visitors place a value on the park based on direct use of its resources. Park use may include viewing from
27 overlooks, hiking on trails, camping, or participating in a river trip. No studies have been done specifically on Grand
28 Canyon use value; however, an FAA report related to commercial air-tour limitations provides some Grand Canyon
29 use estimates based on studies done in other locations (FAA 2000c) *and more recent visitation data and benefits*
30 *value estimates allow updated value estimates.*

31
32 FAA used the benefit transfer method to create these estimates. FAA took existing economic studies with detailed
33 site-specific information that identified use values for visitors to other places and applied those data to Grand
34 Canyon visitors. Intrinsic use value for backcountry visitors was taken from a national study of outdoor recreation;
35 intrinsic use value for river runners from the Final EIS for Glen Canyon Dam Operations; and use value for other
36 visitors was obtained from an analysis of recreation at Bryce Canyon National Park. As a weighted average, data
37 *suggest* an intrinsic value of about \$49 per day above and beyond actual expenditures per day, previously estimated
38 to be \$80 to \$90 per day. *Table 3.33 shows the 1998 visitation data and intrinsic use values used by FAA to derive*
39 *an estimated intrinsic value for the park to visitors in 1998.*

40
41 Although the FAA report provides some estimate of GCNP's use value, the benefit transfer method, as applied, has
42 certain shortcomings. Estimates provided in Table 3.42 likely do not fully reflect Grand Canyon's actual intrinsic
43 use value mainly because values visitors place on visiting and recreating in other places will not be the same as the
44 values visitors place on Grand Canyon. Economic values estimated for intrinsic use of other places cannot

necessarily be transferred to Grand Canyon visitors, although there is some relevance since data used were derived from regional amenities with some similarity or other national park units.

Table 3.33 provides updated estimates of intrinsic use value for 2010. Updated estimates reflect the most recent GCNP visitation and river use data and estimated use values per visitor day by activity type from a 2005 national meta-study conducted for the U.S. Forest Service (Loomis 2005). The 2005 use values have been updated for inflation to 2010 dollars. The proportion of backcountry use among all GCNP visitors was assumed the same in 2010 as in 1998.

Table 3.33 Estimated Intrinsic Use Value of Grand Canyon National Park 1998 and 2010

Visitor Type	Total Visitor Days	Use Value per Visitor Day	Total Use Value
<i>1998 Estimates from FAA Report</i>			
Backcountry	92,097	\$37.13	\$3,419,562
River	66,938	\$92.44	\$6,187,749
Other	5,314,491	\$48.72	\$258,922,002
Total	5,473,526		\$268,529,312
<i>2010 Estimates from more recent data</i>			
<i>Backcountry</i>	<i>73,839</i>	<i>\$60.14</i>	<i>\$3,440,677</i>
<i>River</i>	<i>101,137</i>	<i>\$116.49</i>	<i>\$11,781,449</i>
<i>Other</i>	<i>4,213,410</i>	<i>\$56.22</i>	<i>\$236,877,910</i>
<i>Total</i>	<i>4,388,386</i>		<i>\$253,100,036</i>

Source: Federal Aviation Administration, Docket No. FAA-1999-5927-280; NPS.gov Park Statistics; Grand Canyon River Office Statistics Calendar Year 2010; Loomis 2005; Bureau of Labor Statistics Inflation Calculator

Non-use Values of Grand Canyon National Park

Estimates of non-use values rely mostly on the contingent valuation method, which asks survey respondents who are not visitors to a particular place to answer questions about values they ascribe to that place. This method is relatively controversial due to the survey questions' hypothetical nature, and arguments have been made that values estimated from these surveys are inflated. Regardless, non-use values such as World Heritage designation and importance to native people, Americans, and global visitors clearly exist for Grand Canyon and are relevant in this EIS.

At least one non-use study relates to the Glen Canyon and Grand Canyon area. The survey's focus was the value respondents placed on improving environmental and cultural resources in this area. The sample group included people in the local area as well as a national sample group. Average non-use values for the Glen Canyon/Grand Canyon area were found to range about \$20 to \$30 per household and estimates of total non-use value of the area were estimated in the range of about \$3.5 billion to \$5 billion when calculated at the national level (2010 dollars⁵²) (Welsh, et al. 1995).

This information demonstrates there is a value the public ascribes to the presence or existence of GCNP in its current condition, regardless of whether they have visited or will ever visit the park. However, contingent valuation information applied in this instance presents several limitations when attempting to place a quantifiable dollar value on those perceptions. These figures are based on hypothetical questions of willingness to pay for an improvement to a resource that may have limited relevance to this particular case. Also, this particular study estimated the value of both Glen Canyon and Grand Canyon together and the estimated total non-use value may not reflect Grand Canyon by itself.

⁵² 1995 Welsh report figures were updated to 2010 dollars using the Bureau of Labor Statistics CPI inflation calculator

CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

GENERAL METHODOLOGY FOR ESTABLISHING IMPACT INTENSITY THRESHOLDS AND MEASURING EFFECTS BY RESOURCE

General Analysis Method

Impact analyses and conclusions are based on data from existing literature, information, and insights provided by NPS, other agency experts, and professional judgment. A very large amount of data was produced and examined for this analysis, using a wide variety of metrics related to sound, noise, and other subjects. All available data and other relevant factors (context, duration, timing) were carefully considered in making impact determinations in this EIS.

Items Specific to Meeting NPS Criteria for NEPA Analysis

When developing impact criteria and thresholds for NEPA documents, the NPS follows NPS Director's Order 12, Conservation Planning, Environmental Impact Analysis and Decision Making, to develop park (and/or project) specific impact criteria and thresholds, taking into consideration the type of proposed action and context, intensity, duration, and timing of potential impacts. Because impact analyses must consider all of these factors, a given action may have a variety of impacts (for example, major adverse localized impacts in some areas, and moderate beneficial impacts in others). Thresholds and other criteria for each impact topic evaluated in this EIS were developed to determine relative differences in impacts among Alternatives solely for this project. They represent a means to evaluate impacts of this project as required by NEPA, and as such, they are not necessarily applicable to all GCNP projects or to similar projects in other parks. *All determinations in this EIS were made by NPS, are specific to the Overflights Act, and have no broader application.* Figure 4.1 outlines the NPS impact analysis process.

Effects of Alternatives were analyzed by evaluating existing impacts of Alternative A (No Action/Current Conditions), then comparing anticipated impacts of Action Alternatives (E, F, and *Modified Preferred*) to Alternative A's existing impacts. Impacts are presented and compared to Alternative A for Base Year and Ten-Year Forecast Peak and Off-Peak Seasons (see below for definitions).

Methodology

For each impact topic described in Chapter 3, the following impact assessment methodology was followed for each Alternative

1. Define Issues of Concern

Issues were developed based on public and internal scoping and tribal consultation described in Chapters 1 and 5.

2. Identify Area of Potential Effect

Unless otherwise specified for an individual impact topic, Area of Potential Effect for this EIS is generally the Special Flight Rules Area for direct effects, and the entire study area⁵³ for cumulative effects. However, for substantial restoration of natural quiet, the Area of Potential Effect is Grand Canyon National Park, not the entire SFRA or study area, and only up to 17,999 feet MSL (73 Federal Register 55130).

Direct effects of Alternatives primarily include impacts of air-tour and air-tour-related aircraft, which vary by Alternative below 18,000 feet MSL in the SFRA. Effects of other aircraft below 18,000 feet within the SFRA do not vary by Alternative and are included in the analysis. Effects of other noise sources, including all ground-based noise sources and aircraft above and outside the SFRA are included only in Cumulative Effects analysis (see below).

3. Identify Mitigation Measures

Action Alternative mitigation measures to manage aircraft impacts are described in Chapter 2. Impact analysis considers mitigation measures reasonably implemented before assessing impacts

⁵³ As described in Chapter 1's Scope of Analysis and shown on Map 1.2, the rectangular study area encompasses the park, the Special Flight Rules Area, and lands beyond

4. Identify Environmental Consequences

Environmental Consequences (Impacts or Effects) are described using the following bulleted items.

- **Timeframe**

Evaluation considered a change in air-tour noise impacts over time resulting from actions proposed in the Alternatives such as changes in air-tour routes, air-tour operations, and/or implementation of quiet-technology incentives or requirements. For each Alternative, analysis includes impact assessment during Base Year and Ten-Year Forecast. In addition, in the Action Alternatives, analysis considers seasonal changes in air-tour routes or route use. Therefore, impacts were considered during an Alternative's Peak and Off-Peak Season. Peak and Off-Peak Season vary by Alternative, as shown below, with the exception of Alternative A, No Action/Current Conditions, which does not have Peak and Off-Peak Seasons

Under Alternative A, all routes are open and can be used year-round. Historically fewer operations occur in winter, but some winter high-use days approach Peak Day.⁵⁴ Because there are no seasonal differences in management of air-tours under Alternative A, only Peak Day was included in Alternative A's impact analysis (Peak Day could theoretically occur any time of year because, in Alternative A, no management constraints limit or prevent use)

- **Base Year** 2005 is the Base Year used for noise modeling in this EIS. The best available data as of the end of 2005 is used as the base for noise modeling for the Alternatives. Since 2005, the 2005 database has been checked against data from subsequent years, and although there are some differences, given all factors contributing to those differences, the 2005 database has proven consistent enough to continue as a reasonable base for evaluating impacts of Alternatives in this EIS. *NPS and FAA jointly examined all data available at the time (to 2009) to determine if data from a different year would provide enough difference to warrant re-modeling Alternatives previously modeled by Volpe 2006-2007. In data examined through 2009, both NPS and FAA concluded there was not sufficient difference in more recent years to re-do the modeling, and that 2005 data still presented an accurate summary of noise conditions*

- **Ten-Year Forecast** Ten-Year Forecast is the best estimate of what will occur ten years after implementing each Alternative, starting from the Base Year scenario. For the Ten-Year Forecast, growth in aircraft operations was assumed as explained in Appendix D. Also, full implementation of each Alternative's action elements is assumed to be achieved in the Ten-Year Forecast (for example, full conversion to quiet-technology aircraft if that is an Alternative element)

- **Peak Season** Because Action Alternatives (E, F, and *Modified Preferred*) propose different seasonal changes to routes, Alternatives are analyzed for different Peak Seasons. Alternative A (No Action/Current Conditions) does not contain, and is not analyzed for, Peak and Off-Peak Seasons

Alternative	Peak Season
E	July 1- September 15
F	February 1-November 30
<i>Modified Preferred</i>	<i>April 1-November 14</i>

⁵⁴ Peak Day Noise analysis for this EIS is based on a 12-hour time period of 7 a.m. to 7 p.m. on the Peak Day, the day with the highest total number of air-tour and air-tour-related operations. Based on a review of the best available data at the time EIS noise modeling analysis began, Peak Day occurred August 8, 2005, with a total 635 operations. This day forms the basis for Base Year analyses for the Alternatives. Data for subsequent years was checked to ensure use of 2005 Peak Day as the basis for Base Year analysis was still reasonable

- 1 • **Off-Peak Season** Because Action Alternatives (E, F, and **Modified Preferred**) propose different
 2 seasonal changes to routes, Alternatives are analyzed for different Off-Peak Seasons. Alternative A (No
 3 Action/Current Conditions) does not contain, and is not analyzed for, Peak and Off-Peak Seasons

Alternative	Off Peak Season
E	September 16-June 30
F	December 1-January 31
Modified Preferred	November 15-March 31

4
5
6 Effects were characterized based on

- 7 • **Direct Effect** Caused by an action and occurs in the same time and place as the action
8
- 9 • **Indirect Effect** Caused by an action but occurs later in time or farther away but still reasonably
10 foreseeable
- 11
- 12 • **Beneficial Effect** Generally a positive change in resource condition, a positive change in visitor
13 experience, or a change that moves a resource or visitor experience toward a
14 desired condition (consistent with the purpose and/or management objectives of
15 the affected park land or other area)
- 16
- 17 • **Adverse Effect** Generally a change that moves the resource or visitor experience away from a
18 desired condition or that detracts from visitor experience or resource condition.
19 More specific descriptions of adverse and beneficial impacts may be provided
20 for individual Impact Topics
- 21
- 22 • **Impact Intensity** Uses four intensity thresholds, **negligible**, **minor**, **moderate**, and **major**
23 as defined for each impact topic and explained below in Impact Intensity
24 Threshold and shown in Table 4.1
- 25
- 26 • **Duration** Considers length of time a resource would be affected by an event or related
27 series of events. Duration (**short or long term**) varies by impact topic and is
28 addressed in each
- 29
- 30 • **Timing** Considers sensitive time periods or seasons, sensitive time(s) of day, how often
31 impact would occur, and whether impact is recurring
- 32
- 33 • **Area** **Marble Canyon, East End, Central, and West End** as shown on Map 3.2
- 34
- 35 • **Context** Generally refers to an impact's geographical extent, whether **regional** or
36 **localized**, but also whether it would occur in a location sensitive to such
37 impacts. Generally, regional impacts in this EIS are associated with a large part
38 of the park or SFRA. Localized impacts are generally associated with specific
39 sites or flight routes. If definitions vary from these, they are discussed under that
40 impact topic
- 41 ○ **Management Zone** Park Management Zones are an important part of Context (see
42 above) for some Impact Topics. Park Management Zones considered in this EIS are
43 **Wilderness, Non-Wilderness, and Developed** (as described in Chapter 3). In general,
44 impact analyses consider that, in the Developed Zone (about 2% of the park), more
45 noise sources are present and more noise impact (from all sources, including aircraft)
46 are accepted than in Wilderness and Non-Wilderness Zones, based on each
47 Management Zone's objectives
- 48

- 1 • **Cumulative Effect** As described in CEQ’s regulation 1508.7 as follows
 - 2 ○ Cumulative Impacts are impacts that result from incremental impacts of the
 - 3 action when added to other past, present, and reasonably foreseeable future
 - 4 actions, regardless of what agency or person undertakes such other actions
 - 5 ○ Cumulative Impacts can result from individually minor but collectively
 - 6 significant actions taking place over a period of time

7
8 Each cumulative impact analysis is additive, considering the overall impact of each
9 Alternative when combined with effects of other past, present, and reasonably
10 foreseeable future actions—in and outside the Area of Potential Effect. Thus, it was
11 necessary to identify other ongoing or reasonably foreseeable future projects at GCNP
12 and, if applicable, the surrounding region. Because the scope of this project is relatively
13 large, the geographic and temporal scope of the cumulative analysis is similarly large.
14 The geographic scope for this analysis includes actions in and adjacent to park
15 boundaries, while the temporal scope includes projects in a range of generally ten years
16 (except Ethnographic Resources which considers a longer period). Given this, projects
17 were identified for conducting cumulative effects analysis, and are listed in Appendix G

18
19 Cumulative effects analysis includes noise from aircraft flying 18,000 feet and above,
20 aircraft flying below 18,000 feet but outside the SFRA, non-aircraft noise sources, and
21 impacts of Alternatives

22
23 The park area affected by non-aircraft noise sources is localized to areas of human use,
24 primarily Developed Zone areas (2% of the park), and a small component from vehicles
25 on remote roads, motorboats on the Colorado River, and area mining activities. Aircraft
26 flights above and outside the SFRA are the primary cumulative noise source impacting
27 most of the SFRA
28

29 **Sound Metrics and Noise Modeling For All Alternatives**

30
31 Noise was characterized based on the following metrics.

32
33 FAA’s Integrated Noise Model (INM) was used to predict effects of Alternatives regarding Soundscape and noise
34 impacts. For additional information on metrics and modeling see Appendix D.
35

- 36 • **Percent Time Audible (%TAUD)** *Sometimes also called Audibility in this EIS.* Percent of time during the 12-hour day
37 used in this analysis (7 a.m. to 7 p.m.) aircraft noise can be heard by humans and other
38 animals with normal hearing. Percent Time Audible refers to potential for a human or
39 animal to detect presence of sound, and provides information primarily related to
40 duration of aircraft noise impacts
41

42 The extent to which aircraft noise are actually heard on the ground depends on amplitude
43 (sound pressure level) and sound structure (its frequency content and temporal pattern);
44 hearing ability and attention of the animal or human; and other simultaneous sounds
45 (ambient conditions). Since aircraft noise can be heard at or below ambient conditions,
46 the Percent Time Audible metric is even sensitive to distant noise. However, because
47 Percent Time Audible says nothing about how loud the aircraft is, Percent Time Audible
48 is used in conjunction with Average Sound Level (L_{Aeq12}), Percent Time Above (TALA),
49 **and Distance** metrics (both described below) to provide additional insight into the nature
50 of the noise and its potential impacts
51

52 Percent Time Audible was also used to assess restoration of natural quiet to GCNP’s
53 Soundscape. Substantial Restoration of Natural Quiet is defined by NPS to mean 50% or
54 more of the park will achieve natural quiet (no aircraft audible) 75 to 100% of the day,
55 each and every day. All Alternatives must meet Public Law 100-91 provisions to
56 substantially restore natural quiet in the park. However, Substantial Restoration of

1 Natural Quiet is a determination rather than a metric value that lends itself to an impact
 2 intensity level definition, and is applicable only to GCNP, not other lands in the SFRA or
 3 study area. The *progress toward* Substantial Restoration of Natural Quiet *made* by an
 4 Alternative is not reported in terms of negligible, minor, moderate, or major impact
 5 intensity level. In addition Percent Time Audible was only calculated within the GCNP
 6 boundary
 7

8 • **Average**
 9 **Sound**
 10 **Level** (L_{Aeq12})

11 **Also known as Equivalent Sound Level.** The logarithmic average, on an energy basis,
 12 of aircraft noise pressure levels in decibels (dBA) over the 12-hour day used in this
 13 analysis. Average Sound Level takes into account number of aircraft operations,
 14 their time-varying sound levels, and their duration. It provides information primarily
 15 related to energy intensity of aircraft noise impacts (in lay terms, loudness). However,
 16 occasional loud sound levels may heavily influence (increase) Average Sound Level.
 17 Long periods without aircraft noise may also influence (decrease) Average Sound Level
 18 values. The Average Sound Level metric does not take ambient sound levels into account
 19 and only provides a measure of sound levels emitted by aircraft operations by themselves.
 20 Average Sound Level is used in conjunction with Percent Time Audible and Percent
 21 Time Above to gain fuller insight into the nature of the noise and its potential impacts

22 • **Distance**
 23 **in Meters**

24 Distance (**also known as Slant Distance**) relates primarily to **proximity** of aircraft to
 25 a location or point of interest on the ground, such as a visitor attraction site or wildlife
 26 habitat, not to the relationship of distance and sound levels. Distance impacts include
 27 visual aspects such as how big or how close an aircraft appears to visitors or wildlife
 28 on the ground, with related issues of disturbance, seclusion, solitude, and privacy

29 Distance measures also provide important information about opportunities for air-tour
 30 visitors to view specific ground features. (Ground points of interest, known as Location
 31 Points, are shown on Map 3.2). **Distances shown in analysis are for Peak Season only.**
 32 For routes that change during Off-Peak Season, Distances for routes not in use during
 33 Off-Peak Season would be greater than 2,000 meters

34 • **Percent Time Above**

35 35, 45, and 55 dBA (TALA35, TALA45, and TALA55, respectively)
 36 Percentage of time during the 12-hour day used in this analysis that aircraft noise
 37 exceed 35, 45, and 55 dBA, respectively. The 10 dBA increments generally represent
 38 a ten-fold increase in number of aircraft (assuming roughly the same amount of noise
 39 for each aircraft). Percent Time Above metrics are used in conjunction with Average
 40 Sound Level and Percent Time Audible to gain fuller insight into the nature of the noise
 41 and its potential impacts

42 Two types of noise-modeling analyses were performed for this EIS, 1) Contour Analysis (Percent Time Audible and
 43 Average Sound Level), and 2) representative Location Point Analysis (for all metrics).

44 • **Contour Analysis**

45 Produced maps presenting SFRA flight tracks and key features, with data values in
 46 colored contours for the entire park and and/or SFRA as shown in each map's legend;
 47 data tables summarize contour data by Management Zone (Developed, Non-Wilderness,
 48 and Wilderness). Contour Analysis was not performed for Marble Canyon, East End,
 49 Central, and West End and SFRA (see Appendix D for further information on INM
 50 modeling)

51 • **Location Point**
 52 **Analysis**

53 NPS identified 127 individual points (shown on Map 3.2 and Table 3.2) to represent
 54 noise-sensitive areas for park resources or visitor experiences, or as part of a ten-
 55 kilometer grid to ensure sufficient locations throughout the park were included in
 56 noise modeling. For further information on noise modeling see Appendix D

Both Contour and Location Point Analysis include Percent Time Audible and Average
 Sound Level. Percent Time Above is only computed for Location Point Analysis.

1 Because ambient data outside GCNP is limited, and calculations of Percent Time Audible
 2 require ambient values as inputs, Percent Time Audible is only calculated for the area
 3 inside GCNP. Calculations of Average Sound Level require noise source data as inputs
 4 (mostly aircraft in this EIS), so Average Sound Level is calculated for the entire SFRA.
 5

- 6 • **Dual-Zone System** Noise modeling for this EIS uses a Dual-Zone System (Audibility and Noticeability),⁵⁵
 7 for Percent Time Audible calculations, which generally addresses different objectives for
 8 different Management Zones. Specifically, for *the Audibility Zone* (approximately 66%
 9 of the park), natural ambient sound levels were used directly in computing Percent Time
 10 Audible in the noise model. For areas in the Noticeability Zone (approximately 34% of
 11 the park), 10 dB were added to natural ambient sound levels in the noise model to
 12 account for factors such as increased visitor activity and presence of non-natural sound
 13 sources. For reasons explained in the Federal Register Notice described in the footnote,
 14 when NPS and FAA agreed to use the Dual-Zone System for modeling at GCNP, most of
 15 the Developed Zone (including South and North Rim developed areas), GCNP's West
 16 End, and Marble Canyon are within the Noticeability Zone
 17

18 The Dual-Zone System was used in calculations to assess whether natural quiet has been
 19 substantially restored to GCNP. When interpreting modeling results, NPS takes into
 20 account that the overall definition of Substantial Restoration of Natural Quiet is based on
 21 audibility, not noticeability
 22

23 Development of Impact Intensity Thresholds

24 To identify possible consequences of noise exposure, NPS reviewed noise standards accepted by the American
 25 National Standards Institute (ANSI) and the Environmental Protection Agency (EPA), the entire body of relevant
 26 peer-reviewed scientific literature, park management objectives and mandates (GMP, NPS Management Policies,
 27 etc.), natural ambient and other sound data measured at Grand Canyon, and public scoping comments. NPS also
 28 consulted applicable agencies, scientists, subject-matter and resource experts, and affiliated tribes.
 29

30 Consistent with CEQ regulations (40 CFR 1502.22), and NPS Director's Order 12, Conservation Planning,
 31 Environmental Impact Analysis and Decision Making (Sections 4.4 and 4.5), and considering the review described
 32 above, the NPS determined that
 33

- 34 • The current state of scientific knowledge is incomplete or unavailable for some effects of aircraft noise on
 35 Impact Topics evaluated in this EIS. For example, numerous studies document responses of visitors and wildlife
 36 to loud noise events. However, chronic exposure to less obvious (less loud) noise sources is less understood.
 37 Also evidence of behavioral responses to noise is insufficient to be decisively interpreted or dismissed
- 38 • Impact analysis methodology is essential in evaluating reasonably foreseeable significant adverse impacts on
 39 the human environment
- 40 • Simple comparisons of noise metric values do not provide enough information to understand differences in
 41 impacts among Alternatives sufficient to make reasoned decisions based on best available science
 42

43 After considering the above bulleted items, and incorporating theoretical approaches and research methods generally
 44 accepted in the scientific community, NPS used professional judgment regarding consequences requiring
 45 management action to develop impact intensity threshold descriptions and select specific values for the quantitative
 46 framework shown in Table 4.1. For all Impact Topics except Socioeconomics (to which noise modeling does not
 47 apply), NPS applied noise modeling and other data to threshold descriptions to make determinations on Alternative
 48 A (No Action/Current Conditions) impact levels, then used a similar approach to evaluate changes in impacts for
 49 Action Alternatives compared to Alternative A.
 50

51 The quantitative framework in Table 4.1 is only one part of the impact intensity determination process. While this
 52 framework is integrated into impact intensity threshold descriptions as applicable for individual Impact Topics, it is

⁵⁵ Audibility/Noticeability zones for noise modeling are not the same as park Management Zones. The Dual-Zone System is explained in 64 Federal Register 3969 and 38006, Notice Change in Noise Evaluation Methodology for Air-tour operations Over Grand Canyon National Park, and in Appendix D. A map of Dual-Zones for noise modeling is in Appendix D, Fig. 1

impossible to develop a single framework that works equally well in all situations all the time. Therefore, final impact intensity determinations may differ from a strict adherence to the framework if, in NPS professional judgment, the preponderance of evidence from all available information in relation to context, duration, or timing indicates a different impact level or a range of levels, such as situations where not all metrics indicate the same impact intensity level.

Multiple metrics and approaches are considered as appropriate for each impact topic and situation to provide the most reasonably complete description of noise and other impacts. Potential for interactive effects of metrics grouped together are examined, in addition to values of individual metrics. Scientific literature most closely related to individual species and specific situations was also re-evaluated to see if any adjustment to impact intensity level indicated by the framework was warranted considering the particular context, duration, or timing involved. To estimate level and length of time a resource or visitor may be affected by aircraft noise, Percent Time Audible in combination with Average Sound Levels were the primary metrics evaluated. Distance was also a factor (except in Soundscapes and Socioeconomics where Distance does not apply). In addition, analyses considered the qualitative response a resource or visitor would likely have to the sound environment. Both the metrics and this assessment of response were used to determine level of impact.

There were many cases when metrics did not all clearly indicate the same level of impact (negligible, minor, moderate, or major). In such cases, a hierarchy was generally applied relating to a metric's importance level in eliciting visitor or resource response, tempered by professional judgment related to metric values in specific situations. Percent Time Audible was usually given more weight in determining impact level because it generally better indicates amount of time a resource or visitor is exposed to conditions outside natural conditions (i.e., impacted at some level) than Average Sound Level (usually second in the hierarchy) or Distance (usually third in the hierarchy). Metrics indicating Percent Time Above certain decibel levels were usually considered to help clarify information provided by the other metrics.

For areas outside GCNP, but in the SFRA where Percent Time Audible was not assessed, Average Sound Level was normally considered more important in determining impact intensity level than Distance.

Table 4.1 NPS Quantitative Impact Analysis Framework

Metric ^a	Negligible	Minor	Moderate	Major
Percent Time Audible (Aircraft) during a 12-hour Day ^{bc}	Less than 5%	Greater than <i>or equal to</i> 5% and less than 10%	Greater than <i>or equal to</i> 10% and less than 25%	Greater than <i>or equal to</i> 25%
Average Sound Level (L_{Aeq12}) Energy Average of Aircraft noise Levels during a 12-hour Day ^d	Less than 15 dBA	Greater than <i>or equal to</i> 15 dBA and less than 25 dBA	Greater than <i>or equal to</i> 25 dBA and less than 35 dBA	Greater than <i>or equal to</i> 35 dBA
Distance between Points of Interest on the Ground and Aircraft Routes	Greater than 2,000 meters	Less than <i>or equal to</i> 2,000 meters and greater than 1,000 meters	Less than <i>or equal to</i> 1,000 meters and greater than 500 meters	Less than <i>or equal to</i> 500 meters

^aSee text above for definitions of these metrics

^bPercent Time Audible and Average Sound Level consider a 12-hour time period (7 a.m. to 7 p.m.)

^cThe framework for negligible, minor, moderate, and major in terms of Percent Time Audible was selected for reasons which include 1) Substantial Restoration of Natural Quiet at GCNP depends on park percent in which aircraft are audible less than 25% of a 12-hour day (the breakpoint between moderate and major impact levels); 2) 5% Percent Time Audible translates to an average of one flight per hour for the entire 12-hour day using an average of three minutes audibility per flight (the breakpoint between Negligible and Minor impact levels); and 3) 10% Percent Time Audible is a reasonable minor/moderate breakpoint considering the other two breakpoints and all above information sources

^dSpecific Average Sound Levels values were selected in the framework for reasons which include 1) accepted EPA and ANSI standards (Acoustical Society of America 2002, Crocker1997) recommend levels at and below 35 dBA (breakpoint between moderate and major impact levels) for numerous indoor settings where there is a reasonable expectation for quiet (classrooms, theaters), and for outdoor rural settings; 2) increments of 10 dBA in Average Sound Level are consistent with a ten-fold increase in number of aircraft (assuming roughly the same amount of noise for each aircraft)

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Summary

Impacts are presented in the most reasonably accurate manner available. As appropriate, different impact intensity descriptions are presented for different locations, contexts, or time periods. Impacts are not averaged over large areas or long periods unless specifically stated. For example, moderate to major adverse impacts might occur beneath flight routes at the same time moderate to major beneficial impacts occur in portions of Flight-Free Zones, and impacts may be quite different during different time periods.

The NPS equates the term *major impacts* (or effects) to the term *significant* as used in NEPA and its implementing regulations. The NPS thus distinguishes between proposed actions and associated effects requiring EIS preparation versus those that require only an Environmental Assessment.

All available data were comprehensively examined to make impact determinations for each impact topic using standard NPS impact analysis methods outlined in Figure 4.1 to Figure 4.5. Criteria or conditions considered in determining magnitude of impact were developed based on guidance from the NPS Intermountain Regional Office Environmental Quality Division, the NPS Natural Resource Program Center’s Natural Sounds Program, and park planning and resource staffs’ best professional judgment. Likewise, intensity determined for each impact topic was based on all available data.

Figure 4.1 General NPS Methodology for Impact Analysis

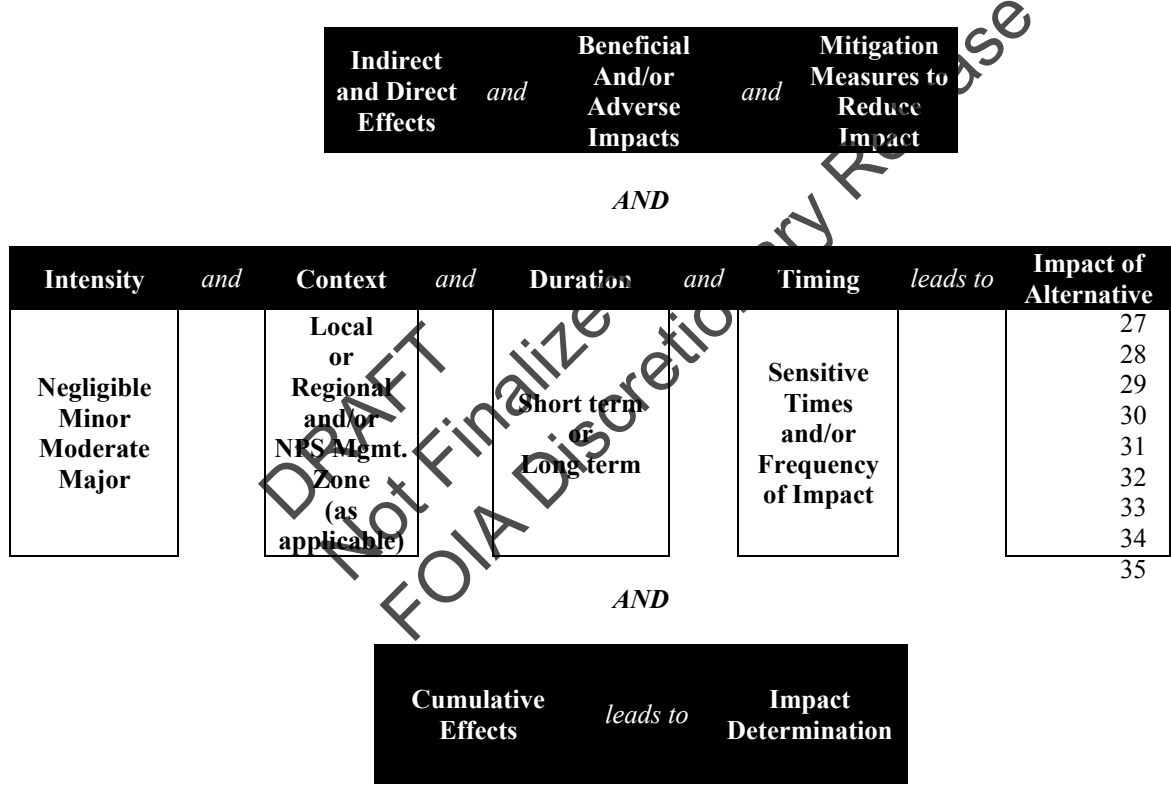
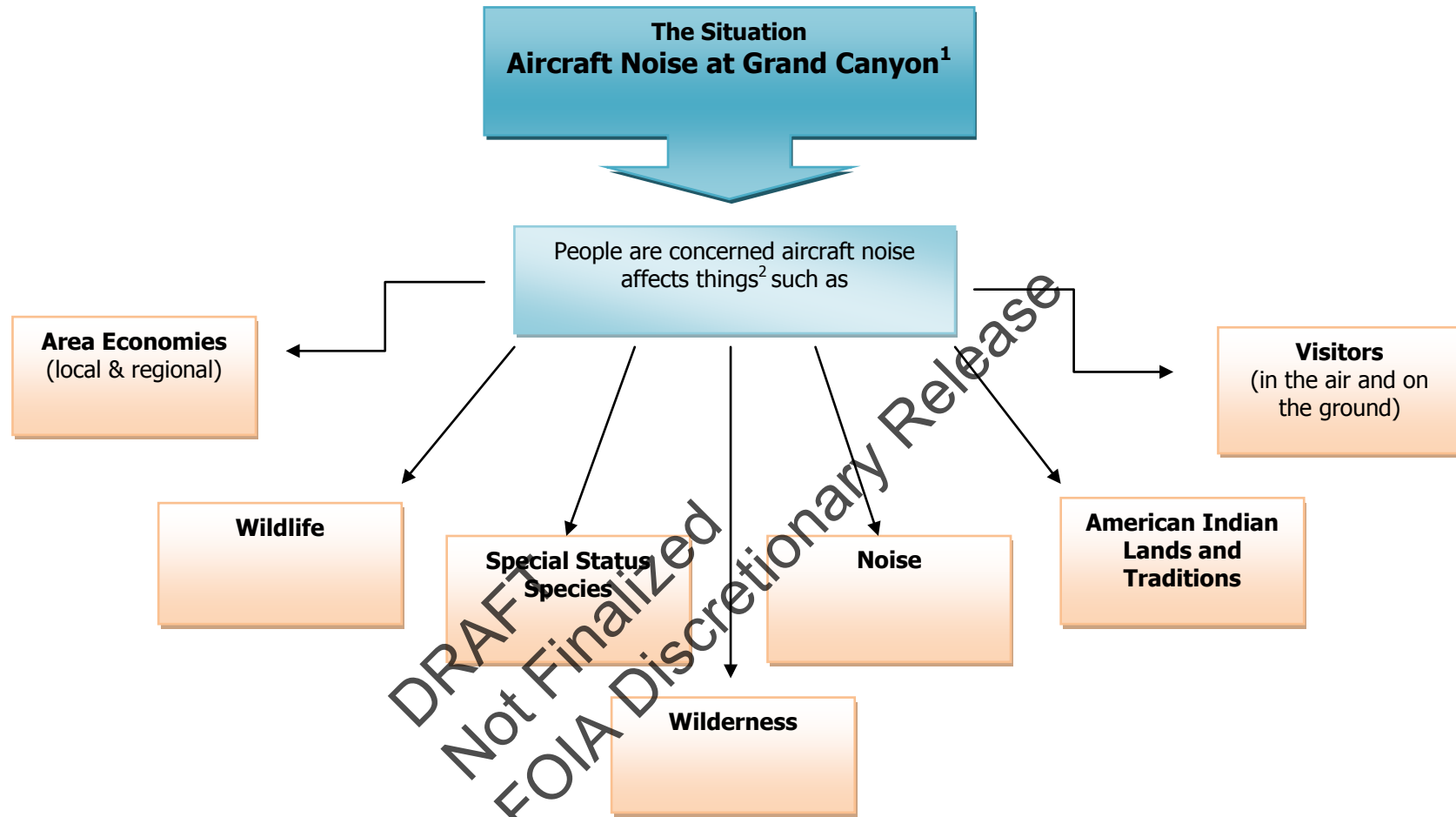


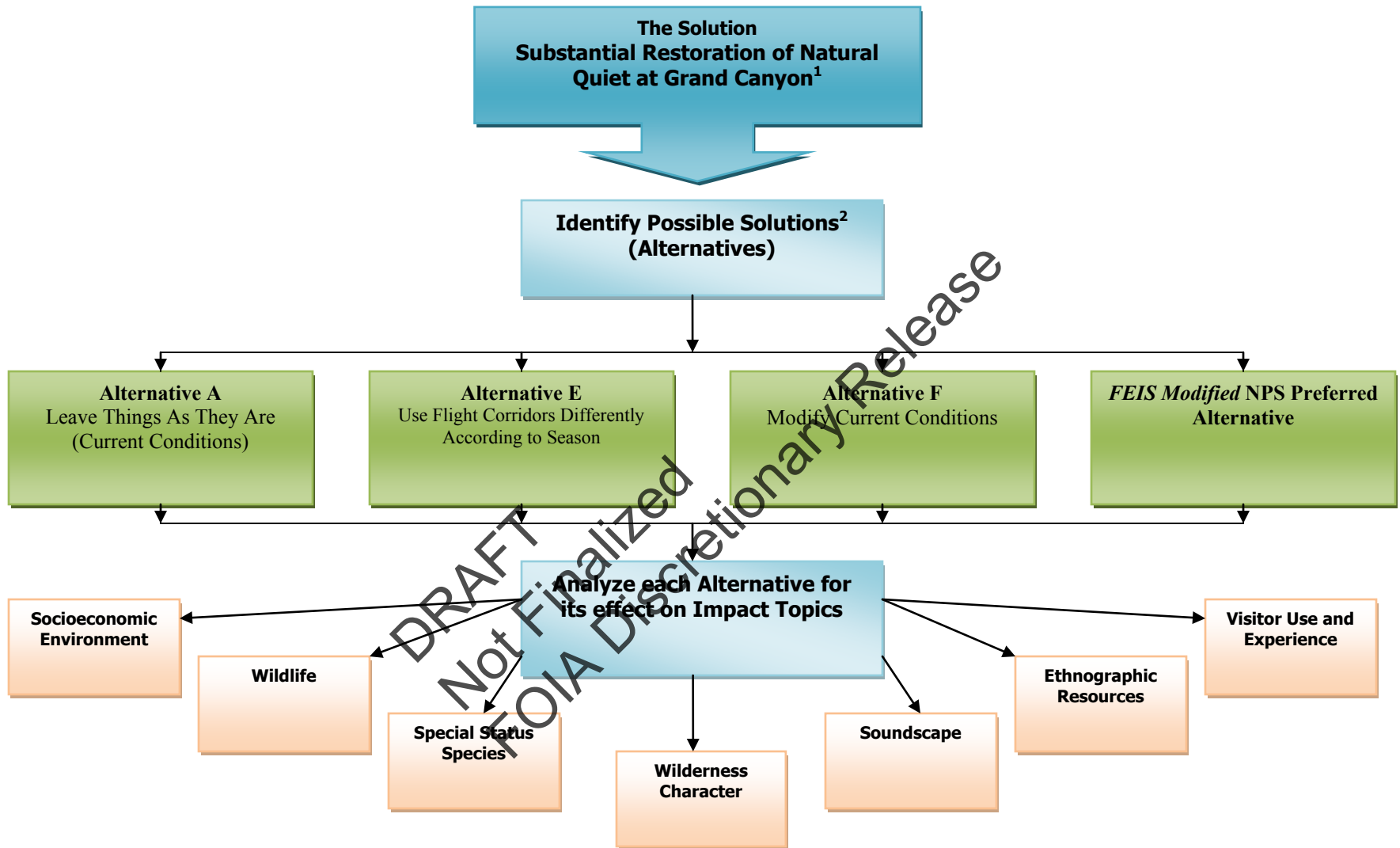
Figure 4.2 The EIS Process Step One



¹ In an EIS the affected location is called the *Area of Potential Effect* or the *Study Area*. In this EIS, the Study Area is larger than Grand Canyon National Park. See Map 1.2

² Things potentially affected by the situation are called *Impact Topics* listed in the next Figure, and are determined as described in Chapter 1

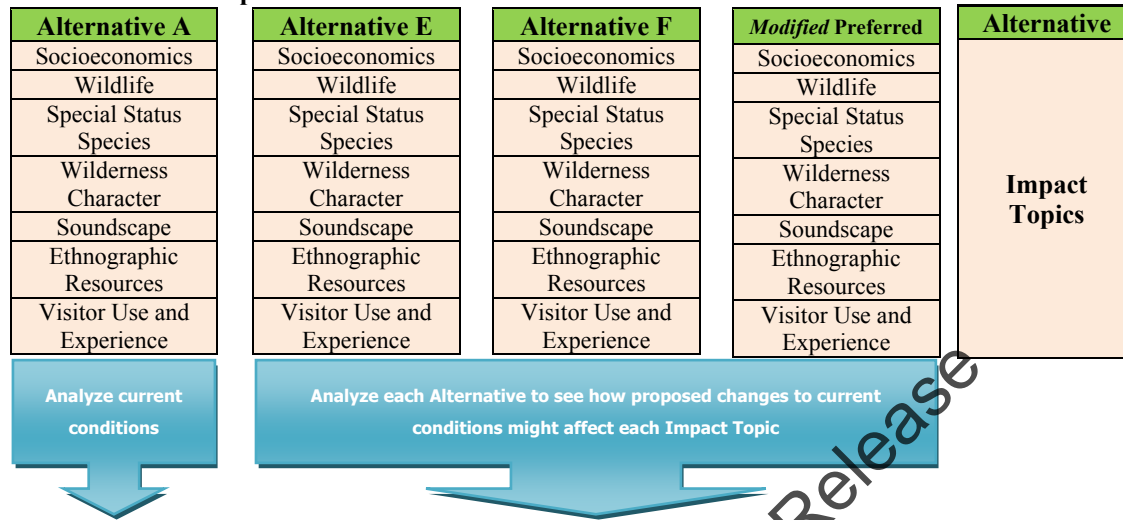
Figure 4.3 The EIS Process Step Two



¹As directed by law and policy; see Chapter 1 and Appendix A

²Alternatives are derived from public scoping, consultation, and subject-matter experts as described in Chapters 2 and 5

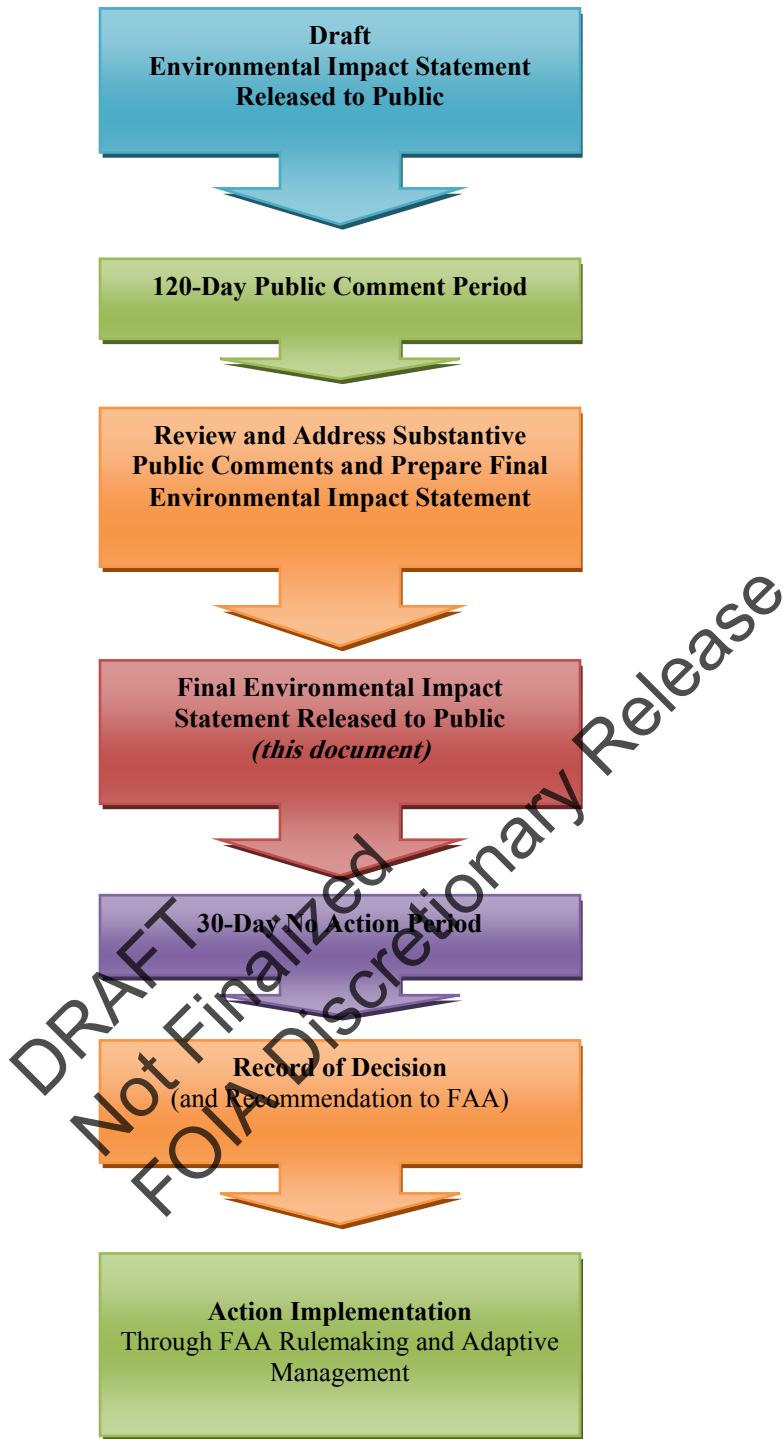
Figure 4.4 The EIS Process Step Three



In this EIS, Impact Topics under Each Alternative are Analyzed by								
Effects	Direct	Metrics	Percent Time Audible	Time Frame	Peak Season			
	Indirect		Average Sound Level		Off-Peak Season			
	Beneficial		Distance	<p>Factors in this Table are combined and assessed to reach a conclusion about each Alternative's combined effects, as shown in Figure 4.1 and summarized in Table 2.6</p>				
Adverse	Percent Time Above							
Intensity	Negligible		Marble Canyon					
	Minor		East End					
	Moderate		Central					
	Major		West End					
Duration	Short Term		Management Zone				Developed	
	Long Term						Non-Wilderness	
Context	Localized	Wilderness	Cumulative Impacts				Alternative impacts plus impacts from other past, present, and reasonably foreseeable future actions	
	Regional	Time Frame					Base Year	
Timing	Sensitive Times and/or Frequency of Impact		Ten-Year Forecast	<p>Definition of Each Term Above Remains the Same for All Alternatives</p>				
		Peak and Off Peak Season Change in Alternatives E, F, and Modified Preferred						
<p>Each Term Above Is Defined in Each Alternative</p>								
<p>All Above Terms are Defined in this Methodology Section</p>								

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Figure 4.5 The EIS Process Step Four



SOUNDSCAPE

General Methodology

Soundscape

Methods and impact *intensity* thresholds used for Soundscape analysis in this EIS were developed specifically for circumstances at GCNP, and are not necessarily intended to be used or set precedents for use, in other national parks. **All determinations in this EIS were made by NPS, are specific to the Overflights Act, and have no broader application.** In the thresholds below, all aspects of aircraft noise intensity and duration including, but not limited to, aircraft Percent Time Audible and Average Sound Level are included in the term *aircraft noise intensity*. Also, see Chapter 4, General Methodology, for a discussion of overall methodology for impact analysis for all impact topics.

Because Soundscapes are recognized as a resource throughout the national park system, **and the SFRA is a product of the Overflights Act, solely** for the purpose of this EIS these **methods and** thresholds apply to other NPS-managed lands within the SFRA boundary, including NPS lands in Lake Mead National Recreation Area, Glen Canyon National Recreation Area, and Grand Canyon-Parashant National Monument; **impacts for these areas are described below in NPS Units in SFRA Outside GCNP. These methods and thresholds have not been applied to lands outside the SFRA within these NPS units, and analysis related to substantial restoration of natural quiet has only been applied to GCNP.**

Soundscape impact analysis is presented 1) by Zone (Developed, Non-Wilderness, Wilderness) emphasizing Contour Analysis data in GCNP, 2) by Area (Marble Canyon, East End, Central, West End) emphasizing Location Point data in the SFRA, 3) for NPS Units in the SFRA but Outside GCNP, 4) Cumulative Impacts, and 5) Conclusion.

A summary of impacts across Alternatives is provided at the end of Soundscapes in Summary of Impacts, All Alternatives, Soundscape.

All metrics modeled in noise analysis were reviewed and considered even if not listed in threshold definitions.

NPS Impact Intensity Threshold Descriptions

General Methodology

Soundscape

Threshold Levels

Soundscape

<i>Negligible</i>	Aircraft noise rarely audible, aircraft audible less than 5% of the 12-hour day used in this analysis. Natural sounds predominate.
	Average aircraft noise intensity in a specific area less than 15 dBA
<i>Minor</i>	Aircraft noise audible for a small portion of applicable time periods, aircraft audible greater than or equal to 5% and less than 10% of the 12-hour day
	Average aircraft noise intensity in a specific area greater than or equal to 15 dBA and less than 25 dBA
<i>Moderate</i>	Aircraft noise audible for an intermediate portion of applicable time periods, aircraft audible greater than or equal to 10% and less than 25% of the 12-hour day
	Average aircraft noise intensity in a specific area greater than or equal to 25 dBA and less than 35 dBA
<i>Major</i>	Aircraft noise audible for a large portion of applicable time periods, aircraft audible greater than or equal to 25% of the 12-hour day
	Average aircraft noise intensity in a specific area greater than or equal to 35 dBA

1	Type of Impact	Soundscape
2		
3	<i>Adverse</i>	Impacts detract from progress toward achieving substantial restoration of natural quiet or other
4		Overflights Act mandates , increase aircraft noise intensity or audibility , and/or increase duration
5		of aircraft noise events
6		
7	<i>Beneficial</i>	Impacts contribute to progress toward achieving substantial restoration of natural quiet or other
8		Overflights Act mandates , decrease aircraft noise intensity or audibility , and/or decrease duration
9		of aircraft noise events. Beneficial effects are usually described in terms of changes in impacts
10		compared to Alternative A
11	Context	Soundscape
12		
13	<i>Regional</i>	Impacts affect majority of the park or SFRA, or multiple backcountry use areas, attraction sites,
14		trails, or flight routes
15		
16	<i>Localized</i>	Impacts affect a small area, such as a single backcountry use area, a specific attraction site, a
17		specific trail, or flight route
18		
19	<i>Park</i>	Non-natural sound has greatest intensity of impact in NPS areas in the Wilderness Zone,
20	<i>Management</i>	then Non-Wilderness Zone, and least in the Developed Zone. For example, an Average
21	<i>Zone</i>	Sound Level consistent with the moderate intensity level definition in the Wilderness Zone may be
22		considered a minor intensity impact in the Developed Zone while the same level in the Non-
23		Wilderness Zone may be considered minor-to-moderate, depending on other factors including
24		duration and timing
25	Duration	Soundscape
26		
27	<i>Short Term</i>	Impacts associated with individual, infrequent, and/or non-repetitive actions impact Soundscape
28		only during and shortly after specified actions
29		
30	<i>Long Term</i>	Impacts persist well beyond completion of individual actions, generally impacting Soundscape
31		longer than the day action occurs. Related actions frequent or repetitive over more than a few days
32		would also be considered long-term impacts
33		
34	Timing	Frequency of occurrence and time of day can be important considerations in assessing Soundscape
35		impacts. Seasonality and sensitive time periods are described in impact topics where most relevant
36		(Visitor Use and Experience, Wildlife), and not in Soundscape analysis
37		
38	Background Information	Soundscape
39		
40		In national park units, Soundscape is the aggregate of all sounds in an area; it is the park's total acoustic
41		environment. In a national park setting, Soundscape can be composed of both natural ambient sound and a variety of
42		human-made sounds. Natural Soundscapes are composed completely of natural sounds without the presence of
43		human-made sounds (NPS 2006b). The NPS recognizes the natural Soundscape of each national park unit as an
44		inherent resource, and manages this resource to "restore degraded Soundscapes to the natural conditions wherever
45		possible, and protect natural Soundscapes from degradation due to noise" (NPS 2006b).
46		
47		This section describes potential noise impacts of the Alternatives using various noise metrics to determine the extent
48		to which each Alternative would 1) improve substantial restoration of natural quiet, and 2) result in impacts to
49		Soundscape in NPS units in the study area.
50		
51		The NPS considers a park's natural Soundscape to be a resource just like other natural and cultural resources found
52		in a park. Soundscapes have their own inherent value that is susceptible to impacts from air-tours. Soundscapes can
53		also serve as a guide to evaluating impacts to other park resources such as wildlife, cultural resources, and visitor
54		experience. Noise modeling results for each Alternative were used as important parts of the impact assessment
55		methodology described at the beginning of Chapter 4 to determine level of impact of aircraft overflights on
56		Soundscapes of NPS lands in the SFRA.

Figure 4.6 Alternative A Percent Time Audible Base Year

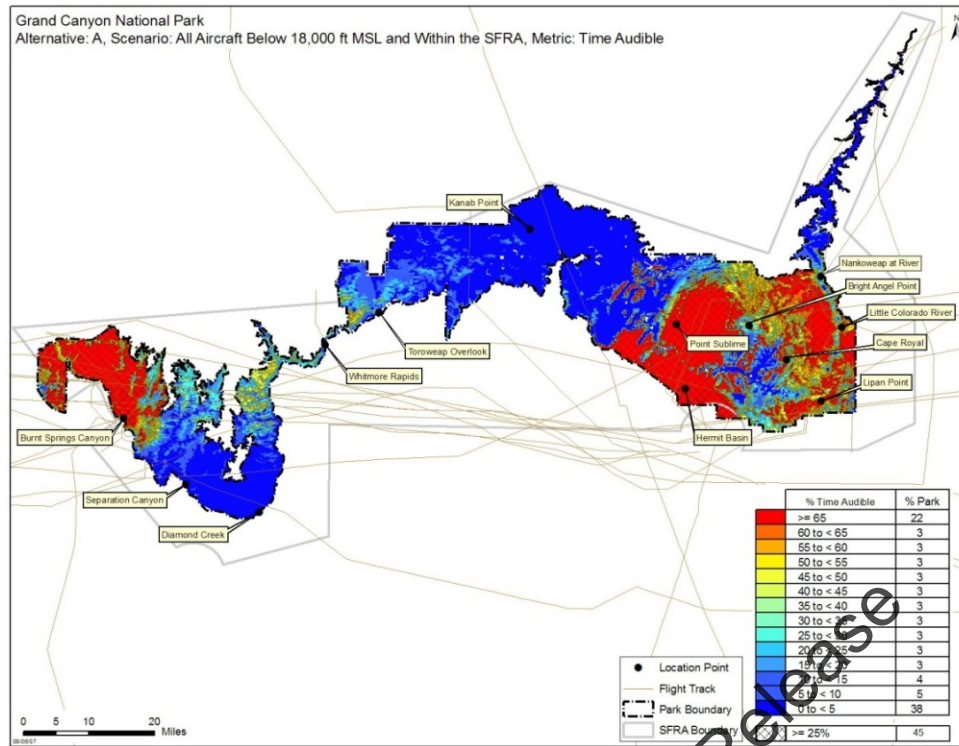
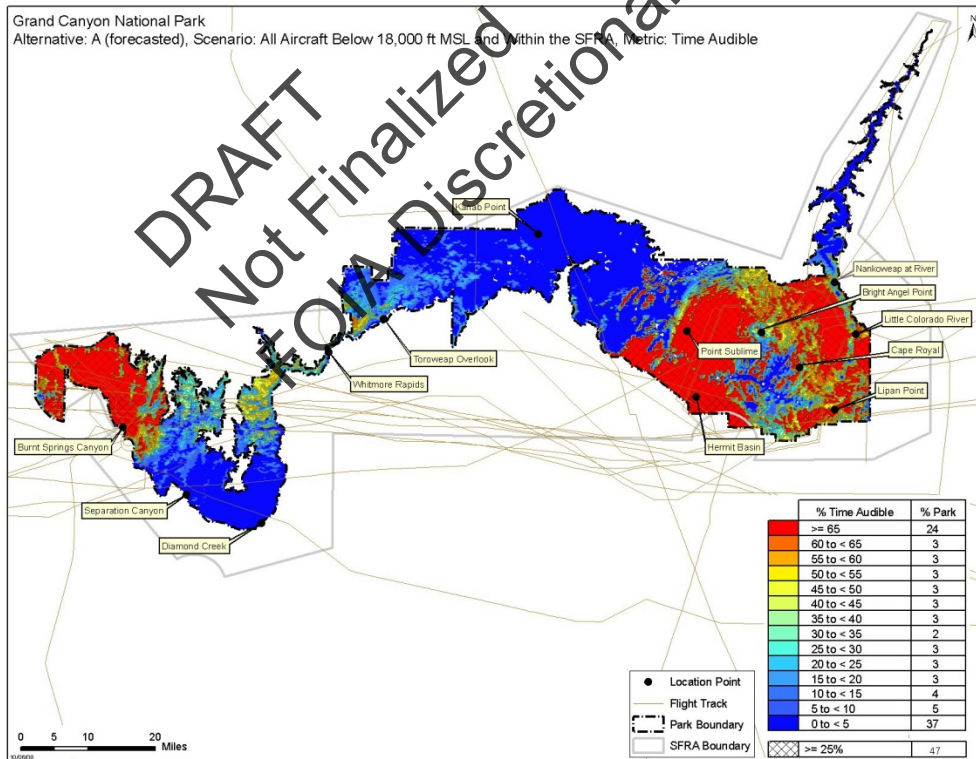


Figure 4.7 Alternative A Percent Time Audible Ten-Year Forecast



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Figure 4.8 Alternative A Average Sound Level Base Year

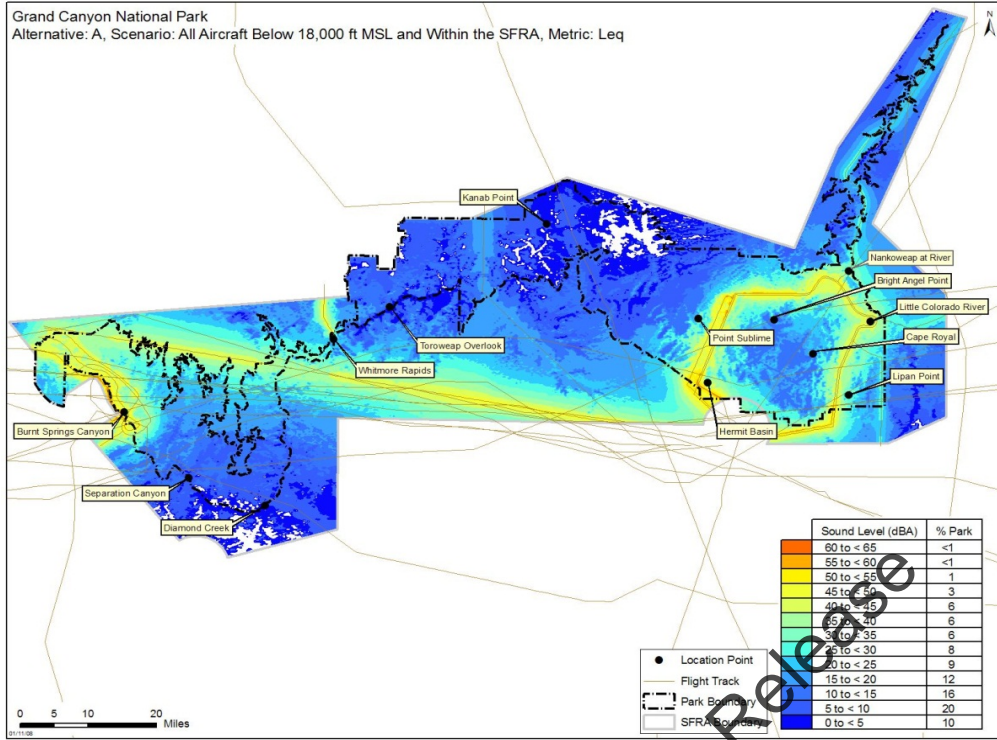
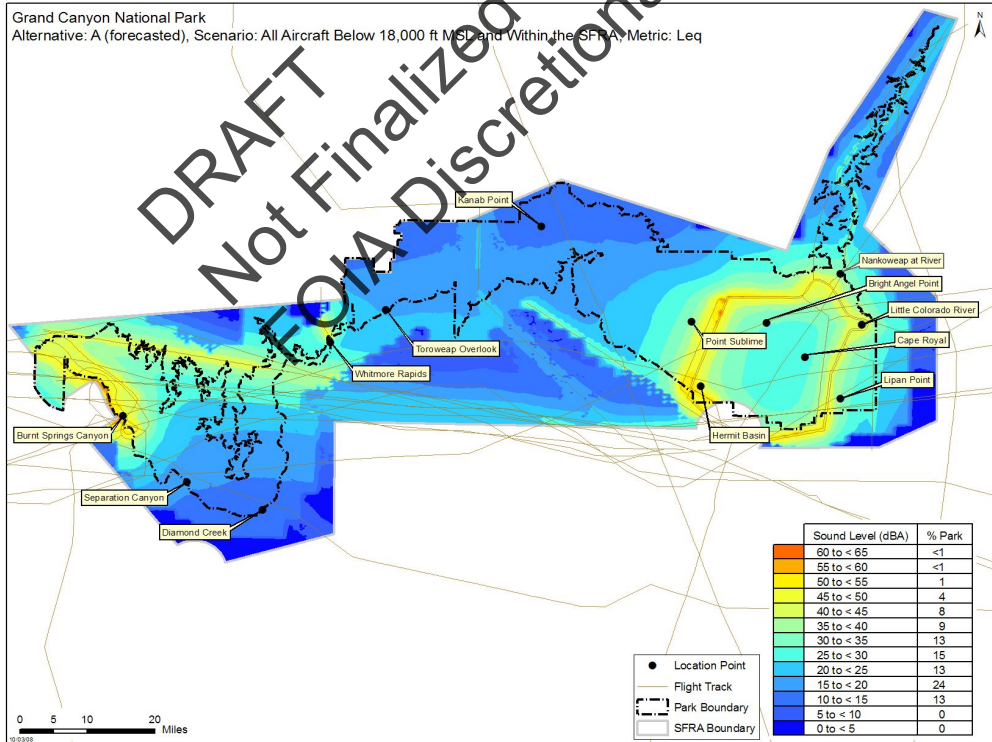


Figure 4.9 Alternative A Average Sound Level Ten-Year Forecast



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1 **Table 4.2 Alternative A Percent Time Audible Contour Analysis Results^{abc}**

Percent Time Audible	Base Year (Percent of Zone)				Ten Year Forecast (Percent of Zone)			
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP
% Park Making Progress Toward SRNQ				55%				53%
≥ 25	88%	79%	43%	45%	90%	80%	45%	47%
10 to < 25	6%	8%	10%	10%	5%	7%	10%	10%
5 to < 10	1%	3%	6%	5%	1%	2%	6%	5%
> 0 to < 5	5%	11%	40%	38%	5%	11%	39%	37%

^aDue to rounding differences, totals shown in this table may differ from Appendix D by up to 2%

^bBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only within GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

^cColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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Table 4.3 Alternative A Average Sound Level Contour Analysis Results^{ab}

Average Sound Level	Base Year (% of Zone)					Ten Year Forecast (% of Zone)				
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA
≥ 35	10%	21%	15%	16%	15%	24%	33%	22%	23%	14%
25 to < 35	55%	37%	12%	14%	15%	74%	57%	26%	28%	21%
15 to < 25	33%	28%	21%	22%	27%	22%	10%	38%	37%	41%
> 0 to < 15	3%	14%	48%	46%	40%	0%	1%	13%	13%	24%

^aDue to rounding differences, totals shown in this table may differ from Appendix D by up to 2%

^bColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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ALTERNATIVE A NO ACTION/CURRENT CONDITION SOUNDSCAPE

Alternative A would continue all aspects of current management for general aviation and air-tour operations in the SFRA and, under NEPA, serves as the baseline against which to compare Action Alternatives. Alternative A would achieve Substantial Restoration of Natural Quiet in 55% of the park 75 to 100% of the day Base Year, and 53% of the park Ten-Year Forecast, as shown in Table 4.2 and 4.3.

Alternative A noise modeling mapped results (all aircraft below 18,000 feet MSL and in the SFRA scenario) for Percent Time Audible and Average Sound Level are shown on Figures 4.6 through 4.9. Tables 4.2 and 4.3 present Contour Analysis results computed for Percent Time Audible and Average Sound Level, respectively, for Alternative A. Table 4.4 presents Location Point results computed for all metrics for Alternative A. Unless otherwise stated, Alternative A metric values discussed in the text are taken from these figures and tables.

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Developed Zone (about 2% of GCNP) Alternative A Soundscape

With exception of a very small area at Tuweep, all GCNP Developed Zone areas are in East End. Audibility calculations for the Developed Zone added 10 dBA to natural ambient sound levels due to the Dual-Zone System explained in Chapter 4, Methodology. As such, analysis considers Developed Zone management objectives which accept presence of many non-natural sound sources (increased background ambient sound levels) including most of the park’s visitors and their activities, presence of paved roads and motorized transportation, and developed facilities. **Alternative A is not analyzed for Peak and Off-Peak Season because there are no route changes based on season in this Alternative.**

1 **Table 4.4 Alternative A Location Point Results^{ab}**

Location Point Grouping		Base Year					Ten Year Forecast				
		TAUD ^c	L _{Aeq12} ^d	TALA35 dBA ^e	TALA45 dBA ^e	TALA55 dBA ^e	TAUD	L _{Aeq12}	TALA35 dBA	TALA45 dBA	TALA55 dBA
Marble Canyon	Max	3%	24 dBA	1%	0%	0%	3%	25 dBA	2%	0%	0%
	Median	2%	14 dBA	0%	0%	0%	2%	16 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
East End	Max	100%	49 dBA	100%	51%	5%	100%	49 dBA	100%	57%	5%
	Median	64%	28 dBA	5%	0%	0%	67%	29 dBA	6%	0%	0%
	Min	0%	6 dBA	0%	0%	0%	0%	7 dBA	0%	0%	0%
Central	Max	22%	27 dBA	4%	0%	0%	25%	27 dBA	5%	0%	0%
	Median	1%	10 dBA	0%	0%	0%	1%	10 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	93%	47 dBA	71%	29%	4%	95%	48 dBA	81%	33%	5%
	Median	19%	22 dBA	1%	0%	0%	21%	23 dBA	1%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	100%	49 dBA	100%	51%	5%	100%	49 dBA	100%	57%	5%
	Median	9%	17 dBA	0%	0%	0%	10%	18 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

^aBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level (L_{Aeq12}) contours were computed in the entire SFRA

^bMax refers to maximum Location Point value for a Location Point grouping for each respective specific metric; conversely, Min refers to minimum Location Point value. Median characterizes the central tendency of the results. That is, 50% of results are above the median; 50% below. The median, as opposed to the arithmetic mean, is more appropriate for data not normally distributed

^cTAUD = Percent Time Audible

^dL_{Aeq12} = Average Sound Level

^eTALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft noise exceed 35, 45, and 55 dBA, respectively

2
3
4 *Developed Zone Alternative A Soundscape*
5 *Base Year*

6 Average Sound Level would generally be 25 dBA or more in 65% of the Developed Zone; **that is, Average**
7 **Sound Level would be 25 to <35 dBA in 55% of the Zone (moderate adverse impact), and greater than or equal**
8 **to 35 dBA in 10% of the Developed Zone (major adverse impact).** Percent Time Audible would generally be
9 **10% or more in 94% of the Developed Zone; that is, 10 to <25% in 88% of the Developed Zone (moderate**
10 **adverse impact), and greater than or equal to 25% in 6% of the Zone (major adverse impact).** Thus **65% to**
11 **94%** of the Developed Zone would experience moderate to major adverse impacts due to amount of air-tour
12 activity in both Zuni Point and Dragon Corridors. Although major adverse impacts would occur, effects would be
13 a mix of short and long term given amount of visitor activity and presence of non-natural sound sources.
14

15 *Developed Zone Alternative A Soundscape*
16 *Ten-Year Forecast*

17 Because Alternative A includes growth in operations, but does not include quiet-technology incentives or
18 conversion requirements, adverse impacts would increase to 98% of the Developed Zone experiencing Average
19 Sound Level greater than **or equal to 25 dBA**, and 95% of the Developed Zone with Percent Time Audible
20 greater than **or equal to 10%** of the day (areas with moderate to major adverse impacts). This would represent a
21 minor to moderate adverse change in impacts due to forecasted increase in air-tour operations from Base Year to
22 Ten-Year Forecast⁵⁶.
23

⁵⁶Ten-Year Forecast is ten years from implementation

1 **Non-Wilderness Zone (4% of GCNP) Alternative A Soundscape**

2
3 Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road
4 corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone area where 10 dBA is added to natural
5 ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with
6 motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The
7 majority of the Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis
8 for audibility calculations in this EIS, consistent with Non-Wilderness Zone management objectives that call for
9 mostly natural conditions to prevail in the Zone.

10 *Non-Wilderness Zone Alternative A Soundscape*
11 *Base Year*

12
13 Average Sound Level would generally be 25 dBA **or more** in 58% of the Non-Wilderness Zone; **that is, Average**
14 **Sound Level would be 25 to <35 dBA in 37% of the Non-Wilderness Zone (moderate adverse impact)**, and
15 greater than **or equal to 35 dBA in 21% of the Non-Wilderness Zone (major adverse impact)**. Percent Time
16 Audible would generally be **10% or more in 87% of the Zone; that is, 10 to <25% in 8% of the Zone (moderate**
17 **adverse impact), and greater than or equal to 25% in 79% of the Zone (major adverse impact)**. Thus **58% to**
18 **87%** of the Non-Wilderness Zone would experience moderate to major adverse impacts due to amount of air-
19 tour activity in Zuni Point and Dragon Corridors. Although long-term major adverse impacts would occur, some
20 effects would be short term given amount of visitor activity and presence of non-natural sound sources in some
21 of the Zone.

22
23 *Non-Wilderness Zone Alternative A Soundscape*
24 *Ten-Year Forecast*

25 Because Alternative A includes growth in operations but does not include quiet-technology incentives or
26 conversion requirements, adverse impacts would increase to 90% of the Non-Wilderness Zone with Average
27 Sound Level greater than **or equal to 25 dBA**, and 87% of the Non-Wilderness Zone with air-tour aircraft
28 Percent Time Audible greater than **or equal to 10% of the day (areas with moderate to major adverse impacts)**.
29 This would represent a minor to moderate adverse change in impact due to forecasted increase in air-tour
30 operations from Base Year to Ten-Year Forecast.

31
32 **Wilderness Zone (about 94% of GCNP) Alternative A Soundscape**

33
34 In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the
35 Wilderness Zone's increased size and geographic extent compared to the others. Most of the Wilderness Zone is in
36 the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System
37 acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

38
39 *Wilderness Zone Alternative A Soundscape*
40 *Base Year*

41 Average Sound Level would generally be 25 dBA **or more** in 27% of the Wilderness Zone; **that is, Average**
42 **Sound Level would be 25 to <35 dBA in 12% of the Wilderness Zone (moderate adverse impact)**, and greater
43 than **or equal to 35 dBA in 15% of the Wilderness Zone (major adverse impact)**. Percent Time Audible would
44 generally be **10% or more in 53% of the Zone; that is, 10 to <25% Time Audible (moderate adverse impact) in**
45 **10% of the Zone, and greater than or equal to 25% (major adverse impact) in 43% of the Zone**. Thus, **27% to**
46 **53%** of the Wilderness Zone **would** experience moderate to major adverse impacts, and impacts would mostly be
47 concentrated in East and West Ends as shown in Figures 4.6 to 4.9. In the Wilderness Zone, major adverse
48 impacts would mostly be long-term.

49
50 *Wilderness Zone Alternative A Soundscape*
51 *Ten-Year Forecast*

52 Because Alternative A includes growth in operations, but does not include quiet-technology incentives or
53 conversion requirements, adverse impacts would increase to 48% of the Zone with Average Sound Level greater
54 than **or equal to 25 dBA**, and 55% of the Wilderness Zone with Percent Time Audible greater than **or equal to**
55 **10% of the day (areas with moderate to major adverse impacts)**. This would represent a negligible to minor

1 adverse change in impacts due to forecasted increase in air-tour operations from Base Year to Ten-Year
2 Forecast.

3
4 **Marble Canyon** **Alternative A** **Soundscape**

5
6 Marble Canyon's west side is located in the Wilderness Zone; its east side is in the Non-Wilderness Zone. It is also
7 entirely in the Dual-Zone noticeability area in which 10 dBA is added to natural ambient sound levels in calculating
8 Percent Time Audible (see Chapter 4, Methodology).

9
10 *Marble Canyon* *Alternative A* *Soundscape*
11 *Base Year*

12 Localized long- and short-term impacts would generally be negligible to minor adverse (based on Figures 4.6 to
13 4.9, Average Sound Level would generally be less than 15 dBA and Percent Time Audible less than 5%).
14 Location Points range zero to 3% Percent Time Audible, and Average Sound Level zero to 24 dBA.

15
16 *Marble Canyon* *Alternative A* *Soundscape*
17 *Ten-Year Forecast*

18 Localized long- and short-term impacts would generally be negligible to minor adverse (based on Figures 4.6 to
19 4.9, Average Sound Level would generally be less than 15 dBA and Percent Time Audible less than 5%). Results
20 would increase negligibly (no increase in median Percent Time Audible and one to 2 dBA in median Average
21 Sound Level) Base Year to Ten-Year Forecast.

22
23 **East End** **Alternative A** **Soundscape**

24
25 Under Alternative A, greatest exposure to noise and visual impacts would continue East End, which contains over
26 half the Peak Day air-tour operations. East End includes all three Management Zones: Developed, Non-Wilderness,
27 and Wilderness, and heavily-used air-tour routes in Zuni Point and Dragon Corridors for both short-loop tours and
28 the long-loop tour between Zuni Point and Dragon Corridors over North Rim. Also, most of East End's land area is
29 contained in Bright Angel Flight-free Zone.

30
31 *East End* *Alternative A* *Soundscape*
32 *Base Year*

33 Although the majority of East End Location Points do not experience Average Sound Level greater than *or equal*
34 *to* 35 dBA, several Location Points (**96 Mile Camp, The Basin, Eremita Mesa, Ten X Meadow, and Tower of**
35 **Ra**) show Average Sound Level as high as 45 to 55 dBA, and Percent Time Audible 5 to 50% of the day. Air-
36 tour aircraft in locations away from the river (represented by the **Little Colorado River** and **Nankoweap Mesa**
37 Location Points) Percent Time Audible would be 34 to 87% of the day with Average Sound Level 43 dBA. Close
38 to the river, as represented by the **Nankoweap River** Location Point, these effects would be less, with aircraft
39 Average Sound Level of 34 dBA and Percent Time Audible approximately 7%. Areas beneath Zuni Point and
40 Dragon Corridor routes and Black-1A/Green-1A over North Rim would experience nearly continuous noise at 52
41 to almost 100% Percent Time Audible, with Average Sound Level at 28 to 49 dBA. Amid Bright Angel Flight-
42 free Zone, represented by **Grid Location Points 12 and 13**, air-tour operations would have negligible impact on
43 natural Soundscape with Percent Time Audible of less than one percent, and aircraft Average Sound Level 12 to
44 13 dBA.

45
46 **East End Location Points** Percent Time Audible range zero to almost 100% with Average Sound Level 6 to 49
47 dBA. Average Sound Level for individual aircraft events would not exceed 35 dBA for most locations; however,
48 at some locations, aircraft events would exceed 35 dBA 100% of the day, 45 dBA 51% of the day, and 55 dBA
49 5% of the day. Areas under and near East End air-tour routes would experience long-term major adverse impacts
50 (Average Sound Level greater than 40 dBA with Percent Time Audible greater than 50%). Areas amid Bright
51 Angel Flight-free Zone would experience negligible to minor adverse impacts.

52
53 *East End* *Alternative A* *Soundscape*
54 *Ten-Year Forecast*

55 **East End areas** would see negligible increases in impacts (3% increase in median Percent Time Audible and one
56 dBA in median Average Sound Level) Base Year to Ten-Year Forecast.

1 **Central** **Alternative A** **Soundscape**

2
3 The Central area is in the Wilderness Zone, with exception of a few Non-Wilderness Zone dirt road corridors, and a
4 very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System audibility area in
5 which natural ambient sound levels are used directly in Percent Time Audible calculations. This area comprises
6 most of the Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.

7
8 *Central* *Alternative A* *Soundscape*
9 *Base Year*

10 **Central area Location Points** range zero to 22% Percent Time Audible with Average Sound Level zero to 27
11 dBA. Average Sound Level for the loudest individual aircraft events would exceed 35 dBA 4% of the day.
12 Localized long- and short-term impacts would be negligible to moderate adverse (based on Figures 4.6 to 4.9,
13 Average Sound Level would generally be less than 10 dBA and Percent Time Audible less than 5%).

14
15 *Central* *Alternative A* *Soundscape*
16 *Ten-Year Forecast*

17 **Central area Location Point** results would increase negligibly (*no* increase in median Percent Time Audible
18 and no increase in median Average Sound Level) Base Year to Ten-Year Forecast.

19
20 **West End** **Alternative A** **Soundscape**

21
22 West End is in the Wilderness Zone, and entirely in the Dual-Zone System noticeability area in which 10 dBA is
23 added to natural ambient sound levels in Percent Time Audible calculations. West End impacts depend on proximity
24 to Blue Direct and Blue-2/Green-4.

25
26 *West End* *Alternative A* *Soundscape*
27 *Base Year*

28 Location Points range zero to 93% Percent Time Audible with Average Sound Level zero to 47 dBA. Average
29 Sound Level for individual aircraft events would not exceed 35 dBA for most locations; however, at some
30 locations, aircraft events would exceed 35 dBA 71% of the day, 45 dBA 29% of the day, and 55 dBA 4% of the
31 day. Beneath West End air-tour routes (Green-4, Blue-2, and Blue Direct South), represented by Location Points
32 **Burnt Springs Canyon, Bat Cave, and Grid Location Point 33**, there would be high Percent Time Audible of
33 air-tour aircraft 70 to 93% of the day, and Average Sound Level would be high at 42 to 47 dBA. Under Brown
34 routes (**Whitmore Rapids and Parashant Wash** Location Points), and further west along the river, would be
35 less affected with Percent Time Audible at 12% and Average Sound Level 21 to 33 dBA. Areas under Blue
36 Direct North and South, including **Grid Location Points 28 and 32**, would have a Percent Time Audible 14% to
37 44% and Average Sound Level 17 to 27 dBA.

38
39 In the **northern West End** near air-tour routes, localized long- and short-term impacts would be major adverse
40 (Figures 4.6 to 4.9); Average Sound Level would be greater than 40 dBA with Percent Time Audible greater
41 than 65%). In the southern West End (mostly Sanup Flight-free Zone), localized long-term impacts would be
42 negligible to minor adverse (Figures 4.6 to 4.9). Average Sound Level would be 10 to 20 dBA with Percent
43 Time Audible less than 20%).

44
45 *West End* *Alternative A* *Soundscape*
46 *Ten-Year Forecast*

47 Because Alternative A includes growth in operations but does not include quiet-technology incentives or
48 conversion requirements, **West End area** adverse impacts would increase a negligible amount (2% in median
49 Percent Time Audible, and one dBA in Average Sound Level) from Base Year to Ten-Year Forecast.

50
51 **NPS Units in the SFRA outside** **Alternative A** **Soundscape**
52 **Grand Canyon National Park**

53
54 For park lands directly under and within five miles of Blue Direct routes (Lake Mead National Recreation Area and
55 Grand Canyon-Parashant National Monument) and other busy GCNP air-tour corridors, adverse impacts would be

1 considered major adverse Base Year (Average Sound Level would range 40 to 50 dBA) with negligible increases
2 Ten-Year Forecast.

4 Cumulative Impacts

Alternative A

Soundscape

6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future
7 actions. In this context, Cumulative Impacts include impacts on Soundscape from sounds of*

- 8 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
- 9 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
- 10 *3) ground-based noise sources, plus*
- 11 *4) noise from air-tour-and-related aircraft under Alternative A*

13 *That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).*

15 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All
16 Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout
17 the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or
18 above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the
19 SFRA see Appendix D, Figures 91 to 94).*

21 *Noise from ground-based sources includes vehicles, building noise, machinery, and electronics, also impacts
22 Soundscape, but is mostly concentrated in the Developed Zone (2% of the park), although a small component
23 exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire
24 management activities, and mining activities outside the park. Noise from ground-based sources is discussed in
25 Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time
26 Audible capable of masking some aircraft noise.*

28 *Noise from ground-based sources is usually very localized. Even though there is some spread into some
29 backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of
30 spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated
31 by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often
32 the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of
33 civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights
34 and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare
35 and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.
36 Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the
37 park and SFRA; there are no areas in GCNP where the natural Soundscape is not adversely affected by aircraft
38 noise some of the time.*

40 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives
41 (Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly
42 affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables
43 43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives
44 (Alternative A in this case).*

46 *Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in
47 Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is
48 detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year
49 Forecast. Noise from ground-based sources was not able to be included in noise modeling for the EIS; however,
50 since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of
51 the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in
52 interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas
53 north of the park.*

55 *Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All
56 Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the*

1 *difference between Cumulative Impacts and impacts of Alternative A by itself. For the Entire Park Cumulative*
 2 *Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the park, with*
 3 *Average Sound Level 25 to <35 dBA in 85% of the park, with none of the park below 25 dBA, and 24% at 35 dBA*
 4 *or more. For the Entire Park results for Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or*
 5 *more of the day in 27% of the park, with Average Sound Level 25 to <35 dBA in 28% of the park, with 50% of the*
 6 *park below 25 dBA, and 22% at 35 dBA or more.*

7
 8 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 9 *including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour*
 10 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
 11 *impacts under the Alternatives reduces Cumulative Impacts.*

12
 13 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 14 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 15 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 16 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 17 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
 18 *in the Conclusions section below.*

19
 20 **Conclusion** **Alternative A** **Soundscape**

21
 22 Under Alternative A, a range of aircraft Average Sound Level and Percent Time Audible would affect GCNP
 23 Soundscapes. Alternative A would *make progress toward* Substantial Restoration of Natural Quiet in 55% of the
 24 park 75 to 100% of the day Base Year; which would decrease slightly to 53% of the park Ten-Year Forecast due to
 25 increases in air-tour operations (a negligible change in impacts).
 26

27 Because Alternative A includes growth in operations, but no quiet-technology conversion requirements, noise
 28 impacts would increase Base Year to Ten-Year Forecast in all Zones and areas. However, increases in impacts
 29 would generally be negligible. Near busy air-tour corridors, such as those in East End, changes might not be
 30 discernible as some affected areas already experience close to 100% audibility. However, for areas where Percent
 31 Time Audible is less than, but close to 25%, future increases might jeopardize achievement of substantial restoration
 32 of natural quiet.
 33

34 *Conclusion by Zone* *Alternative A* *Soundscape*
 35 *Ten-Year Forecast*

36 Wilderness Zone (94% of GCNP); area of moderate to major adverse impacts would be 48 to 55% of the Zone.
 37 Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impacts would be 87 to 90% of the
 38 Zone. Developed Zone (about 2% of GCNP); area of moderate to major adverse impacts would be 95 to 98% of the
 39 Zone.
 40

41 *Conclusion by Area* *Alternative A* *Soundscape*

42 In Marble Canyon, Central areas, and West End's southern portion, localized long- and short-term impacts would
 43 generally be negligible to minor adverse (Average Sound Level would often be less than 15 dBA and Percent Time
 44 Audible less than 5%). Greatest exposure to noise impacts would occur under and near East and West End heavily-
 45 used air-tour routes where long- and short-term major adverse impacts would occur Base Year and Ten-Year
 46 Forecast (aircraft Average Sound Level 40 to 50 dBA, and Percent Time Audible greater than 65%). Away from
 47 routes amid Flight-free Zones, impacts would be negligible to minor adverse.
 48

49 **Cumulative Impacts Summary** **Alternative A** **Soundscape**

50
 51 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 52 *impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts in*
 53 *all three Zones (Developed, Non-Wilderness, and Wilderness) and all four sections (Marble Canyon, East End,*
 54 *Central, and West End) of the park would tend to increase to major adverse Cumulative Impacts under and near*
 55 *air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In*

1 *comparison with the other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts*
 2 *(Alternative E ranks first in lowest Cumulative Impacts).*

3
 4 **ALTERNATIVE E**

ALTERNATING SEASONAL USE

SOUNDSCAPE

5
 6 Alternative E, Alternating Seasonal Use, would maximize park area in Flight-free Zones, and seasonally alternate
 7 use of Zuni Point and Dragon Corridor routes.

8
 9 Base Year Peak Season, *Alternative E would make progress toward* Substantial Restoration of Natural Quiet in
 10 75% of the park 75 to 100% of the day. This represents moderate beneficial change in impacts with a 20% increase
 11 in park area *making progress toward SRNQ* as shown in Table 4.23 compared to Alternative A. Base Year Off-
 12 Peak Season *Alternative E would make progress toward* Substantial Restoration of Natural Quiet in 78% of the
 13 park as shown in Table 4.23. This represents moderate beneficial change in impacts with a 23% increase in park area
 14 restored compared to Alternative A.

15
 16 Ten-Year Forecast Peak Season *Alternative E would make progress toward* Substantial Restoration of Natural
 17 Quiet in 84% of the park as shown in Table 4.24. This represents major beneficial change in impacts with a 31%
 18 increase in park area *making progress toward SRNQ* compared to Alternative A. Ten-Year Forecast Off-Peak
 19 Season *Alternative E would make progress toward* Substantial Restoration of Natural Quiet in 86% of the park as
 20 shown in Table 4.24. This represents major beneficial changes in impacts compared to Alternative A with a 33%
 21 increase in park area *making progress toward SRNQ*.

22
 23 Mapped results of noise modeling for Alternative E for Percent Time Audible and Average Sound Level are shown
 24 in Figures 4.10 through 4.17. Table 4.5 through 4.10 present Contour Analysis and Location Point results computed
 25 for Alternative E Peak and Off-Peak Seasons, respectively, and includes comparisons with Alternative A, No
 26 Action/Current Condition.

27
 28
 29
 DRAFT
 Not Finalized
 FOIA Discretionary Release

Figure 4.10 **Alternative E** **Percent Time Audible** **Base Year** **Peak Season**

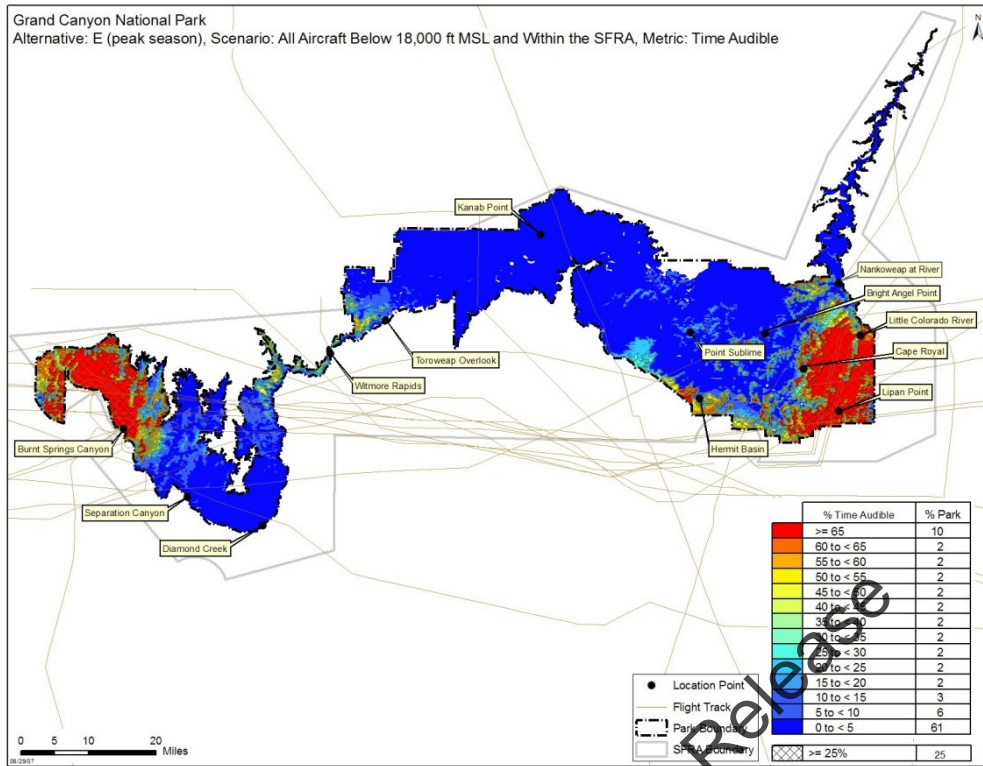


Figure 4.11 **Alternative E** **Percent Time Audible** **Ten-Year Forecast** **Peak Season**

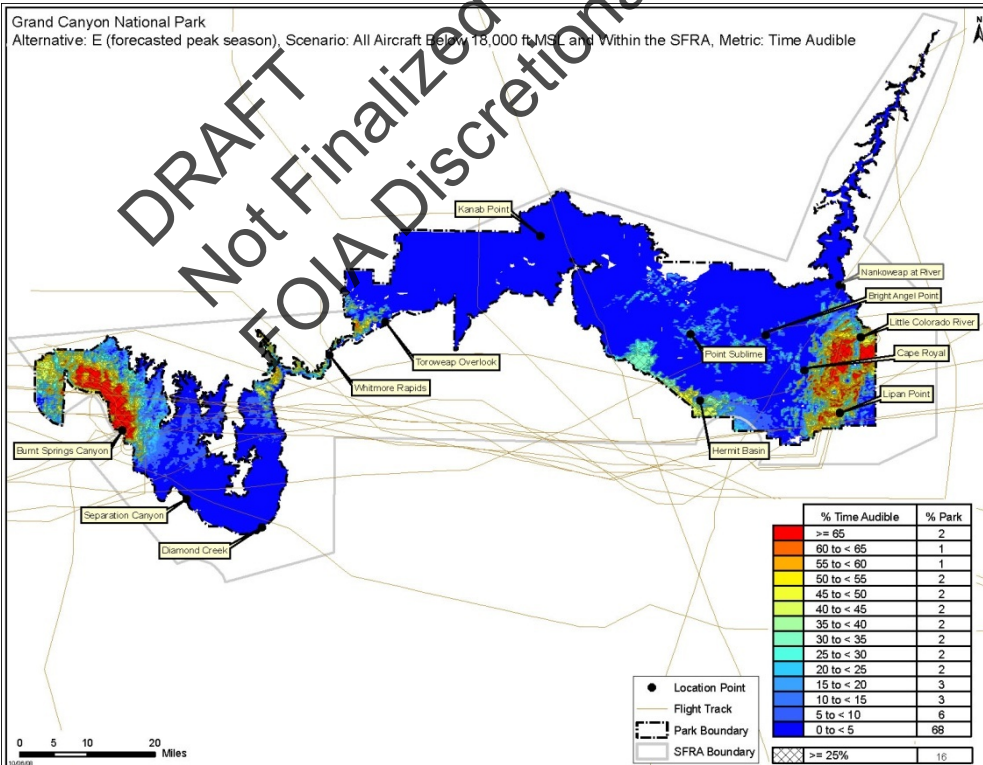


Figure 4.12 Alternative E Percent Time Audible Base Year Off-Peak Season

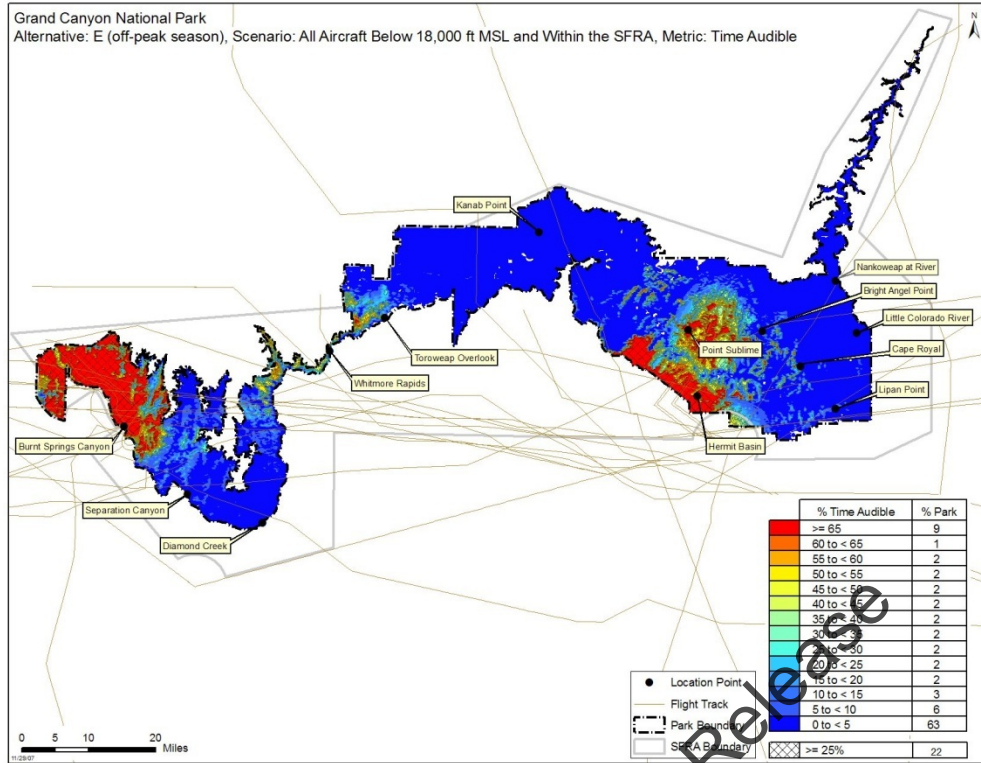
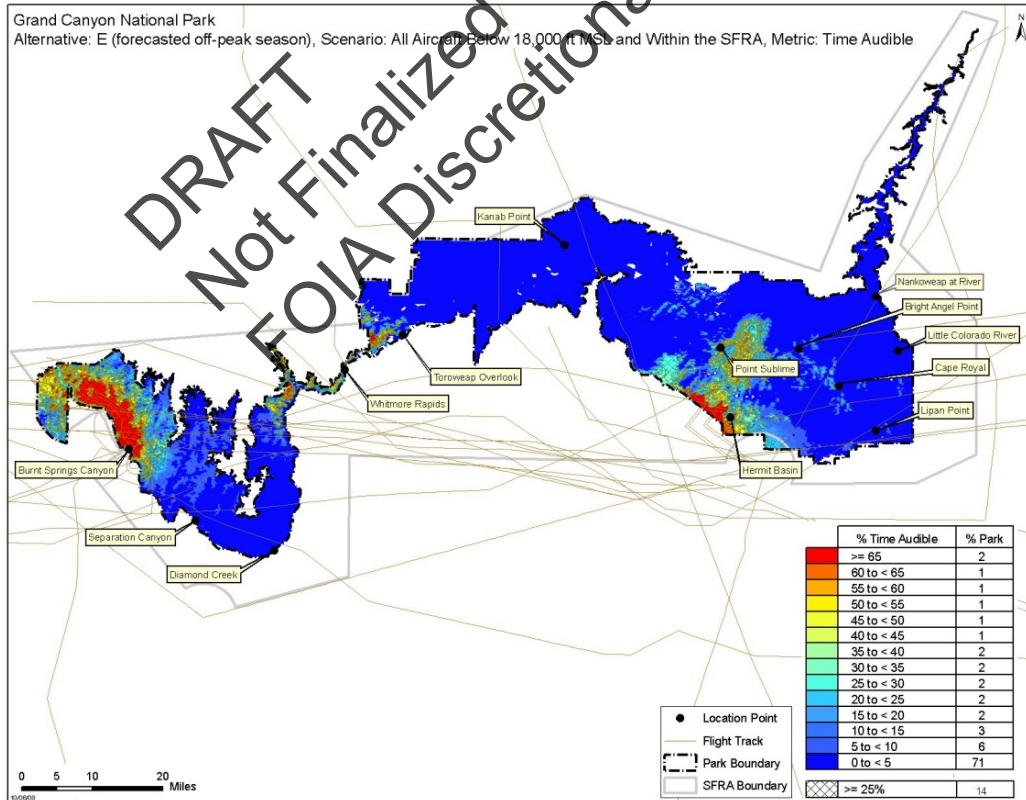


Figure 4.13 Alternative E Percent Time Audible Ten Year Forecast Off-Peak Season



1

Figure 4.14 Alternative E Average Sound Level Base Year Peak Season

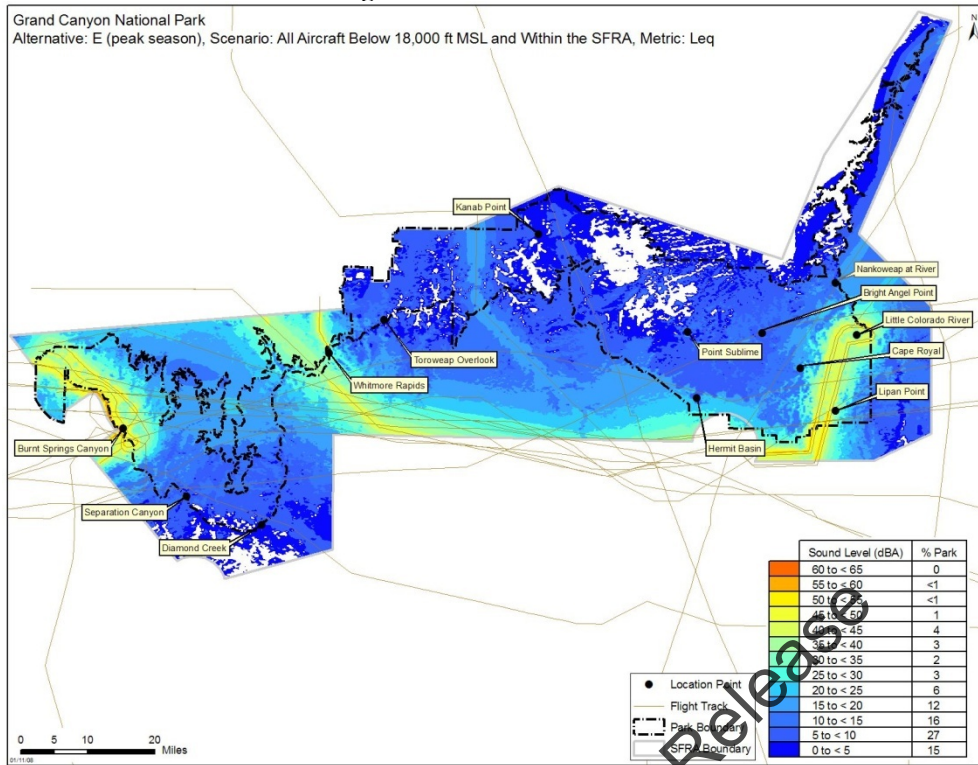


Figure 4.15 Alternative E Average Sound Level Ten Year Forecast Peak Season

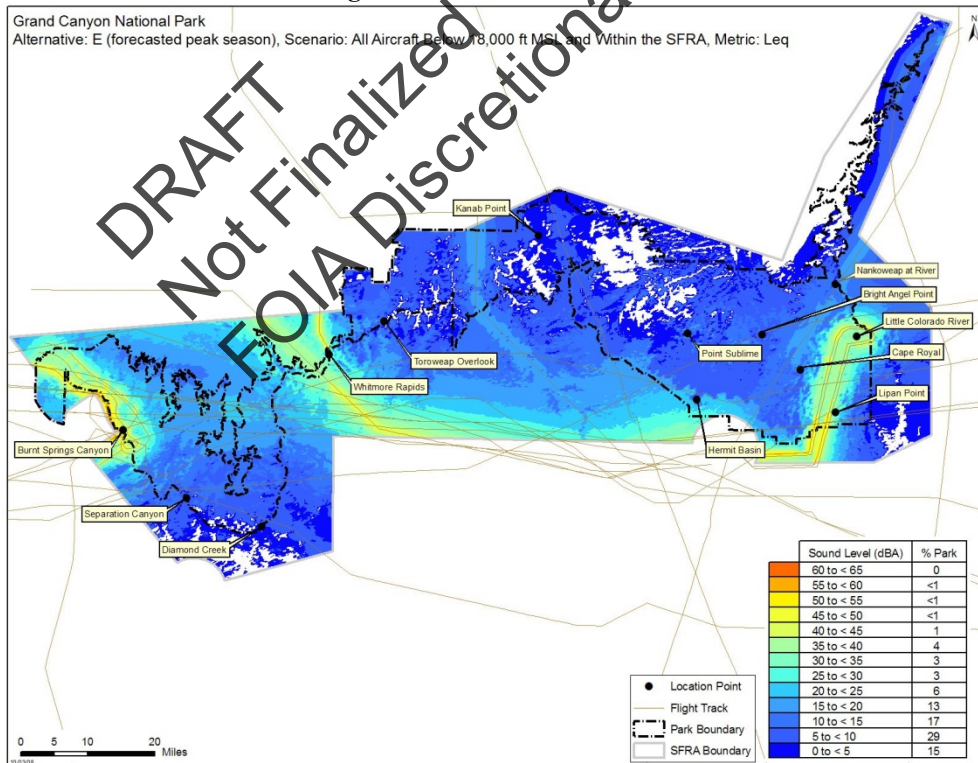


Figure 4.16 Alternative E Average Sound Level Base Year Off-Peak Season

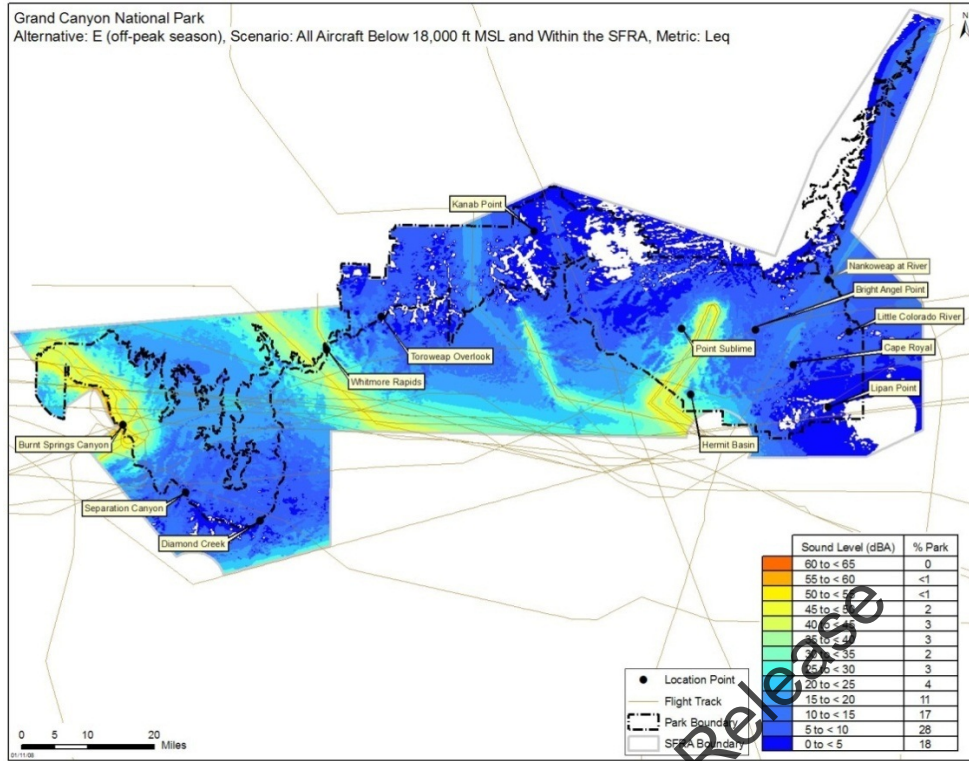
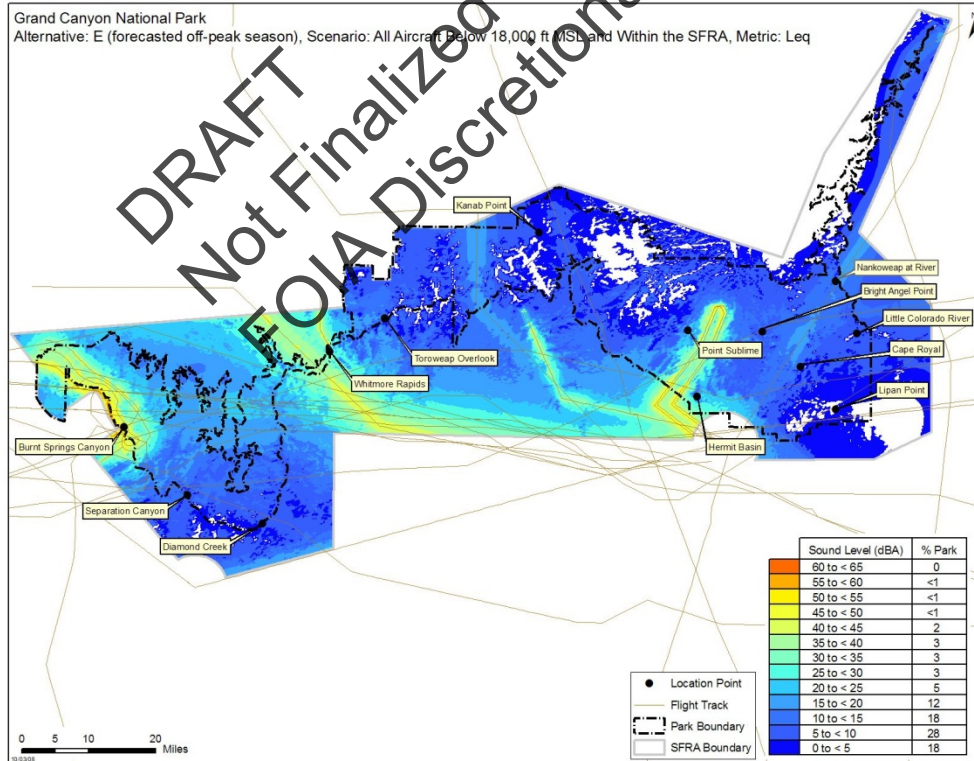


Figure 4.17 Alternative E Average Sound Level Ten-Year Forecast Off-Peak Season



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1 **Table 4.5** **Alternative E** **Percent Time Audible** **Contour Analysis Results**
 2 **Peak Season^{abc}**

Percent Time Audible	Base Year (Percent of Zone)				Ten Year Forecast (Percent of Zone)			
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP
% Park Making Progress Toward SRNQ				75%				84%
≥ 25	52%	52%	23%	25%	26%	21%	16%	16%
10 to < 25	17%	13%	7%	7%	32%	18%	8%	8%
5 to < 10	15%	5%	6%	6%	16%	15%	6%	6%
> 0 to < 5	16%	31%	63%	61%	25%	44%	69%	68%
Percent of Zone Difference in Percent Time Audible Contour Results with Alternative A								
≥ 25	36%	27%	20%	21%	64%	59%	29%	30%
10 to < 25	-11%	-5%	4%	3%	-27%	-12%	3%	2%
5 to < 10	-14%	-2%	0%	0%	-15%	-13%	0%	-1%
> 0 to < 5	-11%	-20%	-23%	-23%	-20%	-33%	-30%	-30%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

^cColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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 5 **Table 4.6** **Alternative E** **Average Sound Level** **Contour Analysis Results** **Peak Season^{ab}**

Average Sound Level	Base Year (Percent of Zone)					Ten Year Forecast (Percent of Zone)				
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA
≥ 35	7%	6%	8%	8%	8%	5%	5%	6%	6%	6%
25 to < 35	12%	13%	5%	6%	9%	7%	10%	5%	5%	9%
15 to < 25	59%	41%	16%	18%	24%	62%	38%	18%	19%	24%
> 0 to < 15	22%	39%	60%	59%	51%	25%	47%	62%	61%	51%
Percent of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	3%	15%	7%	7%	7%	19%	27%	16%	17%	8%
25 to < 35	43%	24%	7%	8%	7%	67%	47%	21%	23%	11%
15 to < 25	-26%	-13%	5%	4%	3%	-61%	-29%	20%	18%	16%
> 0 to < 15	-20%	-25%	-12%	-13%	-11%	-25%	-46%	-48%	-48%	-27%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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1 **Table 4.7 Alternative E Location Point Results Peak Season^a**

Location Point Grouping		Base Year					Ten Year Forecast				
		TAUD ^b	L _{Aeq12} ^c	TALA 35 dBA ^d	TALA 45 dBA ^d	TALA 55 dBA ^d	TAUD	L _{Aeq12}	TALA 35 dBA	TALA 45 dBA	TALA 55 dBA
Marble Canyon	Max	1%	13 dBA	0%	0%	0%	1%	13 dBA	0%	0%	0%
	Median	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
East End	Max	88%	53 dBA	54%	15%	5%	66%	51 dBA	46%	12%	4%
	Median	17%	13 dBA	0%	0%	0%	10%	12 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	1 dBA	0%	0%	0%
Central	Max	15%	18 dBA	0%	0%	0%	16%	19 dBA	0%	0%	0%
	Median	1%	7 dBA	0%	0%	0%	1%	8 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	92%	47 dBA	70%	28%	4%	84%	46 dBA	65%	23%	4%
	Median	5%	18 dBA	0%	0%	0%	4%	19 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	92%	53 dBA	70%	28%	5%	84%	51 dBA	65%	23%	4%
	Median	1%	11 dBA	0%	0%	0%	1%	10 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Difference in Location Points Results with Alternative A											
Marble Canyon	Max	2%	11 dBA	1%	0%	0%	2%	12 dBA	1%	0%	0%
	Median	1%	14 dBA	0%	0%	0%	2%	16 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
East End	Max	12%	-4 dBA	46%	36%	0%	34%	-2 dBA	54%	45%	1%
	Median	47%	15 dBA	5%	0%	0%	58%	17 dBA	6%	0%	0%
	Min	0%	6 dBA	0%	0%	0%	0%	6 dBA	0%	0%	0%
Central	Max	8%	9 dBA	4%	0%	0%	9%	9 dBA	4%	0%	0%
	Median	0%	3 dBA	0%	0%	0%	1%	3 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	1%	0 dBA	1%	0%	0%	12%	2 dBA	17%	10%	1%
	Median	14%	4 dBA	0%	0%	0%	17%	4 dBA	1%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	8%	-4 dBA	30%	23%	0%	16%	-2 dBA	36%	3400%	100%
	Median	7%	3 dBA	0%	0%	0%	9%	8 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

^aMax refers to maximum Location Point value for a Location Point grouping for each respective specific metric; conversely, Min refers to minimum Location Point value. The median characterizes the central tendency of the results. That is, 50% of results are above the median, 50% are below. The median, as opposed to the arithmetic mean, is more appropriate for data not normally distributed

^bTAUD = Percent Time Audible

^cL_{Aeq12} = Average Sound Level

^dTALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft noise exceed 35, 45, and 55 dBA, respectively

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1 **Table 4.8 Alternative E Percent Audible Contour Analysis Results Off-Peak Season^{abc}**

Percent Percent Time Audible	Base Year (Percent of Zone)				Ten Year Forecast (Percent of Zone)			
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP
% Park Making Progress Toward SRNQ				78%				86%
≥ 25	31%	26%	22%	22%	17%	14%	14%	14%
10 to < 25	17%	13%	7%	8%	32%	18%	6%	7%
5 to < 10	14%	10%	6%	6%	13%	11%	5%	6%
> 0 to < 5	36%	49%	64%	63%	35%	53%	72%	71%
% of Zone Difference in TAUD Contour Results with Alternative A								
≥ 25	57%	53%	21%	23%	73%	66%	31%	32%
10 to < 25	-11%	-5%	3%	3%	-27%	-12%	4%	3%
5 to < 10	-13%	-8%	0%	0%	-13%	-9%	0%	0%
> 0 to < 5	-32%	-38%	-24%	-25%	-31%	-42%	-34%	-34%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

^cColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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4 **Table 4.9 Alternative E Average Sound Level Contour Analysis Result Off-Peak Season^{ab}**

Average Sound Level	Base Year (Percent of Zone)					Ten Year Forecast (Percent of Zone)				
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA
≥ 35	0%	1%	8%	7%	8%	0%	0%	5%	5%	6%
25 to < 35	6%	11%	5%	5%	9%	5%	11%	5%	5%	10%
15 to < 25	48%	26%	15%	15%	21%	48%	23%	17%	17%	23%
> 0 to < 15	45%	55%	64%	63%	53%	46%	58%	64%	64%	53%
Percent of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	10%	20%	8%	8%	6%	24%	32%	17%	18%	8%
25 to < 35	49%	26%	7%	8%	6%	70%	46%	21%	23%	11%
15 to < 25	-15%	3%	7%	6%	6%	-47%	-13%	22%	19%	18%
> 0 to < 15	-43%	-41%	-16%	-18%	-12%	-46%	-58%	-51%	-51%	-28%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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1 **Table 4.10 Alternative E Location Point Results Off-Peak Season^a**

Location Point Grouping		Base Year					Ten Year Forecast				
		TAUD ^b	L _{Aeq12} ^c	TALA35 dBA ^d	TALA45 dBA ^d	TALA55 dBA ^d	TAUD	L _{Aeq12}	TALA35 dBA	TALA45 dBA	TALA55 dBA
Marble Canyon	Max	1%	13 dBA	0%	0%	0%	1%	13 dBA	0%	0%	0%
	Median	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
East End	Max	93%	46 dBA	34%	10%	3%	78%	44 dBA	29%	7%	2%
	Median	1%	8 dBA	0%	0%	0%	1%	9 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Central	Max	25%	26 dBA	1%	0%	0%	20%	24 dBA	1%	0%	0%
	Median	1%	8 dBA	0%	0%	0%	1%	8 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	96%	48 dBA	82%	32%	5%	88%	46 dBA	74%	24%	4%
	Median	5%	19 dBA	0%	0%	0%	4%	20 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	1 dBA	0%	0%	0%
All Location Points	Max	96%	48 dBA	82%	32%	5%	88%	46 dBA	74%	24%	4%
	Median	2%	9 dBA	0%	0%	0%	1%	10 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Difference in Location Points Results with Alternative A											
Marble Canyon	Max	2%	11 dBA	1%	0%	0%	2%	12 dBA	0%	0%	0%
	Median	1%	14 dBA	0%	0%	0%	2%	16 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
East End	Max	7%	3 dBA	66%	41%	2%	21%	10 dBA	71%	50%	3%
	Median	63%	20 dBA	5%	0%	0%	66%	10 dBA	6%	0%	0%
	Min	0%	6 dBA	0%	0%	0%	0%	7 dBA	0%	0%	0%
Central	Max	-3%	1 dBA	3%	0%	0%	6%	3 dBA	4%	0%	0%
	Median	0%	2 dBA	0%	0%	0%	1%	2 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	-3%	0 dBA	-11%	4%	0%	8%	2 dBA	8%	9%	2%
	Median	14%	3 dBA	0%	0%	0%	17%	3 dBA	1%	0%	0%
	Min	0%	4 dBA	0%	0%	0%	0%	-1 dBA	0%	0%	0%
All Location Points	Max	4%	3 dBA	18%	19%	0%	12%	3 dBA	26%	33%	2%
	Median	7%	7 dBA	0%	0%	0%	9%	8 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

^aMax refers to maximum Location Point value for a Location Point grouping for each respective specific metric; conversely, Min refers to minimum Location Point value. The median characterizes the central tendency of the results. That is, 50% of results are above the median; 50% are below. The median, as opposed to the arithmetic mean, is more appropriate for data not normally distributed

^bTAUD = Percent Time Audible

^cL_{Aeq12} = Average Sound Level

^dTALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft noise exceed 35, 45, and 55 dBA, respectively

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1 **Developed Zone (about 2% of GCNP) Alternative E Soundscape**

2
3 With exception of a very small Developed Zone area at Tuweep, all GCNP Developed Zone areas are in East End.
4 Developed Zone audibility calculations added 10 dBA to natural ambient sound levels due to the Dual-Zone System
5 acoustic approach explained in Chapter 4, Methodology. As such, analysis considers Developed Zone management
6 objectives which accept presence of many non-natural sound sources (increased background ambient sound levels)
7 including most of the park's visitors and their activities, presence of paved roads and motorized transportation, and
8 developed facilities.
9

10 *Developed Zone Alternative E Soundscape*
11 *Base Year Peak Season*

12 Average Sound Level would generally be 25 dBA or more in 19% of the Developed Zone; that is, Average
13 Sound Level would be 25 to <35 dBA in 12% of the Zone (moderate adverse impact) and greater than **or equal**
14 **to** 35 dBA in 7% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in
15 69% of the Zone; that is Percent Time Audible of 10 to <25% in 17% of the Zone (moderate adverse impact)
16 and greater than **or equal to** 25% in 52% of the Zone (major adverse impact). This would represent a reduction
17 of 46% in area with Average Sound Level 25 dBA or more, and a reduction of 25% in area of 10% or more
18 Percent Time Audible compared to Alternative A (a 25 to 46% reduction in areas of moderate to major adverse
19 impact), resulting in a moderate to major beneficial change in impacts compared to Alternative A.
20

21 *Developed Zone Alternative E Soundscape*
22 *Base Year Off-Peak Season*

23 Average Sound Level would generally be greater than 25 dBA in 6% of the Developed Zone; that is, Average
24 Sound Level would be 25 to <35 dBA in 6% of the Zone (moderate adverse impact) and no areas greater than **or**
25 **equal to** 35 dBA in the Zone (no areas of major adverse impact in terms of Average Sound Level). Percent Time
26 Audible would generally be 10% or more of the day in 48% of the Zone, that is 10 to <25% Percent Time
27 Audible in 17% of the Zone (moderate adverse impact) and Percent Time Audible greater than **or equal to** 25%
28 in 31% of the Zone (major adverse impact). This would represent a reduction of 59% in area with Average
29 Sound Level of 25 dBA or more, and a reduction of 46% in area of 10% or more Percent Time Audible
30 compared to Alternative A (a 46 to 59% reduction in areas of moderate to major adverse impact), resulting in a
31 major beneficial change in impacts compared to Alternative A.
32

33 *Developed Zone Alternative E Soundscape*
34 *Ten-Year Forecast Peak Season*

35 Average Sound Level would generally be greater than 25 dBA in 12% of the Developed Zone; that is, Average
36 Sound Level would be 25 to <35 dBA in 7% of the Zone (moderate adverse impact), and greater than **or equal to**
37 35 dBA in 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in
38 58% of the Zone; that is, 10 to <25% Percent Time Audible in 32% of the Zone (moderate adverse impact), and
39 greater than **or equal to** 25% Percent Time Audible in 26% of the Zone (major adverse impact). This would
40 represent a reduction of 86% in area with Average Sound Level of 25 dBA or more, and a reduction of 37% in
41 area of 10% or more Percent Time Audible compared to Alternative A (a 37 to 86% reduction in areas of
42 moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.
43

44 *Developed Zone Alternative E Soundscape*
45 *Ten-Year Forecast Off-Peak Season*

46 Average Sound Level would generally be greater than 25 dBA in 5% of the Developed Zone; that is, Average
47 Sound Level would be 25 to <35 dBA in 5% of the Zone (moderate adverse impact), and no areas in the Zone
48 would be greater than **or equal to** 35 dBA (no areas of major adverse impact). Percent Time Audible would
49 generally be 10% or more in 49% of the Zone; that is, 10 to <25% Percent Time Audible in 32% of the Zone
50 (moderate adverse impact), and greater than **or equal to** 25% Percent Time Audible in 17% of the Zone (major
51 adverse impact). This would represent a reduction of 94% in area with Average Sound Level of 25 dBA or more,
52 and a reduction of 46% in area of 10% or more Percent Time Audible compared to Alternative A (a 10 to 94%
53 reduction in areas of moderate to major adverse impact), resulting in a moderate to major beneficial change in
54 impacts compared to Alternative A.
55

1 **Non-Wilderness Zone (6% of GCNP) Alternative E Soundscape**
 2

3 Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road
 4 corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone System area where 10 dBA is added to natural
 5 ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with
 6 motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The
 7 majority of the Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis
 8 for audibility calculations, consistent with Non-Wilderness Zone management objectives that call for mostly natural
 9 conditions to prevail in the Zone.

10
 11 *Non-Wilderness Zone Alternative E Soundscape*
 12 *Base Year Peak Season*

13 Average Sound Level would generally be 25 dBA or more in 19% of the Zone; that is, Average Sound Level
 14 would be 25 to <35 dBA in 13% of the Zone (moderate adverse impact), and greater than **or equal to** 35 dBA in
 15 6% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in
 16 65% of the Zone; that is, 10 to <25% Percent Time Audible in 13% of the Zone (moderate adverse impact), and
 17 greater than **or equal to** 25% Percent Time Audible in 52% of the Zone (major adverse impact). This would
 18 represent a reduction of 39% in area with Average Sound Level of 25 dBA or more, and a reduction of 22% in
 19 area of 10% or more Percent Time Audible compared to Alternative A (a 22 to 39% reduction in areas of
 20 moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

21
 22 *Non-Wilderness Zone Alternative E Soundscape*
 23 *Base Year Off-Peak Season*

24 Average Sound Level would generally be greater than 25 dBA in 12% of the Zone; that is, Average Sound Level
 25 would be 25 to <35 dBA in 11% of the Zone (moderate adverse impact), and greater than **or equal to** 35 dBA in
 26 1% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in
 27 39% of the Zone; that is, 10 to <25% Percent Time Audible in 13% of the Zone (moderate adverse impact), and
 28 greater than **or equal to** 25% Percent Time Audible in 26% of the Zone (major adverse impact). This would
 29 represent a reduction of 46% in area with Average Sound Level of 25 dBA or more, and a reduction of 48% in
 30 area of 10% or more Percent Time Audible compared to Alternative A (a 46 to 48% reduction in areas of
 31 moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

32
 33 *Non-Wilderness Zone Alternative E Soundscape*
 34 *Ten-Year Forecast Peak Season*

35 Average Sound Level would generally be greater than 25 dBA in 15% of the Zone; that is, Average Sound Level
 36 would be 25 to <35 dBA in 10% of the Zone (moderate adverse impact), and greater than **or equal to** 35 dBA in
 37 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 39% of the
 38 Zone; that is, 10 to <25% Percent Time Audible in 18% of the Zone (moderate adverse impact), and greater than
 39 **or equal to** 25% Percent Time Audible in 21% of the Zone (major adverse impact). This would represent a
 40 reduction of 74% in area with Average Sound Level of 25 dBA or more, and a reduction of 47% in area of 10%
 41 or more Percent Time Audible compared to Alternative A (a 47 to 74% reduction in areas of moderate to major
 42 adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

43
 44 *Non-Wilderness Zone Alternative E Soundscape*
 45 *Ten-Year Forecast Off-Peak Season*

46 Average Sound Level would generally be greater than 25 dBA in 11% of the Zone; that is, Average Sound Level
 47 would be 25 to <35 dBA in 11% of the Zone (moderate adverse impact), and no areas of the Zone would be
 48 greater than **or equal to** 35 dBA (no areas of major adverse impact in the Zone). Percent Time Audible would
 49 generally be 10% or more in 32% of the Zone; that is, 10 to <25% Percent Time Audible in 18% of the Zone
 50 (moderate adverse impact), and greater than **or equal to** 25% Percent Time Audible in 14% of the Zone (major
 51 adverse impact). This would represent a reduction of 78% in area with Average Sound Level of 25 dBA or more,
 52 and a reduction of 54% in area of 10% or more Percent Time Audible compared to Alternative A (a 54 to 78%
 53 reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts
 54 compared to Alternative A.
 55
 56

1 **Wilderness Zone (94% of GCNP) Alternative E Soundscape**

2
3 In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the
4 Wilderness Zone increased size and geographic extent as compared to the others. Most of the Wilderness Zone is in
5 the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System
6 acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

7
8 *Wilderness Zone Alternative E Soundscape*
9 *Base Year Peak Season*

10 Average Sound Level would generally be 25 dBA or more in 13% of the Zone; that is, Average Sound Level
11 would be 25 to <35 dBA in 5% of the Zone (moderate adverse impact), and greater than **or equal to** 35 dBA in
12 8% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 30% of the
13 Zone; that is, **10** to <25% Percent Time Audible in 7% of the Zone (moderate adverse impact), and greater than
14 or equal to 25% Percent Time Audible in 23% of the Zone (major adverse impact). This would represent a **14%**
15 reduction in area with Average Sound Level of 25 dBA or more and a reduction of **24%** in area of 10% or more
16 Percent Time Audible compared to Alternative A (a **14 to 24%** reduction in areas of moderate to major adverse
17 impact), resulting in a **moderate** beneficial change in impacts compared to Alternative A.

18
19 *Wilderness Zone Alternative E Soundscape*
20 *Base Year Off-Peak Season*

21 Average Sound Level would generally be greater than **or equal to** 25 dBA in 13% of the Zone; that is, Average
22 Sound Level would be 25 to <35 dBA in 5% of the Zone (moderate adverse impact) and greater than **or equal to**
23 35 dBA in 8% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of
24 the day in 29% of the Zone; that is 10 to <25% Percent Time Audible in 7% of the Zone (moderate adverse
25 impact) and greater than **or equal to** 25% Percent Time Audible in 22% of the Zone (major adverse impact).
26 This would represent a reduction of 15% in area with Average Sound Level of 25 dBA or more and a reduction
27 of 24% in area of 10% or more Percent Time Audible compared to Alternative A (a 15 to 24% reduction in areas
28 of moderate to major adverse impact), resulting in a moderate beneficial change in impacts compared to
29 Alternative A.

30
31 *Wilderness Zone Alternative E Soundscape*
32 *Ten-Year Forecast Peak Season*

33 Average Sound Level would generally be greater than **or equal to** 25 dBA in 11% of the Zone; that is, Average
34 Sound Level would be 25 to <35 dBA in 5% of the Zone (moderate adverse impact) and greater than 35 dBA in
35 6% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in
36 24% of the Zone; that is, 10 to <25% Percent Time Audible in 8% of the Zone (moderate adverse impact) and
37 greater than **or equal to** 25% Percent Time Audible in 16% of the Zone (major adverse impact). This would
38 represent a reduction of 37% in area with Average Sound Level of 25 dBA or more and a reduction of 32% in
39 area of 10% or more Percent Time Audible compared to Alternative A (a 32 to 37% reduction in areas of
40 moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

41
42 *Wilderness Zone Alternative E Soundscape*
43 *Ten-Year Forecast Off-Peak Season*

44 Average Sound Level would generally be greater than **or equal to** 25 dBA in 10% of the Zone; that is, Average
45 Sound Level would be 25 to <35 dBA in 5% of the Zone (moderate adverse impact) and greater than **or equal to**
46 35 dBA in 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of
47 the day in 20% of the Zone; that is, 10 to <25% Percent Time Audible in 6% of the Zone (moderate adverse
48 impact) and greater than **or equal to** 25% Percent Time Audible in 14% of the Zone (major adverse impact).
49 This would represent a reduction of 38% in area with Average Sound Level of 25 dBA or more and a reduction
50 of 35% in area of 10% or more Percent Time Audible compared to Alternative A (a 35 to 38% reduction in areas
51 of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

1 **Marble Canyon** **Alternative E** **Soundscape**

2
3 Marble Canyon's west side is in the Wilderness Zone; it's east side in the Non-Wilderness Zone. It is also entirely in
4 the Dual-Zone System noticeability area in which 10 dBA is added to natural ambient sound levels in calculating
5 Percent Time Audible (Chapter 4, Methodology). Seasonal use of Dragon and Zuni Point Corridors would not affect
6 this area. In Marble Canyon, based on Figures 4.10 to 4.17, air-tour aircraft Average Sound Level would be barely
7 audible at less than 15 dBA), due to Bright Angel Flight-free Zone being substantially enlarged by extending its
8 boundary north to include all of Marble Canyon.

9
10 *Marble Canyon* *Alternative E* *Soundscape*
11 *All Scenarios*

12 **Marble Canyon Location Points** Percent Time Audible range zero to one percent, and Average Sound Level
13 zero to 13 dBA Peak and Off-Peak Seasons. Results would be nearly identical (within Percent Time Audible of
14 one percent and one dBA Average Sound Level) Base Year to Ten-Year Forecast. These values represent
15 negligible impacts and negligible to minor beneficial changes in impacts compared to Alternative A.

16
17 **East End** **Alternative E** **Soundscape**

18
19 Under Alternative E, as in Alternative A, greatest exposure to noise and visual impacts would continue East End.
20 However, air-tour sounds would be reduced beneath Dragon Corridor when closed Peak Season and conversely,
21 beneath Zuni Point Corridor when closed Off-Peak Season. This would result in a major beneficial change in
22 impacts compared to Alternative A. Alternative E curfews would benefit Soundscape in all East End Management
23 Zones.

24
25 *East End* *Alternative E* *Soundscape*
26 *Base Year Peak Season*

27 **East End Location Points** would range zero to 88% Percent Time Audible (median 17%), and zero to 53 dBA
28 (median 13 dBA). At some locations, aircraft events would exceed 35 dBA for 54% of the day, 45 dBA for 15%
29 of the day, and 55 dBA for 5% of the day. Because this represents a 47% reduction in median Percent Time
30 Audible and a 12% reduction in maximum Percent Time Audible, this would be a moderate to major beneficial
31 change in East End impacts compared to Alternative A. Localized long- and short-term adverse impacts would
32 be major in areas near Zuni Point Corridor, and comparable to Alternative A (from Figures 4.10 to 4.17, Average
33 Sound Level would be 40 to 50 dBA, Percent Time Audible would be greater than 75%). Impacts would be
34 negligible to minor in areas near Dragon Corridor, a major beneficial change in impacts compared to Alternative
35 A. Although the majority of Location Points do not experience Average Sound Level greater 35 dBA, *several*
36 Location Points (*including Grid Location Point 14, Lipan Point and Temple Butte*) show Average Sound
37 Level *above* 45 dBA 5% or more of the day.

38
39 *East End* *Alternative E* *Soundscape*
40 *Base Year Off-Peak Season*

41 **East End Location Points** would range zero to 93% Percent Time Audible (median 1%), and zero to 46 dBA
42 (median 8 dBA). At some locations, aircraft events would exceed 35 dBA for 34% of the day, 45 dBA for 10%
43 of the day, and 55 dBA for 3% of the day. Because this represents a 63% reduction in median Percent Time
44 Audible and a 7% reduction in maximum Percent Time Audible, this would be a minor to major beneficial
45 change in East End impacts compared to Alternative A. Localized long- and short-term adverse impacts would
46 be major in areas near Dragon Corridor and comparable to Alternative A (from Figures 4.10 to 4.17, Average
47 Sound Level would be 40 to 50 dBA, Percent Time Audible would be greater than 75%). Impacts would be
48 negligible to minor adverse in areas near Zuni Point Corridor, a major beneficial change in impacts compared to
49 Alternative A. Although the majority of Location Points do not experience Average Sound Level greater 35
50 dBA, Location Points (**96 Mile Camp, Eremita Mesa, The Ranch, and Tower of Ra**) show Average Sound
51 Level *above* 45 dBA 5% *or more* of the day.

52
53 *East End* *Alternative E* *Soundscape*
54 *Ten-Year Forecast Peak Season*

55 **East End Location Points** would range zero to 66% Percent Time Audible (median 10%); a 20% reduction in
56 maximum Percent Time Audible Base Year to Ten-Year Forecast, and a 7% reduction in median Percent Time

1 Audible Base Year to Ten-Year Forecast, because Alternative E includes quiet-technology incentives and
 2 conversion requirements. Average Sound Level would range one to 51 dBA (median 12 dBA), within one dBA
 3 of Average Sound Level Base Year. This represents a 58% reduction in median Percent Time Audible, and a
 4 34% reduction in maximum Percent Time Audible. Impacts would be negligible to minor adverse under and near
 5 Dragon Corridor (a major beneficial change from Alternative A); major adverse under and near Zuni Point
 6 Corridor (a negligible change from Alternative A); negligible across North Rim (a moderate to major beneficial
 7 change from Alternative A); and negligible to minor adverse away from active routes and amid Bright Angel
 8 Flight-free Zone (a negligible change from Alternative A).
 9

10 *East End* *Alternative E* *Soundscape*
 11 *Ten-Year Forecast Off-Peak Season*

12 **East End Location Points** Percent Time Audible would range zero to 78% (median one percent), and Average
 13 Sound Level zero to 44 dBA (median 9 dBA). Compared to Base Year Off-Peak Season, this represents no
 14 change in median Percent Time Audible but a 15% reduction in maximum Percent Time Audible; this also
 15 represents negligible change in median and Average Sound Level (changes of one and 2 dBA). This represents a
 16 66% reduction in median Percent Time Audible, and a 21% reduction in maximum Percent Time Audible, due in
 17 large part to Alternative E quiet-technology conversion requirements. Impacts would be major adverse under and
 18 near Dragon Corridor (a negligible change from Alternative A); negligible to minor adverse under and near Zuni
 19 Point Corridor (a major beneficial change from Alternative A); negligible across North Rim (a moderate to major
 20 beneficial change from Alternative A); and negligible to minor adverse away from active routes and amid Bright
 21 Angel Flight-free Zone (a negligible change from Alternative A).
 22

23 **Central** **Alternative E** **Soundscape**

24
 25 The Central area is located in the Wilderness Zone, with exception of a few Non-Wilderness Zone dirt road
 26 corridors, and a very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System
 27 audibility area in which natural ambient sound levels are used directly in calculations of Percent Time Audible. This
 28 area comprises most of the Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.
 29

30 *Central* *Alternative E* *Soundscape*
 31 *Base and Ten-Year Forecast Peak Season*

32 Base Year **Central area Location Points** range zero to 15% Percent Time Audible (median one percent), and
 33 Average Sound Level zero to 18 dBA (median 7 dBA). Impacts would be negligible to minor adverse, a minor
 34 beneficial change in impacts compared to Alternative A. Results are nearly identical (one percent and one dBA)
 35 Ten-Year Forecast. Modified Blue Direct routes contribute to slightly lower Average Sound Level and Percent
 36 Time Audible.
 37

38 *Central* *Alternative E* *Soundscape*
 39 *Base Year and Ten-Year Forecast Off-Peak Season*

40 **Central area Location Points** Percent Time Audible range zero to 25% (median one percent), and Average
 41 Sound Level zero to 26 dBA (median 8 dBA). These increases over Peak Season results are due to increased
 42 operations on the modified Blue Direct route Off-Peak Season. There would be negligible changes in impacts
 43 Base Year to Ten-Year Forecast. Impacts would range from negligible to moderate adverse with negligible
 44 change in impacts compared to Alternative A Base Year Off-Peak Season.
 45

46 **West End** **Alternative E** **Soundscape**

47
 48 West End is located in the Wilderness Zone and entirely in the Dual-Zone System noticeability area in which 10
 49 dBA is added to natural ambient sound levels in Percent Time Audible calculations. Impacts to West End areas tend
 50 to be much localized, depending on proximity to Blue Direct and Blue-2/Green-4 routes. Blue-2/Green-4 would be
 51 the same as under Alternative A. Blue Direct North would be moved east and shortened over GCNP, and Blue
 52 Direct South would be eliminated.
 53
 54

1 *West End* *Alternative E* *Soundscape*
 2 *Base Year and Ten-Year Forecast Peak Season*

3 **West End Location Points** Percent Time Audible ranges zero to 92% (median 5%), and Average Sound Level
 4 zero to 47 dBA (median 18 dBA). At some locations, aircraft events would exceed 35 dBA for 70% of the day,
 5 45 dBA for 28% of the day, and 55 dBA for 4% of the day. Peak Season Ten-Year Forecast, Average Sound
 6 Level would be essentially unchanged from Base Year, but maximum Percent Time Audible would be reduced
 7 8% due to Alternative E quiet-technology conversion requirements. Median Percent Time Audible would be
 8 reduced 14% Base Year and 17% Ten-Year Forecast, which represent minor to moderate beneficial changes in
 9 impacts compared to Alternative A.

10 For areas near Blue-2 and Green-4 routes (**West End's northern portion**), localized long- and short-term
 11 impacts would be moderate to major adverse (from Figures 4.5 to 4.12, Average Sound Level would be 40 to 50
 12 dBA, Percent Time Audible would be greater than 65%), with negligible change in impacts compared to
 13 Alternative A. In **West End's southern portion**, localized long-term impacts would be negligible to minor
 14 adverse (from Figures 4.10 to 4.17, Average Sound Level would be 10 to 20 dBA, Percent Time Audible would
 15 be less than 20%), with negligible change in impacts compared to Alternative A.

16 *West End* *Alternative E* *Soundscape*
 17 *Base Year and Ten-Year Forecast Off-Peak Season*

18 **For West End Location Points**, results for Base Year and Ten-Year Forecast Off-Peak Season are very similar,
 19 and also similar to Peak Season. Because operation growth is anticipated Ten-Year Forecast, and Alternative E
 20 quiet-technology incentives and conversion requirements would provide some mitigation with a decrease in
 21 affected area size, those areas still affected would see an increase in localized impacts. Overall impacts would
 22 see reduction in Percent Time Audible of 5 to 10% and one dBA Average Sound Level compared to Base Year,
 23 and a reduction in Percent Time Audible of 14 to 17% and 2 to 4 dBA Average Sound Level compared to
 24 Alternative A. There would be moderate to major adverse impacts in **West End's northern portion** near air-
 25 tour routes (a minor beneficial change in impacts from Alternative A), and negligible to minor adverse impacts
 26 in **West End's southern portion** away from routes (a negligible to moderate beneficial change from Alternative A).
 27
 28
 29

30 **NPS Units in SFRA** *Alternative E* **Soundscape**
 31 **Outside Grand Canyon National Park**

32
 33 For NPS lands directly under and within five miles of **Blue Direct, Blue-2, and Green-4 routes** (Lake Mead
 34 National Recreation Area and Grand Canyon-Parashant National Monument), impacts would be major adverse
 35 (Average Sound Level 40 to 50 dBA). Impacts to these lands as a result of modified Blue Direct routes would shift
 36 from more remote and sensitive Wilderness areas in Grand Canyon-Parashant National Monument's southern
 37 portion to somewhat less sensitive areas in the Monument's more northern areas. Also, due to elimination of Blue
 38 Direct South, some aircraft would likely fly outside the SFRA south along existing airways. Because growth in
 39 operations is anticipated Ten-Year Forecast, and although Alternative E quiet-technology incentives and conversion
 40 requirements would provide some mitigation with decreased affected area size, those areas still affected would see
 41 an increase in localized impacts. The **remainder of the SFRA outside GCNP** would experience Average Sound
 42 Level less than 25 dBA. Localized long- and short-term impacts would be minor adverse. As with GCNP, **the SFRA**
 43 **as a whole** would benefit from Alternative E quiet-technology incentives and conversion requirements.
 44

45 **Cumulative Impacts** *Alternative E* **Soundscape**

46
 47 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 48 *actions. In this context, Cumulative Impacts include impacts on Soundscape from sounds of*

- 49 1. *high-altitude aircraft at or above 18,000 feet MSL plus*
- 50 2. *aircraft below 18,000 feet MSL and outside the SFRA plus*
- 51 3. *ground-based noise sources plus*
- 52 4. *noise from air-tour-and-related aircraft under Alternative E*

53
 54 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 Alternative E.*
 55

1 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts common to all*
2 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
3 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (for high-altitude aircraft at or*
4 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; for aircraft below 18,000 feet MSL and outside the*
5 *SFRA Appendix D, Figures 91 to 94).*

6
7 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
8 *Soundscape, but is mostly concentrated in the Developed Zone (2% of the park), although there is a small*
9 *component in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
10 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
11 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
12 *Audible capable of masking some aircraft noise.*

13
14 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
15 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
16 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
17 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
18 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
19 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
20 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
21 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
22 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
23 *park and SFRA; there are no areas in GCNP where the natural Soundscape is not adversely affected by aircraft*
24 *noise some of the time.*

25
26 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in Alternatives (#4*
27 *Alternative E compared to the other Alternatives). Noise sources 1 and 2 and 3 are generally not directly affected*
28 *by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables 43 to*
29 *70); however, their noise impact generally increases impacts of noise produced under the Alternatives*
30 *(Alternative E in this case).*

31
32 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
33 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
34 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
35 *Wilderness Zone, and Entire Park Base Year and Ten-Year Forecast. Noise from ground-based was not able to*
36 *be included in noise modeling for this EIS; however, since noise from ground-based sources affects less than*
37 *10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in interpreting*
38 *Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near unpaved*
39 *roads, the Colorado River, and mining activity areas north of the park.*

40
41 *Comparing noise impacts from just Alternative E by itself (Appendix D, Tables 16 (Peak Season) and 21 (Off-*
42 *Peak Season) (Ten-Year Forecast)) versus All Aircraft (4 Alternative E plus 1 and 2) (Appendix D, Tables 49*
43 *(Peak Season) and 53 (Off-Peak Season) (Ten-Year Forecast)) gives a good indication of the difference between*
44 *Cumulative Impacts and impacts of Alternative E by itself. For the Entire Park Cumulative Impact results (Peak*
45 *and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 83% of the park,*
46 *with Average Sound Level 25 to <35 dBA in 92 to 93% of the park, with one percent of the park below 25 dBA*
47 *and 6 to 7% at 35 dBA or more. For the Entire Park results for Alternative E by itself (Peak and Off-Peak Season*
48 *Ten-Year Forecast), aircraft are audible 60% or more of the day in 3% of the park, with Average Sound Level 25*
49 *to <35 dBA in 6 to 9% of the park, with 74 to 81% of the park below 25 dBA and 5% at 35 dBA or more.*

50
51 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
52 *including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour*
53 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
54 *impacts under the Alternatives reduces Cumulative Impacts.*

55

1 *Again, differences in Cumulative Impacts between Alternatives are apparent in the detailed impact analysis*
 2 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 3 *Alternative (route locations/number/altitudes/quiet technology conversion, etc.). When added to noise impacts of*
 4 *cumulative sources Common to All Alternatives described above (1, 2, and 3), impact levels for each area*
 5 *described for Alternative E would generally increase by one level as shown in the Cumulative Impacts Summary*
 6 *discussion in the Conclusions section below.*

7
 8 **Conclusion** **Alternative E** **Soundscape**

9
 10 As further explained in Chapter 4's Socioeconomic Environment, fewer flight operations are expected in Alternative
 11 E than in other Alternatives, so Soundscape would also benefit from less noise from fewer operations. Because
 12 Alternative E includes quiet-technology incentives and conversion requirements, noise impacts would decrease
 13 resulting in negligible to moderate beneficial changes in impacts Base Year to Ten-Year Forecast in the park as a
 14 whole.

15
 16 Base Year would *make progress toward SRNQ* Substantial Restoration of Natural Quiet in 75% of the park Peak
 17 Season, and 78% Off-Peak Season. These represent moderate beneficial changes in impacts compared to Alternative
 18 A with a 20% increase in park area restored Peak Season, and a 23% increase Off-Peak Season.

19
 20 Ten-Year Forecast *would make progress toward SRNQ* in 84% of the park Peak Season, and 86% of the park Off-
 21 Peak Season. These represent major beneficial changes in impacts compared to Alternative A with a 31% increase in
 22 park area restored Peak Season, and a 33% increase Off-Peak Season.

23
 24 **Conclusion by Zone** **Alternative E** **Soundscape**

25 *Ten-Year Forecast Peak Season*

26 *Wilderness Zone* (about 94% of GCNP); area of moderate to major adverse impacts would be 11 to 24% of the
 27 Zone, a major beneficial change in impacts (32 to 37% reduction in area of moderate to major adverse impacts)
 28 compared to Alternative A.

29
 30 *Non-Wilderness Zone* (about 4% of GCNP); area of moderate to major adverse impacts would be 15 to 39% of
 31 the Zone, a major beneficial change in impacts (47 to 74% reduction in area of moderate to major adverse
 32 impacts) compared to Alternative A.

33
 34 *Developed Zone* (about 2% of GCNP); area of moderate to major adverse impacts would be 12 to 58% of the
 35 Zone, a major beneficial change in impacts (37 to 56% reduction in area of moderate to major adverse impacts)
 36 compared to Alternative A.

37
 38 **Conclusion by Area** **Alternative E** **Soundscape**

39 *Base Year and Ten-Year Forecast*

40 In Marble Canyon, Central, and West End (southern portions), localized long- and short-term adverse impacts
 41 would generally be negligible to minor adverse with negligible to moderate beneficial changes in impacts
 42 compared to Alternative A. Greatest noise exposure would occur in East End where long- and short-term impacts
 43 would generally be moderate to major adverse in areas under and near air-tour routes in the seasonally active
 44 Corridor, with negligible change in impacts compared to Alternative A. However, in East End areas near
 45 seasonally inactive air-tour routes and amid Flight-free Zones, there would be negligible to minor adverse
 46 impacts with moderate to major beneficial change in impacts compared to Alternative A. In West End's northern
 47 portion with air-tour routes, there would be moderate to major adverse impacts with minor beneficial changes in
 48 impacts compared to Alternative A.

49
 50 **Cumulative Impacts Summary** **Alternative E** **Soundscape**

51
 52 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 53 *impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts in*
 54 *all three Zones (Developed, Non-Wilderness, and Wilderness) and all four park sections (Marble Canyon, East*
 55 *End, Central, and West End) would tend to increase to major adverse Cumulative Impacts under and near air-*
 56 *tour routes, and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In*

1 *comparison with the other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts followed*
 2 *by the Modified NPS Preferred Alternative and Alternative F (Alternative A ranks last).*
 3

4 **ALTERNATIVE F** **MODIFIED CURRENT CONDITIONS** **SOUNDSCAPE**
 5

6 Base Year Peak and Off-Peak Season, Alternative F modifies West End tour routes to alleviate noise at Eagle and
 7 Guano Point Location Points, and seasonally shifts Dragon Corridor routes. Alternative F would *make progress*
 8 *toward SRNQ* in 51% of the park Peak Season, and 59% of the park Off-Peak Season, as shown in Table 4.23.
 9 These represent negligible changes in impacts from Alternative A with a 4% decrease in park area *making progress*
 10 *toward SRNQ* Peak Season, and a 4% increase Off-Peak Season.
 11

12 Ten-Year Forecast Peak and Off-Peak Season would *make progress toward* Substantial Restoration of Natural Quiet
 13 in 66% of the park Peak Season, and 75% of the park Off-Peak Season as shown in Table 4.24. These represent
 14 moderate beneficial changes in impacts from Alternative A with a 13% increase in park area *making progress*
 15 *toward SRNQ* Peak Season, and a 22% increase Off-Peak Season.
 16

17 Mapped results of Alternative F noise modeling for Percent Time Audible and Average Sound Level are shown in
 18 Figures 4.18 to 4.25. Tables 4.11 to 4.16 present Contour Analysis and Location Point results computed for
 19 Alternative F Peak and Off-Peak Seasons, respectively, and include comparisons with Alternative A.
 20

21 **Developed Zone (about 2% of GCNP)** **Alternative F** **Soundscape**
 22

23 With exception of a very small Developed Zone area at Tuweep, all GCNP Developed Zone areas are in East End.
 24 Audibility calculations for the Developed Zone included 10 dBA added to natural ambient sound levels due to the
 25 Dual-Zone System acoustic approach explained in Chapter 4, Methodology. As such, analysis considers Developed
 26 Zone management objectives which accept presence of many non-natural sound sources (increased background
 27 ambient sound levels) including most of the park's visitors and their activities, presence of paved roads and
 28 motorized transportation, and developed facilities.
 29

30 *Developed Zone* *Alternative F* *Soundscape*
 31 *Base Year Peak Season*

32 Average Sound Level would generally be 25 dBA or more in 68% of the Developed Zone; that is, Average
 33 Sound Level would be 25 to <35 dBA in 58% of the Zone (moderate adverse impact), and greater than *or equal*
 34 *to* 35 dBA in 10% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in
 35 95% of the Zone; that is, 10 to <25% in 6% of the Zone (moderate adverse impact), and greater than *or equal to*
 36 25% in 89% of the Zone (major adverse impact). This would represent a negligible change of 4% in area with
 37 Average Sound Level of 25 dBA or more and a negligible change of one percent in area of 10% or more Percent
 38 Time Audible compared to Alternative A (a negligible change in areas of moderate to major adverse impact),
 39 resulting in a negligible change in impacts compared to Alternative A.
 40

41 *Developed Zone* *Alternative F* *Soundscape*
 42 *Base Year Off-Peak Season*

43 Average Sound Level would generally be 25 dBA *or more* in **21%** of the Zone; that is, Average Sound Level
 44 would be 25 to <35 dBA in **18%** of the Zone (moderate adverse impact), and greater than *or equal to* 35 dBA in
 45 **3%** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 79% of the
 46 Zone; that is, 10 to <25% in 28% of the Zone (moderate adverse impact), and greater than *or equal to* 25% in
 47 51% of the Zone (major adverse impact). This would represent a reduction of 44% in area with Average Sound
 48 Level of 25 dBA or more, and a reduction of 15% in area of 10% or more Percent Time Audible compared to
 49 Alternative A (a 15 to 44% reduction in areas of moderate to major adverse impacts), resulting in a moderate to
 50 major beneficial change in impacts compared to Alternative A.
 51

Figure 4.18 Alternative F Percent Time Audible Base Year Peak Season

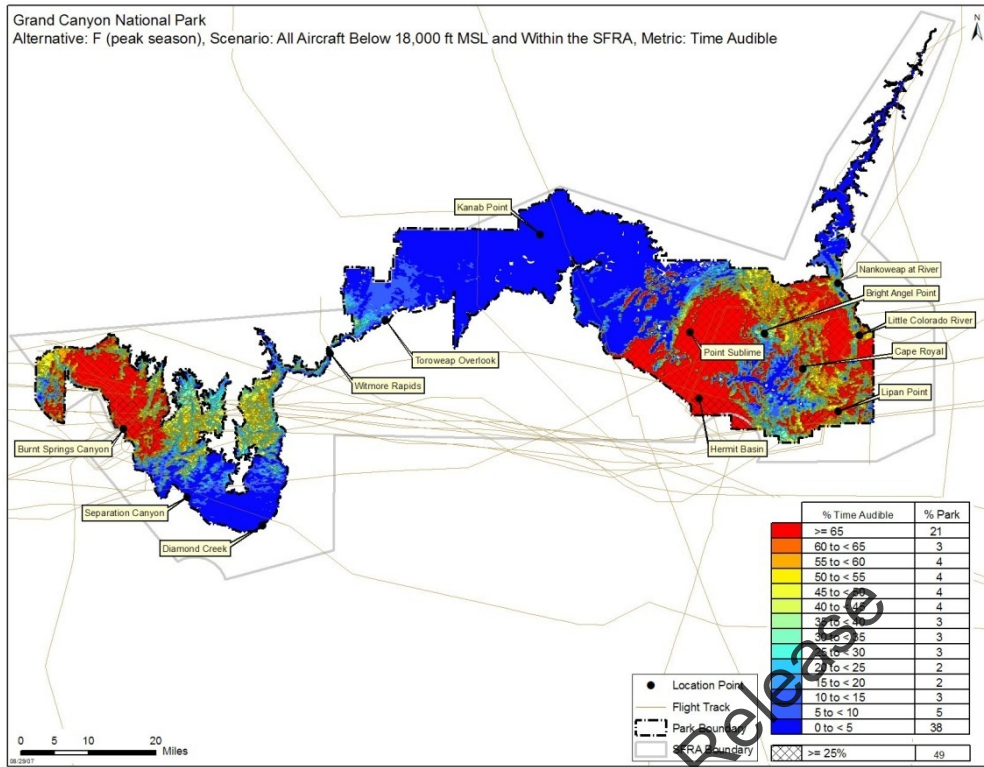


Figure 4.19 Alternative F Percent Time Audible Ten-Year Forecast Peak Season

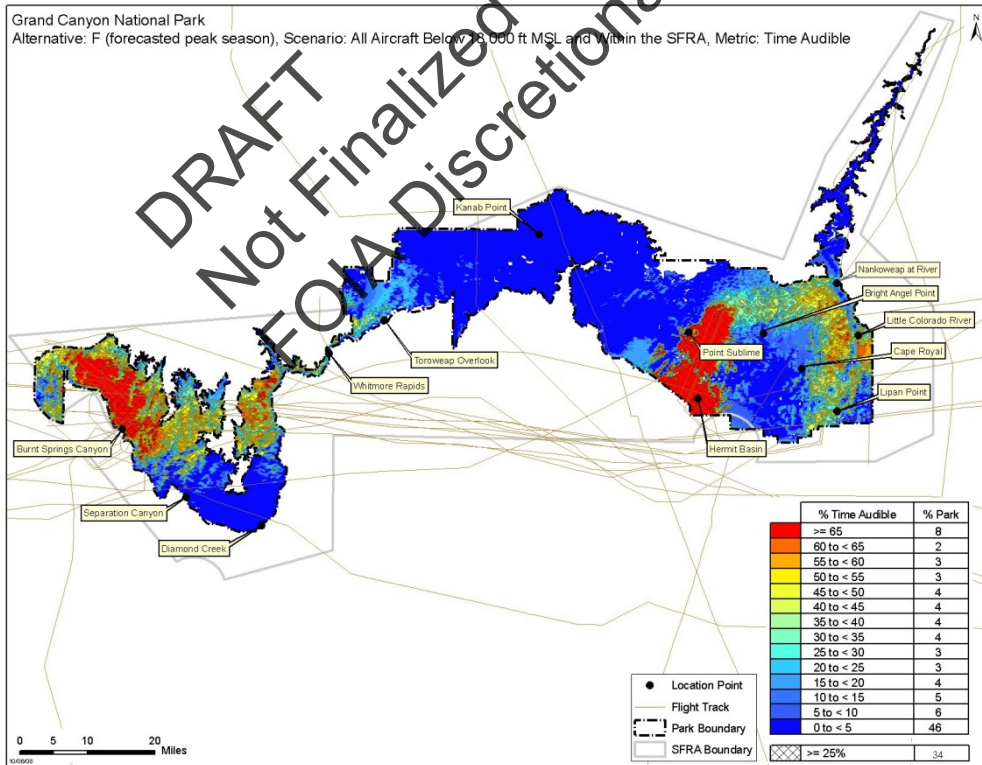


Figure 4.20 Alternative F Percent Time Audible Base Year Off-Peak Season

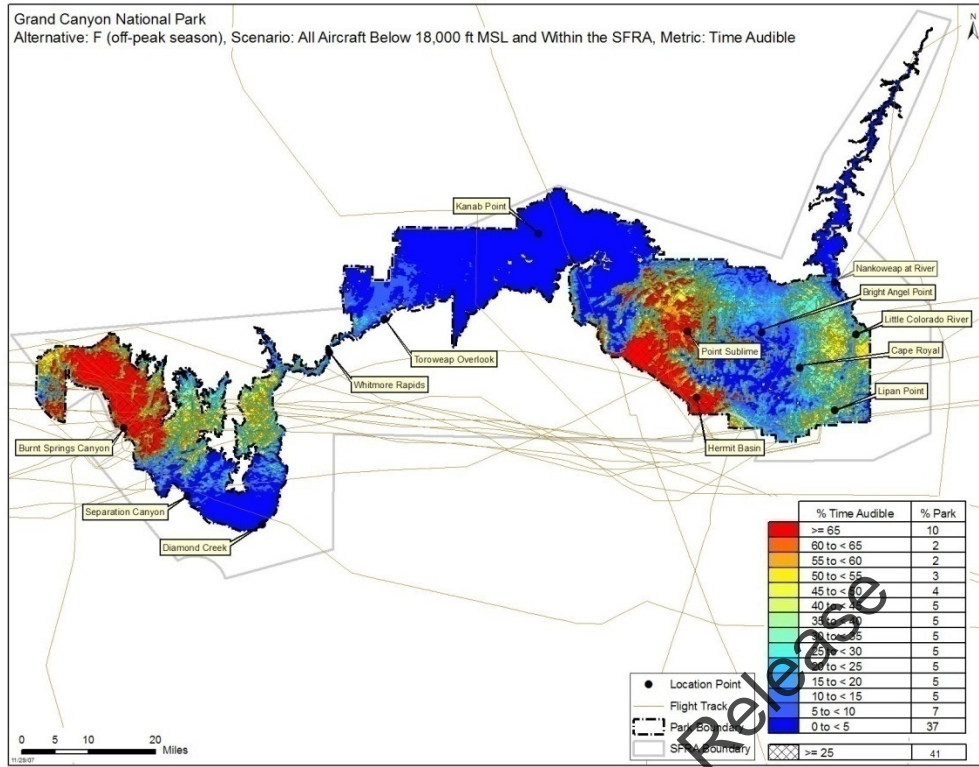


Figure 4.21 Alternative F Percent Time Audible Ten-Year Forecast Off-Peak Season

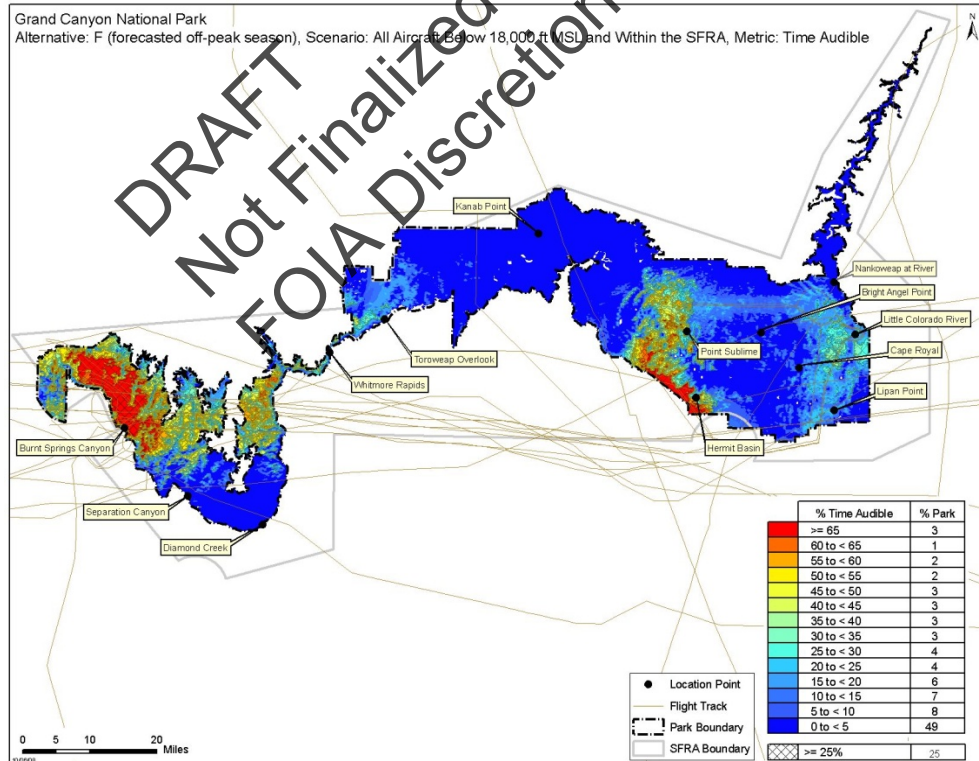


Figure 4.22 Alternative F Average Sound Level Base Year Peak Season

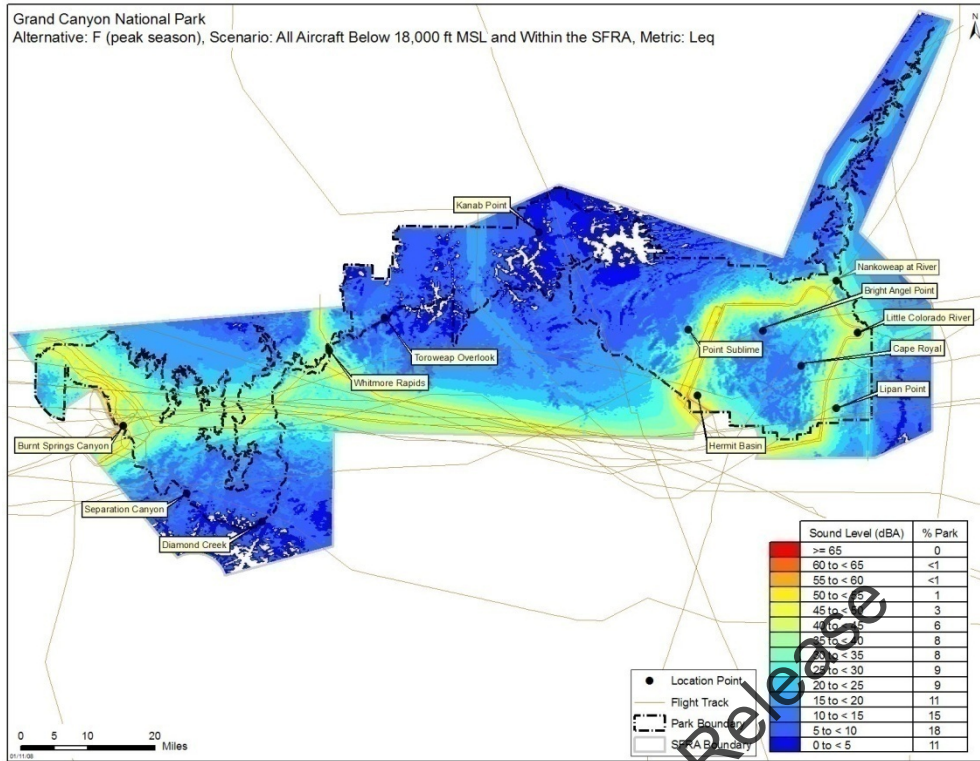


Figure 4.23 Alternative F Average Sound Level Ten-Year Forecast Peak Season

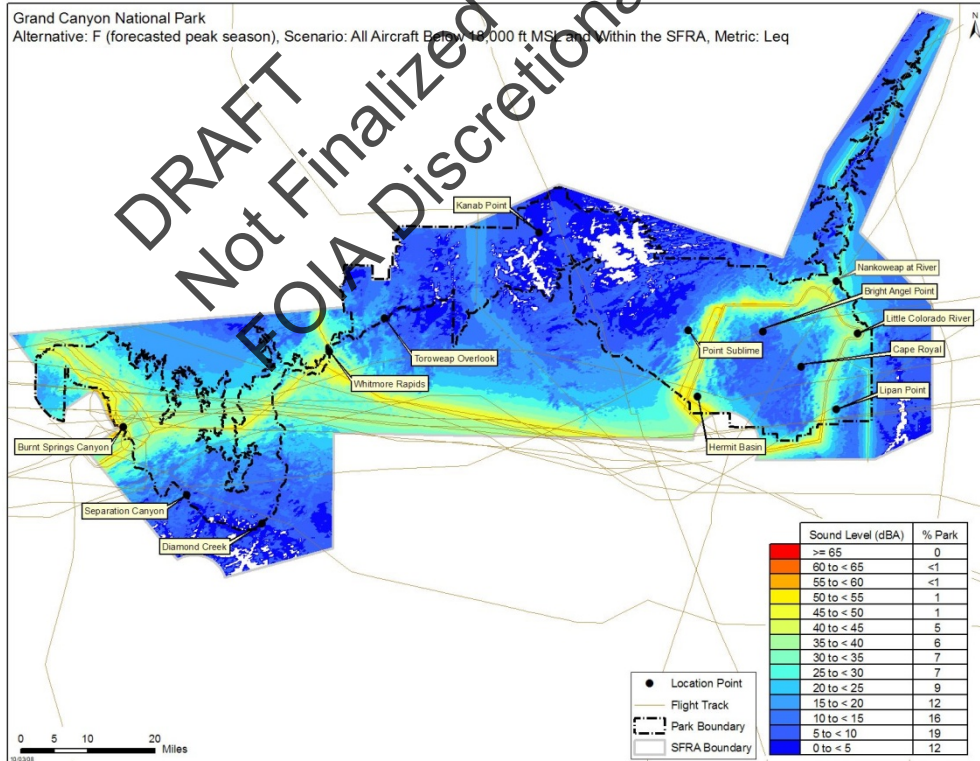


Figure 4.24 Alternative F Average Sound Level Base Year Off-Peak Season

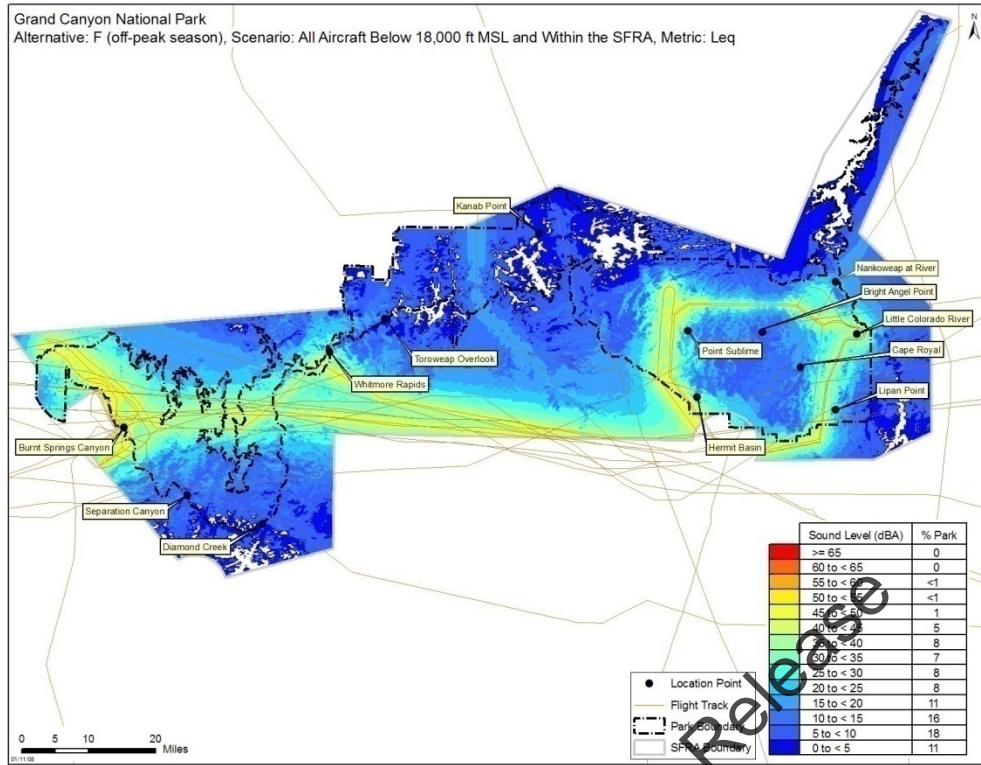
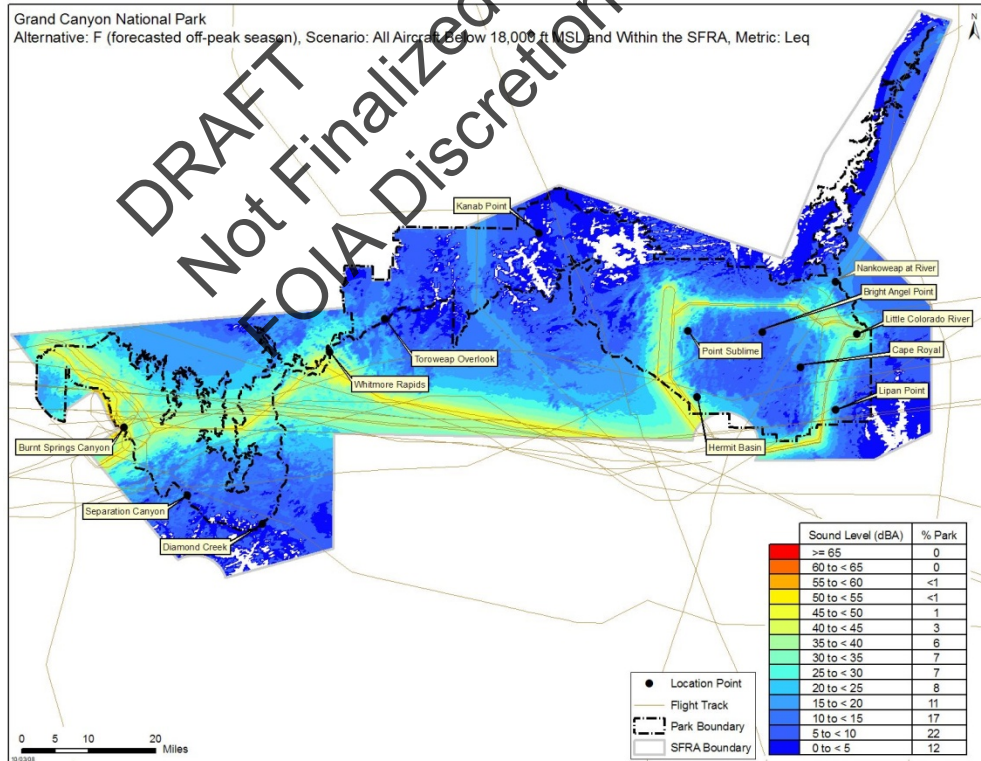


Figure 4.25 Alternative F Average Sound Level Ten-Year Forecast Off-Peak Season



1
2

1 **Table 4.11** **Alternative F** **Percent Time Audible** **Contour Analysis Results**
 2 **Peak Season^{abc}**

Percent Time Audible	Base Year (Percent of Zone)				Ten Year Forecast (Percent of Zone)			
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP
% Park Making Progress Toward SRNQ				51%				66%
≥ 25	89%	80%	47%	49%	29%	30%	34%	34%
10 to < 25	6%	7%	8%	8%	26%	19%	12%	13%
5 to < 10	3%	4%	5%	5%	24%	19%	5%	6%
> 0 to < 5	2%	10%	40%	38%	21%	31%	47%	46%
% of Zone Difference in TAUD Contour Results with Alternative A								
≥ 25	-1%	-1%	-4%	-3%	61%	50%	11%	13%
10 to < 25	0%	1%	3%	3%	-21%	-13%	-2%	-3%
5 to < 10	-2%	-1%	1%	1%	-23%	-17%	0%	-1%
> 0 to < 5	2%	1%	0%	0%	-17%	-20%	-8%	-9%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

^cColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

3 **Table 4.12** **Alternative F** **Average Sound Level** **Contour Analysis Results**
 4 **Peak Season^{ab}**

Average Sound Level	Base Year (Percent of Zone)					Ten Year Forecast (Percent of Zone)				
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA
≥ 35	10%	21%	17%	17%	15%	5%	13%	14%	14%	13%
25 to < 35	58%	38%	15%	16%	15%	19%	23%	14%	14%	14%
15 to < 25	30%	28%	20%	20%	27%	67%	37%	20%	21%	26%
> 0 to < 15	3%	14%	45%	44%	41%	10%	27%	49%	48%	44%
Percent of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	0%	0%	-2%	-2%	-1%	19%	19%	8%	9%	1%
25 to < 35	-4%	-1%	-3%	-2%	1%	56%	35%	12%	14%	7%
15 to < 25	4%	1%	2%	2%	0%	-65%	-27%	19%	16%	14%
> 0 to < 15	0%	0%	2%	2%	-1%	-10%	-27%	-36%	-35%	-20%

^aDue to rounding differences, totals shown in this table may differ from Appendix D by up to 2%.

^bColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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1 **Table 4.13 Alternative F Location Point Results Peak Season**

Location Point Grouping		Base Year					Ten Year Forecast				
		TAUD ^b	L _{Aeq12} ^c	TALA35 dBA ^d	TALA45 dBA ^d	TALA55 dBA ^d	TAUD	L _{Aeq12}	TALA35 dBA	TALA45 dBA	TALA55 dBA
Marble Canyon	Max	3%	24 dBA	1%	0%	0%	3%	24 dBA	1%	0%	0%
	Median	2%	14 dBA	0%	0%	0%	2%	15 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
East End	Max	100%	49 dBA	100%	51%	5%	98%	46 dBA	100%	38%	3%
	Median	64%	28 dBA	5%	0%	0%	25%	24 dBA	0%	0%	0%
	Min	0%	7 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
Central	Max	12%	25 dBA	2%	0%	0%	21%	26 dBA	4%	0%	0%
	Median	1%	8 dBA	0%	0%	0%	1%	9 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	91%	47 dBA	66%	24%	4%	85%	46 dBA	60%	23%	3%
	Median	17%	17 dBA	0%	0%	0%	14%	18 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	100%	49 dBA	100%	51%	5%	98%	46 dBA	100%	38%	3%
	Median	4%	17 dBA	0%	0%	0%	3%	16 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Difference in Location Points Results with Alternative A											
Marble Canyon	Max	0%	0 dBA	0%	0%	0%	0%	1 dBA	0%	0%	0%
	Median	0%	0 dBA	0%	0%	0%	0%	1 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
East End	Max	0%	0 dBA	0%	0%	0%	2%	3 dBA	0%	19%	2%
	Median	0%	0 dBA	0%	0%	0%	42%	5 dBA	6%	0%	0%
	Min	0%	-1 dBA	0%	0%	0%	0%	4 dBA	0%	0%	0%
Central	Max	10%	2 dBA	2%	0%	0%	5%	1 dBA	1%	0%	0%
	Median	0%	2 dBA	0%	0%	0%	1%	1 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	2%	1 dBA	6%	4%	0%	10%	2 dBA	21%	10%	2%
	Median	1%	4 dBA	0%	0%	0%	7%	4 dBA	1%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	0%	0 dBA	0%	0%	0%	2%	3 dBA	0%	19%	2%
	Median	5%	0 dBA	0%	0%	0%	7%	2 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

^aMax refers to maximum Location Point value for a Location Point grouping for each respective specific metric; conversely, Min refers to minimum Location Point value. The median characterizes the central tendency of the results. That is, 50% of results are above the median, 50% below. The median, as opposed to the arithmetic mean, is more appropriate for data not normally distributed

^bTAUD = Percent Time Audible

^cL_{Aeq12} = Average Sound Level

^dTALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft noise exceed 35, 45, and 55 dBA, respectively

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1 **Table 4.14 Alternative F Percent Time Audible Contour Analysis Results**
 2 **Off-Peak Season^{ab}**

Percent Time Audible	Base Year (Percent of Zone)				Ten Year Forecast (Percent of Zone)			
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP
% Park Making Progress Toward SRNQ				59%				75%
≥ 25	51%	43%	41%	41%	4%	10%	25%	25%
10 to < 25	28%	35%	13%	14%	35%	18%	17%	17%
5 to < 10	11%	10%	7%	7%	28%	23%	8%	8%
> 0 to < 5	10%	13%	39%	37%	33%	48%	50%	49%
Percent of Zone Difference in Percent Time Audible Contour Results with Alternative A								
≥ 25	37%	36%	3%	4%	86%	70%	19%	22%
10 to < 25	-22%	-27%	-3%	-4%	-30%	-12%	-6%	-7%
5 to < 10	-10%	-7%	-1%	-1%	-27%	-21%	-2%	-3%
> 0 to < 5	-5%	-2%	1%	1%	-28%	-38%	-11%	-12%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

3 **Table 4.15 Alternative F Average Sound Level Contour Analysis Results**
 4 **Off-Peak Season^a**
 5
 6

Average Sound Level	Base Year (Percent of Zone)					Ten Year Forecast (Percent of Zone)				
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA
≥ 35	3%	7%	15%	14%	14%	2%	5%	11%	11%	11%
25 to < 35	18%	26%	15%	18%	13%	7%	13%	14%	14%	13%
15 to < 25	65%	34%	18%	19%	21%	62%	39%	18%	19%	22%
> 0 to < 15	15%	36%	47%	46%	47%	30%	42%	51%	51%	48%
Percent of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	7%	14%	0%	1%	1%	22%	28%	11%	12%	3%
25 to < 35	37%	14%	-2%	-1%	2%	68%	44%	12%	14%	8%
15 to < 25	-32%	-6%	3%	3%	6%	-60%	-30%	21%	18%	19%
> 0 to < 15	-12%	-22%	1%	0%	-6%	-30%	-42%	-38%	-38%	-23%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

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1 **Table 4.16 Alternative F Location Point Results Off-Peak Season^a**

Location Point Grouping		Base Year					Ten Year Forecast				
		TAUD (%) ^b	L _{Aeq12} (dBA) ^c	TALA35 dBA (%) ^d	TALA45 dBA (%) ^d	TALA55 dBA (%) ^d	TAUD (%)	L _{Aeq12} (dBA)	TALA35 dBA (%)	TALA45 dBA (%)	TALA55 dBA (%)
Marble Canyon	Max	1%	13 dBA	0%	0%	0%	1%	13 dBA	0%	0%	0%
	Median	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
East End	Max	95%	49 dBA	37%	14%	5%	83%	47 dBA	36%	11%	4%
	Median	28%	21 dBA	0%	0%	0%	11%	17 dBA	0%	0%	0%
	Min	0%	3 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Central	Max	25%	24 dBA	2%	0%	0%	17%	26 dBA	3%	0%	0%
	Median	1%	7 dBA	0%	0%	0%	1%	9 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	90%	46 dBA	68%	23%	4%	81%	45 dBA	62%	21%	3%
	Median	15%	17 dBA	0%	0%	0%	11%	17 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	95%	49 dBA	68%	23%	5%	83%	47 dBA	62%	21%	4%
	Median	5%	13 dBA	0%	0%	0%	2%	13 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Difference in Location Points Results with Alternative A											
Marble Canyon	Max	2%	11 dBA	1%	0%	0%	2%	12 dBA	0%	0%	0%
	Median	1%	14 dBA	0%	0%	0%	2%	16 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
East End	Max	5%	0 dBA	63%	37%	0%	17%	2 dBA	64%	46%	1%
	Median	36%	7 dBA	5%	0%	0%	56%	11 dBA	6%	0%	0%
	Min	0%	3 dBA	0%	0%	0%	0%	7 dBA	0%	0%	0%
Central	Max	-3%	3 dBA	2%	0%	0%	8%	2 dBA	1%	0%	0%
	Median	0%	2 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	3%	1 dBA	3%	0%	0%	14%	2 dBA	20%	12%	3%
	Median	4%	5 dBA	0%	0%	0%	11%	5 dBA	1%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	5%	0 dBA	2%	28%	0%	17%	2 dBA	38%	36%	1%
	Median	3%	3 dBA	0%	0%	0%	8%	5 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

^aThe average used in this context is characterized by the media—the central tendency of the results. That is, 50% of results are above the median; 50% are below. The median, as opposed to the arithmetic mean, is more appropriate for data not normally distributed

^bTAUD = Percent Time Audible

^cL_{Aeq12} = Average Sound Level

^dTALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft noise exceed 35, 45, and 55 dBA, respectively

2
3
4 *Developed Zone Alternative F Soundscape*
5 *Ten-Year Forecast Peak Season*

6 Average Sound Level would generally be 25 dBA **or more** in 24% of the Zone; that is, Average Sound Level
7 would be 25 to <35 dBA in 19% of the Zone (moderate adverse impact), and greater than **or equal to** 35 dBA in
8 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 55% of the
9 Zone; that is, 10 to <25% in 26% of the Zone (moderate adverse impact), and greater than **or equal to** 25% in
10 29% of the Zone (major adverse impact). This would represent a reduction of 75% in area with Average Sound
11 Level of 25 dBA or more, and a reduction of 40% in area of 10% or more Percent Time Audible compared to
12 Alternative A (a 40 to 75% reduction in areas of moderate to major adverse impact), resulting in a major
13 beneficial change in impacts compared to Alternative A.
14

1 *Developed Zone* *Alternative F* *Soundscape*
 2 *Ten-Year Forecast Off-Peak Season*

3 Average Sound Level would generally be 25 dBA **or more** in 9% of the Zone; that is, Average Sound Level
 4 would be 25 to <35 dBA in 7% of the Zone (moderate adverse impact), and greater than **or equal to** 35 dBA in
 5 2% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 39% of the
 6 Zone; that is, between 10 and <25% in 35% of the Zone (moderate adverse impact), and greater than **or equal to**
 7 25% in 4% of the Zone (major adverse impact). This would represent a reduction of 90% in area with Average
 8 Sound Level of 25 dBA or more, and a reduction of 56% in area of 10% or more Percent Time Audible
 9 compared to Alternative A (a 56 to 90% reduction in areas of moderate to major adverse impact), resulting in a
 10 major beneficial change in impacts compared to Alternative A.

11 **Non-Wilderness Zone (6% of GCNP)** **Alternative F** **Soundscape**

12 Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road
 13 corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone System area where 10 dBA is added to natural
 14 ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with
 15 motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The
 16 majority of the Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis
 17 for audibility calculations, consistent with Non-Wilderness Zone management objectives that call for mostly natural
 18 conditions to prevail in the Zone.

19 *Non-Wilderness Zone* *Alternative F* *Soundscape*
 20 *Base Year Peak Season*

21 Average Sound Level would generally be 25 dBA or more in 59% of the Zone; that is, Average Sound Level
 22 would be 25 to <35 dBA in 38% of the Zone (moderate adverse impact), and greater than **or equal to** 35 dBA in
 23 21% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 87% of the
 24 Zone; that is, 10% to <25% in 7% of the Zone (moderate adverse impact), and greater than **or equal to** 25% in
 25 80% of the Zone (major adverse impact). This would represent a negligible change of one percent in area with
 26 Average Sound Level of 25 dBA or more and in area of 10% or more Percent Time Audible compared to
 27 Alternative A (a negligible change in areas of moderate to major adverse impact), resulting in a negligible
 28 change in impacts compared to Alternative A.

29 *Non-Wilderness Zone* *Alternative F* *Soundscape*
 30 *Base Year Off-Peak Season*

31 Average Sound Level would generally be 25 dBA **or more** in 30% of the Zone; that is, Average Sound Level
 32 would be 25 to <35 dBA in 23% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 33 7% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 78% of the
 34 Zone; that is, 10 to <25% in 35% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
 35 43% of the Zone (major adverse impact). This would represent a reduction of 28% in area with Average Sound
 36 Level of 25 dBA or more and a reduction of 9% in area of 10% or more Percent Time Audible compared to
 37 Alternative A (a 9 to 28% reduction in areas of moderate to major adverse impact), resulting in a minor to
 38 moderate beneficial change in impacts compared to Alternative A.

39 *Non-Wilderness Zone* *Alternative F* *Soundscape*
 40 *Ten-Year Forecast Peak Season*

41 Average Sound Level would generally be 25 dBA **or more** in 36% of the Zone; that is, Average Sound Level
 42 would be 25 to <35 dBA in 23% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 43 13% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 49% of the
 44 Zone; that is, 10 to <25% in 19% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
 45 30% of the Zone (major adverse impact). This would represent a reduction of 54% in area with Average Sound
 46 Level of 25 dBA or more and a reduction of 37% in area of 10% or more Percent Time Audible compared to
 47 Alternative A (a 37 to 54% reduction in areas of moderate to major adverse impact), resulting in a major
 48 beneficial change in impacts compared to Alternative A.

1 *Non-Wilderness Zone* *Alternative F* *Soundscape*

2 *Ten-Year Forecast Off-Peak Season*

3 Average Sound Level would generally be 25 dBA **or more** in 18% of the Zone; that is, Average Sound Level
4 would be 25 to <35 dBA in 13% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
5 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 28% of the
6 Zone; that is, 10 to <25% in 18% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
7 10% of the Zone (major adverse impact). This would represent a reduction of 72% in area with Average Sound
8 Level of 25 dBA or more and a reduction of 58% in area of 10% or more Percent Time Audible compared to
9 Alternative A (a 58 to 72% reduction in areas of moderate to major adverse impact), resulting in a major
10 beneficial change in impacts compared to Alternative A.

11
12 **Wilderness Zone (about 94% of GCNP)** *Alternative F* **Soundscape**

13
14 In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the
15 Wilderness Zone's increased size and geographic extent as compared to the others. Most of the Wilderness Zone is
16 in the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System
17 acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

18
19 *Wilderness Zone* *Alternative F* *Soundscape*

20 *Base Year Peak Season*

21 Average Sound Level would generally be 25 dBA **or more** in 32% of the Zone; that is, Average Sound Level
22 would be 25 to <35 dBA in 15% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
23 17% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 55% of the
24 Zone; that is, 10 to <25% in 8% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in 47%
25 of the Zone (major adverse impact). This would represent an increase of 5% in area with Average Sound Level
26 of 25 dBA or more and an increase of one percent in area of 10% or more Percent Time Audible compared to
27 Alternative A (a one to 5% increase in areas of moderate to major adverse impact), resulting in a negligible to
28 minor adverse change in impacts compared to Alternative A.

29
30 *Wilderness Zone* *Alternative F* *Soundscape*

31 *Base Year Off-Peak Season*

32 Average Sound Level would generally be 25 dBA **or more** in 30% of the Zone; that is, Average Sound Level
33 would be 25 to <35 dBA in 15% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
34 15% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 54% of the
35 Zone; that is, 10 to <25% in 13% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
36 41% of the Zone (major adverse impact). This would represent a negligible change (**2% and essentially no**
37 **change, respectively**) in area with Average Sound Level of 25 dBA or more and in area of 10% or more Percent
38 Time Audible compared to Alternative A (a negligible change in areas of moderate to major adverse impact),
39 resulting in a negligible change in impacts compared to Alternative A.

40
41 *Wilderness Zone* *Alternative F* *Soundscape*

42 *Ten-Year Forecast Peak Season*

43 Average Sound Level would generally be 25 dBA **or more** in 28% of the Zone; that is, Average Sound Level
44 would be 25 to <35 dBA in 14% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
45 14% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 46% of the
46 Zone; that is, 10 to <25% in 12% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
47 34% of the Zone (major adverse impact). This would represent a 20% reduction in area with Average Sound
48 Level of 25 dBA or more and a reduction of 9% in area of 10% or more Percent Time Audible compared to
49 Alternative A (a 9 to 20% reduction in areas of moderate to major adverse impact), resulting in a minor
50 beneficial change in impacts compared to Alternative A.

51
52 *Wilderness Zone* *Alternative F* *Soundscape*

53 *Ten-Year Forecast Off-Peak Season*

54 Average Sound Level would generally be 25 dBA **or more** in 25% of the Zone; that is, Average Sound Level
55 would be 25 to <35 dBA in 14% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
56 11% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 42% of the

Zone; that is, 10 to <25% in 17% of the Zone (moderate adverse impact) and greater than *or equal to* 25% in 25% of the Zone (major adverse impact). This would represent a reduction of 23% in area with Average Sound Level of 25 dBA or more and a reduction of 13% in area of 10% or more Percent Time Audible compared to Alternative A (a 13 to 23% reduction in areas of moderate to major adverse impact), resulting in a minor to moderate beneficial change in impacts compared to Alternative A.

Marble Canyon **Alternative F** **Soundscape**

Marble Canyon's west side is located in the Wilderness Zone; the east side in the Non-Wilderness Zone. It is also entirely in the Dual-Zone System noticeability area in which 10 dBA is added to natural ambient sound levels in calculating Percent Time Audible (Chapter 4, Methodology). Modifications to air-tour routes in Alternative F would have minimal effect in Marble Canyon

Marble Canyon *Alternative F* *Soundscape*
Base Year and Ten-Year Forecast Peak Season

Localized long- and short-term adverse impacts would be similar to Alternative A Base Year and Ten-Year Forecast. **Marble Canyon Location Points**, Base Year Peak Season, range zero to 3% Percent Time Audible (median 2%), and Average Sound Level zero to 24 dBA (median 14 dBA). Impacts would generally be negligible to minor adverse in these areas (from Figures 4.18 to 4.25, Average Sound Level would generally be less than 15 dBA and Percent Time Audible less than 5%). There would be negligible increases (Percent Time Audible of one percent and Average Sound Level one dBA) Base Year to Ten-Year Forecast, a negligible change from Alternative A.

Marble Canyon *Alternative F* *Soundscape*
Base Year and Ten-Year Forecast Off-Peak Season

Percent Time Audible and Average Sound Level would be less than Peak Season, with **Marble Canyon Location Points** experiencing Percent Time Audible of zero to one percent (median zero percent) and Average Sound Level zero to 13 dBA (median zero dBA), with almost no change between Base Year and Ten-Year Forecast. These values represent negligible impacts in Marble Canyon and negligible to minor beneficial changes in impacts compared to Alternative A (one percent less median Percent Time Audible and 14 to 16 dBA lower Average Sound Level).

East End **Alternative F** **Soundscape**

Under Alternative F, greatest exposure to noise and visual impacts would continue in East End. Dragon Corridor's seven-mile western shift Off-Peak Season would shift impacts seven-miles west. East End contains all three Management Zones: Developed, Non-Wilderness, and Wilderness.

East End air-tour aircraft Percent Time Audible would vary zero to 100% of the day, and Average Sound Level 3 dBA to 49 dBA, depending on how close a Location Point is to East End air-tour routes, and whether it is Peak Season when routes are the same as Alternative A, or Off-Peak Season when Dragon Corridor routes shift seven-miles west.

East End *Alternative F* *Soundscape*
Base Year Peak Season

East End Location Points Percent Time Audible would range zero to 100% (median 64%), and 7 to 49 dBA (median 28 dBA). At some locations, aircraft events would exceed 35 dBA for 100% of the day, 45 dBA for 51% of the day, and 55 dBA for 5% of the day. Localized long- and short-term major adverse impacts would continue in areas close to Zuni Point and Dragon Corridor routes, and routes over North Rim (from Figures 4.18 to 4.25, aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%). Although the majority of Location Points do not experience Average Sound Level greater than 35 dBA, several Location Points (**96 Mile Camp, The Basin, Eremita Mesa, Ten X Meadow, Tower of Ra**) show Average Sound Level as high as 45 to 55 dBA for 5 to 51% of the day. Impacts would be long-term negligible to minor adverse amid Bright Angel Flight-free Zone. Values for Alternative F Base Year Peak Season represent negligible change in impacts compared to Alternative A.

1 *East End* *Alternative F* *Soundscape*

2 *Base Year Off-Peak Season*

3 **East End Location Points** Percent Time Audible would range zero to 95% (median 28%), and 3 to 49 dBA
 4 (median 21 dBA). At some locations, aircraft events would exceed 35 dBA for 37% of the day, 45 dBA for 14%
 5 of the day, and 55 dBA for 5% of the day. Because this represents a reduction of 36% in median Percent Time
 6 Audible, and a 5% reduction in maximum Percent Time Audible due to Dragon Corridor's western shift Off-
 7 Peak Season, this would be a minor to major beneficial change in East End impacts compared to Alternative A.
 8 Localized long- and short-term impacts would be major adverse in areas near the shifted Dragon Corridor, Zuni
 9 Point Corridor, and routes across North Rim (from Figures 4.18 to 4.25, aircraft Average Sound Level would be
 10 40 to 50 dBA, and Percent Time Audible would be greater than 75%), and negligible to minor adverse amid
 11 Bright Angel Flight-free Zone. Bright Angel Flight-free Zone's eastern portion would experience markedly
 12 reduced air-tour sounds Off-Peak Season, while locations closer to Dragon Corridor (near **Point Sublime and**
 13 **Pasture Wash** Location Points) would see only modest reductions.

15 *East End* *Alternative F* *Soundscape*

16 *Ten-Year Forecast Peak Season*

17 **East End Location Points** Percent Time Audible would range zero to 98% (median 25%); Average Sound
 18 Level would range 2 dBA to 46 dBA (median 24 dBA). This represents a reduction of 39% in median Percent
 19 Time Audible from Base Year to Ten-Year Forecast, and a reduction of 42% in median Percent Time Audible
 20 compared to Alternative A, due in large part to Alternative F quiet-technology conversion requirements. There
 21 would be moderate to major adverse impacts under and near Dragon and Zuni Point Corridors and across North
 22 Rim (a moderate to major beneficial change from Alternative A), and negligible to minor adverse impacts away
 23 from active routes and amid Bright Angel Flight-free Zone (a negligible to minor beneficial change from
 24 Alternative A).

26 *East End* *Alternative F* *Soundscape*

27 *Ten-Year Forecast Off-Peak Season*

28 **East End Location Point** Percent Time Audible would range zero to 83% (median 11%), and Average Sound
 29 Level zero to 47 dBA (median 17 dBA); compared to Base Year Off-Peak Season, a 17% reduction in median
 30 Percent Time Audible, and a 12% reduction in maximum Percent Time Audible, but only a 4 dBA reduction in
 31 median Average Sound Level. Compared to Alternative A, this represents a 56% reduction in median Percent
 32 Time Audible, a 17% reduction in maximum Percent Time Audible, and an 11% reduction in median Average
 33 Sound Level, due in large part to Alternative F quiet-technology conversion requirements. There would be
 34 moderate to major adverse impacts under and near Dragon and Zuni Point Corridors and across North Rim,
 35 moderate to major beneficial change in impacts from Alternative A in areas where Dragon Corridor is shifted
 36 from, but moderate to major adverse change in areas the Corridor is shifted to). There would also be negligible to
 37 minor adverse impacts away from active routes and amid Bright Angel Flight-free Zone (negligible to moderate
 38 beneficial change in impacts from Alternative A).

40 **Central** **Alternative F** **Soundscape**

41
 42 The Central area is located in the Wilderness Zone, with exception of a few Non-Wilderness Zone dirt road
 43 corridors, and a very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System
 44 audibility area in which natural ambient sound levels are used directly in audibility calculations. This area comprises
 45 most of the Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.

46
 47 In Central areas, as shown in Figures 4.18 to 4.25, aircraft Average Sound Level would be less than 10 dBA, and
 48 Percent Time Audible would be less than 5%).

50 *Central* *Alternative F* *Soundscape*

51 *Base Year Peak Season*

52 **Central area Location Points** would range zero to 12% Percent Time Audible (median one percent), and zero
 53 to 25 dBA (median 8 dBA). At some locations, aircraft events would exceed 35 dBA for 2% of the day.
 54 Compared to Alternative A, Alternative F values represent a 10% reduction in maximum Percent Time Audible
 55 (no change in median Percent Time Audible, and only a 2 dBA change in maximum and median Average Sound

Level). This represents negligible to minor adverse impacts with a negligible to minor beneficial change in impacts compared to Alternative A.

Central Alternative F Soundscape
Base Year Off-Peak Season

Central area Location Points would range zero to 25% Percent Time Audible (median one percent), and Average Sound Level zero to 24 dBA (median 7 dBA) representing negligible to minor adverse impacts with a negligible change in impacts compared with Alternative A (3% and 3 dBA).

Central Alternative F Soundscape
Ten-Year Forecast Peak Season

Central area Location Points would range zero to 21% Percent Time Audible (median one percent), and zero to 26 dBA (median 9 dBA). At some locations, aircraft events would exceed 35 dBA for 4% of the day. These values represent negligible to minor adverse impacts with a negligible to minor beneficial change in impacts compared to Alternative A.

Central Alternative F Soundscape
Ten-Year Forecast Off-Peak Season

Central area Location Points would range zero to 17% Percent Time Audible (median one percent), and Average Sound Level zero to 26 dBA (median 9 dBA). At some locations, aircraft events would exceed 35 dBA 3% of the day. The values represent negligible to minor adverse impacts with a negligible to minor beneficial change in impacts compared with Alternative A (8% and 2 dBA).

West End Alternative F Soundscape

West End is located in the Wilderness Zone, and entirely in the Dual-Zone System noticeability area in which 10 dBA is added to natural ambient sound levels in audibility calculations. Impacts to West End areas tend to be very localized. Specifically, impacts range negligible to major depending on proximity to Blue Direct and Blue-2/Green-4 routes. Beneficial impacts to Soundscape would be provided for locations where Green-4's southern portion would be eliminated and where Blue Direct South shifts to avoid Eagle and Guano Points.

West End Alternative F Soundscape
Base Year Peak and Off-Peak Season

Base Year Peak Season, **West End Location Points** Percent Time Audible would range zero to 91% (median 17%), and Average Sound Level zero to 47 dBA (median 17 dBA). At some locations, aircraft events would exceed 35 dBA 66% of the day, 45 dBA 24% of the day, and 55 dBA 4% of the day. Values for Base Year Off-Peak Season are within 2% and one dBA of Base Year Peak Season. For areas near Blue Direct and Blue-2/Green-4 routes (**West End's northern portion**), localized long- and short-term impacts would be major adverse (from Figures 4.18 to 4.25, Average Sound Level would be 40 to 50 dBA, Percent Time Audible would be greater than 65%). **In West End's southern portion**, localized long-term impacts would be negligible to minor adverse (from Figures 4.18 to 4.25, Average Sound Level would be 10 to 20 dBA, Percent Time Audible would be less than 20%). Minor beneficial changes in impacts from Alternative A would occur where Green-4's southern portion would be eliminated. There would be an average decrease in Percent Time Audible throughout this area (approximately 10%), but impacts would increase in the localized area at **Horse Flat Canyon Location Point** with non-quiet-technology operations exiting the route (also Percent Time Audible approximately 10%). There would also be localized short-term moderate adverse changes in impacts for locations such as **Granite Peak Location Point** (Percent Time Audible would increase approximately 20%), with Blue Direct South's southern shift to avoid **Eagle and Guano Point Location Points**. Conversely, there would also be localized moderate beneficial changes in impacts for locations such as **Andrus Canyon Location Point** (Percent Time Audible would decrease approximately 20%). These values represent negligible change in impacts compared to Alternative A (a one to 4% reduction in median Percent Time Audible, and a 4 to 5 dBA reduction in median Average Sound Level).

1 *West End* *Alternative F* *Soundscape*
 2 *Ten-Year Forecast Peak Season*

3 **West End Location Points** Percent Time Audible would range zero to 85% Percent Time Audible (median
 4 14%), and Average Sound Level zero to 46 dBA (median 18 dBA). At some locations, aircraft events would
 5 exceed 35 dBA 60% of the day, 45 dBA 23% of the day, and 55 dBA 3% of the day. Similar levels and
 6 differences between **West End's northern and southern portions** would be as described for Base Year Peak
 7 Season. These values are generally slightly less than Base Year Peak Season. Compared to Alternative A, they
 8 represent a 7% reduction in median Percent Time Audible, and a 10% reduction in maximum Percent Time
 9 Audible, as well as a 4 dBA reduction in median Average Sound Level, due to quiet-technology conversion
 10 requirements in Alternative F. There would be moderate to major adverse impacts in the **northern area** near air-
 11 tour routes (minor beneficial change in impacts from Alternative A), and negligible to minor adverse impacts in
 12 the **southern area** away from routes (negligible to minor beneficial change from Alternative A).
 13

14 *West End* *Alternative F* *Soundscape*
 15 *Ten-Year Forecast Off-Peak Season*

16 **West End Location Points** Ten-Year Forecast Off-Peak Season results are slightly lower than Ten-Year
 17 Forecast Peak Season (3 to 4% less Percent Time Audible, one dBA lower Average Sound Level). Similar levels
 18 and differences between **West End's northern and southern portions** would be as described for Base Year
 19 Peak Season. Compared to Alternative A, they represent an 11% reduction in median Percent Time Audible, and
 20 a 14% reduction in maximum Percent Time Audible, as well as a 5 dBA reduction in median Average Sound
 21 Level. There would be moderate to major adverse impacts in the **northern area** near air-tour routes (minor
 22 beneficial change in impacts from Alternative A), and negligible to minor adverse impacts in the **southern area**
 23 away from routes (negligible to moderate beneficial change from Alternative A).
 24

25 **NPS Units in the SFRA** *Alternative F* **Soundscape**
 26 **Outside Grand Canyon National Park**

27
 28 Blue Direct South's southern shift to avoid Eagle and Guano Point Location Points provides localized long- and
 29 short-term moderate beneficial impacts for **lands directly under and within five miles of Blue Direct routes** (Lake
 30 Mead National Recreation Area and Grand Canyon-Parashant National Monument); specifically, Percent Time
 31 Audible would decrease approximately 20%. Alternative F quiet-technology incentives and conversion requirements
 32 would provide some mitigation by decreasing affected area size; however, those areas still affected would see an
 33 increase in localized impacts due to growth in operations. **The remainder of the SFRA outside GCNP boundaries**
 34 would experience Average Sound Level less than 25 dBA. Localized long- and short-term impacts would generally
 35 be considered minor adverse overall to these lands. As with GCNP, **the SFRA as a whole** would benefit from quiet-
 36 technology incentives and conversion requirements Ten-Year Forecast.
 37

38 **Cumulative Impacts** *Alternative F* **Soundscape**

39
 40 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 41 *actions. In this context, Cumulative Impacts includes impacts on Soundscape from sounds of*

- 42 1. *high-altitude aircraft at or above 18,000 feet MSL plus*
- 43 2. *aircraft below 18,000 feet MSL and outside the SFRA plus*
- 44 3. *ground-based noise sources plus*
- 45 4. *noise from air-tour-and-related aircraft under Alternative F*

46
 47 *That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 Alternative F.*
 48

49 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 50 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 51 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (for high-altitude aircraft at or*
 52 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; for aircraft below 18,000 feet MSL and outside the*
 53 *SFRA see Appendix D, Figures 91 to 94).*
 54

55 *Noise from ground-based sources includes vehicles, building noise, machinery, and electronics, also impacts*
 56 *Soundscape, but is mostly concentrated in the Developed Zone (2% of the park), although a small component*

1 *exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
2 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
3 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
4 *Audible capable of masking some aircraft noise.*

5
6 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
7 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
8 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
9 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
10 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
11 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
12 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon’s rare*
13 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
14 *Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the*
15 *park and SFRA; there are no areas in GCNP where the natural Soundscape is not adversely affected by aircraft*
16 *noise some of the time.*

17
18 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in Alternative F compared*
19 *to the other Alternatives. Noise sources 1, 2, and 3 are generally not directly affected by the Alternatives, so their*
20 *noise impact is considered Common to All Alternatives (Appendix D, Tables 43 to 70); however, their noise*
21 *impact generally increases impacts of the noise produced under Alternatives (Alternative F in this case).*

22
23 *Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in*
24 *Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season),*
25 *noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone,*
26 *Wilderness Zone, and Entire Park Base Year and Ten-Year Forecast. Noise from ground-based sources was not*
27 *able to be included in noise modeling for this EIS; however, since noise from ground-based sources affects less*
28 *than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in interpreting*
29 *Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near unpaved*
30 *roads, the Colorado River, and mining activity areas north of the park.*

31
32 *Comparing noise impacts from just Alternative F by itself (Appendix D, Tables 26 (Peak Season) and 31 (Off-*
33 *Peak Season) (Ten-Year Forecast) versus All Aircraft (4 Alternative F plus 1 and 2) (Appendix D, Tables 57*
34 *(Peak Season) and 61 (Off-Peak Season) (Ten-Year Forecast)) gives a good indication of the difference between*
35 *Cumulative Impacts and impacts of Alternative F by itself. For the Entire Park Cumulative Impact results (Peak*
36 *and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 87 to 89% of the*
37 *park, with Average Sound Level 25 to <35 dBA in 84 to 86% of the park, with 1% of the park below 25 dBA and*
38 *15 to 18% at 35 dBA or more. For the Entire Park, results for Alternative F by itself (Peak and Off-Peak Season*
39 *Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to 10% of the park, with Average Sound*
40 *Level 25 to <35 dBA in 14% of the park, with 68 to 70% of the park below 25 dBA and 10 to 13% at 35 dBA or more.*

41
42 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
43 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
44 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
45 *impacts under the Alternatives reduces Cumulative Impacts.*

46
47 *Again, differences in Cumulative Impacts between Alternatives are apparent in the detailed impact analysis*
48 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
49 *Alternative (route locations/number/altitudes/quiet technology conversion, etc.). When added to noise impacts of*
50 *cumulative sources Common to All Alternatives described above (1, 2, and 3), impact levels for each area*
51 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts Summary*
52 *discussion in the Conclusions section below.*

1 **Conclusion** **Alternative F** **Soundscape**

2
3 Because Alternative F includes quiet-technology incentives and conversion requirements, noise impacts would
4 decrease from Base Year to Ten-Year Forecast in the park as a whole. Beneficial impacts would occur in both
5 Percent Time Audible and Average Sound Level.

6
7 Base Year Alternative F would *make progress toward* Substantial Restoration of Natural Quiet in 51% of the park
8 Peak Season, and 59% of the park Off-Peak Season. These represent negligible changes in impacts from Alternative
9 A with a 4% decrease in park area *making progress toward SRNQ* Peak Season, and a 4% increase Off-Peak
10 Season.

11
12 Ten-Year Forecast would *make progress toward* Substantial Restoration of Natural Quiet in 66% of the park Peak
13 Season, and 75% of the park Off-Peak Season. These represent moderate beneficial changes in impacts from
14 Alternative A with a 13% increase in park area *making progress toward SRNQ* Peak Season, and a 22% increase
15 Off-Peak Season.

16 **Conclusion** **Alternative F** **Soundscape**

17 *Conclusion by Zone* *Alternative F* *Soundscape*
18
19 *Ten-Year Forecast Peak Season*

20 Wilderness Zone (about 94% of GCNP); area of moderate to major adverse impact would be 28 to 46% of the
21 Zone, a minor beneficial change in impacts (9 to 20% reduction in area of moderate to major adverse impacts)
22 compared to Alternative A.

23
24
25 Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impact would be 36 to 49% of
26 the Zone, a major beneficial change in impacts (37 to 54% reduction in area of moderate to major adverse
27 impacts) compared to Alternative A.

28
29 Developed Zone (about 2% of GCNP); area of moderate to major adverse impact would be 24 to 55% of the
30 Zone, a major beneficial change in impacts (40 to 76% reduction in area of moderate to major adverse impacts)
31 compared to Alternative A.

32
33 *Conclusion by Area* *Alternative F* *Soundscape*
34 *Base Year and Ten-Year Forecast*

35 In Marble Canyon, Central areas, West End (southern portions), localized long- and short-term impacts would be
36 negligible to minor adverse (aircraft Average Sound Level would generally be less than 15 dBA, and Percent
37 Time Audible would be less than 5%) with negligible to moderate beneficial changes in impacts compared to
38 Alternative A depending on specific location. Greatest exposure to noise and visual impacts occur in East End
39 and West End's northern portion where long- and short-term moderate to major adverse impacts would occur
40 (aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%),
41 with moderate to major beneficial changes in impacts compared to Alternative A East End, and minor beneficial
42 changes in impacts compared to Alternative A West End. Negligible to minor adverse impacts would occur away
43 from active routes and amid Flight-free Zones with negligible to moderate beneficial change in impacts
44 compared to alternative A East End. Beneficial impacts to Soundscape East End due to Dragon Corridor's seven-
45 mile western shift Off-Peak Season are clearly seen in modeled results.

46
47 **Cumulative Impacts** **Alternative F** **Soundscape**

48
49 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
50 *impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts in*
51 *all three Zones (Developed, Non-Wilderness, and Wilderness) and all four park sections (Marble Canyon, East*
52 *End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour*
53 *routes, and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison*
54 *with other Alternatives, Alternative F ranks third in lowest overall Cumulative Impacts behind Alternative E and*
55 *the Modified NPS Preferred Alternative (Alternative A ranks last).*

MODIFIED NPS PREFERRED ALTERNATIVE**SOUNDSCAPE**

The *Modified* NPS Preferred Alternative includes *seasonal route closures*, quiet-technology incentives, a modified allocation system, modified tour routes to avoid sensitive resources, and curfews.

Base Year, the *Modified* NPS Preferred Alternative would *make progress toward* Substantial Restoration of Natural Quiet in *57%* of the park Peak Season, and in *74%* of the park Off-Peak Season, as shown in Table 4.23. These represent a negligible change in impacts compared to Alternative A Peak Season with a *2% increase* in park area *making progress toward SRNQ*, and a moderate beneficial change in impacts compared to Alternative A Off-Peak Season with a *19%* increase.

Ten-Year Forecast *the Modified NPS Preferred Alternative would make progress toward* Substantial Restoration of Natural Quiet in *73%* of the park Peak Season, and *85%* Off-Peak Season, as shown in Table 4.24. These represent moderate to major beneficial changes in impacts compared to Alternative A with a *20%* increase in park area *making progress toward SRNQ* Peak Season, and a *32%* increase Off-Peak Season.

Mapped results of noise modeling for the *Modified* NPS Preferred Alternative for Percent Time Audible and Average Sound Level are shown on Figures 4.26 to 4.33. Table 4.17 to 4.22 present Contour Analysis and Location Point results computed for the *Modified* NPS Preferred Alternative Peak and Off-Peak Seasons, respectively, and include comparisons with Alternative A.

Developed Zone (about 2% of GCNP) Modified NPS Preferred Alternative Soundscape

With exception of a very small Developed Zone area at Tuweep, GCNP Developed Zone areas are in East End. Audibility calculations for the Developed Zone included 10 dBA added to natural ambient sound levels due to the Dual-Zone System acoustic approach explained in Chapter 4, Methodology. As such, analysis considers Developed Zone management objectives which accept presence of many non-natural sound sources (increased background ambient sound levels) including most of the park's visitors and their activities, presence of paved roads and motorized transportation, and developed facilities.

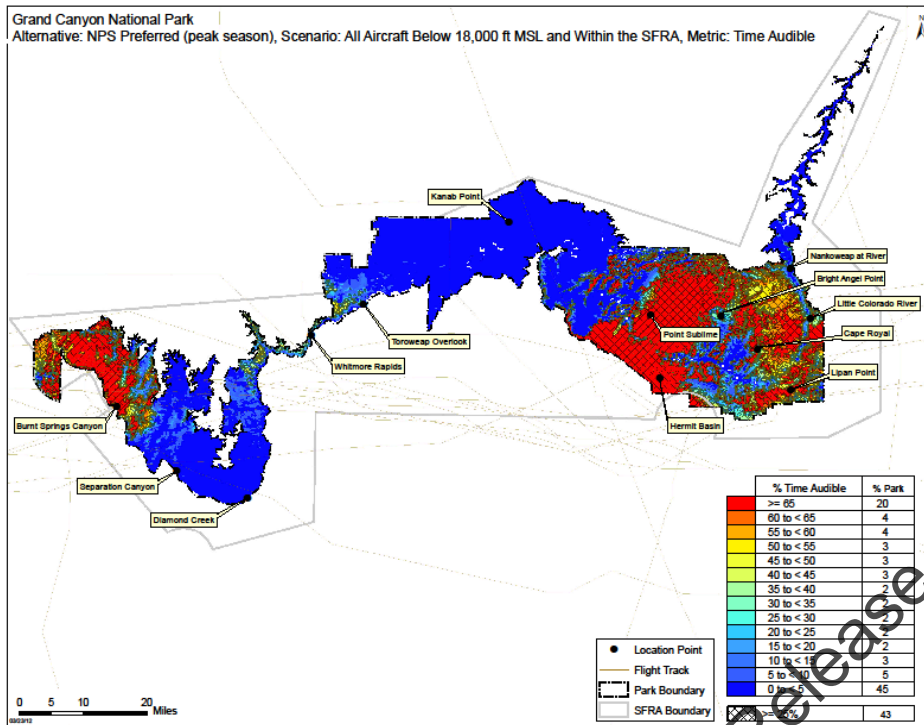
Developed Zone Modified NPS Preferred Alternative Soundscape
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in *43%* of the Zone; that is, Average Sound Level would be 25 to <35 dBA in *38%* of the Zone (moderate adverse impact) and greater than *or equal to* 35 dBA in *5%* of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in *86%* of the Zone; that is 10 to <25% in *13%* of the Zone (moderate adverse impact) and greater than *or equal to* 25% in *73%* of the Zone (major adverse impact). This would represent a reduction of *20%* in area with aircraft Average Sound Level of 25 dBA or more and a reduction of *10%* in area of 10% or more Percent Time Audible compared to Alternative A (a *10% to 20%* reduction in areas of moderate to major adverse impact), resulting in a *minor to moderate beneficial change in impacts compared to Alternative A, primarily due to closure of the Nankoweap loop (Point Imperial), route modifications, and the change to the Dragon Corridor dogleg (Hermits Rest).*

Developed Zone Modified NPS Preferred Alternative Soundscape
Base Year Off-Peak Season

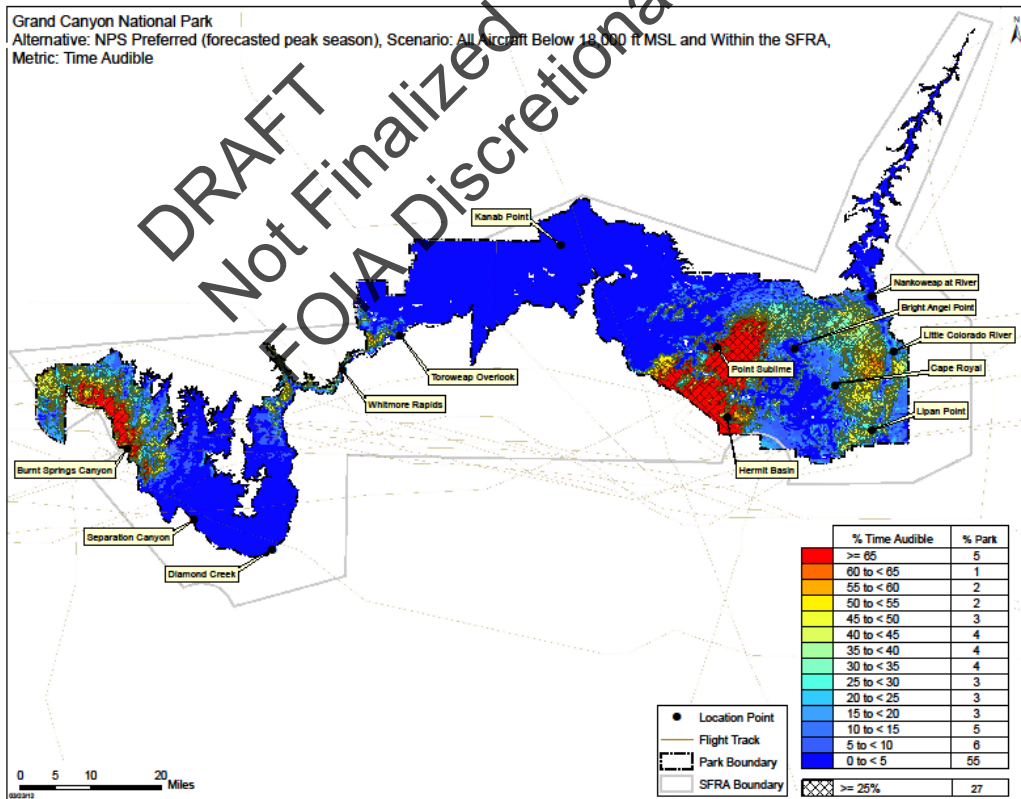
Average Sound Level would generally be 25 dBA *or more* in *7%* of the Zone; that is, Average Sound Level would be 25 to <35 dBA in *7%* of the Zone (moderate adverse impact) and greater than *or equal to* 35 dBA in *none* of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in *44%* of the Zone; that is 10 to <25% in *11%* of the Zone (moderate adverse impact) and greater than *or equal to* 25% in *33%* of the Zone (major adverse impact). This would represent a reduction of *58%* in area with Average Sound Level of 25 dBA or more and a reduction of *51%* in area of 10% or more Percent Time Audible compared to Alternative A (a *51 to 58%* reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A, primarily due to fewer air-tour operations Off-Peak Season, and *Off-Peak Season closure of Zuni Point Corridor short-loop air-tour routes and long-loop Zuni-Dragon air-tour routes.*

Figure 4.26 Modified NPS Preferred Percent Time Audible Base Year Peak Season



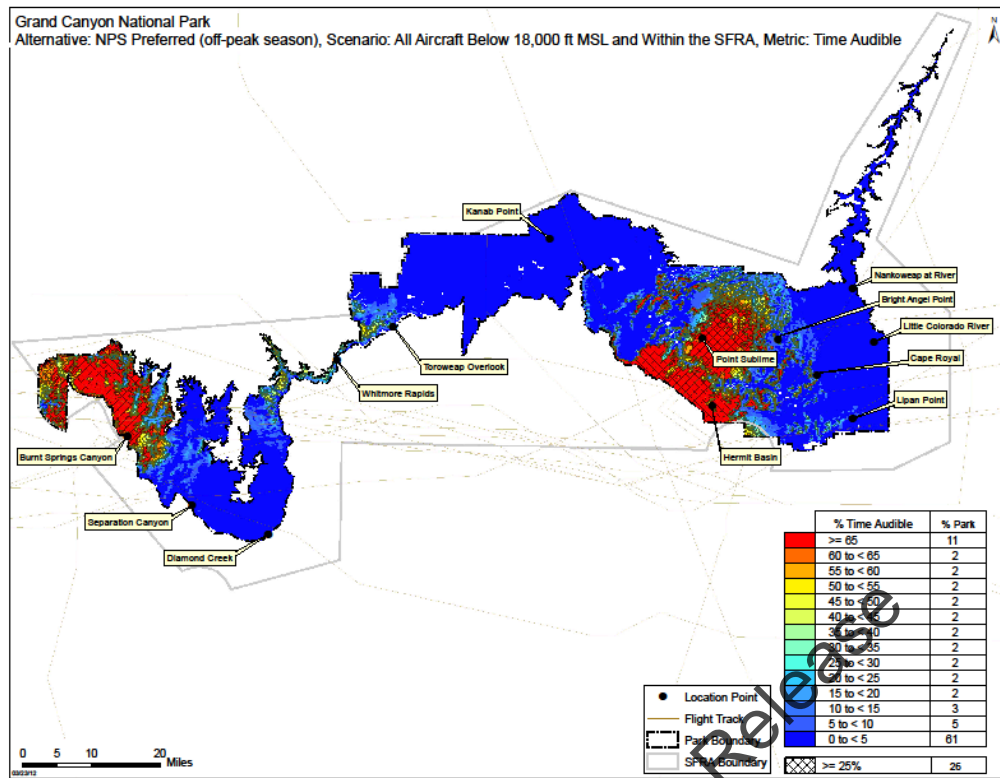
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Figure 4.27 Modified NPS Preferred Percent Time Audible Ten Year Forecast Peak Season



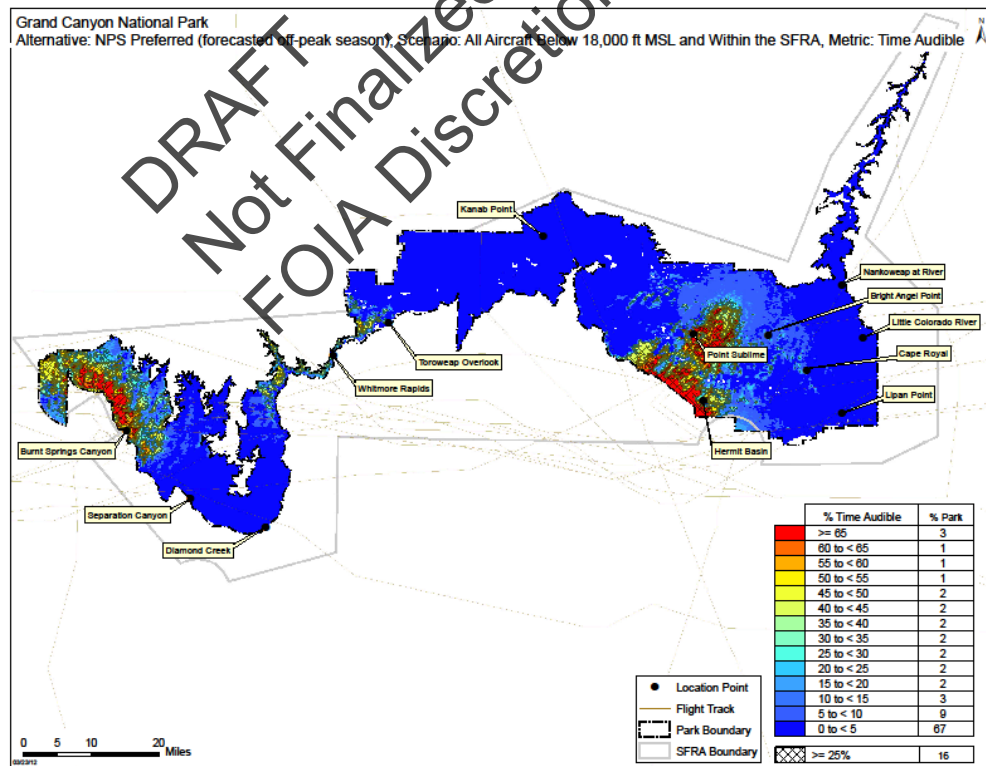
3

Figure 4.28 Modified NPS Preferred Percent Time Audible Base Year Off-Peak Season



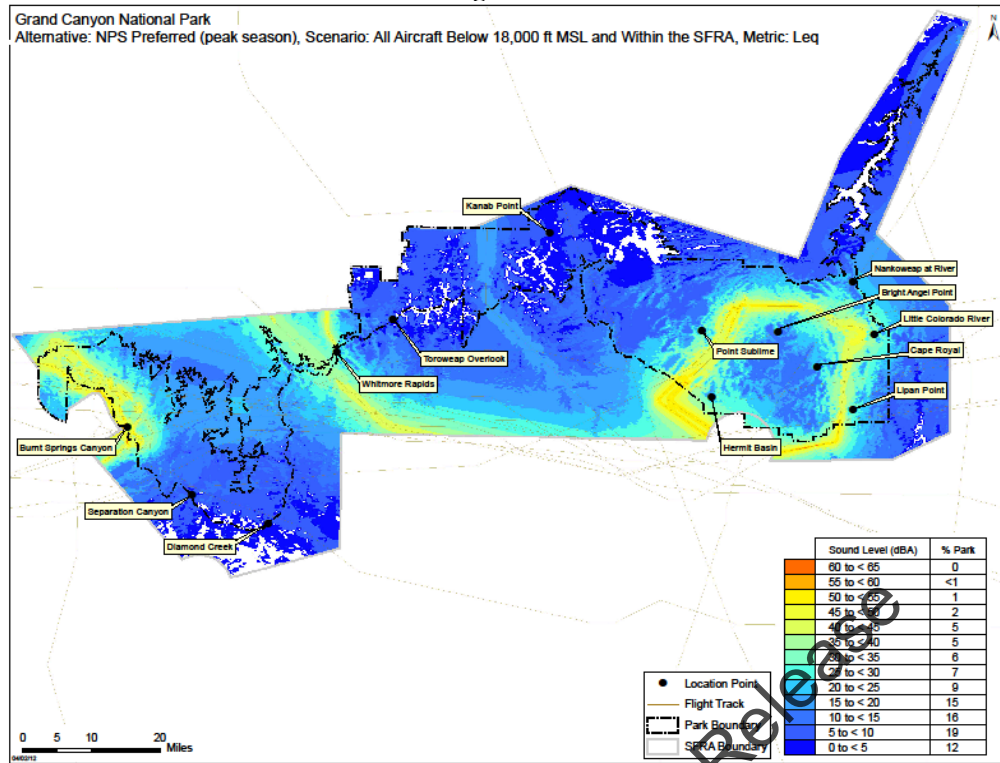
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Figure 4.29 Modified NPS Preferred Percent Time Audible Ten-Year Forecast Off-Peak Season



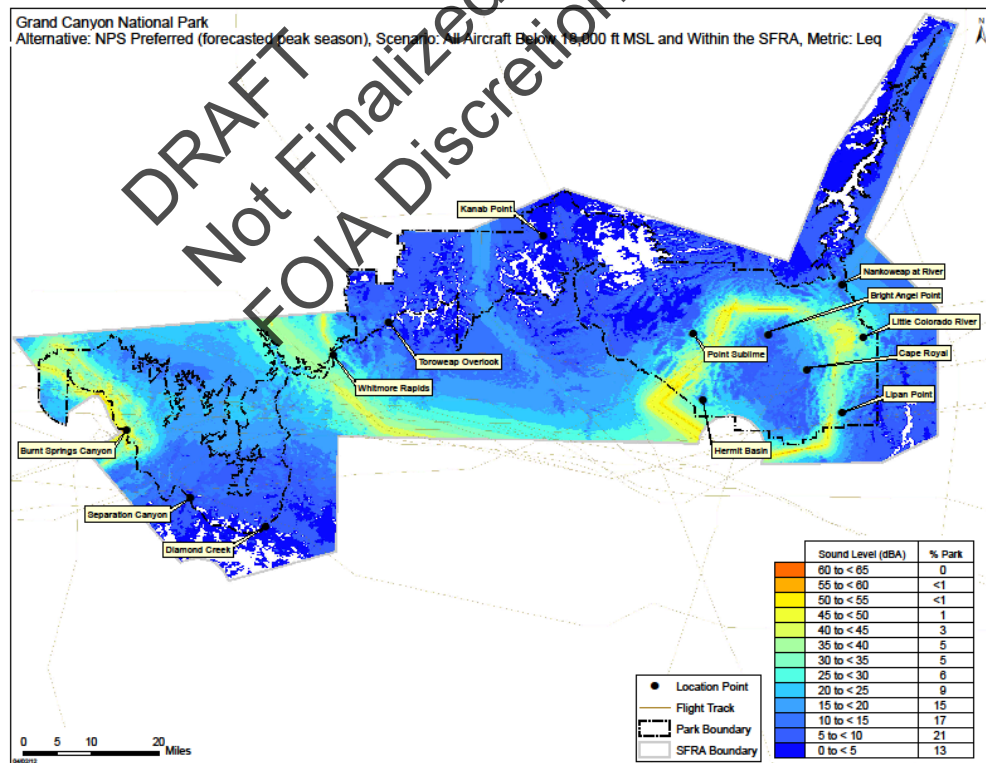
3

Figure 4.30 *Modified NPS Preferred* Average Sound Level Base Year Peak Season



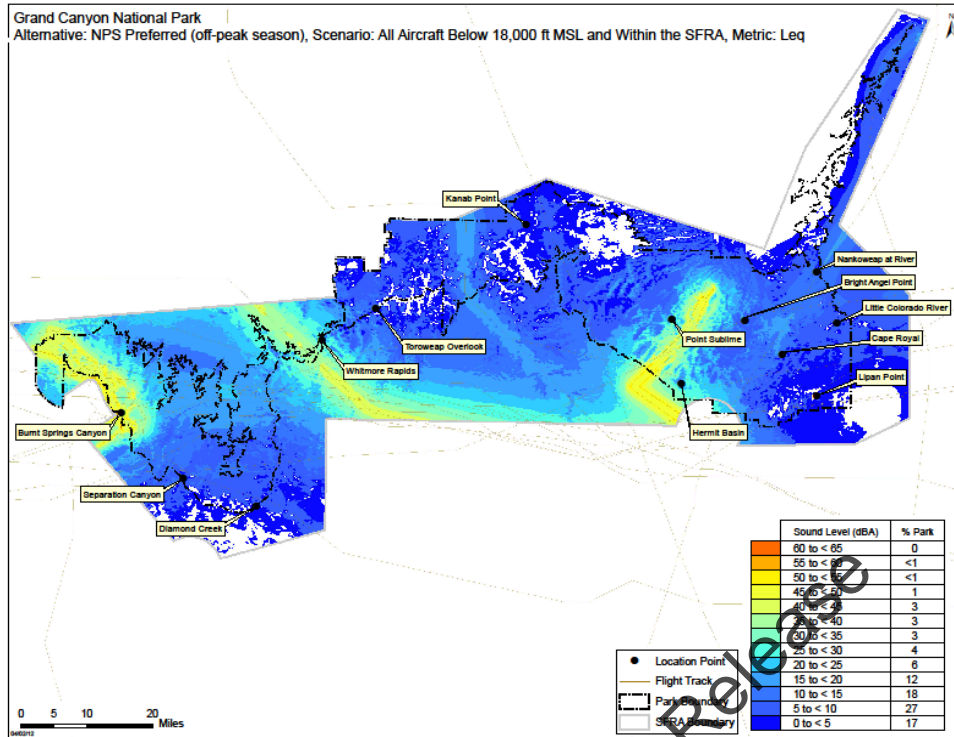
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Figure 4.31 *Modified NPS Preferred* Average Sound Level Peak Season Ten-Year Forecast



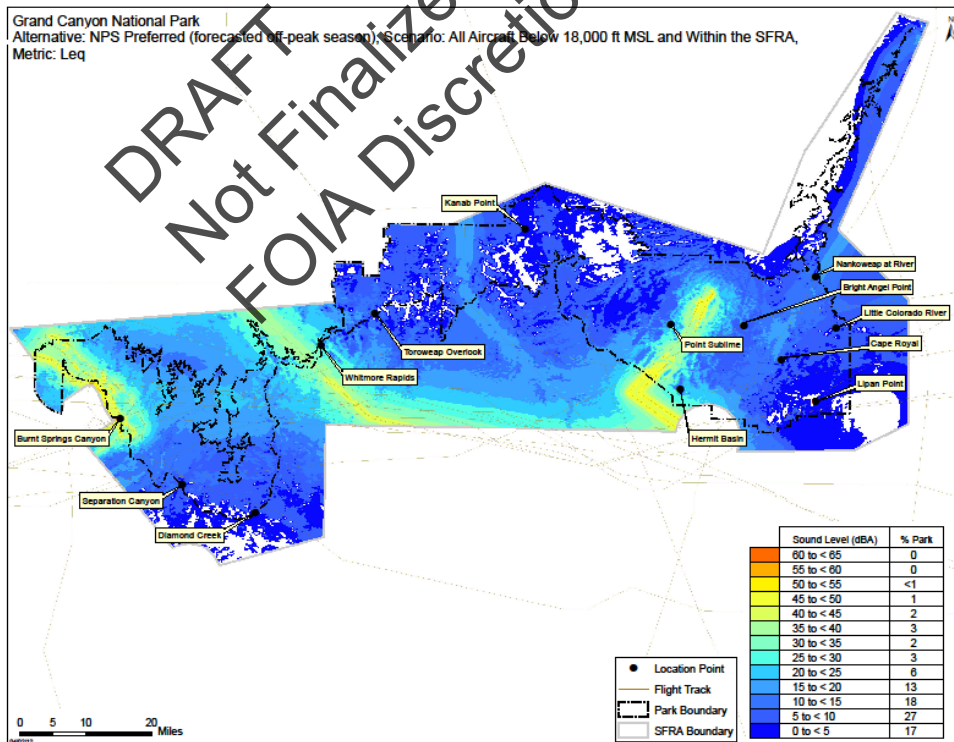
3

Figure 4.32 *Modified NPS Preferred* **Average Sound Level** **Base Year**
Off-Peak Season



1

Figure 4.33 *Modified NPS Preferred* **Average Sound Level** **Ten-Year Forecast**
Off-Peak Season



2
3

1
2

Table 4.17 Modified NPS Preferred Alternative Contour Analysis Results Percent Time Audible Peak Season^{abc}

Percent Time Audible	Base Year (Percent of Zone)				Ten Year Forecast (Percent of Zone)			
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP
% Park <25%TAUD ^d				57%				73%
≥ 25	73%	76%	41%	43%	35%	31%	27%	27%
10 to < 25	13%	10%	6%	6%	31%	29%	10%	11%
5 to < 10	10%	4%	4%	4%	19%	16%	5%	6%
> 0 to < 5	4%	10%	48%	45%	16%	24%	57%	55%
Percent of Zone Difference in Percent Time Audible Contour Results with Alternative A								
≥ 25	16%	2%	3%	3%	55%	49%	18%	20%
10 to < 25	-6%	-2%	4%	4%	-26%	-23%	0%	-1%
5 to < 10	-10%	-2%	1%	1%	-18%	-13%	0%	-1%
> 0 to < 5	0%	1%	-8%	-7%	-11%	-13%	-18%	-18%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

^cColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

^dTAUD is aircraft Percent Time Audible. The percent of park <25%TAUD is the area of the park making progress toward substantial restoration of natural quiet

3
4
5
6

Table 4.18 Modified NPS Preferred Alternative Contour Analysis Results Average Sound Level Peak Season^{ab}

Average Sound Level	Base Year (Percent of Zone)					Ten Year Forecast (Percent of Zone)				
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA
≥ 35	5%	2%	12%	17%	10%	4%	6%	9%	9%	8%
25 to < 35	38%	37%	12%	13%	12%	12%	21%	10%	10%	11%
15 to < 25	53%	32%	23%	23%	26%	75%	39%	23%	24%	27%
> 0 to < 15	3%	19%	49%	47%	48%	9%	34%	52%	51%	49%
Percent of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	4%	9%	3%	3%	4%	20%	26%	13%	14%	7%
25 to < 35	16%	0%	1%	1%	4%	62%	37%	17%	18%	10%
15 to < 25	-20%	-4%	-1%	-1%	1%	-73%	-30%	16%	13%	14%
> 0 to < 15	0%	-5%	-1%	-1%	-8%	-9%	-33%	-39%	-38%	-25%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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1 **Table 4.19 Modified NPS Preferred Location Point Results Peak Season^a**

Location Point Grouping		Base Year					Ten Year Forecast				
		TAUD ^b	L _{Aeq12} ^c	TALA35 dBA ^d	TALA45 dBA ^d	TALA55 dBA ^d	TAUD	L _{Aeq12}	TALA35 dBA	TALA45 dBA	TALA55 dBA
Marble Canyon	Max	1%	13 dBA	0%	0%	0%	1%	13 dBA	0%	0%	0%
	Median	0%	1 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
East End	Max	100%	52 dBA	100%	42%	11%	98%	50 dBA	100%	33%	8%
	Median	60%	26 dBA	0%	0%	0%	27%	21 dBA	0%	0%	0%
	Min	0%	7 dBA	0%	0%	0%	0%	3 dBA	0%	0%	0%
Central	Max	21%	18 dBA	0%	0%	0%	15%	19 dBA	0%	0%	0%
	Median	1%	8 dBA	0%	0%	0%	1%	8 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	93%	45 dBA	57%	21%	2%	88%	43 dBA	53%	16%	0%
	Median	5%	18 dBA	0%	0%	0%	3%	19 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	100%	52 dBA	100%	42%	11%	98%	51 dBA	100%	33%	8%
	Median	2%	14 dBA	0%	0%	0%	2%	13 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Difference in Location Points Results with Alternative A											
Marble Canyon	Max	2%	11 dBA	1%	0%	0%	2%	12 dBA	1%	0%	0%
	Median	1%	13 dBA	0%	0%	0%	2%	16 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
East End	Max	0%	-3 dBA	0%	10%	-6%	2%	1 dBA	0%	24%	-3%
	Median	3%	3 dBA	5%	0%	0%	40%	4 dBA	6%	0%	0%
	Min	0%	-1 dBA	0%	0%	0%	0%	3 dBA	0%	0%	0%
Central	Max	2%	9 dBA	4%	0%	0%	10%	9 dBA	4%	0%	0%
	Median	0%	2 dBA	0%	0%	0%	1%	3 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	1%	2 dBA	15%	8%	2%	7%	5 dBA	29%	17%	5%
	Median	14%	4 dBA	0%	0%	0%	17%	4 dBA	1%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	0%	-3 dBA	0%	10%	-6%	2%	-1dBA	0%	24%	-3%
	Median	6%	3 dBA	0%	0%	0%	8%	5 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

^aMax refers to the maximum Location Point value for a Location Point grouping for each respective specific metric; conversely, Min refers to the minimum Location Point value. The median characterizes the central tendency of the results. That is, 50% of results are above the median; 50% are below. The median, as opposed to the arithmetic mean, is more appropriate for data that are not normally distributed

^bTAUD = Percent Time Audible

^cL_{Aeq12} = Average Sound Level

^dTALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft noise exceed 35, 45, and 55 dBA, respectively

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Table 4.20 Modified NPS Preferred Alternative Contour Analysis Results Percent Time Audible Off-Peak^{abc}

Percent Time Audible	Base Year (Percent of Zone)				Ten Year Forecast (Percent of Zone)			
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP
% Park Making Progress Toward SRNQ				74%				85%
≥ 25	33%	33%	25%	26%	14%	13%	16%	15%
10 to < 25	11%	14%	7%	8%	22%	15%	7%	7%
5 to < 10	16%	7%	5%	5%	24%	24%	9%	9%
> 0 to < 5	37%	44%	62%	61%	38%	45%	68%	67%
Percent of Zone Difference in Percent Time Audible Contour Results with Alternative A								
≥ 25	56%	46%	18%	20%	76%	67%	29%	31%
10 to < 25	-5%	-6%	3%	3%	-17%	-8%	4%	3%
5 to < 10	-16%	-5%	1%	0%	-23%	-21%	-3%	-4%
> 0 to < 5	-32%	-33%	-22%	-23%	-33%	-34%	-29%	-30%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bBecause limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

^cColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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Table 4.21 Modified NPS Preferred Alternative Contour Analysis Results Average Sound Level Off-Peak^{ab}

Average Sound Level	Base Year (Percent of Zone)					Ten Year Forecast (Percent of Zone)				
	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA	Developed Zone	Non Wilderness Zone	Wilderness Zone	In GCNP	In SFRA
≥ 35	0%	0%	8%	7%	7%	0%	0%	6%	5%	6%
25 to < 35	7%	12%	6%	6%	8%	3%	8%	6%	6%	9%
15 to < 25	50%	31%	17%	18%	21%	51%	32%	19%	19%	23%
> 0 to < 15	40%	52%	62%	61%	54%	42%	55%	63%	62%	54%
Percent of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	10%	21%	8%	8%	7%	24%	33%	16%	17%	9%
25 to < 35	48%	25%	6%	8%	7%	72%	49%	21%	22%	12%
15 to < 25	-17%	-3%	5%	4%	7%	-49%	-22%	20%	17%	18%
> 0 to < 15	-37%	-38%	-14%	-15%	-14%	-42%	-54%	-49%	-49%	-29%

^aDue to rounding differences, totals in this table may differ from Appendix D by up to 2%

^bColumns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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1 **Table 4.22 Modified NPS Preferred Location Point Results Off-Peak Season^a**

Location Point Grouping		Base Year					Ten Year Forecast				
		TAUD ^b	L _{Aeq12} ^c	TALA35 dBA ^d	TALA45 dBA ^d	TALA55 dBA ^d	TAUD	L _{Aeq12}	TALA35 dBA	TALA45 dBA	TALA55 dBA
Marble Canyon	Max	1%	13 dBA	0%	0%	0%	1%	13 dBA	0%	0%	0%
	Median	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
East End	Max	98%	49 dBA	56%	21%	5%	92%	47 dBA	54%	16%	4%
	Median	1%	10 dBA	0%	0%	0%	1%	10 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Central	Max	15%	18 dBA	0%	0%	0%	14%	19 dBA	0%	0%	0%
	Median	1%	7 dBA	0%	0%	0%	1%	7 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	91%	45 dBA	55%	19%	2%	85%	43 dBA	51%	14%	0%
	Median	4%	18 dBA	0%	0%	0%	3%	18 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	98%	49 dBA	56%	21%	5%	92%	47 dBA	54%	16%	4%
	Median	1%	9 dBA	0%	0%	0%	1%	9 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Difference in Location Points Results with Alternative A											
Marble Canyon	Max	2%	11 dBA	1%	0%	0%	2%	12 dBA	1%	0%	0%
	Median	1%	14 dBA	0%	0%	0%	2%	16 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	2 dBA	0%	0%	0%
East End	Max	1%	0 dBA	44%	31%	1%	8%	3 dBA	46%	41%	2%
	Median	62%	19 dBA	5%	0%	0%	65%	19 dBA	6%	0%	0%
	Min	0%	6 dBA	0%	0%	0%	0%	7 dBA	0%	0%	0%
Central	Max	8%	9 dBA	4%	0%	0%	11%	9 dBA	4%	0%	0%
	Median	1%	3 dBA	0%	0%	0%	1%	3 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	2%	2 dBA	16%	10%	2%	10%	5 dBA	31%	19%	5%
	Median	14%	3 dBA	0%	0%	0%	17%	4 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	1%	0 dBA	44%	31%	1%	8%	3 dBA	46%	41%	2%
	Median	8%	8 dBA	0%	0%	0%	9%	9 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

^aMax refers to the maximum Location Point value for a Location Point grouping for each respective specific metric; conversely, Min refers to the minimum Location Point value. The median characterizes the central tendency of the results. That is, 50% of results are above the median; 50% are below. The median, as opposed to the arithmetic mean, is more appropriate for data that are not normally distributed

^bTAUD = Percent Time Audible

^cL_{Aeq12} = Average Sound Level

^dTALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft noise exceed 35, 45, and 55 dBA, respectively

2
3
4 *Developed Zone Modified NPS Preferred Alternative Soundscape*
5 *Ten-Year Forecast Peak Season*

6 Average Sound Level would generally be 25 dBA **or more** in **16%** of the Zone; that is, Average Sound Level
7 would be 25 to <35 dBA in **12%** of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
8 **4%** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in
9 **66%** of the Zone; that is 10 to <25% in **31%** of the Zone (moderate adverse impact) and greater than **or equal to**
10 25% in **35%** of the Zone (major adverse impact). This would represent a reduction of **82%** in area with Average
11 Sound Level of 25 dBA or more and a reduction of **29%** in area of 10% or more Percent Time Audible compared
12 to Alternative A (a **29 to 82%** reduction in areas of moderate to major adverse impact), resulting in a **moderate to**
13 major beneficial change in impacts compared to Alternative A.
14

1 *Developed Zone* **Modified NPS Preferred Alternative** *Soundscape*
 2 *Ten-Year Forecast Off-Peak Season*

3 Average Sound Level would generally be 25 dBA **or more** in 3% of the Zone; that is, Average Sound Level
 4 would be 25 to <35 dBA in 3% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 5 **none** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 36% of the
 6 Zone; that is 10 to <25% in 22% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
 7 14% of the Zone (major adverse impact). This would represent a reduction of 96% in area with Average Sound
 8 Level of 25 dBA or more and a reduction of 59% in area of 10% or more Percent Time Audible compared to
 9 Alternative A (a 59 to 96% reduction in areas of moderate to major adverse impact), resulting in a major
 10 beneficial change in impacts compared to Alternative A.

11 **Non-Wilderness Zone (6% of GCNP)** **Modified NPS Preferred Alternative** *Soundscape*

12 Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road
 13 corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone System area where 10 dBA is added to natural
 14 ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with
 15 motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The
 16 majority of Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis for
 17 audibility calculations, consistent with Non-Wilderness Zone management objectives that call for mostly natural
 18 conditions to prevail.

19 *Non-Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*
 20 *Base Year Peak Season*

21 Average Sound Level would generally be 25 dBA or more in 49% of the Zone, that is, Average Sound Level
 22 would be 25 to <35 dBA in 37% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 23 12% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 86% of the
 24 Zone; that is 10 to <25% in 10% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in 76%
 25 of the Zone (major adverse impact). This would represent a 9% reduction in area with Average Sound Level of
 26 25 dBA or more and no change in area of 10% or more Percent Time Audible compared to Alternative A (a zero
 27 to 9% reduction in areas of moderate to major adverse impact), resulting in a negligible **to minor beneficial**
 28 change in impacts compared to Alternative A.

29 For areas near Dragon Corridor routes, implementation of a Dragon Corridor dogleg would result in negligible to
 30 minor increases in Percent Time Audible for areas closest to it as tours would be flying a slightly longer route;
 31 however, it would also **result in moderate to major beneficial change in impacts in Hermit Basin and 96 Mile**
 32 **Camp. Elimination of Marble Canyon routes would result in minor beneficial changes in soundscape impacts**
 33 **compared to Alternative A.**

34 *Non-Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*
 35 *Base Year Off-Peak Season*

36 Average Sound Level would generally be 25 dBA **or more** in 12% of the Zone; that is, Average Sound Level
 37 would be 25 to <35 dBA in 12% of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 38 **none** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 47% of the
 39 Zone; that is 10 to <25% in 14% of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
 40 33% of the Zone (major adverse impact). This would represent a reduction of 46% in area with Average Sound
 41 Level of 25 dBA or more and a reduction of 40% in area of 10% or more Percent Time Audible compared to
 42 Alternative A (a 40 to 46% reduction in areas of moderate to major adverse impact), resulting in a **major**
 43 beneficial change in impacts compared to Alternative A.

44 **Areas** close to active **Dragon** Corridor **short-loop** routes **would have** negligible to **minor decreases** in Percent
 45 Time Audible for areas closest as tours would be flying **only a Dragon Corridor** short loop **Off-Peak Season,**
 46 **but flight numbers are lower in Off-Peak Season compared to Peak.**

1 *Non-Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*
 2 *Ten-Year Forecast Peak Season*

3 Average Sound Level would generally be 25 dBA **or more** in **27%** of the Zone; that is, Average Sound Level
 4 would be 25 to <35 dBA in **21%** of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 5 **6%** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in **60%** of the
 6 Zone; that is 10 to <25% in **29%** of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
 7 31% of the Zone (major adverse impact). This would represent a **63%** reduction in area with Average Sound
 8 Level of 25 dBA or more and a **26%** reduction in area of 10% or more Percent Time Audible compared to
 9 Alternative A (a **26 to 63%** reduction in areas of moderate to major adverse impact), resulting in a **moderate to**
 10 major beneficial change in impacts compared to Alternative A, primarily **due to route changes and** quiet-
 11 technology incentives and conversion **requirements in the Modified NPS Preferred Alternative. Elimination of**
 12 **Marble Canyon routes would result in minor beneficial changes in soundscape impacts compared to**
 13 **Alternative A.**

15 *Non-Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*
 16 *Ten-Year Forecast Off-Peak Season*

17 Average Sound Level would generally be 25 dBA **or more** in **8%** of the Zone; that is, Average Sound Level
 18 would be 25 to <35 dBA in **8%** of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 19 **none** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in **28%** of the
 20 Zone; that is 10 to <25% in **15%** of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
 21 **13%** of the Zone (major adverse impact). This represents a **82%** reduction in area with Average Sound Level of
 22 25 dBA or more and a **59%** reduction in area of 10% or more Percent Time Audible compared to Alternative A
 23 (a **59 to 82%** reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in
 24 impacts compared to Alternative A, primarily **due to route changes and** quiet technology incentives and
 25 conversion requirements **in the Modified NPS Preferred Alternative.**

27 **Wilderness Zone (94% of GCNP)** **Modified NPS Preferred Alternative** **Soundscape**

28
 29 In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the
 30 Wilderness Zone's increased size and geographic extent as compared to the others. Most of the Wilderness Zone is
 31 in the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System
 32 acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

34 *Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*
 35 *Base Year Peak Season*

36 Average Sound Level would generally be 25 dBA **or more** in **24%** of the Zone; that is, Average Sound Level
 37 would be 25 to <35 dBA in **12%** of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 38 **12%** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in
 39 **47%** of the Zone; that is 10 to <25% in **6%** of the Zone (moderate adverse impact) and greater than **or equal to**
 40 25% in **41%** of the Zone (major adverse impact). **This would represent a 4% reduction in area with Average**
 41 **Sound Level of 25 dBA or more, and a 7% reduction in area of 10% or more Percent Time Audible compared**
 42 **to Alternative A (a 4 to 7% reduction in areas of moderate to major adverse impact), resulting in a negligible**
 43 **to minor beneficial change in impacts compared to Alternative A (with larger beneficial change in impacts in**
 44 **areas of West End where current Blue Direct routes are located, due to moving those routes to the Z-shaped**
 45 **Route location in this Alternative).**

47 *Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*
 48 *Base Year Off-Peak Season*

49 Average Sound Level would generally be 25 dBA **or more** in **14%** of the Zone; that is, Average Sound Level
 50 would be 25 to <35 dBA in **6%** of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 51 **8%** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in
 52 **32%** of the Zone; that is 10 to <25% in **7%** of the Zone (moderate adverse impact) and greater than **or equal to**
 53 25% in **25%** of the Zone (major adverse impact). This would represent a **14%** reduction in area with Average
 54 Sound Level of 25 dBA or more and a **21%** reduction in area of 10% or more Percent Time Audible compared to
 55 Alternative A (a **14 to 21%** reduction in areas of moderate to major adverse impact), resulting in a **minor to**
 56 **moderate** beneficial change in impacts compared to Alternative A.

1 *Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*

2 *Ten-Year Forecast Peak Season*

3 Average Sound Level would generally be 25 dBA **or more** in **19%** of the Zone; that is, Average Sound Level
 4 would be 25 to <35 dBA in **10%** of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 5 **9%** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in **37%** of the
 6 Zone; that is 10 to <25% in **10%** of the Zone (moderate adverse impact) and greater than **or equal to** 25% in
 7 **27%** of the Zone (major adverse impact). This would represent a reduction of **30%** in area with Average Sound
 8 Level of 25 dBA or more and a reduction of **18%** in area of 10% or more Percent Time Audible compared to
 9 Alternative A (a **18 to 30%** reduction in areas of moderate to major adverse impact), resulting in a moderate
 10 beneficial change in impacts compared to Alternative A, primarily because the **Modified NPS Preferred**
 11 **Alternative Peak Season** includes **the Z-shaped Route between Las Vegas and Grand Canyon, plus** quiet-
 12 technology incentives and conversion requirements.
 13

14 *Wilderness Zone* **Modified NPS Preferred Alternative** *Soundscape*

15 *Ten-Year Forecast Off-Peak Season*

16 Average Sound Level would generally be 25 dBA **or more** in **12%** of the Zone; that is, Average Sound Level
 17 would be 25 to <35 dBA in **6%** of the Zone (moderate adverse impact) and greater than **or equal to** 35 dBA in
 18 **6%** of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in **23%** of the
 19 Zone; that is 10 to <25% in **7%** of the Zone (moderate adverse impact) and greater than **or equal to** 25% in **16%**
 20 of the Zone (major adverse impact). This would represent a reduction of **37%** in area with Average Sound Level
 21 of 25 dBA or more and a reduction of **33%** in area of 10% or more Percent Time Audible compared to
 22 Alternative A (a **33 to 37%** reduction in areas of moderate to major adverse impact), resulting in a **moderate to**
 23 **major** beneficial change in impacts compared to Alternative A, primarily because the **Modified NPS Preferred**
 24 **Alternative includes Off-Peak Season closure of Zuni Point Corridor and routes over North Rim, and the Z-**
 25 **shaped Route between Las Vegas and Grand Canyon, plus quiet-technology incentives and conversion**
 26 **requirements.**
 27

28 **Marble Canyon** **Modified NPS Preferred Alternative** **Soundscape**

29
 30 Marble Canyon's west side is located in the Wilderness Zone; the east side in Non-Wilderness Zone. It is also
 31 entirely in the Dual-Zone System noticeability area in which 10 dB A is added to natural ambient sound levels in
 32 calculating audibility (Chapter 4, Methodology). **Closure of Marble Canyon routes would mainly eliminate early**
 33 **morning air-tour noise.** In Marble Canyon, based on Figures 4.26 to 4.33, air-tour aircraft Average Sound Level
 34 would be less than 15 dBA, and audible **less than 3% of the day.**
 35

36 *Marble Canyon* **Modified NPS Preferred Alternative** *Soundscape*

37 *Base Year and Ten-Year Forecast Peak Season*

38 Marble Canyon Location Points Percent Time Audible range zero to one percent, and Average Sound Level zero
 39 to **13** dBA. These values represent negligible impacts with negligible to minor beneficial changes in impacts
 40 compared to Alternative A.
 41

42 *Marble Canyon* **Modified NPS Preferred Alternative** *Soundscape*

43 *Base Year and Ten-Year Forecast Peak and Off-Peak Season*

44 Marble Canyon Location Points **Peak and Off-Peak Season**, Percent Time Audible **would** range zero to one
 45 percent, and Average Sound Level zero to **13** dBA (**median 0 to 1 dBA**). These values represent negligible
 46 impacts with negligible to minor beneficial changes in impacts compared to Alternative A.
 47

48 **East End** **Modified NPS Preferred Alternative** **Soundscape**

49
 50 Under the **Modified NPS Preferred Alternative**, greatest exposure to noise and visual impacts would continue in East
 51 End. However, air-tour sounds would be reduced due to **Off-Peak Season closure** of Zuni Point Corridor **and the**
 52 **long-loop route over North Rim, and elimination of the Nankoweap loop and Marble Canyon routes.** East End
 53 includes all three Management Zones: Developed, Non-Wilderness, and Wilderness. The one-hour extended curfew
 54 would benefit Soundscape in all East End Management Zones. Localized long- and short-term impacts would
 55 generally be **moderate to** major adverse under and near **open routes in** Zuni Point and Dragon Corridors and North
 56 Rim, and negligible to minor adverse amid Bright Angel Flight-free Zone. Additionally, creation of a Dragon

1 Corridor dogleg would increase Percent Time Audible, but reduce Average Sound Level in the dogleg localized
 2 area. Impacts would be reduced compared to Alternative A in Nankoweap, Little Colorado River confluence, and
 3 Hermit Basin Location Point areas.

4
 5 *East End* *Modified NPS Preferred Alternative* *Soundscape*
 6 *Base Year Peak Season*

7 **East End Location Points** would range zero to 100% Percent Time Audible (median 60%), and Average Sound
 8 Level 7 dBA to 52 dBA (median 26 dBA). At some locations, aircraft events would exceed 35 dBA 100% of the
 9 day, 45 dBA 42% of the day, and 55 dBA 11% of the day. This would result in *moderate to major adverse*
 10 *impacts under and near heavily used air-tour routes, and negligible to minor adverse impacts away from*
 11 *routes, representing a negligible to minor beneficial change in impacts compared to Alternative A. Although the*
 12 *majority of Location Points do not experience Average Sound Level greater than 35 dBA, 14 Location Points*
 13 *show Average Sound level above 45 dBA for one to 42% of the day, and four (The Basin, The Ranch, Ten X*
 14 *Meadow, and Zuni Alpha) show Average Sound Level above 55 dBA for 2 to 11% of the day.*

15
 16 *East End* *Modified NPS Preferred Alternative* *Soundscape*
 17 *Base Year Off-Peak Season*

18 **East End Location Points** would range zero to 98% Percent Time Audible (median 1%), and zero to 49 dBA
 19 (median 10 dBA). At some locations, aircraft events would exceed 35 dBA 56% of the day, 45 dBA 21% of the
 20 day, and 55 dBA 5% of the day. Because this represents a 62% reduction in median Percent Time Audible and a
 21 1% reduction in maximum Percent Time Audible, *and a 19 dBA reduction in median Average Sound Level and*
 22 *no reduction in maximum sound level compared to Alternative A, this would result in minor to major adverse*
 23 *impacts under and near open Dragon Corridor air-tour routes, and negligible to minor adverse impacts in the*
 24 *eastern area away from open routes. These represent a negligible to major beneficial change in impacts*
 25 *compared to Alternative A. Although the majority of Location Points would not experience Average Sound*
 26 *Level greater than 35 dBA, three Location Points (96 Mile, The Ranch, and Tower of Ra) show Average*
 27 *Sound Level above 45 dBA 2 to 21% of the day, and one (The Ranch) shows Average Sound Levels above 55*
 28 *dBA for 5% of the day.*

29
 30 *East End* *Modified NPS Preferred Alternative* *Soundscape*
 31 *Ten-Year Forecast Peak Season*

32 **East End Location Points** Percent Time Audible would range zero to 98% Percent Time Audible (median
 33 27%), a reduction of 33% compared to Base Year median Percent Time Audible, and a 40% reduction in median
 34 Percent Time Audible compared to Alternative A. Average Sound Level would range 3 to 50 dBA (median 21
 35 dBA). *These are slightly reduced compared to Base Year, with a negligible to moderate beneficial change*
 36 *compared to Alternative A. There would generally be minor to major adverse impacts under and near routes in*
 37 *Zuni Point and Dragon Corridors and across North Rim but major noise reductions resulting in a major*
 38 *beneficial change in impacts from Alternative A. There would also be a negligible to minor adverse impact away*
 39 *from routes and amid Bright Angel Flight-free Zone (a negligible to moderate beneficial change in impacts from*
 40 *Alternative A). Although the majority of Location Points would not experience Average Sound Level greater*
 41 *than 35 dBA, eight Location Points show Average Sound Level above 45 dBA one to 33% of the day, and*
 42 *three (The Ranch, Ten X Meadow, and Zuni Alpha) would have Average Sound Levels above 55 dBA 3 to 8%*
 43 *of the day.*

44
 45 *East End* *Modified NPS Preferred Alternative* *Soundscape*
 46 *Ten-Year Forecast Off-Peak Season*

47 **East End Location Points** Percent Time Audible would range zero to 92% (median 1%), and Average Sound
 48 Level zero to 47 dBA (median 10 dBA). Compared to Base Year Off-Peak Season, this represents *no change* in
 49 median Percent Time Audible *or* in median Average Sound Level. *Compared to Alternative A, this represents a*
 50 *65% reduction in median Percent Time Audible and an 8% reduction in maximum Percent Time Audible, and a*
 51 *19 dBA reduction in median Average Sound Level and a 3 dBA reduction in maximum Average Sound Level.*
 52 *There would generally be minor to major adverse impacts under and near open Dragon Corridor routes (minor*
 53 *to major beneficial change in impacts from Alternative A), and a negligible to minor adverse impact in the*
 54 *eastern area away from open routes (a major beneficial change in impacts from Alternative A) and amid*
 55 *Bright Angel Flight-free Zone (a negligible to major beneficial change from Alternative A). Although the*
 56 *majority of Location Points would not experience Average Sound Level greater than 35 dBA, two Location*

1 **Points (The Ranch and Tower of Ra) show Average Sound Level above 45 dBA, 2 to 16% of the day, and one**
 2 **(The Ranch) shows Average Sound Levels above 55 dBA 4% of the day.**

3
 4 **Central** **Modified NPS Preferred Alternative** **Soundscape**

5
 6 The Central area is located in the Wilderness Zone, excepting a few Non-Wilderness Zone dirt road corridors, and a
 7 very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System audibility area in
 8 which natural ambient sound levels are used directly in audibility calculations. This area comprises most of the
 9 Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.

10
 11 *Central* *Modified NPS Preferred Alternative* *Soundscape*
 12 *Base Year and Ten-Year Forecast Peak Season*

13 **Central area Location Points** range zero to 21% Percent Time Audible (median one percent), and Average
 14 Sound Level zero to 19 dBA (median 8 dBA). **At no location would Average Sound Level exceed 35 dBA Base**
 15 **Year or Ten-Year Forecast.** Impacts would generally be negligible **to minor adverse**, with negligible **to minor**
 16 **beneficial** change from Alternative A (2 to 10% reductions in Percent Time Audible and 2 to 9 dBA reductions
 17 in Average Sound Level compared to Alternative A). **Prospect Canyon (PRSPCT) Location Point would**
 18 **experience the greatest overall noise at 15% Percent Time Audible and 18 dBA Average Sound Level Ten-**
 19 **Year Forecast (the only Location Point greater than 2% Percent Time Audible).**

20
 21 *Central* *Modified NPS Preferred Alternative* *Soundscape*
 22 *Base Year and Ten-Year Forecast Off-Peak Season*

23 **Central area Location Points** range zero to 15% Percent Time Audible (median one percent), and Average
 24 Sound Level zero to 19 dBA (median 7 dBA). **At no location would Average Sound Level exceed 35 dBA Base**
 25 **Year or Ten-Year Forecast.** Impacts would generally be negligible **to minor adverse**, with negligible **to minor**
 26 **beneficial** change from Alternative A (within 8 to 11% Percent Time Audible and 9 dBA Average Sound
 27 Level). **Prospect Canyon (PRSPCT) Location Point would experience the greatest overall noise at 14%**
 28 **Percent Time Audible and 17 dBA Average Sound Level Ten-Year Forecast (the only Location Point greater**
 29 **than 2% Percent Time Audible).**

30
 31 **West End** **Modified NPS Preferred Alternative** **Soundscape**

32
 33 West End is located in the Wilderness Zone, and entirely in the Dual-Zone System noticeability area in which 10
 34 dBA is added to natural ambient sound levels in audibility calculations. Impacts to West End areas tend to be very
 35 localized, depending on proximity to **Z-shaped Route** and Blue-2/Green-4 routes.

36
 37 *West End* *Modified NPS Preferred Alternative* *Soundscape*
 38 *Base Year and Ten-Year Forecast Peak Season*

39 Overall impacts would be very similar to Alternative A. **West End Location Points** range zero to 93% Percent
 40 Time Audible (median 43 to 5%), and Average Sound Level zero to 45 dBA (median 18 to 19 dBA). At some
 41 locations **Base Year**, aircraft events would exceed 35 dBA for 57% of the day, 45 dBA 21% of the day, and 55
 42 dBA 2% of the day. Peak Season Ten-Year Forecast, Average Sound Level and Percent Time Audible would be
 43 **slightly reduced from Base Year by one to 5% Percent Time Audible and one to 2 dBA Average Sound Levels.**
 44 These values represent negligible **to major adverse impacts with negligible to moderate** beneficial changes in
 45 impacts compared to Alternative A.

46
 47 For areas near **Z-shaped Route** and Blue-2/Green-4 routes (**West End's northern portion**), localized long- and
 48 short-term impacts would be moderate to major adverse (from Figures 4.26 to 4.33, **and Location Points**),
 49 Average Sound Level would be 35 to 45 dBA, aircraft Percent Time Audible would be greater than 40% **near**
 50 **the Z-shaped Route and greater than 65% near Blue-2/Green-4 routes**). **In areas near Blue-2/Green-4 routes,**
 51 **aircraft events would exceed 45 dBA 21% of the day Base Year (16% Ten-Year Forecast).** In **West End's**
 52 **southern portion**, localized long-term impacts would **generally** be negligible (from Figures 4.26 to 4.33,
 53 Average Sound Level would be 0 to 10 dBA, aircraft Percent Time Audible would be less than 5 percent **in**
 54 **areas near Separation Canyon and Diamond Creek**). These values represent negligible to minor beneficial
 55 changes in impacts compared to Alternative A.

1 *West End* **Modified NPS Preferred Alternative** *Soundscape*
 2 *Base Year and Ten-Year Forecast Off-Peak Season*

3 Results are very similar to Peak Season. *West End Location Points Percent Time Audible range zero to 91%*
 4 *Base (85% Forecast) (median 3 to 4%), and Average Sound Level zero to 45 dBA Base (43 dBA Forecast)*
 5 *(median 18 dBA). At some locations near Green-4/Blue-2 routes Base Year, aircraft events would exceed 35*
 6 *dBA for 55% of the day, 45 dBA 19% of the day, and 55 dBA 2% of the day. Off-Peak Season Ten-Year*
 7 *Forecast, Average Sound Level and Percent Time Audible would be slightly reduced from Base Year by one to*
 8 *5% Percent Time Audible and one to 2 dBA Average Sound Level. In areas near Blue-2/Green-4 routes,*
 9 *aircraft events would exceed 45 dBA 19% of the day Base Year (14% Ten-Year Forecast). Thus, in West*
 10 *End's northern portion near air-tour routes there would be moderate to major adverse impacts, with negligible*
 11 *to moderate beneficial changes in impacts from Base Year to Ten-Year Forecast due to quiet technology*
 12 *conversion, and negligible to moderate beneficial changes in impacts compared to Alternative A.*

13
 14 *In West End's southern portion away from air-tour routes, impacts would generally be negligible with*
 15 *negligible to minor beneficial changes in impacts compared to Alternative A (from Figures 4.26 to 4.33,*
 16 *Average Sound Level would be 0 to 10 dBA, aircraft Percent Time Audible would be less than 5% in areas*
 17 *near Separation Canyon and Diamond Creek).*

18
 19 **NPS Units in the SFRA** **Modified NPS Preferred Alternative** **Soundscape**
 20 **Outside Grand Canyon National Park**

21
 22 *Moving the Las Vegas-Grand Canyon routes to the Z-shaped Route would move impacts from some of the most*
 23 *remote and sensitive potential wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant*
 24 *National Monument within the SFRA to less sensitive areas within and outside the SFRA, but within areas still*
 25 *managed for Wilderness characteristics in Grand Canyon-Parashant National Monument. Moving the routes*
 26 *will also greatly reduce impacts on the Grand Canyon-Parashant National Monument administrative site near*
 27 *the base of Mt. Dellenbaugh. Technically, routes can only be designated, and operators can only be required to*
 28 *fly on designated routes within the SFRA. The area outside the SFRA is part of the national airspace with*
 29 *different rules than within the SFRA, so Grand Canyon-related flights can choose where to fly outside the SFRA*
 30 *consistent with regulations governing national airspace. Flight paths outside the SFRA used in noise modeling*
 31 *for the Z-shaped Routes are paths considered most likely (and consistent with routes considered under*
 32 *Alternative E). Because flight paths outside the SFRA are integrally connected with routes within the SFRA, they*
 33 *are also discussed in this section.*

34
 35 *There are three designated Wilderness Areas in Lake Mead National Recreation Area west of the SFRA (Pinto*
 36 *Valley, Jimbilnan, and Jumbo Spring Wilderness Areas) that might be overflowed by Grand Canyon tour aircraft*
 37 *between the Las Vegas area and the Z-shaped Routes; however, it is hoped those areas can be avoided as an Air*
 38 *Tour Management Plan is developed for Lake Mead NRA. Also, the adaptive management process included as*
 39 *part of the Modified NPS Preferred Alternative may offer opportunities to consider slight modifications to the Z-*
 40 *shaped Route if the modifications could reduce impacts on GCNP, Lake Mead NRA, Grand Canyon-Parashant*
 41 *NM, and/or other lands while still accomplishing other goals and objectives for the routes.*

42
 43 For NPS lands directly **under and near the Z-Shaped, Blue-2 and Green-4 Routes** (Lake Mead NRA and Grand
 44 Canyon-Parashant NM) and other busy air-tour corridors in GCNP, impacts would be *moderate to major adverse*
 45 *(from Figures 4.26 to 4.33, Average Sound Level would range 30 to 55 dBA with high levels of aircraft Percent*
 46 *Time Audible). Because Alternative A Blue Direct Routes are in a very different location, these represent a*
 47 *change in location of impacts compared to Alternative A Base Year (with an increase in impacts in the new*
 48 *location and a decrease in the current location under Alternative A).*

49
 50 **Modified NPS Preferred Alternative** quiet-technology incentives and conversion requirements would provide some
 51 mitigation to these adverse impacts by decreasing affected area size; however, those areas still affected would
 52 experience additional localized impacts if operations increase. *Because there would be no routes in Marble Canyon*
 53 *under the Modified NPS Preferred Alternative, impacts to Glen Canyon National Recreation Area would be*
 54 *negligible, with moderate to major beneficial changes in impacts compared to Alternative A Base Year and Ten-*
 55 *Year Forecast. The remainder of the SFRA outside GCNP would experience Average Sound Level less than 25*
 56 *dBA, with localized long- and short-term negligible to minor adverse impacts. As with GCNP, the SFRA as a*

1 **whole** would benefit from *Modified* NPS Preferred Alternative quiet-technology incentives and conversion
 2 requirements.

3
 4 **Cumulative Impacts** *Modified* NPS Preferred Alternative **Soundscape**

5
 6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future
 7 actions. In this context, Cumulative Impacts include impacts on Soundscape from sounds of*

- 8 1. *high-altitude aircraft at or above 18,000 feet MSL plus*
- 9 2. *aircraft below 18,000 feet MSL and outside the SFRA plus*
- 10 3. *ground-based noise sources plus*
- 11 4. *noise from air-tour-and-related aircraft under the Modified NPS Preferred Alternative*

12
 13 *That is, Cumulative Impacts for the Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4
 14 Modified NPS Preferred Alternative.*

15
 16 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All
 17 Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout
 18 the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (for high-altitude aircraft at or
 19 above 18,000 feet MSL see Appendix D, Figures 87 to 90; for aircraft below 18,000 feet MSL and outside the
 20 SFRA see Appendix D, Figures 91 to 94).*

21
 22 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics also impacts
 23 Soundscape, but it is mostly concentrated in the Developed Zone (2% of the park), although there is a small
 24 component in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire
 25 management activities, and mining activities outside the park. Noise from ground-based sources is discussed in
 26 Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time
 27 Audible capable of masking some aircraft noise.*

28
 29 *Noise from ground-based sources is usually very localized. Even though there is some spread into some
 30 backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of
 31 spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated
 32 by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often
 33 the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of
 34 civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights
 35 and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare
 36 and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.
 37 Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural
 38 noise over most of the park and SFRA; there are no areas in GCNP where the natural Soundscape is not
 39 adversely affected by aircraft noise some of the time.*

40
 41 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in Alternatives (Modified
 42 NPS Preferred Alternative compared to the other Alternatives). Noise sources 1, 2, and 3 are generally not
 43 directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D,
 44 Tables 43 to 70); however, their noise impact generally increases impacts of the noise produced under
 45 Alternatives (Modified NPS Preferred Alternative in this case).*

46
 47 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for
 48 Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season), and Tables 67 and 69
 49 (Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for
 50 Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park Base Year and Ten-Year Forecast.
 51 Noise from ground-based sources was not able to be included in noise modeling for this EIS; however, since
 52 noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the
 53 park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting
 54 localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the
 55 park.*

1 *Comparing noise impacts from just the Modified NPS Preferred Alternative by itself (Appendix D, Tables 36*
 2 *(Peak Season) and Table 41 (Off-Peak Season) (Ten-Year Forecast)) versus All Aircraft (Modified NPS*
 3 *Preferred Alternative plus 1 and 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) (Ten-Year*
 4 *Forecast)) gives a good indication of the difference between Cumulative Impacts and impacts of the Modified*
 5 *NPS Preferred Alternative by itself. For Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-*
 6 *Year Forecast), All Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound*
 7 *Level 25 to <35 dBA in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA*
 8 *or more. For Entire Park results Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-*
 9 *Year Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25*
 10 *to <35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

11
 12 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 13 *including Flight-free Zones, whereas noise from the Modified NPS Preferred Alternative is more concentrated*
 14 *under and near air-tour routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing*
 15 *air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

16
 17 *Again, differences in Cumulative Impacts between Alternatives are apparent in the detailed impact analysis*
 18 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 19 *Alternative (route locations/number/altitudes/quiet technology conversion, etc.). When added to noise impacts of*
 20 *cumulative sources Common to All Alternatives described above (1, 2, and 3), impact levels for each area*
 21 *described for the Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 22 *Cumulative Impacts Summary discussion in the Conclusion section below.*

23
 24 **Conclusion** *Modified NPS Preferred Alternative* **Soundscape**

25
 26 Under the *Modified* NPS Preferred Alternative, a range of aircraft noise intensities and audibility would affect
 27 GCNP Soundscapes. Beneficial impacts East End due to quiet-technology incentives and seasonal *closure of* Zuni
 28 Point Corridor *short-loop routes and Zuni-Dragon long-loop routes in* Off-Peak Season are clearly seen in
 29 modeled results. All East End Management Zones and Marble Canyon benefit from the additional one-hour curfew.
 30 Because the *Modified* NPS Preferred Alternative includes quiet-technology incentives and conversion requirements,
 31 noise impacts would decrease from Base Year to Ten-Year Forecast. Beneficial *changes in* impacts would be seen
 32 in both Percent Time Audible and Average Sound Level.

33
 34 Base Year *the Modified NPS Preferred Alternative would make progress toward* Substantial Restoration of Natural
 35 Quiet in 57% of the park Peak Season, and in 74% of the park Off-Peak Season. These represent a negligible change
 36 in impacts compared to Alternative A with a 2% *increase* in park area *making progress toward SRNQ Peak*
 37 *Season*, and a *moderate* beneficial change in impacts compared to Alternative A with a 19% increase *Off-Peak*
 38 *Season*.

39
 40 Ten-Year Forecast, *the Modified NPS Preferred Alternative would make progress toward* Substantial Restoration
 41 of Natural Quiet in 73% of the park Peak Season, and 85% of the park Off-Peak Season. These represent moderate
 42 *to major* beneficial changes in impacts compared to Alternative A with a 21% increase in park area *making*
 43 *progress toward SRNQ* Peak Season, and a 32% increase Off-Peak Season.

44
 45 *Conclusion by Zone* *Modified NPS Preferred Alternative* *Soundscape*

46 *Ten-Year Forecast Peak Season*

47 Wilderness Zone (about 94% of GCNP); area of moderate to major adverse impact would be 19 to 37% of the
 48 Zone, a moderate beneficial change in impacts (18 to 30% reduction in area of moderate to major adverse
 49 impacts) compared to Alternative A.

50
 51 Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impact would be 27 to 60% of
 52 the Zone, a *moderate to major* beneficial change in impacts (26 to 63% reduction in area of moderate to major
 53 adverse impacts) compared to Alternative A.

1 Developed Zone (about 2% of GCNP); area of moderate to major adverse impact would be **16 to 66%** of the
 2 Zone, a **moderate to major** beneficial change in impacts (**29 to 82%** reduction in area of moderate to major
 3 adverse impacts) compared to Alternative A.

4
 5 **Conclusion by Zone** *Modified NPS Preferred Alternative* *Soundscape*

6 **Ten-Year Forecast Off-Peak Season**

7 **Wilderness Zone (about 94% of GCNP); area of moderate to major adverse impact would be 12 to 23% of the**
 8 **Zone, a moderate to major beneficial change in impacts (33 to 37% reduction in area of moderate to major**
 9 **adverse impacts) compared to Alternative A.**

10
 11 **Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impact would be 8 to 28% of**
 12 **the Zone, a major beneficial change in impacts (59 to 82% reduction in area of moderate to major adverse**
 13 **impacts) compared to Alternative A.**

14
 15 **Developed Zone (about 2% of GCNP); area of moderate to major adverse impact would be 3 to 36% of the**
 16 **Zone, a major beneficial change in impacts (59 to 96% reduction in area of moderate to major adverse**
 17 **impacts) compared to Alternative A.**

18
 19 **Conclusion by Area** *Modified NPS Preferred Alternative* *Soundscape*

20 **Ten-Year Forecast Peak Season**

21 In Marble Canyon, Central areas, and West End (southern portions), localized long- and short-term impacts
 22 would generally be negligible to minor adverse (Average Sound Level less than 15 dBA, aircraft Percent Time
 23 Audible less than 5%) with negligible to minor beneficial change compared to Alternative A. Greatest exposure
 24 to noise and visual impacts would occur under and near air-tour routes in East End and West End's northern
 25 portion where long- and short-term moderate to major adverse impacts would occur (Average Sound Level
 26 **greater than 45 dBA at seven Location Points West End and aircraft Percent Time Audible greater than 50% at**
 27 **six Location Points**) with negligible to minor beneficial change in impacts compared to Alternative A West End
 28 and East End **under and near routes. In West and East End areas away from routes and amid Flight-free Zones,**
 29 **impacts would be negligible to minor adverse with negligible to moderate beneficial change from Alternative A.**

30
 31 **Conclusion by Area** *Modified NPS Preferred Alternative* *Soundscape*

32 **Ten-Year Forecast Off-Peak Season**

33 **Impacts would be similar to (slightly less than) Ten-Year Forecast Peak Season in all areas except East End,**
 34 **where Off-Peak Season closure of Zuni Point Corridor short-loop routes and Zuni-Dragon long-loop routes**
 35 **would greatly reduce noise and impacts in the eastern portions of East End away from open Dragon Corridor**
 36 **short-loop routes (major beneficial changes in impacts compared to Alternative A). In Marble Canyon,**
 37 **Central areas, and West End (southern portions), localized long- and short-term impacts would generally be**
 38 **negligible to minor adverse (Average Sound Level less than 15 dBA, aircraft Percent Time Audible less than**
 39 **5%) with negligible to minor beneficial change compared to Alternative A.**

40
 41 **Greatest exposure to noise and visual impacts would occur under and near air-tour routes in East End and**
 42 **West End's northern portion where long- and short-term moderate to major adverse impacts would occur**
 43 **(Average Sound Level greater than 45 dBA at seven Location Points West End and two Location Points East**
 44 **End, aircraft Percent Time Audible greater than 50% at five Location Points each West and East End) with**
 45 **negligible to minor beneficial change in impacts compared to Alternative A West End, and minor to major**
 46 **beneficial change compared to Alternative A East End. In East End areas away from routes and amid Flight-**
 47 **free Zones, impacts would be negligible to minor adverse with negligible to moderate beneficial change from**
 48 **Alternative A.**

49
 50 **Cumulative Impacts Summary** *Modified NPS Preferred Alternative* *Soundscape*

51
 52 **As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase**
 53 **impact levels for each area described above for the Modified NPS Preferred Alternative by one level. That is,**
 54 **Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four park**
 55 **sections (Marble Canyon, East End, Central, West End) would tend to increase to major adverse Cumulative**
 56 **Impacts under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of**

1 ***Flight-free Zones. In comparison with other Alternatives, the Modified NPS Preferred Alternative ranks second***
 2 ***behind Alternative E for the lowest overall Cumulative Impacts (Alternative A ranks last).***

3
 4 **Summary of Impacts**

All Alternatives

Soundscape

5
 6 Substantial Restoration of Natural Quiet at Grand Canyon National Park will be achieved when reduction of noise
 7 from aircraft operations below 18,000 feet MSL results in at least 50% or more of the park achieving restoration of
 8 natural quiet (no aircraft audible) 75 to 100% of the day, each and every day. The four Alternatives analyzed in this
 9 EIS provide different ways of meeting agency goals and/or objectives.

10
 11 Tables 4.23 through 4.26 provide summary comparisons for different metrics modeled. Comparing Alternatives for
 12 all metrics, those with the lowest overall Soundscape impacts are Alternatives E and the ***Modified*** NPS Preferred.
 13 The Alternative with greatest overall Soundscape impact is Alternative A.

14
 15 Common to all Alternatives, a range of aircraft noise intensities and audibility would affect GCNP Soundscapes and
 16 ***NPS*** areas outside the park in the SFRA. In ***the Developed Zone***, aircraft audibility can ***sometimes*** be masked by
 17 non-natural sound sources ***such as vehicles, building noise, machinery, and electronics. There is also a small***
 18 ***component of non-natural noise produced in the park by vehicles on remote unpaved roads, motorboats on the***
 19 ***Colorado River, and mining activities outside the park.***

20
 21 In the Wilderness Zone, results vary to a greater degree than in the Developed and Non-Wilderness Zones due to the
 22 Wilderness Zone's ***large*** size and geographic extent as compared to the others. In Marble Canyon, Central areas, and
 23 West End's southern portion, localized long- and short-term adverse impacts would ***generally*** be negligible
 24 (Average Sound Level less than 15 dBA, Percent Time Audible less than 5%) under all Alternatives.

25
 26 Although each Alternative provides different elements to manage air-tours and air-tour-related activity, greatest
 27 exposure to noise and visual impacts remain ***under and near heavily travelled air-tour routes in*** East and West
 28 Ends where long- and short-term impacts would ***generally*** be ***moderate to major*** adverse (Average Sound Level 40
 29 to 50 dBA, Percent Time Audible greater than 75%). A range of beneficial impacts is evident in modeled results.
 30 Comparing elements among Alternatives for all metrics, Alternatives with greatest benefits include seasonal
 31 closures or changes to air-tour routes, extended curfew hours, and quiet-technology incentives or conversion
 32 requirements.
 33
 34

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1 **Table 4.23 Contour Analysis Comparison All Alternatives Percent Time Audible**^{57,58}
 2 **Base Year**

Percent Time Audible	Percent of Park by Alternative						
	A	E		F		Modified Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
≥ 25	45	25	22	49	41	43	26
10 to < 25	10	7	8	8	14	6	8
5 to < 10	5	6	6	5	7	4	5
> 0 to < 5	38	61	63	38	37	45	61
% Park Making Progress Toward SRNQ	55	75	78	51	59	57	74

3 **Table 4.24 Contour Analysis Comparison All Alternatives Percent Time Audible**
 4 **Ten-Year Forecast**

Percent Time Audible	Percent of Park by Alternative						
	A	E		F		Modified Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
≥ 25	47	16	14	34	25	27	15
10 to < 25	10	8	7	13	17	11	7
5 to < 10	5	6	6	5	8	6	9
> 0 to < 5	37	69	71	47	49	55	67
% Park Making Progress Toward SRNQ	53	84	86	66	75	73	85

6 **Table 4.25 Contour Analysis Comparison All Alternatives Average Sound Level**
 7 **Base Year**

Average Sound Level (dBA)	Percent of Park by Alternative						
	A	E		F		Modified Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
≥ 35	16	8	7	17	14	12	7
25 to < 35	14	6	5	16	15	13	6
15 to < 25	22	18	15	20	19	23	18
> 0 to < 15	46	59	63	44	46	47	61

10 **Table 4.26 Contour Analysis Comparison All Alternatives Average Sound Level**
 11 **Ten-Year Forecast**

Average Sound Level (dBA)	Percent of Park by Alternative						
	A	E		F		Modified Preferred	
		Peak	Off Peak	Peak	Off Peak	Peak	Off Peak
≥ 35	23	6	5	14	11	9	5
25 to < 35	28	5	5	14	14	10	6
15 to < 25	37	19	17	21	19	24	19
> 0 to < 15	13	61	64	48	51	51	62

⁵⁷ Because limited ambient data were available outside GCNP, contours for Percent Time Audible were computed only in GCNP boundaries; Average Sound Level contours were computed in the entire SFRA

⁵⁸ Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or below 0 dBA

1 WILDERNESS CHARACTER

3 General Assumptions

Wilderness Character

4
5 In the thresholds below, all aspects of aircraft noise intensity and duration, including but not limited to aircraft
6 audibility, Average Sound Level (sound energy metrics), and timing are considered in the phrase *impacts due to the*
7 *event*. Audibility is the ability of animals and humans with normal hearing to hear a given sound. Audibility is
8 affected by hearing ability of individual animals and humans, other simultaneous interfering sounds or stimuli, and
9 by sound frequency content and amplitude. Sound energy metrics include Average Sound Level and Percent Time
10 Above decibel levels. Aircraft noise intensity and duration is an important component of Wilderness Character
11 related to Wildlife, Special Status Species, Soundscape, and Visitor Use and Experience.

12
13 A measure of Distance between points of interest to wilderness visitors and aircraft routes is used as an indicator
14 related to effects of aircraft being in close proximity to sensitive Wilderness sites, including visibility and presence
15 of aircraft to people on the ground (issues related to privacy and solitude), and of people on the ground to people in
16 aircraft. While there is usually a close correlation between Distance and sound intensity, this Distance measure is
17 included primarily to address effects other than aircraft noise.

19 NPS-Specific Methodology

Wilderness Character

20
21 *Also, see Chapter 4, General Methodology, for discussion of overall methodology for impact analysis for all*
22 *impact topics.*

23
24 Analysis of impacts to Wilderness Character considers the impact analyses for all other impact topics. Analysis
25 relies to a large extent on noise modeling results at Location Points in the park and those that fall in designated or
26 proposed Wilderness areas on other Federal lands in the SFRA, but all relevant information including other available
27 noise modeling data was also considered. Noise data is presented typically as a range between Location Points in an
28 area of the park or SFRA to provide an understanding of the level of effect for specific areas influenced by air-tour
29 operations. Distribution of these points in relation to Wilderness and current flight routes is depicted on Map 3.3.
30 For this impacts analysis, Wilderness Character includes consideration of qualities or characteristics (based on
31 Wilderness Act suitability criteria) as described in Chapter 3, Wilderness Character.

32
33 SFRA overflights would not result in physical development or landscape trammeling. Therefore analysis of impacts
34 to Wilderness Character focus on effects to natural conditions (Special Status Species and Wildlife) and
35 opportunities for solitude or a primitive and unconfined type of recreation (Visitor Use and Experience,
36 Soundscape).

37
38 Wilderness Character impact analysis applies to Wilderness lands in the SFRA, which includes proposed Wilderness
39 in the park and other NPS lands, and designated Wilderness on outside the park (see Chapter 3). The park's Non-
40 Wilderness and Developed Zones, as well as Non-Wilderness lands outside the park but in the SFRA, are not
41 assessed for impacts to Wilderness Character.

43 Impact Intensity Threshold Descriptions

Wilderness Character

44
45 As described in General Methodology, NPS applied noise modeling and other data to threshold descriptions to
46 determine levels of impact in Alternative A, No Action/Current Condition, and then used a similar approach to
47 evaluate changes in impacts in the Action Alternatives compared to the No Action Alternative. Threshold
48 descriptions for Wilderness are

50 Threshold Levels

Wilderness Character

51
52 *Negligible* Impacts due to the event have little or no discernible effect on Wilderness Character

53
54 Natural conditions prevail. Forces of nature primarily affect Wilderness lands

55
56 Outstanding opportunities exist for solitude or a primitive and unconfined type of recreation

1		Aircraft audible less than 5% of the 12-hour day used in this analysis
2		
3		Distance from points of interest to aircraft routes is greater than 2,000 meters
4		
5		Aircraft noise intensity in a specific area is less than 15 dBA
6		
7	Minor	
8		Impacts due to the event are slightly detectable to Wilderness Character in limited areas
9		
10		Natural conditions predominate. Wilderness lands generally appear affected primarily by forces of nature
11		
12		
13		Outstanding opportunities for solitude or a primitive and unconfined type of recreation are affected a small amount by audibility, sound levels, proximity, or timing of aircraft events
14		
15		
16		Aircraft audible greater than <i>or equal to</i> 5% and less than 10% of the 12-hour day
17		Distance from points of interest to aircraft routes is greater than 1,000 and less than <i>or equal to</i> 2,000 meters
18		
19		
20		Aircraft noise intensity in a specific area is greater than <i>or equal to</i> 15 dBA and less than 25 dBA
21		
22	Moderate	Impacts due to the action are readily apparent to Wilderness Character in limited areas
23		
24		It is apparent that natural conditions are altered by the event
25		
26		Outstanding opportunities for solitude or a primitive and unconfined type of recreation are affected an intermediate amount, and may be restricted to limited areas or during limited times of year, due to audibility, sound levels, proximity, or timing of aircraft events
27		
28		
29		
30		Aircraft audible greater than <i>or equal to</i> 10% and less than 25% of the 12-hour day
31		
32		Distance from points of interest to aircraft routes is greater than 500 and less than <i>or equal to</i> 1,000 meters
33		
34		
35		Aircraft noise intensity in a specific area is greater than <i>or equal to</i> 25 dBA and less than 35 dBA
36		
37	Major	Impacts of the action substantially alter Wilderness Character throughout a large portion of Wilderness lands
38		
39		
40		Natural conditions are substantially altered by the action
41		
42		Outstanding opportunities for solitude or a primitive and unconfined type of recreation are limited, and may be restricted through much of the Wilderness lands and/or during much of the year, due to audibility, sound levels, proximity, or timing of aircraft events
43		
44		
45		
46		Aircraft audible greater than <i>or equal to</i> 25% of the 12-hour day
47		
48		Distance from points of interest to aircraft routes is less than <i>or equal to</i> 500 meters
49		
50		Aircraft noise intensity in a specific area is greater than <i>or equal to</i> 35 dBA
51		
52	Type of Impact	Wilderness Character
53		
54	Adverse	Impacts of the event impede preservation of Wilderness Character components (natural conditions and outstanding opportunities for solitude or a primitive and unconfined type of recreation) or
55		

1 degrade public purposes of Wilderness (recreation, scenic, scientific, education, conservation, and
2 historical use)

3
4 *Beneficial* Impacts of the event contribute to or maintain the preservation of Wilderness Character components
5 (natural conditions and outstanding opportunities for solitude or a primitive and unconfined type of
6 recreation) or support public purposes of Wilderness (recreation, scenic, scientific, education,
7 conservation, and historical use). ***Beneficial effects are usually described in terms of changes in
8 impacts compared to Alternative A***
9

10 **Context** **Wilderness Character**

11
12 *Regional* Impacts affect majority of lands proposed for or designated as Wilderness within the Study Area

13
14 *Localized* Impacts confined to specific areas in proposed or designated Wilderness in the Study Area

15
16 *Park* Not applicable. Wilderness Character is only assessed 1) for NPS lands designated,
17 *Management* proposed, or recommended as Wilderness in the NPS Wilderness Zone and 2) for non- NPS lands
18 *Zone* designated as Wilderness or determined eligible for Wilderness designation depending on policies
19 of the applicable land manager

20 **Duration** **Wilderness Character**

21
22 *Short Term* Impacts associated with individual, infrequent, and/or non-repetitive events affecting Wilderness
23 Character no more than the day the events occur

24
25 *Long Term* Impacts continue after completion of individual events and persist longer than the day events
26 occur. Related events that are frequent or repetitive over more than a few days would also be
27 considered long-term

28
29 **Timing** Frequency of occurrence is an important timing consideration in assessing impacts to Wilderness
30 Character. A subset of that issue is whether impacts would occur year-round or seasonally. Time
31 of day, especially morning and evening, can also be important in visitor opportunities to
32 experience solitude and Wilderness resources affected primarily by forces of nature
33

34 **ALTERNATIVE A** **NO ACTION** **WILDERNESS CHARACTER**

35
36 Under Alternative A, a range of aircraft noise intensities and audibility would affect Wilderness Character,
37 especially East End. At all locations, impacts would be about the same Base Year and Ten-Year Forecast.
38

39 Nearly 50% of Wilderness⁵⁹ in the Study Area would have air-tour aircraft Percent Time Audible greater than 25%
40 of the day predominantly East and West Ends under and near air-tour routes. Air-tour Average Sound Level would
41 generally be low, less than 25 dBA, in about 69% of proposed Wilderness Base Year. From Base Year to Ten-Year
42 Forecast, Average Sound Level would increase as air-tour operations increase with 45% of the area experiencing
43 noise at less than 25 dBA, and 22% of the area exposed to Average Sound Level greater than 35 dBA. Greatest
44 exposure to noise and visual impacts would occur under and near heavily used air-tour routes in East End and
45 portions of the West End where Average Sound Level would be 40 to 50 dBA, and where aircraft Percent Time
46 Audible would be greater than 75%.
47

48 **Marble Canyon** **Alternative A** **Wilderness Character**

49
50 Near Marble Canyon and in Paria Canyon-Vermilion Cliffs Wilderness Area, natural character and outstanding
51 opportunities for solitude or primitive and unconfined types of recreation would be affected to a small degree by air-
52 tour aircraft sights or sounds.
53

⁵⁹ In accordance with NPS policies, lands proposed for Wilderness designation are managed as Wilderness until Congress acts to designate Wilderness or remove it from consideration

1 Marble Canyon Wilderness area Location Points would be quiet with air-tour aircraft Percent Time Audible zero to
 2 approximately 3% of the day, and Average Sound Level 3 to 24 dBA. Aircraft visibility would be low, and aircraft
 3 would generally be more than 2,000 meters away from points on the ground. The natural sound condition would be
 4 infrequently interrupted by air-tour aircraft noise, and there would be little visual evidence of aircraft under
 5 Alternative A. In Marble Canyon there would be little effect on elements of the natural environment such as
 6 opportunities for solitude. In few locations (e.g. North and South Canyon Location Points), aircraft would be 800 to
 7 1,000 meters from points on the ground, which would decrease opportunities for solitude. In Marble Canyon,
 8 aircraft sights and sounds would have a negligible to minor long-term adverse effect on Wilderness Character.
 9

10 In Marble Canyon, routes near Saddle Mountain Wilderness aircraft Percent Time Audible would be up to 50% of
 11 the day at greater than 35 dBA, representing minor to major adverse impact levels. In Paria Canyon-Vermilion Cliffs
 12 Wilderness Area, Average Sound Level would be much lower, generally at negligible impact levels audible less than
 13 5% of the day at less than 15 dBA both Base Year and Ten-Year Forecast.
 14

15 **Table 4.27 Alternative A Average Sound Level and Slant Distances Marble Canyon**

Location Point Name	Alternative A				
	Percent Time Audible (%)		Average Sound Level(dBA)		Slant Distance (m)
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast	
North Canyon	3%	3%	24	25	999
South Canyon	2%	3%	21	23	816
Cliff Dwellers Lodge	1%	1%	6	10	3,695
Grid Location Point 2	2%	3%	16	19	858
Grid Location Point 3	3%	3%	14	16	2,958
Grid Location Point 5	2%	2%	8		2,335
Marble Canyon Dam Site	0%	0%	3		3,845

16 **East End Alternative A Wilderness Character**

17
 18
 19 In areas near **Little Colorado River Nankoweap Mesa, and Nankoweap River** Location Points, there would be
 20 localized long-term impacts on Wilderness Character that would vary depending on proximity to air-tour routes and
 21 the river. Air-tour aircraft would be audible in locations away from the river 34 to 87% of the day with aircraft
 22 Average Sound Level of 43 dBA. Aircraft would be approximately 1,000 to 1,600 meters away from points on the
 23 ground. In these areas, natural conditions would be altered, and opportunities for solitude frequently interrupted with
 24 aircraft visible and high levels of noise throughout the day. Impacts from aircraft on Wilderness Character would be
 25 long-term moderate to major adverse.
 26

27 Close to the river, as represented by the **Nankoweap River** Location Point, these effects would be less with aircraft
 28 Average Sound Level of 34 dBA and Percent Time Audible approximately 7%. Aircraft visibility would be low, and
 29 aircraft would be approximately 1,500 meters away from points on the ground. Higher natural ambient sound levels
 30 near the river (25 to 65 dBA) would reduce the frequency at which air-tour aircraft would be audible allowing
 31 natural conditions to predominate and ample opportunity for solitude. Impacts from aircraft on Wilderness Character
 32 would be long-term negligible to minor adverse.
 33

34 Outside park boundaries, **Saddle Mountain Wilderness Area** Location Point would have an aircraft Average
 35 Sound Level of 37 dBA. Aircraft Percent Time Audible would be 51%, and 1,716 meters away from points on the
 36 ground. Due to air-tour routes Black-4, Black-1, and Green-1 in the area, impacts on Wilderness Character would be
 37 long-term moderate to major adverse.
 38
 39

1 **Table 4.28 Alternative A Average Sound Level and Slant Distances East End**

Location Point Name	Alternative A				
	Percent Time Audible (%)		Average Sound Level (dBA)		Slant Distance (m)
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast	
Little Colorado River/Nankoweap Area					
Little Colorado River	34	37	43	43	1,629
Nankoweap Mesa	87	90	43	43	973
Nankoweap River	7	8	34	35	1,449
Dragon Corridor					
Hermit Basin	99	100	42	42	1,518
96 Mile Camp	72	74	45	45	1,573
Tower of Ra	97	98	44	45	1,147
Eremita Mesa	100	100	49	49	1,034
North Rim					
Grid Location Point 16	80	84	33	34	2,589
The Basin	73	75	48	48	477
Grid Location Point 6	52	56	19	20	6,935
Zuni Point Corridor					
Grid Location Point 14	70	74	34	34	687
Grid Location Point 15	65	69	28	29	1,637
Temple Butte	62	66	37	38	1,458
Bright Angel Flight-Free Zone					
Grid Location Point 11	55	56	18	18	8,081
Grid Location Point 12	1	1	13	13	9,014
Grid Location Point 13	1	1	12	13	7,925
Toroweap /Shinumo Flight-Free Zone					
Grid Location Point 18	60	60	16	17	8,449
Pasture Wash	98	98	20	21	5,532
Point Sublime	100	100	33	35	3,760
Grid Location Point 7	1	1	7	8	8,888
Bass Camp	0	0	7	7	13,358
Rainbow Plateau	0	0	6	7	14,878
Grid Location Point 10	22	22	25	25	2,931
Outside the Park					
Saddle Mountain	51	58	37	37	1,716

2
3 Aircraft noise **beneath Zuni Point and Dragon Corridor** routes and **Black-1A/Green-1A routes over North Rim**
4 would result in areas of nearly continuous noise at 62% to almost 100% Percent Time Audible (as represented by
5 Location Points **Hermit Basin, 96 Mile Camp, Point Sublime, Tower of Ra, Temple Butte, Grid Location**
6 **Points 15 and 16**). Aircraft Average Sound Level would be 28 to 49 dBA. In these areas, air-tour noise would alter
7 natural conditions and reduce opportunities for solitude a large part of the day. Aircraft would not be closer than
8 1,000 meters. Impacts to Wilderness Character would be long-term moderate to major adverse. Location Points
9 represented by **The Basin** and **Grid Location Point 14** would have aircraft closer than 1,000 meters and impacts to
10 Wilderness Character would be long term major adverse.

11
12 Beneath **Bright Angel Flight-Free Zone**, air-tour aircraft noise would vary widely. Wilderness locations near air-
13 tour routes would experience almost continuous noise, while those amid Bright Angel Flight-free Zone would
14 experience less noise. Amid Bright Angel Flight-free Zone, represented by **Grid Location Points 12 and 13**, air-
15 tour operations would have very little effect on natural conditions or opportunities for solitude with Percent Time
16 Audible of less than one percent, and Average Sound Level 12 to 13 dBA. Air-tour aircraft noise would likely not be
17 audible. Aircraft would be at Distances greater than 2,000 meters. Impacts to Wilderness Character would be long
18 term negligible adverse.
19

In contrast, areas closer to **Dragon Corridor** routes, represented by **Grid Location Point 11**, would have aircraft Percent Time Audible about 55% at Average Sound Level 18 dBA. Aircraft would be audible frequently at low levels. Aircraft would be at Distances greater than 2,000 meters. In these areas, as in areas under tour routes, natural conditions would be disturbed and opportunities for solitude would be substantially reduced. Impacts to Wilderness Character would be long term moderate to major adverse due to the higher time air-tour noise would be audible.

At **Toroweap/Shinumo Flight-free Zone's** eastern segment, at **Grid Location Point 18** and **Pasture Wash** Location Points, air-tour aircraft Percent Time Audible would be 60 and 98% of the day with aircraft Average Sound Level 16 and 20 dBA, respectively, and aircraft would be at Distances greater than 2,000 meters. Due to audibility of air-tour routes, natural conditions would be disturbed by aircraft noise, and opportunities for solitude would be greatly reduced. Impacts to Wilderness Character would be long term moderate to major adverse due to the high amount of time aircraft would be audible.

Central Alternative A Wilderness Character

In the Central area and adjacent Wilderness, Wilderness Character would be least affected by aircraft overflight noise. This area comprises most of **Toroweap/Shinumo Flight-Free Zone**, and is transected by two general-aviation corridors. In this remote park area, Percent Time Audible would range up to 18%, with Average Sound Level up to 16 dBA. Aircraft would be barely visible at Distances much greater than 2,000 meters. With aircraft providing a slight visual impact, and low Average Sound Level, there would be small effects on naturalness of Wilderness or opportunities for solitude. Impacts to Wilderness Character would generally be long term negligible at most Central area locations, but up to moderate adverse at a few locations.

Table 4.29 Alternative A Average Sound Level and Slant Distances Central

Location Point Name	Alternative A				Slant Distance (m)
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast	
The Dome	1	1	16	16	13,109
Tuweep	12	14	15	16	8,688
Tuweep	15	17	15	11	14,322
Hancock Knolls	2	2	10	10	30,162
1 km W of Kanab Point	2	2	9	9	18,850
Grid Location Point 8	3	3	10	10	13,765
Grid Location Point 9	1	1	5	5	11,103
Grid Location Point 20	0	0	4	4	22,053
Grid Location Point 21	2	2	14	14	20,393
Grid Location Point 22	18	21	12	13	26,089
Grid Location Point 23	2	2	10	10	29,326
Grid Location Point 24	3	4	8	8	21,073
Grid Location Point 25	11	12	9	10	20,188
Havas Point	0	0	0	0	10,450
Kanab Point	1	1	6	7	19,021
Mt. Sinyala	1	1	0	0	7,272
Stone Creek	0	0	0	0	21,882
Surprise Valley	1	1	0	0	25,500
Toroweap Overlook	0	0	13	14	9,625
Upper Deer Creek	1	1	1	1	23,683

West End Alternative A Wilderness Character

A range of aircraft noise intensities and audibility would affect Wilderness Character under Alternative A West End. This park area includes a high volume of helicopter traffic for river access managed under the Colorado River Management Plan. It also includes Sanup Flight-free Zone.

In **West End areas beneath air-tour routes** (Green-4, Blue-2, and Blue Direct South), represented by Location Points **Burnt Springs Canyon, Bat Cave, and Grid Location Point 33**, air-tour aircraft Percent Time Audible would be 70 to 93% of the day, and Average Sound Level would be 42 to 47 dBA. Aircraft visibility would be fairly low, 1,000 to 1,200 meters from points on the ground. Natural conditions in Wilderness would be detectably altered, and opportunities for solitude would be substantially reduced by high Percent Time Audible and Average Sound Level. Impacts to Wilderness Character would be long term moderate to major adverse due to the high amount of time aircraft would be audible.

West End Location Points near Brown routes (represented by **Whitmore Rapids** and **Parashant Wash** Location Points), and further west along the river, would be less affected with Percent Time Audible at 12%, and Average Sound Level 21 to 33 dBA. Aircraft would be 1,800 to 2,800 meters from points on the ground. Natural conditions and opportunities for solitude would be disturbed intermittently due to relatively high level of air-tour noise. Impacts to Wilderness Character would be long term moderate adverse.

West End Areas under Blue Direct North and Blue Direct South routes, including **Grid Location Points 28 and 32**, would have Percent Time Audible 14 to 44%, and Average Sound Level 17 to 27 dBA. Distances from aircraft to points on the ground would be more than 2,000 meters. Air-tour operations on Blue Direct routes would result in Average Sound Level that would frequently and substantially alter natural conditions of Wilderness and reduce greatly the opportunity for solitude. Impacts to Wilderness Character would be long term moderate to major adverse.

In **West End's southern portion away from routes**, including Sanup Flight-free Zone, there would be negligible to minor adverse impacts.

Table 4.30 Alternative A Average Sound Level and Slant Distances West End

Location Point Name	Alternative A				Slant Distance (m)
	Percent Time Audible (%)		Average Sound Level(dBA)		
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast	
Burnt Springs Canyon	70	75	46	47	1,215
Bat Cave	93	93	47	48	1,134
Grid Location Point 33	87	90	42	43	1,105
Whitmore Rapids	12	13	21	21	1,804
Grid Location Point 28	14	14	17	18	8,327
Grid Location Point 32	44	49	27	28	2,016
Diamond Creek	0	0	0	0	27,108
Separation Canyon	0	1	9	9	16,020
Granite Gorge	58	63	34	35	2,397
Grid Location Point 29	7	8	12	13	9,306
Grid Location Point 30	39	42	28	28	2,008
Grid Location Point 34	0	0	1	1	28,206
Granite Peak	2	2	17	18	5,264
Kelly Point	1	1	10	10	20,278
Jackson Canyon	18	20	24	25	5,610
Parashant Wash	12	14	33	33	2,852
Pumpkin Springs	0	0	7	8	12,630
Peach Spring Canyon South	NA	NA	0	0	42,795
Sanup	79	83	38	38	1,820
Separation Canyon, 1 km north of Colorado River	1	1	8	8	15,819
Separation Canyon at Colorado River	0	0	7	7	16,377
Suicide Point	15	17	22	23	2,093
Three Springs	1	2	8	9	14,750
Twin Point	19	22	23	23	3,347
West End	58	63	39	40	1,688

1 **NPS Units in SFRA Outside GCNP** **Alternative A** **Wilderness Character**

2
3 Based on modeled noise results for Wilderness **directly under and within five miles of Blue Direct routes**
4 (proposed wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument),
5 impacts would be moderate to major adverse with aircraft Average Sound Level 40 to 50 dBA and Percent Time
6 Audible greater than 50% Base Year and Ten-Year Forecast.

7
8 **Cumulative Impacts** **Alternative A** **Wilderness Character**

9
10 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
11 *actions. In this context, Cumulative Impacts include impacts on Soundscape from sounds of*

- 12 1) *high-altitude aircraft at or above 18,000 feet MSL, plus*
13 2) *aircraft below 18,000 feet MSL and outside the SFRA, plus*
14 3) *ground-based noise sources, plus*
15 4) *noise from air-tour-and-related aircraft under Alternative A*

16
17 *That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).*

18
19 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
20 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
21 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
22 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
23 *SFRA see Appendix D, Figures 91 to 94).*

24
25 *Noise from ground-based sources includes vehicles, building noise, machinery, and electronics, also impacts*
26 *Soundscape, but is mostly concentrated in the Developed Zone (2% of the park), although a small component*
27 *exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
28 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
29 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
30 *Audible capable of masking some aircraft noise.*

31
32 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
33 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
34 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
35 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
36 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
37 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
38 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
39 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
40 *Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the*
41 *park and SFRA; there are no areas in GCNP where the natural Soundscape is not adversely affected by aircraft*
42 *noise some of the time.*

43
44 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
45 *(Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
46 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
47 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
48 *(Alternative A in this case).*

49
50 *Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in*
51 *Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is*
52 *detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year*
53 *Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS;*
54 *however, since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas*
55 *(2% of the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in*

1 *interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas*
 2 *north of the park.*

3
 4 *Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All*
 5 *Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the*
 6 *difference between Cumulative Impacts and impacts of Alternative A by itself. For the Proposed Wilderness Zone*
 7 *Cumulative Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the*
 8 *park's Proposed Wilderness Zone, with Average Sound Level 25 to <35 dBA in 75% of the Zone, with none of the*
 9 *Zone below 25 dBA, and 24% of the Zone at 35 dBA or more. For the Proposed Wilderness Zone results for*
 10 *Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or more of the day in 26% of the Zone, with*
 11 *Average Sound Level 25 to <35 dBA in 27% of the Zone, with 52% of the Zone below 25 dBA, and 22 % at 35*
 12 *dBA or more.*

13
 14 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 15 *including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour*
 16 *routes; (b) Cumulative Impacts increase impacts of Alternative, and (c) reducing air-tour-and-related impacts*
 17 *under the Alternatives reduces Cumulative Impacts.*

18
 19 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 20 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 21 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 22 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 23 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
 24 *in the Conclusions section below.*

25
 26 **Conclusion** **Alternative A** **Wilderness Character**

27
 28 Overall, 48% of park proposed Wilderness area would have air-tour aircraft audible more than 25% of the day, but,
 29 with a few exceptions, most of the proposed Wilderness area would have air-tour aircraft Average Sound Level less
 30 than 25 dBA. In Marble Canyon, Central areas, and West End's southern portions, aircraft Average Sound Level
 31 would generally be less than 15 dBA with Percent Time Audible less than 5%. In these areas, when air-tour aircraft
 32 would be audible it would usually be very infrequent and at low sound levels allowing for natural conditions to
 33 persist and ample opportunities for solitude. Greatest exposure to noise and visual impacts would occur under and
 34 near air-tour routes in East End and West End's northern portions where aircraft Average Sound Level would be 40
 35 to 50 dBA and Percent Time Audible would be audible greater than 75% of the day. Natural conditions and
 36 opportunities for solitude would be reduced and disrupted frequently. Although impacts at all locations would
 37 increase slightly, level of impact would be about the same Base Year and Ten-Year Forecast.

38
 39 *Conclusion Marble Canyon* *Alternative A* *Wilderness Character*
 40 Alternative A would result in long-term negligible to minor adverse impacts to Wilderness Character in GCNP and
 41 the Paria Canyon-Vermilion Cliffs Wilderness Area, but minor to major adverse impacts in the Saddle Mountain
 42 Wilderness Area.

43
 44 *Conclusion East End* *Alternative A* *Wilderness Character*
 45 Alternative A would result in long-term moderate to major adverse impacts to Wilderness Character in areas under
 46 and near air-tour routes in Dragon and Zuni Point Corridors and across North Rim, but negligible to minor adverse
 47 impacts in areas away from tour routes and amid Bright Angel Flight-free Zone.

48
 49 *Conclusion Central* *Alternative A* *Wilderness Character*
 50 Alternative A would result in negligible impacts to Wilderness Character at most Central area Location Points, but
 51 up to moderate adverse impacts at a few locations.

52
 53 *Conclusion West End* *Alternative A* *Wilderness Character*
 54 Alternative A would result in long-term moderate to major adverse impacts to Wilderness Character at Location
 55 Points under Green-4, Blue-2, and Blue Direct South routes. Long-term moderate adverse impacts would result at
 56 Location Points near Whitmore Rapids under Brown routes. Long-term moderate adverse impacts would result at

1 Blue Direct North and Blue Direct South routes. There would be long-term negligible to minor adverse impacts in
2 areas away from routes in West End's southern portion including Sanup Flight-free Zone.

3
4 ***Cumulative Impacts Summary*** ***Alternative A*** ***Wilderness Character***

5
6 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
7 *impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts in*
8 *all three Zones (Developed, Non-Wilderness, and Wilderness) and all four park sections (Marble Canyon, East*
9 *End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour*
10 *routes, and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison*
11 *with the other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts (Alternative E ranks*
12 *first in lowest Cumulative Impacts).*

13
14 **ALTERNATIVE E** **ALTERNATING SEASONAL USE** **WILDERNESS CHARACTER**

15
16 Alternative E would result in beneficial change in impacts compared to Alternative A due to reduced amount of area
17 exposed to high Average Sound Level for long periods of the day. Natural conditions would be improved and
18 opportunities for solitude and primitive recreation increased in the majority of the proposed Wilderness. The
19 majority of proposed Wilderness (63% in Base Year Peak Season; 72% Ten-Year Forecast Off-Peak Season) would
20 have air-tour aircraft Percent Time Audible less than 5% of the day. Ten-Year Forecast the amount of proposed
21 Wilderness that experiences air-tours Percent Time Audible greater than 25% of the day would be reduced to 21%
22 and 14%, Peak and Off-Peak Season respectively. Peak and Off-Peak Season, 60% or more of proposed Wilderness
23 would have average air-tour aircraft Average Sound Level less than 15 dBA Base Year and Ten-Year Forecast.

24
25 **Marble Canyon** **Alternative E** **Wilderness Character**

26
27 In Marble Canyon, there would be a slight improvement in Wilderness Character both inside and outside the park
28 compared to Alternative A as Average Sound Level due to air-tour aircraft would be low (generally less than 5 dBA,
29 and aircraft Percent Time Audible would be less than 15% of the day. This is due to Bright Angel Flight-free Zone
30 being substantially enlarged by extending its boundary north to include all of Marble Canyon.

31
32 Tables 4.31 and 4.32 present Slant Distances and Average Sound Level for Marble Canyon Location Points.
33 Proposed Wilderness in Marble Canyon (represented by Location Points North Canyon, South Canyon, Grid
34 Location Point 3, and Marble Canyon Dam Site) and adjacent Wilderness outside the park (represented by Location
35 Points Cliff Dwellers Lodge and Grid Location Points 2 and 5) would be quiet, similar to Alternative A.

36
37 **Marble Canyon** **Alternative E** **Wilderness Character**
38 ***All Scenarios***

39 Air-tour aircraft Percent Time Audible would be zero to one percent of the day, approximately 2 to 3% less than
40 Alternative A. Aircraft Average Sound Level would be zero to 13 dBA, a 3 to 24 dBA decrease from Alternative
41 A. There would be no air-tour aircraft visible from points on the ground. Improvements over Alternative A
42 would occur at all Location Points, and most at **North** and **South Canyon** Location Points where Average Sound
43 Level would decrease to 21 to 24 dBA. The naturalness of Wilderness and opportunities for solitude or primitive
44 and unconfined recreation would be improved to a small degree.

45
46 Because there would be no air-tour routes in Marble Canyon under Alternative E, impacts on **Saddle Mountain**
47 **Wilderness, Paria Canyon-Vermilion Cliffs Wilderness, and proposed GCNP Wilderness** would be
48 negligible. In GCNP, this represents a negligible to minor long-term beneficial change in impacts from
49 Alternative A, but in Saddle Mountain and Paria Canyon-Vermilion Cliffs Wildernesses it is a moderate to major
50 beneficial change from Alternative A.

Table 4.31 Alternative E Slant Distances Marble Canyon

Location Point Name	Alternative A		Alternative E	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
North Canyon	999		36,247	35,248
South Canyon	816		26,091	25,275
Cliff Dwellers Lodge	3,695		50,287	46,591
Grid Location Point 2	858		54,066	53,208
Grid Location Point 3	2,958		44,163	41,205
Grid Location Point 5	2,335		43,729	41,394
Marble Canyon Dam Site	3,845		17,396	13,551

Δ indicates change in noise metric data from Alternative A

Table 4.32 Alternative E Average Sound Level Marble Canyon

Location Name	Alternative E																			
	Alternative A				Peak Season								Off-Peak Season							
	Time Audible (%)		Equivalent Sound Level		Time Audible (%)				Equivalent Sound Level (dBA)				Time Audible (%)				Equivalent Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
North Canyon	3	3	24	25	0	-2	0	-3	-24	0	-25	0	-2	0	-3	0	-24	0	-25	
South Canyon	2	3	21	23	0	-3	0	-3	0	-21	0	-23	0	-2	0	-2	0	-21	0	-23
Cliff Dwellers Lodge	1	1	6	10	0	-3	0	-3	0	-6	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 2	2	3	16	19	0	-2	0	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	4	16	1	-2	0	-2	7	-8	7	-9	1	-2	1	-2	7	-8	7	-9
Grid Location Point 5	2	2	8	12	0	-2	0	-2	0	-8	0	-12	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4

Δ indicates change in noise metric data from Alternative A

1 **East End** **Alternative E** **Wilderness Character**

2
3 Beneficial change in effects on East End Wilderness due to Dragon Corridor closure Peak Season, and conversely,
4 Zuni Point Corridor closure Off-Peak Season is clearly seen in modeled noise results. Localized long-term adverse
5 impacts would be major in areas near the open Corridor and comparable to Alternative A (Average Sound Level 40
6 to 50 dBA, and Percent Time Audible greater than 75%). Impacts would be negligible in areas near the closed
7 Corridor, a substantial benefit as compared to Alternative A. East End as a whole would benefit from extended
8 curfew hours. Tables 4.33 and 4.34 present Slant Distances and Average Sound Level for East End Location Points.

9
10 *East End* *Alternative E* *Wilderness Character*
11 *Base Year Peak Season*

12 Near areas represented by **Little Colorado River** and **Nankoweap Mesa** Location Points, air-tour aircraft
13 Percent Time Audible would be 36 to 78%, an increase of 2% at the Little Colorado River Location Point and a
14 decrease of 9% at Nankoweap Mesa Location Point. There would be somewhat lower Average Sound Level of
15 23 to 39 dBA, a decrease of 4 to 20 dBA. Aircraft would be more Distant than in Alternative A, and greater than
16 2,000 meters away from points on the ground. Although moderate to major adverse impacts would occur, there
17 would be a long-term negligible to minor beneficial change in impacts from Alternative A.

18
19 **At locations close to the river**, represented by **Nankoweap River** Location Point, aircraft Average Sound Level
20 would be approximately 12 dBA and, due to close proximity to relatively loud river sounds, Percent Time
21 Audible would be less than one percent. This represents a 23 dBA decline in Average Sound Level and a 7%
22 decline in Percent Time Audible from Alternative A. Aircraft would be more than 9,000 meters away from the
23 ground. There would be negligible impacts, a long-term minor beneficial change in impacts from Alternative A.

24
25 **Outside park boundaries, Saddle Mountain** Location Point would have aircraft Average Sound Level of 13
26 dBA, a decline of 24 dBA compared to Alternative A. Percent Time Audible would be one percent, a decrease of
27 50% compared to Alternative A. Aircraft would be very Distant from points on the ground (approximately
28 15,000 meters). Natural conditions would be improved, and there would be much greater opportunity to enjoy
29 natural sights and sounds and experience solitude and unconfined recreation. There would be negligible impacts,
30 a long-term moderate to major beneficial change in impacts from Alternative A due to reduction in air-tour
31 aircraft Percent Time Audible, and lack of visibility of aircraft from the ground.

32
33 When Dragon Corridor routes would not be in use, aircraft Percent Time Audible would be less than one to 13%
34 of the day, a decrease of 71 to 96% compared to Alternative A at **Hermit Basin**, **Tower of Ra**, and **96 Mile**
35 **Camp** Location Points. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from
36 Alternative A. **Eremita Mesa** Percent Time Audible would be 67% of the day, a 33% reduction compared to
37 Alternative A at Average Sound Level of 21 dBA, a decline of 29 dBA. The area near Eremita Mesa Location
38 Point would continue to experience air-tour noise from aircraft on Blue Direct and Brown routes as they
39 approach and depart Grand Canyon Airport. As Dragon Corridor routes would be inactive, aircraft would not be
40 visible or far less visible than in Alternative A at locations on the ground. Due to the substantial reduction in time
41 and level of audible aircraft noise and reduced visual impact, there would be large improvement in natural
42 conditions and increase in opportunities for solitude in Wilderness. Negligible to minor adverse impacts would
43 occur, a long-term moderate to major beneficial change in impacts from Alternative A.

44
45 When **Zuni Point Corridor would be in use**, Percent Time Audible in areas represented by **Grid Location**
46 **Point 14** and **Temple Butte** Location Points would be 75 to 81%, an approximate 12% increase compared to
47 Alternative A. Aircraft Average Sound Level would be 38 to 39 dBA, a 5 dBA increase from Alternative A. At
48 Grid Location Point 14, aircraft visibility from points on the ground would decrease as air-tour aircraft would be
49 900 meters farther away compared to Alternative A. At Temple Butte Location Point air-tours would be
50 approximately 400 meters closer to points on the ground compared to Alternative A. In areas under Zuni Point
51 Corridor, natural conditions in Wilderness would be disturbed, and opportunities for solitude and unconfined
52 primitive recreation would be frequently disrupted. Major adverse impacts would in occur, but there would be a
53 long-term minor adverse change in impacts from Alternative A due to increased air-tour Percent Time Audible.

54
55 **Beneath Bright Angel Flight-free Zone**, which includes **areas along North Rim** in this Alternative, air-tour
56 aircraft noise would vary somewhat due to alternating seasonal use patterns in Zuni Point and Dragon Corridors.

1 Near Dragon Corridor, in Location Points such as **The Basin** and **Grid Location Point 11**, audible aircraft noise
 2 would be generally less than in Alternative A. Aircraft Percent Time Audible would be one to 6% of the day, a
 3 49% to 72% decline compared to Alternative A, and Average Sound Level would be 5 to 9 dBA, a decrease of 9
 4 dBA at Grid Location Point 11, and a 42 dBA decrease along North Rim near The Basin Location Point. There
 5 would be a large increase (3,446 meters) in aircraft Distance from locations on the ground from Alternative A,
 6 along North Rim near The Basin Location Point. Natural conditions and opportunities for solitude and
 7 unconfined recreation in Wilderness in Bright Angel Flight-free Zone and along North Rim, near Dragon
 8 Corridor, would be substantially improved. There would be negligible impacts across North Rim, and negligible
 9 to minor adverse impacts in areas near Dragon Corridor Base Year Peak Season, a long-term moderate to major
 10 beneficial change in impacts from Alternative A in Wilderness Character.

11
 12 In areas **amid Bright Angel Flight-free Zone**, represented by **Grid Location Points 12 and 13**, there would be
 13 little change in impacts from Alternative A Peak and Off-Peak Season. Aircraft Percent Time Audible Base Year
 14 Peak Season would be similar to Alternative A, one percent or less, with Average Sound Level 10 to 12 dBA.
 15 Aircraft noise would be at low levels. Air-tour aircraft would be greater than 9,000 meters away. Negligible
 16 impacts would occur with negligible change in impacts from Alternative A at these points.

17
 18 When routes in Dragon Corridor would be inactive, at **Toroweap/Shinumo Flight-free Zone's eastern edge**, at
 19 **Grid Location Point 18** and **Pasture Wash** Location Points, aircraft Percent Time Audible would be one
 20 percent and 28% of the day, a decrease of 59 to 70% from Alternative A. Aircraft Average Sound Level of 6 and
 21 16 dBA would occur, a 5 to 10 dBA decrease compared to Alternative A. Air-tour aircraft would be greater than
 22 6,000 meters away. Reduction in aircraft noise and large reduction in Percent Time Audible would improve
 23 natural conditions and provide increased opportunity for solitude and primitive recreation. Negligible to minor
 24 adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to
 25 Alternative A at these points due to high reduction in Percent Time Audible.

26
 27 *East End* *Alternative E* *Wilderness Character*
 28 *Ten-Year Forecast Peak Season*

29 Air-tour aircraft Percent Time Audible at **Nankoweap Mesa** Location Point would decline by 45%, and Average
 30 Sound Level would decline by 24 dBA compared to Alternative A. Although moderate adverse impacts would
 31 occur, there would be a long-term moderate to major beneficial change in impacts to Wilderness Character due to
 32 high reduction in aircraft Percent Time Audible near Nankoweap Mesa with lesser benefits at **Little Colorado**
 33 **River** Location Point compared to Alternative A.

34
 35 **At locations close to the river** (**Nankoweap River** Location Point), change in aircraft Percent Time Audible,
 36 Average Sound Level, and visibility would not be appreciably different from conditions described Base Year
 37 Peak Season. Negligible to minor adverse impacts would occur, a negligible to minor beneficial change in
 38 impacts compared to Alternative A.

39
 40 Percent Time Audible and Average Sound Level at **Saddle Mountain** Location Point would not be appreciably
 41 different from Base Year Peak Season. Air-tour aircraft Percent Time Audible would be one percent of the day, a
 42 53% decline from Alternative A, at an Average Sound Level of 10 dBA, a 27 dBA decrease compared to
 43 Alternative A. Negligible impacts would occur, a long-term moderate to major beneficial change in impacts from
 44 Alternative A.

45
 46 Decline in aircraft Percent Time Audible and Average Sound Level would be similar to Base Year Peak Season
 47 at **Hermit Basin**, **Tower of Ra**, and **96 Mile Camp** Location Points. Percent Time Audible would range less
 48 than one percent to 16% of the day; a decrease of 74 to 97% from Alternative A. Average Sound Level would
 49 range 8 to 10 dBA, a decline from Alternative A of 32 to 37 dBA. Ten-Year Forecast, near **Eremita Mesa**
 50 Location Point, there would be a 50% decrease in air-tour aircraft Percent Time Audible compared to Alternative
 51 A. Air-tour aircraft Percent Time Audible would be 49% of the day at Average Sound Level of 22 dBA, a 28
 52 dBA decrease from Alternative A. There would be negligible to minor adverse impacts with long-term moderate
 53 to major beneficial change in impacts from Alternative A at these points.

54
 55 **Near Zuni Point Corridor** at **Grid Location Point 14** and **Temple Butte** Location Points, Percent Time
 56 Audible would be 57 to 66%, a decline of 8 to 10% compared to Alternative A with little change in air-tour

1 Average Sound Level. Air-tour aircraft visibility of from points on the ground would be the same as Base Year
 2 (1,038 and 1,591 meters). Moderate to major adverse impacts would occur; however, there would be a minor
 3 beneficial change in impacts at these points compared to Alternative A.

4
 5 At **The Basin** and **Grid Location Point 11** Location Points, impacts and level of beneficial change would be
 6 similar to Base Year Peak Season at Bright Angel Flight-free Zone Location Points. There would be negligible
 7 impacts in Bright Angel Flight-free Zone and in areas near Dragon Corridor, a long-term moderate to major
 8 beneficial change in impacts from Alternative A at these points.

9
 10 At **Grid Location Points 12 and 13**, change in aircraft Percent Time Audible, Average Sound Level, and
 11 visibility would be similar to Base Year Peak Season. Negligible impacts would occur with negligible change in
 12 impacts from Alternative A at these points.

13
 14 At **Toroweap/Shinumo Flight-free Zone, Grid Location Point 18** and **Pasture Wash** Location Points, Percent
 15 Time Audible would be one percent and 31% of the day, a decrease of 60 to 67% from Alternative A. Aircraft
 16 Average Sound Level would be 6 to 17 dBA, a 4 to 10 dBA decrease compared to Alternative A. Aircraft would
 17 be long Distances from points on the ground as in Base Year. There would be negligible to minor adverse
 18 impacts, a long-term moderate to major beneficial change in impacts compared to Alternative A at these points
 19 due to high reduction in Percent Time Audible.

20
 21 *East End*

Alternative E

Wilderness Character

22 *Base Year Off-Peak Season*

23 At areas near **Little Colorado River confluence** and **Nankoweap Mesa** Location Points, air-tour aircraft
 24 Percent Time Audible would be one percent or less, a decrease of 34 and 86% compared to Alternative A.
 25 Aircraft Average Sound Level would be 7 to 14 dBA, a decline of 29 to 36 dBA. When routes in Zuni Point
 26 Corridor are inactive Off-Peak Season, aircraft would not be visible from these areas. Air-tour aircraft would
 27 generally not be audible along the river in this area or at Nankoweap Mesa. Natural conditions in this area would
 28 be improved, and there would be greater opportunity to enjoy natural sights and sounds and experience solitude
 29 and unconfined recreation. Negligible impacts would occur, a long-term moderate to major beneficial change in
 30 impacts compared to Alternative A.

31
 32 At **locations close to the river**, represented by **Nankoweap River** Location Point, aircraft Average Sound Level
 33 would not be appreciably different from Base Year Peak Season. Air-tour aircraft would not be audible, and air-
 34 tour Average Sound Level would be 11 dBA, a 23 dBA decrease compared to Alternative A. Negligible impacts
 35 would occur, a long-term minor beneficial change in impact from Alternative A.

36
 37 When Dragon Corridor would be in use, in areas represented by **Hermit Basin, 96 Mile Camp, Point Sublime,**
 38 **Eremita Mesa,** and **Tower of Ra** Location Points, aircraft Percent Time Audible would be 26 to 93% of the day,
 39 a decrease of 7 to 46% from Alternative A. Aircraft Average Sound Level would be 23 to 46 dBA, 9 to 19 dBA
 40 less than Alternative A, except at Tower of Ra where Average Sound Level would increase by 2 dBA. Aircraft
 41 would be more Distant and less visible than in Alternative A at locations on the ground except at Tower of Ra.
 42 Natural conditions in Wilderness would be altered frequently by sights and sounds of air-tour aircraft, negatively
 43 affecting opportunities for solitude and primitive recreation. There would be moderate to major adverse impacts,
 44 with long-term minor to major beneficial change in impact from Alternative A at these points.

45
 46 When Zuni Point Corridor routes would not be in use, Percent Time Audible at **Grid Location Point 14** and
 47 **Temple Butte** Location Points would be one percent, substantially less (62 to 69%) than Alternative A. Aircraft
 48 Average Sound Level would be 6 to 7 dBA, a decrease of 27 to 32 dBA from Alternative A. Aircraft would be
 49 far less visible than in Alternative A at locations on the ground. Air-tour sounds would be rarely audible and at
 50 very low levels. Natural conditions and opportunities for solitude and unconfined recreation in Wilderness under
 51 Zuni Point Corridor routes Off-Peak Season would be substantially improved. Negligible impacts would occur, a
 52 long-term moderate to major beneficial change in impact from Alternative A.

53
 54 When air-tour routes would be active in Dragon Corridor, air-tour aircraft Percent Time Audible in areas **along**
 55 **North Rim** represented by **The Basin** Location Point, and along **Bright Angel Flight-free Zone western edge**,
 56 represented by **Grid Location Point 11**, would be 14 and 23% of the day; a 32 to 59% reduction compared to

1 Alternative A. Average Sound Level would be 7 to 12 dBA, a decrease of 6 to 41 dBA. Compared to Alternative
 2 A, there would be a substantial improvement in natural conditions and opportunities for solitude and unconfined
 3 recreation in Wilderness in Bright Angel Flight-free Zone and particularly along North Rim. Although minor to
 4 moderate adverse impacts would occur, there would be a long-term moderate to major beneficial change in
 5 impacts from Alternative A at these points.

6
 7 When Dragon Corridor routes would be in use, Percent Time Audible at **Grid Location Points 12 and 13** would
 8 be the same as Alternative A, one percent with aircraft Average Sound Level of 8 to 11 dBA, similar to
 9 Alternative A. When audible, aircraft noise would be at low levels. Air-tour aircraft would not be visible from
 10 locations on the ground. Adverse impacts would occur with negligible change in impacts from Alternative A at
 11 these points.

12
 13 When routes would be active in Dragon Corridor, aircraft Percent Time Audible at **Toroweap/Shinumo Flight-**
 14 **free Zone Grid Location Point 18** and **Pasture Wash** Location Points, would be 34 and 80%, a 19 to 26%
 15 decrease from Alternative A. Aircraft Average Sound Level of 11 to 20 dBA would be similar to Alternative A.
 16 Aircraft visibility would be similar to Alternative A when Dragon Corridor is in use, greater than 5,000 meters
 17 from locations on the ground. Reduction in aircraft noise would improve natural conditions and provide
 18 increased opportunity for solitude and primitive recreation. Although moderate to major adverse impacts would
 19 occur, there would be a long-term moderate beneficial change in impacts compared to Alternative A at these
 20 points due to high reduction in Percent Time Audible.

21
 22 *East End* *Alternative E* *Wilderness Character*
 23 *Ten-Year Forecast Off-Peak Season*

24 For **Little Colorado River** and **Nankoweap Mesa** Location Points, change in aircraft Percent Time Audible,
 25 Average Sound Level, and visibility would not be appreciably different from conditions Base Year Off-Peak
 26 Season. There would be negligible impacts, with long-term moderate to major beneficial change in impact
 27 compared to Alternative A.

28
 29 **At locations close to the river**, represented by **Nankoweap River** Location Point, change in aircraft Percent
 30 Time Audible, Average Sound Level, and visibility would not be appreciably different from Base Year Off-Peak
 31 Season. Negligible impacts would occur, a minor beneficial change in impacts compared to Alternative A.

32
 33 **At Hermit Basin, 96 Mile Camp, Point Sublime, Eremita Mesa, and Tower of Ra** Location Points, Percent
 34 Time Audible would be 17 to 78%; a decline of 21 to 67% from Alternative A. Aircraft Average Sound Level
 35 would range 18 to 44 dBA, a one to 24 dBA decrease. Although air-tour noise would still be present, reductions
 36 in noise compared to Alternative A would result in improvements to natural conditions in Wilderness and would
 37 increase opportunities for solitude with less frequent interruptions. These improvements would be substantial in
 38 areas where Percent Time Audible is greatly reduced, such as near Hermit Basin Location Point. Although
 39 moderate to major adverse impacts would continue, this would be a long-term minor to major beneficial change
 40 in impacts from Alternative A at these points.

41
 42 Impacts and level of beneficial change at **Grid Location 14** and **Temple Butte** Location Points would be similar
 43 to Base Year Off-Peak Season for Zuni Point Corridor points. Negligible impacts would occur, a long-term
 44 moderate to major beneficial change in impacts at these points from Alternative A.

45
 46 Change in aircraft Percent Time Audible, Average Sound Level, and visibility would be the same in **The Basin**
 47 and **Grid Location Point 11** as described Base Year Off-Peak Season for Bright Angel Flight-free Zone
 48 Location Points. Although minor to moderate adverse impacts would occur in Bright Angel Flight-free Zone and
 49 areas near Dragon Corridor, there would be a long-term moderate to major beneficial change in impacts from
 50 Alternative A at these points.

51
 52 Change in aircraft Percent Time Audible at **Grid Location Points 12 and 13**, Average Sound Level, and
 53 visibility would be similar to Base Year Off-Peak Season. Negligible impacts would occur with negligible
 54 change in impacts from Alternative A at these points.

1 Percent Time Audible at Toroweap/Shinumo Flight-free Zone **Grid Location Point 18** and **Pasture Wash**
 2 Location Points would be 5 and 31% of the day, a decrease of 55 to 67% from Alternative A due to conversion to
 3 quiet-technology aircraft. Aircraft Average Sound Level would be 9 to 18 dBA; a 3 to 7 dBA decrease compared
 4 to Alternative A. Aircraft would not be visible from points on the ground. The large reduction in air-tour aircraft
 5 Percent Time Audible would provide a high level of improvement to natural conditions in Toroweap/Shinumo
 6 Flight-free Zone, and more opportunities for solitude with much less frequent interruptions from aircraft noise.
 7 Negligible to moderate adverse impacts would occur, a long-term moderate to major beneficial change in
 8 impacts compared to Alternative A due to high reduction in Percent Time Audible.
 9

10 **Table 4.33 Alternative E Slant Distances East End**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)	Slant Distance (m)	Slant Distance (m)	
			Base Year	Δ
Little Colorado River/Nankoweap Area				
Little Colorado River	1,629	2,043	413	
Nankoweap Mesa	973	6,114	5,140	
Nankoweap River	1,449	9,063	7,615	
Dragon Corridor				
Hermit Basin	1,518	3,605	2,088	
96 Mile Camp	1,573	1,724	151	
Tower of Ra	1,147	511	-637	
Eremita Mesa	1,034	756	-277	
North Rim				
Grid Location Point 16	2,589	12,983	10,394	
The Basin	477	3,923	3,446	
Grid Location Point 6	6,935	732	-6,203	
Zuni Point Corridor				
Grid Location Point 14	687	1,591	904	
Grid Location Point 15	1,637	5,133	3,496	
Temple Butte	1,458	1,038	-420	
Bright Angel Flight-Free Zone				
Grid Location Point 11	8,081	6,862	-1,219	
Grid Location Point 12	9,014	11,236	2,222	
Grid Location Point 13	7,925	9,042	1,117	
Toroweap /Shinumo Flight-Free Zone				
Grid Location Point 18	8,449	6,672	-1,777	
Pasture Wash	5,532	10,990	5,458	
Point Sublime	3,760	3,760	0	
Grid Location Point 7	8,888	8,185	-703	
Bass Camp	13,358	13,358	0	
Rainbow Plateau	14,878	14,878	0	
Grid Location Point 10	2,931	2,931	0	
Outside the Park				
Saddle Mountain	1,716	14,912	13,196	

Δ indicates change in noise metric data from Alternative A

11
12
13

1 **Table 4.34 Alternative E Average Sound Level East End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Little Colorado River/Nankoweap Area																				
Little Colorado River	34	37	43	43	36	2	30	-8	39	-4	34	-8	0	-34	0	-37	7	-36	7	-36
Nankoweap Mesa	87	90	43	43	78	-9	45	-45	23	-20	19	-24	1	-86	2	-88	14	-29	15	-28
Nankoweap at River	7	8	34	35	0	-7	0	-8	12	-23	12	-23	0	-7	0	-8	11	-23	12	-23
Dragon Corridor																				
Hermit Basin	99	100	42	42	13	-87	16	-83	10	-32	10	-32	71	-28	32	-67	23	-19	18	-24
96 Mile Camp	72	74	45	45	0	-71	0	-74	8	-37	8	-37	26	-46	17	-57	37	-7	34	-11
Tower of Ra	97	98	44	45	1	-96	1	-97	8	-36	8	-37	61	-36	49	-49	46	2	44	-1
Eremita Mesa	100	100	49	49	67	-33	49	-50	21	-29	22	-29	93	-7	78	-21	41	-9	38	-12
North Rim																				
Grid Location Point 16	80	84	33	34	17	-63	23	-61	12	-21	12	-21	17	-63	27	-57	12	-21	13	-21
The Basin	73	75	48	48	1	-72	1	-74	5	-42	5	-43	14	-59	1	-74	7	-41	6	-42
Grid Location Point 6	52	56	19	20	0	-52	0	-56	3	-16	3	-16	1	-51	0	-56	3	-17	4	-16
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	81	11	66	-8	39	-5	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	34	-31	11	-58	18	-10	16	-13	1	-64	1	-68	14	-15	14	-14
Temple Butte	62	66	37	38	75	12	57	-10	38	1	35	-2	1	-62	1	-66	6	-32	6	-32
Bright Angel Flight Free Zone																				
Grid Location Point 11	55	56	18	18	6	4	8	49	9	-9	9	-9	23	-32	16	-41	12	-6	11	-7
Grid Location Point 12	1	1	13	14	0	0	1	0	12	-1	12	-2	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	0	0	0	10	-2	9	-4	1	0	1	0	8	-4	8	-5
Toroweap/Shinumo Flight Free Zone																				
Grid Location Point 18	60	60	16	17	1	59	1	-60	6	-10	6	-10	34	-26	5	-55	11	-5	9	-7
Pasture Wash	98	98	20	21	28	-70	31	-67	16	-5	17	-4	80	-19	31	-67	20	-1	18	-3
Point Sublime	100	100	35	35	46	-54	29	-71	16	-20	17	-18	89	-11	63	-37	29	-6	25	-11
Grid Location Point 7	1	1	7	8	0	-1	0	-1	2	-5	3	-5	0	-1	0	-1	2	-5	4	-4
Bass Camp	0	0	7	7	0	0	0	0	0	-7	1	-7	0	0	0	0	3	-4	1	-6
Rainbow Plateau	0	0	6	7	0	0	0	0	2	-4	3	-4	0	0	0	0	3	-3	4	-3
Grid Location Point 10	92	92	25	25	0	-92	0	-92	9	-16	10	-15	44	-48	0	-92	19	-6	14	-11
Outside the Park																				
Saddle Mountain	51	53	37	37	1	-50	1	-53	13	-24	10	-27	1	-50	1	-53	6	-30	7	-30

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

2

1 **Central** **Alternative E** **Wilderness Character**

2
3 Based on modeled noise results there would be little change in impacts from Alternative A as the Central area would
4 remain relatively quiet with Average Sound Level generally less than 10 dBA and aircraft Percent Time Audible less
5 than 5%.

6
7 Tables 4.35 and 4.36 present Slant Distances and Average Sound Level for Central area Location Points. Similar to
8 Alternative A, Wilderness Character throughout most of the Central area and adjacent to the park would be least
9 affected by aircraft noise.

10
11 *Central* *Alternative E* *Wilderness Character*
12 *Base Year Peak Season*

13 When Dragon Corridor air-tour routes would not be in use, **Central Area** aircraft Percent Time Audible would
14 be zero to 13%, a decrease of zero to 17% from Alternative A. Aircraft Average Sound Level would range zero
15 to 15 dBA, similar to Alternative A. Wilderness natural conditions and primitive solitude would be improved
16 slightly compared to Alternative A. Air-tour aircraft Percent Time Audible would be infrequent at low levels.
17 Air-tour aircraft would be greater than 7,000 meters from locations on the ground. Negligible to minor adverse
18 impacts would occur, a long-term negligible to moderate beneficial change in impacts due to modest reduction in
19 air-tour aircraft Percent Time Audible from Alternative A.

20
21 *Central* *Alternative E* *Wilderness Character*
22 *Ten-Year Forecast Peak Season*

23 **Central Area** impacts and level of beneficial change would generally be similar to Base Year Peak Season,
24 except for **Tuweep** Location Point where Percent Time Audible decreases 5 to 19% Base Year to Ten-Year
25 Forecast. Negligible to minor adverse impacts would occur, a long-term negligible to moderate beneficial change
26 in impacts due to modest reduction in Percent Time Audible from Alternative A at these points.

27
28 *Central* *Alternative E* *Wilderness Character*
29 *Base Year Off-Peak Season*

30 When air-tour routes in Dragon Corridor would be in use, **Central Area** Percent Time Audible would range zero
31 to 25%, with highest level of increase compared to Alternative A (13%) occurring at **Tuweep** Location Point due
32 to an increase in operations on Brown-6. In most of the Central area however, air-tour aircraft Percent Time
33 Audible would be reduced up to 17%. Aircraft Average Sound Level of zero to 16 dBA would occur similar to
34 Alternative A. Air-tour aircraft would be very far away from locations on the ground. In most of the Central area
35 there would be little disruption from natural conditions or opportunities for solitude, although toward
36 Toroweap/Shinumo Flight-free Zone's western edge, Wilderness opportunities would be more frequently
37 interrupted with low-level aircraft noise. Negligible to moderate impacts would occur in most of the Central area,
38 a long-term minor to moderate beneficial change in impacts from Alternative A. At Tuweep, there would be a
39 long-term moderate adverse impact with a minor to moderate adverse change in impacts compared to Alternative A.

40
41 *Central* *Alternative E* *Wilderness Character*
42 *Ten-Year Forecast Off-Peak Season*

43 **Central Area**, air-tour aircraft Percent Time Audible would range less than one to 2%, a decrease of up to 17%
44 compared to Alternative A. Aircraft Average Sound Level of zero to 17 dBA would occur similar to Alternative
45 A. Air-tour aircraft would be very far from locations on the ground. Natural conditions and opportunities for
46 solitude would rarely be interrupted due to sounds of air-tour aircraft. Negligible impacts would occur, a long-
47 term minor to moderate beneficial change in impacts from Alternative A due to modest reduction in aircraft
48 Percent Time Audible.

1 **Table 4.35** **Alternative E** **Slant Distances** **Central**

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
The Dome	13,109	13,109	0
Tuweep (GC009)	8,688	8,688	0
Tuweep (GC010)	14,322	14,322	0
Hancock Knolls	30,162	30,162	0
1 km W of Kanab Point	18,850	18,850	0
Grid Location Point 8	13,765	14,603	838
Grid Location Point 9	11,103	19,384	8,281
Grid Location Point 20	22,053	22,053	0
Grid Location Point 21	20,393	20,393	0
Grid Location Point 22	26,089	26,089	0
Grid Location Point 23	29,326	29,326	0
Grid Location Point 24	21,073	21,073	0
Grid Location Point 25	20,188	20,188	0
Havasu Point	10,450	10,450	0
Kanab Point	19,021	19,021	0
Mt. Sinyala	7,272	7,272	0
Stone Creek	21,882	24,475	2,593
Surprise Valley	25,500	26,216	716
Toroweap Overlook	9,625	9,625	0
Upper Deer Creek	23,683	24,049	366

Δ indicates change in noise metric data from Alternative A

2

DRAFT
Not Finalized
FOIA Discretionary Release

1 **Table 4.36 Alternative E Average Sound Level Central**

Location Name	Alternative A				Alternative E															
	Time Audible (%)		Equivalent Sound Level		Peak Season								Off-peak Season							
					Time Audible (%)				Equivalent Sound Level (dBA)				Time Audible (%)				Equivalent Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
The Dome	1	1	16	16	1	0	1	0	12	-4	12	-4	1	0	1	0	12	-4	13	-3
Tuweep (GC009)	12	14	15	16	13	1	0	-14	15	1	16	1	25	13	0	-14	16	1	17	2
Tuweep (GC010)	15	17	11	11	5	-10	0	-17	8	-3	9	-2	8	-7	0	-17	9	-2	10	-1
Hancock Knolls	2	2	10	10	2	0	2	0	9	-1	9	-1	2	0	2	0	9	0	10	0
1 km W of Kanab Point	2	2	9	9	2	0	2	0	6	-2	7	-2	2	0	2	0	7	-2	7	-2
Grid Location Point 8	3	3	10	10	1	-2	1	-2	9	-1	10	0	-1	1	-2	10	1	11	1	
Grid Location Point 9	1	1	5	5	1	0	1	0	3	-2	3	-2	1	0	1	0	4	-1	3	-2
Grid Location Point 20	0	0	4	4	0	0	0	0	4	0	4	0	0	0	0	0	4	0	4	0
Grid Location Point 21	2	2	14	14	2	0	2	0	13	-1	14	-1	2	0	2	0	14	-1	14	-1
Grid Location Point 22	18	21	12	13	1	-17	1	-19	8	-4	9	-4	1	-17	1	-19	9	-3	9	-3
Grid Location Point 23	2	2	10	10	2	0	2	0	9	-1	9	-1	2	0	2	0	9	-1	9	-1
Grid Location Point 24	3	4	8	8	2	-2	2	-2	5	3	6	-2	2	-2	2	-2	5	-3	6	-2
Grid Location Point 25	11	12	9	10	2	-9	2	-10	7	3	7	-3	2	-9	2	-10	7	-3	7	-3
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	1	8	1	1	0	1	0	7	1	8	2	
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	2	1	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Toroweap Overlook	0	0	15	14	0	0	0	0	14	1	15	1	0	0	0	0	15	2	16	2
Upper Deer Creek	1	1	1	1	1	0	1	0	0	-1	0	-1	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates ten-year forecast

2
 3
 4

1 **WEST END** **ALTERNATIVE E** **WILDERNESS CHARACTER**

2
3 West End air-tour routes near Blue-2 and Green-4 would have localized, long-term major adverse impacts as aircraft
4 Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%, similar to
5 Alternative A. For areas near Blue Direct routes, area of audibility would be reduced by approximately 50% due to
6 the short distance the route travels over the park resulting in substantial beneficial effects on proposed Wilderness
7 West End.

8
9 Tables 4.37 and 4.38 present Distances and Average Sound Level for specific West End locations. Location Points
10 represented by **Burnt Springs Canyon**, **Bat Cave**, and **Grid Location Point 33** would continue to be under Green-
11 4 and Blue-2 routes, as in Alternative A.

12
13 *West End* *Alternative E* *Wilderness Character*
14 *Base Year Peak Season*

15 At points **under Green-4 and Blue-2**, Percent Time Audible would range 70 to 92%, representing a one to 7%
16 decrease from Alternative A. Air-tour aircraft Average Sound Level would be the same as Alternative A and
17 range 42 to 47 dBA. Distance would be the same as Alternative A with aircraft 1,100 to 1,200 meters away.
18 Sights and sounds of air-tour aircraft would alter Wilderness Characteristics large portions of the day, affecting
19 natural conditions and opportunities for solitude. Major adverse conditions would occur with negligible to minor
20 beneficial change in impacts from Alternative A.

21
22 At **Whitmore Rapids** and **Parashant Wash** Location Points air-tour aircraft Percent Time Audible would be
23 20% of the day and Average Sound Level of 28 dBA. Percent Time Audible would be 8% higher compared to
24 Alternative A, and Average Sound Level would be 7 dBA higher. Air-tour aircraft would be at Distances greater
25 than 2,000 meters from points on the ground. Wilderness impacts would be slightly greater than Alternative A
26 due to the Blue Direct North route shift. Moderate adverse impacts would occur with minor adverse change in
27 impacts from Alternative A.

28
29 Blue Direct North would be shifted away from the most noise sensitive West End Wilderness lands. Therefore,
30 noise impacts would decrease compared to Alternative A. With elimination of Blue Direct South, some flights
31 would move outside the SFRA and some may shift to Blue Direct North. **Areas under and near relocated Blue**
32 **Direct North** would experience air-tour aircraft noise with Average Sound Level 40 to 50 dBA, similar to
33 Alternative A levels. Areas further from routes would experience Average Sound Level less than 25 dBA. Long-
34 term minor to major impacts would occur with negligible change in impacts from Alternative A.

35
36 **Grid Location Point 28** was closer to Blue Direct North and South routes under Alternative A. Since those
37 routes are moved away from Setup Flight-free Zone, Percent Time Audible would be 5%, a 9% decrease from
38 Alternative A and Average Sound Level 16 dBA, similar to Alternative A. Distances from aircraft to points on
39 the ground would be more than 2,000 meters. Air-tour aircraft would be rarely audible in areas closer to the river.
40 Wilderness would continue minimally altered by air-tour aircraft sights and sounds with minimal improvement in
41 natural conditions and opportunities for solitude compared to Alternative A. Although minor adverse impacts
42 would occur, there would be long-term minor beneficial change in impacts from Alternative A due to reduction
43 in aircraft Percent Time Audible.

44
45 *West End* *Alternative E* *Wilderness Character*
46 *Ten-Year Forecast Peak Season*

47 At points **under Green-4 and Blue-2**, Percent Time Audible would decline to 53 to 84%, a 12 to 13% decrease
48 from Alternative A at **Bat Cave** and **Burnt Springs Canyon** Location Points, and a 37% decrease from
49 Alternative A at **Grid Location Point 33**. Average Sound Level would be similar to Alternative A. Although
50 moderate to major adverse impacts would occur, there would be moderate beneficial change in impacts from
51 Alternative A due to greater reduction in Percent Time Audible.

52
53 Impacts would not notably change at **Whitmore Rapids** and **Parashant Wash** Location Points. Change in
54 Percent Time Audible, Average Sound Level, and Distance would be similar to Base Year Peak Season.
55 Moderate adverse impacts would occur with minor adverse change in impacts from Alternative A.

1 At **Grid Location Point 28**, Percent Time Audible would decline to 3% of the day, a 13% decrease compared to
 2 Alternative A. Average Sound Level and aircraft Distance would be similar to Alternative A. Negligible to minor
 3 adverse impacts would occur, a minor to moderate long-term beneficial change in impacts from Alternative A
 4 due to higher level reduction in aircraft Percent Time Audible.
 5

6 *West End* *Alternative E* *Wilderness Character*
 7 *Base Year Off-Peak Season*

8 At points **under Green-4 and Blue-2**, Percent Time Audible would be 76 to 96%, a 2 to 6% increase from
 9 Alternative A. Air-tour aircraft Average Sound Level would be similar to Alternative A, ranging 43 to 48 dBA.
 10 Sights and sounds of air-tour aircraft would alter Wilderness Character in the area large portions of the day,
 11 affecting natural conditions and opportunities for solitude. Major adverse impacts would occur with negligible to
 12 minor adverse change in impacts from Alternative A.
 13

14 At **Whitmore Rapids and Parashant Wash** Location Points, air-tour aircraft Percent Time Audible would be
 15 24% of the day and Average Sound Level 30 dBA. Aircraft Percent Time Audible would be 12% higher
 16 compared to Alternative A, and Average Sound Level would be 9 dBA higher. Air-tour aircraft would be at
 17 Distances greater than 2,000 meters from points on the ground. Wilderness impacts would be slightly greater
 18 than in Alternative A due to the Blue Direct North shift. Moderate to major adverse impacts would occur with
 19 long-term minor adverse change in impacts from Alternative A.
 20

21 Impacts **near Blue Direct** would be similar to Base Year Peak Season. Minor to major adverse impacts would
 22 occur with negligible change in impacts compared to alternative A.
 23

24 Change in aircraft Percent Time Audible, Average Sound Level, and Distance at **Grid Location Point 28** would
 25 be the same as Base Year Peak Season. Minor adverse impacts would occur with a long-term minor beneficial
 26 change in impacts from Alternative A.
 27

28 *West End* *Alternative E* *Wilderness Character*
 29 *Ten-Year Forecast Off-Peak Season*

30 Percent Time Audible would range 61 to 88%, decreasing 8 to 29% from Alternative A. Air-tour aircraft
 31 Average Sound Level would be 38 to 46 dBA, decreasing up to 5 dBA from Alternative A at **Bat Cave and Grid**
 32 **Location Point 33** Location Points. Near **Burnt Springs Canyon** Location Point air-tour Average Sound Level
 33 would increase to 44 dBA, a 5 dBA decrease from Alternative A. Visibility would continue the same as
 34 Alternative A. Minor adverse impacts would occur with negligible to moderate beneficial change in impacts
 35 from Alternative A due to reduction in Percent Time Audible.
 36

37 Change in aircraft Percent Time Audible, Average Sound Level, and visibility at **Whitmore Rapids and**
 38 **Parashant Wash** Location Points would be similar to Base Year Off-Peak Season. Moderate to major adverse
 39 conditions would occur with long-term minor adverse change in impacts from Alternative A.
 40

41 Change in aircraft Percent Time Audible, Average Sound Level, and visibility in **Grid Location Point 28** would
 42 be the same as Ten-Year Forecast Peak Season. Negligible to minor adverse conditions would occur with long-
 43 term minor to moderate beneficial change in impacts from Alternative A
 44

45 **NPS Units in SFRA Outside GCNP** **Alternative E** **Wilderness Character**

46
 47 Based on modeled noise results for **Wilderness directly under or within five miles of Blue Direct routes**
 48 (proposed wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument),
 49 impacts would be moderate to major adverse with negligible change in impacts compared to Alternative A. Average
 50 Sound Level would be 40 to 50 dBA with high levels of aircraft Percent Time Audible similar to current Blue Direct
 51 North and South Routes under Alternative A. Alternative E quiet-technology incentives and conversion
 52 requirements would provide some mitigation to these long-term adverse impacts with a decrease in size of affected
 53 areas Base Year to Ten-Year Forecast.
 54

55 Also, with Alternative E's changes to Blue Direct route locations, most aircraft on current Blue Direct North and
 56 South routes are expected to travel in the National Airspace System north of the SFRA's northern boundary in the

1 West End before/after crossing the SFRA on relocated Blue Direct North at Andrus Canyon. This would result in
 2 moving flights and associated noise and visual impacts from more sensitive **proposed wilderness lands in Lake**
 3 **Mead National Recreation Area and Grand Canyon-Parashant National Monument** under Alternative A, to
 4 less sensitive areas in those management units under Alternative E, areas where management objectives include
 5 fewer expectations of natural quiet and solitude.

6
 7 **Table 4.37 Alternative E Slant Distances West End**

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,134	1,134	0
Grid Location Point 33	1,105	1,105	0
Whitmore Rapids	1,804	2,512	708
Grid Location Point 28	8,327	21,438	13,111
Grid Location Point 32	2,016	18,618	16,602
Diamond Creek	27,108	10,814	-16,294
Separation Canyon	16,020	16,020	0
Granite Gorge	2,397	1,687	-709
Grid Location Point 29	9,306	11,492	2,187
Grid Location Point 30	2,008	2,008	0
Grid Location Point 34	28,206	11,732	-16,474
Granite Peak	5,264	16,588	11,324
Kelly Point	20,278	20,184	-94
Jackson Canyon	5,610	5,640	30
Parashant Wash	2,862	6,359	3,507
Pumpkin Springs	22,630	22,337	9,707
Peach Spring Canyon South	42,795	4,541	-38,254
Sanup	1,820	3,923	2,103
Separation Canyon, 1 km N of Colorado River	15,819	15,790	-29
Separation Canyon at Colorado River	16,377	16,329	-49
Suicide Point	2,093	13,927	11,834
Three Springs	14,750	20,663	5,913
Twin Point	3,347	6,213	2,867
West End	1,688	1,688	0

Δ indicates change in noise metric data from Alternative A

1 **Table 4.38 Alternative E Average Sound Level West End**

Location Point Name	Alternative E																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	70	-1	62	-13	46	0	43	-4	76	6	67	-9	47	1	44	-3
Bat Cave	93	95	47	48	92	-1	84	-12	47	0	46	-2	96	3	88	-8	48	0	46	-2
Grid Location Point 33	87	90	42	43	80	-7	53	-37	42	0	37	-6	89	2	61	-29	43	1	38	-5
Whitmore Rapids	12	13	21	21	20	8	21	8	28	7	28	6	24	12	25	12	30	9	28	7
Grid Location Point 28	14	16	17	18	5	-9	3	-13	16	-1	17	-1	5	-9	3	-13	16	-1	17	-1
Grid Location Point 32	44	49	27	28	4	-40	5	-43	21	-6	22	-6	4	-40	5	-43	21	-6	22	-6
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	7	1	1
Separation Canyon	0	1	9	9	0	0	1	0	9	0	9	0	0	1	0	0	9	0	9	0
Granite Gorge	58	63	34	35	57	-1	48	-14	34	0	32	-2	63	5	50	-12	35	1	33	-2
Grid Location Point 29	7	8	12	13	7	0	4	-3	12	0	13	1	11	4	6	-2	13	1	13	0
Grid Location Point 30	39	42	28	28	38	-1	13	-29	28	0	26	-5	53	15	16	-26	31	3	25	-3
Grid Location Point 34	0	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	4	2	2	1
Granite Peak	2	2	17	18	2	0	2	0	15	-2	16	-2	2	0	2	0	15	-2	16	-2
Kelly Point	1	1	10	10	1	0	1	0	10	0	10	0	4	3	1	0	10	1	10	0
Jackson Canyon	18	20	24	25	18	0	5	-15	24	0	23	-2	26	9	8	-12	26	2	25	0
Parashant Wash	12	14	33	33	11	-1	14	1	23	-8	24	-9	14	2	18	4	27	-6	25	-8
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	0	0	0	0	0	7	0	8	0
Peach Spring Canyon South	NA	NA	0	0	NA	NA	NA	NA	0	0	0	0	NA	NA	NA	NA	17	17	10	10
Sanup	79	83	38	38	64	15	26	-57	26	-12	20	-18	75	-4	28	-54	27	-11	21	-18
Separation Canyon, 1km N of Colorado River	1	1	8	8	1	0	1	0	8	0	8	0	1	0	1	0	8	0	8	0
Separation Canyon at Colorado River	0	0	7	7	0	0	0	0	7	0	7	0	0	0	0	0	7	0	7	0
Suicide Point	15	17	22	23	8	-11	4	-13	20	-2	21	-2	3	-11	4	-13	20	-2	21	-2
Three Springs	1	2	8	9	0	0	2	0	8	-1	8	-1	2	0	2	0	8	-1	8	-1
Twin Point	19	22	23	23	14	-6	6	-16	21	-1	22	-2	21	2	8	-15	22	0	22	-2
West End	58	63	39	40	51	-7	29	-34	39	0	35	-5	61	3	36	-27	40	1	36	-4

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

2

1 **Cumulative Impacts** **Alternative E** **Wilderness Character**

2
3 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
4 *actions. In this context, Cumulative Impacts include impacts on Soundscape from sounds of*

- 5 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
6 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
7 *3) ground-based noise sources, plus*
8 *4) noise from air-tour-and-related aircraft under Alternative E*
9

10 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 (Alternative E).*

11
12 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
13 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
14 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
15 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
16 *SFRA see Appendix D, Figures 91 to 94).*

17
18 *Noise from ground-based sources includes vehicles, building noise, machinery, and electronics, also impacts*
19 *Soundscape, but is mostly concentrated in the Developed Zone (2% of the park), although a small component*
20 *exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
21 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
22 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
23 *Audible capable of masking some aircraft noise.*

24
25 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
26 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
27 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
28 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
29 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
30 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
31 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
32 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
33 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
34 *park and SFRA; there are no areas in GCNP where the natural Soundscape is not adversely affected by aircraft*
35 *noise some of the time.*

36
37 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
38 *(Alternative E compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
39 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
40 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
41 *(Alternative E in this case).*

42
43 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
44 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
45 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
46 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
47 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
48 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
49 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
50 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

51
52 *Comparing noise impacts from just Alternative E by itself (Appendix D Tables 16 (Peak Season) and 21 (Off-*
53 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative E plus 1 plus 2) (Appendix D Tables 49 (Peak*
54 *Season) and 53 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*
55 *Cumulative Impacts and the impacts of Alternative E by itself. For the Proposed Wilderness Zone Cumulative*
56 *Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day*

1 *in 84 to 85% of the Zone, with Average Sound Level 25 to <35 dBA in 91 to 93% of the Zone, with 1% of the*
 2 *Zone below 25 dBA and 7% at 35 dBA or more. For the Proposed Wilderness Zone results for Alternative E by*
 3 *itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 3 to 4% of*
 4 *the Zone, with Average Sound Level 25 to <35 dBA in 5 to 6% of the Zone, with 79 to 81% of the Zone below 25*
 5 *dBA and 5 to 6% at 35 dBA or more.*

6
 7 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 8 *including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour*
 9 *routes; (b) Cumulative Impacts increase impacts of Alternative, and (c) reducing air-tour-and-related impacts*
 10 *under the Alternatives reduces Cumulative Impacts.*

11
 12 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 13 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 14 *Alternative (route locations/number/altitudes/quiet technology conversion, etc.). When added to noise impacts of*
 15 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 16 *described for Alternative E would generally increase by one level as shown in the Cumulative Impacts discussion*
 17 *in the Conclusions section below.*

18
 19 **Conclusion** **Alternative E** **Wilderness Character**

20
 21 Alternative E would result in beneficial changes in impacts to Wilderness Character compared with Alternative A
 22 due to reduced amount of area exposed to high Percent Time Audible and high Average Sound Level for long
 23 periods of the day. Natural conditions would be improved and opportunities for solitude and primitive recreation
 24 would increase. The majority of Wilderness would have air-tour aircraft noise audible less than 5% of the day and
 25 Average Sound Level less than 15 dBA Base Year and Ten-Year Forecast. Because Alternative E includes quiet-
 26 technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year
 27 Forecast. Beneficial change in impacts from Alternative A would be seen in both Percent Time Audible and
 28 Average Sound Level.

29
 30 *Conclusion Marble Canyon* *Alternative E* *Wilderness Character*

31 All Scenarios, Alternative E would result in sights and sounds of air-tour aircraft that would have negligible impacts
 32 on Marble Canyon Wilderness Character, with negligible to minor long-term beneficial change in impacts in GCNP
 33 compared with Alternative A, and moderate to major beneficial change in impacts in Saddle Mountain and Paria
 34 Canyon-Vermilion Cliffs Wilderness Areas compared to Alternative A.

35
 36 *Conclusion East End* *Alternative E* *Wilderness Character*

37 Base Year and Ten-Year Forecast, when air-tour routes would be inactive under Dragon and Zuni Point Corridors,
 38 and across North Rim, there would be long-term negligible to minor adverse impacts with moderate to major
 39 beneficial change in impacts compared to Alternative A. At locations under Dragon Corridor Off-Peak Season when
 40 air-tour routes would be active, there would be moderate to major adverse impacts from high Percent Time Audible;
 41 however, there would be long-term minor to major beneficial change in impacts compared to Alternative A. At
 42 locations under Zuni Point Corridor Peak Season when routes would be active, there would be moderate to major
 43 adverse impacts with a minor adverse change in impacts compared to Alternative A Base Year, but Ten-Year
 44 Forecast impacts would be reduced resulting in minor beneficial change in impacts compared to Alternative A. At
 45 Location Points away from tour routes in Bright Angel Flight-free Zone and Toroweap/Shinumo Flight-Free Zone's
 46 eastern portion, there would be negligible to minor adverse impacts with moderate to major beneficial change in
 47 impacts compared to Alternative A both Peak and Off-Peak Season.

48
 49 *Conclusion Central* *Alternative E* *Wilderness Character*

50 Alternative E would result in negligible to minor adverse impacts to Wilderness Character Peak and Off-Peak
 51 Season; however, there would be a long-term negligible to moderate beneficial change in impacts compared to
 52 Alternative A at most Central area Location Points.

53
 54 *Conclusion West End* *Alternative E* *Wilderness Character*

55 In West End's northern area under Green-4, Blue-2, and Blue Direct North, Alternative E would result in moderate
 56 to major adverse impacts; however, there would be moderate beneficial change in impacts from Alternative A.

Moderate adverse impacts with minor adverse change in impacts compared to Alternative A would result at Location Points near Brown routes and Whitmore Rapids Location Point due to changes in Blue Direct routes.

NPS Units in SFRA Outside GCNP *Alternative E* *Wilderness Character*
 Long-term moderate to major adverse impacts would continue in proposed Wilderness in Grand Canyon-Parashant National Monument as a result of the reconfiguration of Blue Direct North route, but flights would move to less sensitive areas due to the reconfiguration providing moderate adverse change in impacts in northern portions where flights shift to, and moderate to major beneficial change in impacts in southern portions of that proposed Wilderness where flights shift from.

Cumulative Impacts Summary ***Alternative E*** ***Wilderness Character***

As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four park sections (Marble Canyon, East end, Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of flight-free zones. In comparison with the other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts followed by Modified NPS Preferred Alternative and Alternative F (Alternative A ranks last).

ALTERNATIVE F **MODIFIED CURRENT CONDITIONS** **WILDERNESS CHARACTER**

Alternative F represents the least change from current conditions. It includes seasonal route scheduling, modifies Blue Direct Routes, and contains quiet-technology routes and incentives.

Marble Canyon **Alternative F** **Wilderness Character**

Marble Canyon routes and Base Year impacts would be the same as Alternative A. However, due to Alternative F quiet-technology incentives and conversion requirements, there would be a slight improvement in Wilderness Character over time compared to Alternative A. The area would remain relatively quiet and Wilderness natural conditions and opportunities for solitude or primitive and unconfined recreation would be improved to a small degree. Tables 4.39 and 4.40 present Percent Time Audible, Distance, and Average Sound Level for Marble Canyon Location Points.

Routes in Marble Canyon and associated noise and visual impacts on Saddle Mountain Wilderness and Paria Canyon-Vermilion Cliffs Wilderness would result in negligible to minor adverse impacts and negligible change in impacts from Alternative A in Base Year and Ten-Year Forecast under Alternative F.

Marble Canyon *Alternative F* *Wilderness Character*
Base Year and Ten-Year Forecast Peak Season

In Marble Canyon and adjacent Wilderness outside the park, effects of air-tour aircraft noise in Alternative F would be the same as Alternative A. Negligible to minor adverse impacts would occur with negligible change in impacts from Alternative A.

Marble Canyon *Alternative F* *Wilderness Character*
Base Year and Ten-Year Forecast Off-Peak Season

Conditions would be similar but with noise slightly reduced compared to Peak Season. As represented by **North and South Canyon** Location Points, with reduced operations Off-Peak Season, aircraft would rarely be audible, less than one percent of the day. There would be slight reduction in air-tour aircraft visibility; and aircraft Average Sound Level would be reduced to zero, a decrease of 21 and 24 dBA compared to Alternative A. Negligible impacts would occur with long-term negligible to minor beneficial change in impacts to Wilderness Character compared to Alternative A.

1 **Table 4.39 Alternative F Slant Distances Marble Canyon**

Location Point Name	Alternative A		Alternative F	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
North Canyon	999		999	0
South Canyon	816		822	7
Cliff Dwellers Lodge	3,695		3,695	0
Grid Location Point 2	858		858	0
Grid Location Point 3	2,958		2,958	0
Grid Location Point 5	2,335		2,335	0
Marble Canyon Dam Site	3,845		3,846	1

Δ indicates the change in noise metric data from Alternative A

2
3
4

Table 4.40 Alternative F Average Sound Level Marble Canyon

Location Point Name	Alternative A				Alternative F															
	Time Audible (%)		Equivalent Sound Level		Peak Season								Off Peak Season							
					Time Audible (%)				Equivalent Sound Level (dBA)				Time Audible (%)				Equivalent Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
North Canyon	3	3	24	25	3	0	3	0	24	0	24	-1	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	2	0	2	0	21	0	21	-2	0	-2	0	-2	0	-21	0	-23
Cliff Dwellers Lodge	1	1	6	10	1	0	1	0	6	0	6	-3	0	-1	0	-1	0	-6	0	-10
Grid Location Point 2	2	3	16	19	2	0	2	0	16	0	17	-3	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	4	16	3	0	3	0	14	0	15	-1	1	-2	1	-2	7	-8	7	-9
Grid Location Point 5	2	2	8	12	2	0	2	0	8	0	8	-4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	3	0	2	-1	0	0	0	0	0	-3	0	-4

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

5

1 **East End** **Alternative F** **Wilderness Character**

2
3 Modifications to East End air-tour routes would be small, resulting in impacts similar to Alternative A. Near air-tour
4 routes, aircraft Average Sound Level would be 40 to 50 dBA and Percent Time Audible would be greater than 75%.
5 The seven-mile Dragon Corridor Off-Peak Season shift would essentially shift impacts west seven miles. Beneficial
6 effects to East End's middle and east side would be a 20 to 40% reduction in Percent Time Audible from Alternative
7 A. Due to quiet-technology incentives and conversion requirements in Alternative F, additional beneficial impacts
8 would be expected in both Percent Time Audible and Average Sound Level. Tables 4.41 and 4.42 present Percent
9 Time Audible, Distance, and Average Sound Level for East End Location Points.

10
11 *East End* *Alternative F* *Wilderness Character*
12 *Base Year Peak Season*

13 As represented by **Little Colorado River** confluence and **Nankoweap Mesa** Location Points effects of aircraft
14 noise would be the same as Alternative A. Air-tour sounds would continue to be experienced frequently
15 throughout the day resulting in adverse impacts. Long-term moderate to major adverse impacts would occur and
16 conditions would not be appreciably different from Alternative A.

17
18 Close to the river, as represented by the **Nankoweap River** Location Point, Peak Season conditions would
19 continue the same as in Alternative A, with air-tour aircraft Percent Time Audible 7% of the day and Average
20 Sound Level 34 dBA, minor to moderate adverse impacts with negligible change from Alternative A.

21
22 Impacts would occur at **Saddle Mountain Wilderness Area** the same as Alternative A. Air-tour aircraft Percent
23 Time Audible would be 51% of the day at intermediate Average Sound Level of 37 dBA. Major adverse impacts
24 would occur with no appreciable change in sound conditions or Slant Distance compared to Alternative A.

25
26 Impacts **along North Rim** as represented by **Grid Location Point 16** would be similar to Alternative A with air-
27 tour aircraft Percent Time Audible 84% of the day at Average Sound Level of 33 dBA. Aircraft would be
28 approximately 2,500 meters from locations on the ground. Natural conditions of Wilderness would frequently be
29 altered at intermediate levels of noise, and opportunities for solitude reduced. Major adverse impacts would
30 occur with negligible change in impacts from Alternative A.

31
32 **Beneath Zuni Point Corridor** effects of air-tour aircraft would not be appreciably different from Alternative A.
33 Air-tour aircraft Percent Time Audible would be 62 to 70%, Average Sound Level would be 28 to 37 dBA, and
34 aircraft would be 687 meters to about 1,600 meters from locations on the ground. Air-tour aircraft sights and
35 sounds would frequently alter Wilderness naturalness and opportunities for solitude under these routes. Moderate
36 to major adverse impacts would occur with negligible change in impacts from Alternative A.

37
38 **Beneath Dragon Corridor** effects of air-tour aircraft would be similar to Alternative A. As shown by Location
39 Points **Eremita Mesa**, **Hermit Basin**, **96 Mile Camp**, and **Tower of Ra**, air-tour aircraft Percent Time Audible
40 would be 72 to 100% of the day, and Average Sound Level would be 42 to 49 dBA. Natural Wilderness
41 conditions would be frequently altered with very limited opportunities for solitude or primitive recreation.
42 Aircraft would be visible similar to Alternative A except at Tower of Ra and Eremita Mesa where they would be
43 293 and 677 meters closer to points on the ground compared to Alternative A. Moderate to major adverse effects
44 would occur with a negligible to minor change in adverse impacts compared to Alternative A.

45
46 **Beneath Bright Angel Flight-free Zone** effects of air-tour aircraft would be similar to Alternative A. **Grid**
47 **Location Points 12 and 13** would have air-tour aircraft Percent Time Audible one percent of the day, with
48 Average Sound Level 12 to 13 dBA. Aircraft would be at Distances greater than 2,000 meters. Air-tour aircraft
49 would be rarely audible at relatively low sound levels in Bright Angel Flight-free Zone. There would be
50 negligible impacts with negligible change in impacts compared to Alternative A.

51
52 **Grid Location Point 11** would have aircraft Percent Time Audible about 60% of the day at Average Sound
53 Level of 18 dBA Peak Season similar to Alternative A. Aircraft would be visible at Distances much greater than
54 2,000 meters. Moderate to major adverse impacts would occur with negligible change in impacts from
55 Alternative A.

1 At the eastern edge of **Toroweap/Shinumo Flight-Free Zone**, at **Grid Location Points 7 and 18, Rainbow**
 2 **Plateau, Bass Camp, and Pasture Wash** Location Points effects of aircraft would be similar or slightly greater
 3 than Alternative A. Air-tour aircraft Percent Time Audible would be one percent or less of the day at locations
 4 further west of routes with Average Sound Level of 7 to 8 dBA. Closer to routes, air-tour aircraft Percent Time
 5 Audible would be 60 to 100% of the day, with Average Sound Level 16 to 35 dBA. Air-tour aircraft would be
 6 much closer to locations on the ground compared to Alternative A (except Pasture Wash). Moderate to major
 7 adverse impacts would occur with negligible change in impacts compared to Alternative A.
 8

9 *East End* *Alternative F* *Wilderness Character*
 10 *Ten-Year Forecast Peak Season*

11 Percent Time Audible at **Little Colorado River** confluence and **Nankoweap Mesa** Location Points would
 12 decline to 25% and 68%, respectively, a 12% and 20% decrease from Alternative A. Air-tour aircraft Average
 13 Sound Level would range 37 to 39 dBA, slightly decreased from Alternative A. Moderate to major adverse
 14 impacts would occur with long-term moderate beneficial change in impacts from Alternative A at these points
 15 due to reduction in air-tour aircraft Percent Time Audible.
 16

17 At **Nankoweap River** Location Point, there would be little change from Base Year Peak Season. Natural
 18 conditions would be slightly improved, and opportunities for solitude and primitive recreation would slightly
 19 increase. There would be minor to moderate adverse impacts with negligible change from Alternative A.
 20

21 At **Saddle Mountain** Location Point, Percent Time Audible would decline to 20%, a 33% decrease from
 22 Alternative A. Air-tour Average Sound Level would be similar to Alternative A. Moderate to major adverse
 23 impacts would occur with moderate to major beneficial change in impacts compared to Alternative A due to high
 24 reduction in Percent Time Audible.
 25

26 Air-tour aircraft along **North Rim at Grid Location Point 16** Percent Time Audible would be 42% of the day, a
 27 decrease of 42% from Alternative A. Aircraft Average Sound Level would be 24 dBA, a 9 dBA decrease
 28 compared to Alternative A. Aircraft would continue to be approximately 2,500 meters from areas on the ground.
 29 Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts
 30 compared to Alternative A.
 31

32 Percent Time Audible in **Zuni Point Corridor** area would decline to 41 to 53%, a decrease of 21 to 28% from
 33 Alternative A. Aircraft Average Sound Level would be 24 to 31 dBA, declining 4 to 7 dBA from Alternative A.
 34 Aircraft would be visible the same as described Base Year. There would be modest improvement in natural
 35 conditions and opportunities for solitude as a result of decline in aircraft Percent Time Audible. Moderate to
 36 major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to
 37 Alternative A.
 38

39 Percent Time Audible in **Dragon Corridor** would range 47 to 98%, a decrease of 2 to 27% compared to
 40 Alternative A. Air-tour Average Sound Level would continue similar to Alternative A, ranging 37 to 46 dBA, a
 41 decrease of 3 to 5% compared to Alternative A. Aircraft would be visible as for Base Year. Major adverse
 42 impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due
 43 to decrease in Percent Time Audible.
 44

45 Impacts at **Grid Location Points 12 and 13** would not be appreciably different from Alternative A for **Bright**
 46 **Angel Flight-free Zone** points. Negligible impacts would occur with negligible change in impacts from
 47 Alternative A.
 48

49 Percent Time Audible at **Grid Location Point 11** would decline to 10%, a 45% decrease from Alternative A,
 50 with Average Sound Level at 12 dBA, a 7 dBA decrease from Alternative A. Natural conditions and
 51 opportunities for solitude would be greatly improved in this area. Minor adverse impacts would occur, a
 52 moderate to major beneficial change in impacts compared to Alternative A due the high level of reduction in
 53 Percent Time Audible.
 54

55 Percent Time Audible at **Grid Location Point 18 and Pasture Wash** Location Points would decline to 14 to
 56 20%, a 46 to 78% decrease from Alternative A. There would be little change in aircraft Average Sound Level or

1 Distance of aircraft to Pasture Wash, but distance at Grid Location Point 18 would greatly decrease compared to
 2 Alternative A. Natural conditions and opportunities for solitude would be greatly improved due to the large
 3 decline in air-tour Percent Time Audible. Moderate adverse impacts would occur, a long-term moderate to major
 4 beneficial change in impacts compared to Alternative A due to the large decrease in Percent Time Audible.
 5

6 *East End* *Alternative F* *Wilderness Character*
 7 *Base Year Off-Peak Season*

8 Effects of aircraft near **Little Colorado River** and **Nankoweap Mesa** Location Points would be less than Peak
 9 Season and Alternative A. Aircraft Percent Time Audible would be 17 to 53% of the day, a 17 to 34% decrease
 10 from Alternative A. Aircraft Average Sound Level would be 29 to 38 dBA, a 5 to 14 dBA decrease from
 11 Alternative A. Natural conditions would be improved, and opportunities for solitude and primitive recreation
 12 would be increased with less frequent interruptions by aircraft. Moderate to major adverse impacts would occur,
 13 a moderate to major beneficial change in impacts from Alternative A due to a large reduction in air-tour aircraft
 14 Percent Time Audible.
 15

16 At **Saddle Mountain** Location Point, aircraft Average Sound Level declines to 19 dBA, a decrease of 18 dBA
 17 compared to Alternative A, and Percent Time Audible would be 12% of the day, a 39% decrease from
 18 Alternative A. Minor to moderate adverse impacts from aircraft on Wilderness Character would occur, a long-
 19 term moderate to major beneficial change in impacts compared to Alternative A.
 20

21 When Dragon Corridor shifts Off-Peak Season, Percent Time Audible **along North Rim at Grid Location Point**
 22 **16** would decline to 37%, a 43% decrease from Alternative A. Aircraft Average Sound Level would decline to 15
 23 dBA, an 18 dBA decrease from Alternative A. Aircraft would no longer be visible from locations on the ground.
 24 Natural conditions would be improved and opportunities for solitude increased with less frequent interruptions of
 25 aircraft noise. Moderate to major adverse impacts would occur, a moderate to major beneficial change in impacts
 26 compared to Alternative A.
 27

28 Air-tour aircraft would be audible in **Zuni Point Corridor** area 33 to 43%, a 26 to 33% decrease from
 29 Alternative A. Aircraft Average Sound Level would range 30 to 38 dBA, a 6 dBA decrease and a 10 dBA
 30 increase respectively compared to Alternative A. Aircraft would be visible at Distances similar to Alternative A.
 31 There would be a substantial improvement in natural conditions and opportunities for solitude as a result of large
 32 decline in aircraft Percent Time Audible. Moderate to major adverse impacts would occur, a long-term moderate
 33 to major beneficial change in impacts compared to Alternative A.
 34

35 When Dragon Corridor shifts seven miles west, **at the three Dragon Corridor** Location Points except **Eremita**
 36 **Mesa**, air-tour aircraft would be audible less of the day in most locations ranging one percent to 60%, a decrease
 37 of 39 to 80% compared to Alternative A. Average Sound Level would be 13 to 23 dBA, a 19 to 31 dBA decline.
 38 Noise conditions at Eremita Mesa would continue at high levels and for the majority of the day (95% Percent
 39 Time Audible at 49 dBA). Natural conditions would be greatly improved in Off-Peak Season at locations under
 40 Dragon Corridor, and opportunities for solitude would increase substantially. Negligible to major adverse
 41 impacts would occur, a moderate to major beneficial change in impacts compared to Alternative A.
 42

43 **Bright Angel Flight-free Zone** would not be appreciably different for **Grid Location Points 12 and 13** from
 44 Base Year Peak Season. Negligible impacts would occur with negligible change in impacts from Alternative A.
 45

46 **Grid Location Point 11** would have air-tour aircraft Percent Time Audible less than Alternative A and about
 47 16% of the day, a 39% decrease from Alternative A. Average air-tour aircraft Average Sound Level would be 11
 48 dBA, 7 dBA less than Alternative A. Natural conditions would be greatly improved and there would be a large
 49 increase in opportunities for solitude. Minor to moderate adverse impacts would occur, a long-term moderate to
 50 major beneficial change in impacts compared to Alternative A.
 51

52 When Dragon Corridor moves west Off-Peak Season, aircraft Percent Time Audible at **Grid Location Point 18**
 53 and **Pasture Wash** Location Points would decline slightly in areas that are under routes Peak Season. Percent
 54 Time Audible would still remain relatively high at 57 to 90% of the day, a 3 to 8% decrease respectively in
 55 impacts from Alternative A. Aircraft Average Sound Level would range 25 to 39 dBA, a 5 to 23 dBA increase

1 compared to Alternative A. Moderate to major adverse impacts would occur, a long-term negligible to minor
2 beneficial change in impacts compared to Alternative A.

3
4 In areas represented by **Grid Location Point 7, Bass Camp**, and **Rainbow Plateau** Location Points, there
5 would be a 17 to 36% increase in Percent Time Audible and 7 to 26 dBA increase in Average Sound Level
6 compared to Alternative A. Distances from aircraft to points on the ground would be more than 2,000 meters.
7 Increase in aircraft Percent Time Audible and higher Average Sound Level would alter natural conditions and
8 opportunities for solitude and primitive recreation more frequently. Moderate to major adverse impacts would
9 occur with long-term moderate to major adverse change in impacts compared to Alternative A.

10
11 *East End* *Alternative F* *Wilderness Character*
12 *Ten-Year Forecast Off-Peak Season*

13 Percent Time Audible at **Nankoweap Mesa** Location Point would decline to 33%, a 57% decrease from
14 Alternative A. Aircraft Average Sound Level would be 25 dBA, a 18 dBA decrease from Alternative A. Aircraft
15 would continue to be visible at approximately 900 to 1,600 meters. Natural conditions in Wilderness would be
16 improved, and there would be a large increase in opportunities for solitude and primitive recreation. Moderate to
17 major adverse impacts would occur, a long-term moderate to major beneficial change in impacts from
18 Alternative A due to reduction in Percent Time Audible.

19
20 Percent Time Audible at **Saddle Mountain** Location Point would decline further to 2%, a 51% reduction
21 compared to Alternative A. Air-tour aircraft Average Sound Level would decline to 15 dBA, a 22 dBA decrease
22 from Alternative A. Distance of aircraft from points on the ground would be the same as Alternative A (1,716
23 meters). With a substantial reduction in air-tour aircraft Percent Time Audible and Average Sound Level,
24 negligible impacts from aircraft on Wilderness Character would occur, a long-term moderate to major beneficial
25 change in impacts compared to Alternative A.

26
27 Percent Time Audible along North Rim at **Grid Location Point 16** would decline to 21%, a 63% decrease from
28 Alternative A, and air-tour aircraft Average Sound Level would decline to 13 dBA, a 21 dBA decrease compared
29 to Alternative A. Aircraft would be at Distances greater than 2,000 meters. Natural conditions would improve
30 and opportunities for solitude would increase with decreased aircraft Percent Time Audible. Moderate adverse
31 impacts would occur, a moderate to major beneficial change in impacts compared to Alternative A.

32
33 Sounds of air-tour aircraft would continue to decline in **Zuni Point Corridor**. Air-tour aircraft Percent Time
34 Audible would be 17 to 27% of the day, a decrease of 43 to 52% compared to Alternative A. Average Sound
35 Level would range 24 to 35 dBA, an 11 dBA decrease to a 6 dBA increase compared to Alternative A. Aircraft
36 would be visible at Distances similar to Alternative A. Natural conditions would be improved with increased
37 opportunities for solitude with much less frequent interruption from aircraft noise. Moderate adverse impacts
38 would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due to the
39 large reduction in Percent Time Audible.

40
41 Aircraft Percent Time Audible at **Dragon Corridor** Location Points would further decline to less than one
42 percent at **96 Mile Camp** Location Point, and 6 to 32% at **Tower of Ra** and **Hermit Basin** Location Points
43 respectively. Percent Time Audible would be 68% to 92% less than Alternative A. Aircraft Average Sound Level
44 would decline to 10 to 19 dBA, a decrease of 23 to 35 dBA from Alternative A. Noise conditions at **Eremita**
45 **Mesa** Location Point would continue at high levels (47 dBA) for the majority of the day (83%, a decrease of
46 17% from Alternative A). Aircraft Average Sound Level would decline to 47 dBA Ten-Year Forecast, a 2 dBA
47 decrease from Alternative A. Negligible to moderate adverse impacts would occur, a moderate to major
48 beneficial change in impacts compared to Alternative A.

49
50 At **Grid Location Points 12 and 13**, negligible impacts would occur with negligible change in impacts from
51 Alternative A.

52
53 At **Grid Location Point 11**, minor to moderate adverse impacts would occur, a long-term moderate to major
54 beneficial change in impacts compared to Alternative A.

At **Grid Location Point 18, Rainbow Plateau, and Pasture Wash** Location Points aircraft Percent Time Audible would range 2 to 58%, a 28 to 40% decrease from Alternative A. Average Sound Level would increase, ranging 10 to 35 dBA, a zero to 19 dBA increase from Alternative A. Given Percent Time Audible decrease and Average Sound Level increase, there would be negligible to major impacts with moderate beneficial change in impacts from Alternative A.

At **Grid Location Point 7 and Bass Camp** Location Points, Percent Time Audible would be 2 to 20%, an increase of 2 to 20% compared to Alternative A with Average Sound Level 7 to 29 dBA, an increase of up to 22 dBA from Alternative A. Distance from aircraft to points on the ground would be more than 2,000 meters. Impacts would be negligible to moderate adverse with negligible to moderate adverse changes in impacts compared to Alternative A.

Table 4.41 Alternative F Slant Distances East End

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Little Colorado River	1,629	1,629	0
Nankoweap Mesa	973	970	-3
Nankoweap River	1,449	1,448	0
Dragon Corridor			
Hermit Basin	1,518	1,656	139
96 Mile Camp	1,573	1,573	0
Tower of Ra	1,147	854	-293
Eremita Mesa	1,034	357	-677
North Rim			
Grid Location Point 16	2,589	2,575	-14
The Basin	477	489	13
Grid Location Point 6	6,935	6,946	11
Zuni Point Corridor			
Grid Location Point 14	687	687	0
Grid Location Point 15	1,637	1,636	-1
Temple Butte	1,458	1,458	0
Bright Angel Flight-Free Zone			
Grid Location Point 11	8,081	8,028	-53
Grid Location Point 12	9,014	9,014	0
Grid Location Point 13	7,925	7,925	0
Toroweap /Shinumo Flight-Free Zone			
Grid Location Point 18	8,449	1,341	-7,108
Pasture Wash	5,532	5,532	0
Point Sublime	3,760	3,609	-151
Grid Location Point 7	8,888	6,695	-2,193
Bass Camp	13,358	2,667	-10,691
Rainbow Plateau	14,878	3,294	-11,585
Grid Location Point 10	2,931	2,900	-31
Outside the Park			
Saddle Mountain	1,716	1,716	0

Δ indicates change in noise metric data from Alternative A

1 **Table 4.42 Alternative F Average Sound Level East End**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season				Average Sound Level (dBA)				Off Peak Season				Average Sound Level (dBA)			
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Little Colorado River/Nankoweap Area																				
Little Colorado River	34	37	43	43	34	0	25	-12	43	0	37	-6	17	-17	12	-26	38	-5	33	-10
Nankoweap Mesa	87	90	43	43	87	0	68	-22	43	0	39	-4	53	-34	33	-57	29	-14	25	-18
Nankoweap at River	7	8	34	35	7	0	5	-4	34	0	33	-2	0	-7	0	-8	20	-14	17	-18
Dragon Corridor																				
Hermit Basin	99	100	42	42	99	0	89	-11	42	0	37	-5	60	-39	32	-68	23	-19	19	-23
96 Mile Camp	72	74	45	45	72	0	47	-27	45	0	41	-4	1	-7	0	-74	13	-31	10	-35
Tower of Ra	97	98	44	45	97	0	90	-8	44	0	41	-4	17	-80	6	-92	15	-29	13	-32
Eremita Mesa	100	100	49	49	100	0	98	-2	49	0	46	-3	97	-5	83	-17	49	0	47	-2
North Rim																				
Grid Location Point 16	80	84	33	34	84	4	42	-42	33	0	24	-9	37	-43	21	-63	15	-18	13	-21
The Basin	73	75	48	48	73	0	40	-35	48	0	45	-3	26	-47	16	-60	30	-18	26	-22
Grid Location Point 6	52	56	19	20	52	0	31	-25	19	0	13	-7	12	-41	3	-53	8	-12	4	-15
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	70	0	53	-2	34	0	28	-7	43	-27	27	-47	30	-4	24	-10
Grid Location Point 15	65	69	28	29	65	0	41	-28	28	0	24	-4	33	-33	17	-52	38	10	35	6
Temple Butte	62	66	37	38	62	0	45	-22	37	0	31	-7	37	-26	23	-43	31	-6	27	-11
Bright Angel Flight Free Zone																				
Grid Location Point 11	55	56	18	18	60	5	10	-47	18	0	12	-7	16	-39	7	-49	11	-7	9	-9
Grid Location Point 12	1	1	13	14	1	0	1	0	13	0	12	-2	1	0	1	0	12	-1	12	-2
Grid Location Point 13	1	1	12	12	1	0	1	0	12	0	9	-4	1	0	1	0	9	-3	8	-4
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 18	60	60	16	17	60	0	14	-46	16	0	13	-4	57	-3	32	-28	39	23	35	19
Pasture Wash	98	98	20	21	99	0	20	-78	22	1	17	-3	90	-8	58	-40	25	5	20	0
Point Sublime	100	100	35	35	100	0	94	-6	35	0	30	-6	89	-10	24	-75	19	-16	17	-18
Grid Location Point 7	1	1	7	8	1	0	0	-1	8	1	6	-2	17	17	2	2	11	4	7	0
Bass Camp	0	0	7	7	0	0	0	0	7	0	2	-5	37	36	20	20	33	26	29	22
Rainbow Plateau	0	0	6	7	0	0	0	0	7	1	5	-1	24	24	2	2	13	7	10	4
Grid Location Point 10	92	92	25	25	92	0	0	-92	25	0	19	-6	66	-26	16	-77	32	7	29	4
Outside the Park																				
Saddle Mountain	51	53	37	37	51	0	20	-33	37	0	36	-2	12	-39	2	-51	19	-18	15	-22

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3

1 **Central** **Alternative F** **Wilderness Character**

2
3 In Central areas, there would be little change in impacts from Alternative A as the area would remain relatively quiet
4 with aircraft Average Sound Level generally less than 10 dBA and Percent Time Audible generally less than 5%.

5
6 Tables 4.43 and 4.44 present Slant Distances and Average Sound Level for Central area Location Points. Similar to
7 Alternative A, Wilderness Character throughout most of Central area would be the least affected by air-tour aircraft.

8
9 *Central* *Alternative F* *Wilderness Character*
10 *Base Year and Ten-Year Forecast Peak Season*

11 There would be negligible change as a result of aircraft noise compared to Alternative A for **most Central area**
12 **Location Points**. However, at **Grid Location Point 22**, air-tour aircraft Percent Time Audible would be one
13 percent of the day, a 17% decrease from Alternative A. Aircraft would be greater than 7,000 meters from
14 locations on the ground. Central area natural conditions would persist with little interruption by air-tour aircraft
15 sights and sounds. At most Central locations, negligible to minor adverse impacts would occur with negligible to
16 moderate beneficial change in impacts compared to Alternative A.

17
18 *Central* *Alternative F* *Wilderness Character*
19 *Base Year and Ten-Year Forecast Off-Peak Season*

20 At **Central area Location Points** Percent Time Audible would range less than one to 8% of the day, a decrease
21 of up to 17% from Alternative A. At **Grid Location Point 8** there would be an increase in Percent Time Audible
22 to 25%, a 23% increase from Alternative A. Aircraft Average Sound Level would be similar to Alternative A,
23 ranging less than one to 16 dBA. Negligible to moderate adverse impacts would occur with some Location Points
24 up to a moderate adverse change in impacts, and some Location Points up to a moderate beneficial change in
25 impacts compared to Alternative A.

26
27 **Table 4.43** **Alternative F** **Slant Distances** **Central**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)	Slant Distance (m)	Slant Distance (m)	
			Base Year	Δ
The Dome	13,109	13,109	0	
Tuweep	8,688	8,688	0	
Tuweep	14,322	14,322	0	
Hancock Knolls	30,162	30,162	0	
1 km W of Kanab Point	18,850	18,850	0	
Grid Location Point 8	13,765	13,765	0	
Grid Location Point 9	11,103	11,103	0	
Grid Location Point 20	22,053	22,053	0	
Grid Location Point 21	20,393	20,393	0	
Grid Location Point 22	26,089	26,089	0	
Grid Location Point 23	29,326	29,326	0	
Grid Location Point 24	21,073	21,073	0	
Grid Location Point 25	20,188	20,188	0	
Havasupai Point	10,450	10,450	0	
Kanab Point	19,021	19,021	0	
Mt. Sinyala	7,272	7,272	0	
Stone Creek	21,882	14,255	-7,627	
Surprise Valley	25,500	19,115	-6,385	
Toroweap Overlook	9,625	9,625	0	
Upper Deer Creek	23,683	20,930	-2,752	

Δ indicates change in noise metric data from Alternative A

1 **Table 4.44 Alternative F Average Sound Level Central**

Location Point Name	Alternative A				Alternative F															
	Time Audible (%)		Equivalent Sound Level		Peak Season								Off Peak Season							
					Time Audible (%)				Equivalent Sound Level (dBA)				Time Audible (%)				Equivalent Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
The Dome	1	1	16	16	1	0	1	0	13	-3	14	-2	1	0	1	0	12	-3	13	-3
Tuweep	12	14	15	16	12	0	21	7	19	4	22	6	8	-5	17	3	18	3	21	6
Tuweep	15	17	11	11	5	-10	11	-7	10	-1	12	1	4	-11	9	-8	9	-2	11	0
Hancock Knolls	2	2	10	10	2	0	2	0	10	0	10	0	2	0	2	0	9	0	10	0
1 km W of Kanab Point	2	2	9	9	2	0	2	0	8	-1	8	-1	2	0	2	0	7	-2	8	-1
Grid Location Point 8	3	3	10	10	4	1	1	-2	11	2	9	-1	23	3	0	10	0	10	0	
Grid Location Point 9	1	1	5	5	1	0	1	0	5	0	3	-2	1	0	1	0	6	1	4	-2
Grid Location Point 20	0	0	4	4	0	0	0	0	4	0	4	0	0	0	0	0	4	0	4	0
Grid Location Point 21	2	2	14	14	2	0	2	0	14	0	14	0	2	0	2	0	14	-1	14	0
Grid Location Point 22	18	21	12	13	1	-17	1	-19	10	-3	16	-3	1	-17	1	-19	8	-4	10	-3
Grid Location Point 23	2	2	10	10	2	0	2	0	10	0	10	0	2	0	2	0	9	-1	10	0
Grid Location Point 24	3	4	8	8	2	-2	2	-2	7	9	9	1	2	-2	2	-2	6	-2	8	0
Grid Location Point 25	11	12	9	10	2	-9	2	-10	7	3	7	-2	2	-9	2	-10	6	-3	7	-3
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	2	1	1	0	8	2	7	1	3	2	3	2	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Toroweap Overlook	0	0	13	14	0	0	0	0	17	4	20	6	0	0	0	0	16	3	19	6
Upper Deer Creek	1	1	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A

Forecast indicates ten-year forecast

2

1 **West End** **Alternative F** **Wilderness Character**

2
3 In West End's northern half, aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible
4 would be greater than 65% of the time. However, beneficial impacts to Soundscape would be provided for locations
5 where Green-4's southern portion would be eliminated and where Blue Direct South shifts to avoid Eagle and
6 Guano Points. Because Alternative F includes quiet-technology incentives and conversion requirements, impacts
7 would be mitigated as aircraft convert to quiet technology over time. Increased operations Ten-Year Forecast would
8 adversely affect Wilderness on West End's northeastern side. In West End's southern portion near Sanup Flight-free
9 Zone aircraft Average Sound Level would be 10 to 20 dBA with Percent Time Audible less than 20% of the time.

10
11 Tables 4.45 and 4.46 present Percent Time Audible, Distance, and Average Sound Level for West End Location
12 Points.

13
14 *West End* *Alternative F* *Wilderness Character*
15 *Base Year Peak Season and Off-Peak Season*

16 **Burnt Springs Canyon, Bat Cave, and Grid Location Point 33** Location Points would continue to be under
17 Green-4 and Blue-2 routes as in Alternative A. Percent Time Audible would range 75 to 85% of the day, a 4 to
18 12% decrease from Alternative A at Bat Cave and Grid Location Point 33 Location Points, and a 4% increase at
19 Burnt Springs Canyon Location Point. Average Sound Level would be 42 to 47 dBA, similar to Alternative A.
20 Air-tour aircraft would be about 900 to 1,200 meters from locations on the ground, similar to Alternative A.
21 Major adverse impacts would occur, a long-term minor beneficial change in impacts compared to Alternative A.

22
23 **Whitmore Rapids and Grid Location Point 28** Location Points would be affected by the shift in Blue Direct
24 North quiet-technology route. Percent Time Audible at Whitmore Rapids would be 9%, similar to Alternative A.
25 Aircraft Average Sound Level would increase to 33 dBA, a 12 dBA increase from Alternative A. At Grid
26 Location Point 28, Percent Time Audible would be 41% of the day, a 28% increase compared to Alternative A,
27 and Average Sound Level would increase slightly to 26 dBA. Natural conditions would be substantially altered
28 particularly at higher elevation locations where air-tour aircraft noise would be audible for large portions of the
29 day at intermediate sound levels. Minor to major adverse impacts would occur, a long-term minor to moderate
30 adverse change in impacts compared to Alternative A in locations near the river, and moderate adverse at higher
31 elevations.

32
33 *West End* *Alternative F* *Wilderness Character*
34 *Ten-Year Forecast Peak and Off-Peak Season*

35 At **Burnt Springs Canyon, Bat Cave, and Grid Location Point 33** Location Points, air-tour aircraft Percent
36 Time Audible would range 65 to 83% of the day, a 6 to 25% decrease compared to Alternative A. Average
37 Sound Level would be similar to Alternative A. Natural conditions would improve, in that air-tour aircraft
38 although relatively loud would be audible less frequently. Moderate to major adverse impacts would occur, a
39 long-term minor to moderate beneficial change in impacts compared to Alternative A due to reduction in Percent
40 Time Audible.

41
42 Near **Whitmore Rapids and Grid Location Point 28** Location Points, Percent Time Audible would increase to
43 16 and 52%, an increase of 4 and 38% compared to Alternative A. Average Sound Level and aircraft visibility
44 would not be appreciably different from Peak Season Base Year. Moderate to major adverse impacts would
45 occur with long-term minor to moderate adverse change in impacts compared to Alternative A.

46
47 **NPS Units in SFRA Outside GCNP** **Alternative F** **Wilderness Character**

48 Alternative F changes to Blue Direct routes to avoid Eagle and Guano Points would move locations of moderate to
49 major adverse impacts **under and within five miles of the routes** to proposed Wilderness lands in Lake Mead
50 National Recreation Area and Grand Canyon-Parashant National Monument to the south of where those impacts
51 occur in Alternative A. This would result in moving flights and associated noise and visual impacts to more sensitive
52 Wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument under
53 Alternative F, from slightly less sensitive Wilderness in those same management units under current routes in
54 Alternative A. Average Sound Level and Percent Time Audible would be reduced in some areas and increased in
55 others compared to Alternative A Base Year, ranging from moderate adverse changes in impacts to minor beneficial
56 changes in impacts compared to Alternative A. However, Ten-Year Forecast, Alternative F's quiet-technology

1 incentives and conversion requirements would reduce affected area size, resulting in changes in impacts ranging
 2 from minor adverse to minor beneficial compared to Alternative A.

3
 4
 5

Table 4.45 Alternative F Slant Distances West End

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,134	936	-198
Grid Location Point 33	1,105	1,123	18
Whitmore Rapids	1,804	1,804	0
Grid Location Point 28	8,327	3,336	-4,991
Grid Location Point 32	2,016	2,995	979
Diamond Creek	27,108	23,339	-3,769
Separation Canyon	16,020	14,496	-1,524
Granite Gorge	2,397	2,693	296
Grid Location Point 29	9,306	3,405	-5,901
Grid Location Point 30	2,008	2,110	101
Grid Location Point 34	28,206	29,335	4,871
Granite Peak	5,264	5,257	-7
Kelly Point	20,278	15,089	-5,189
Jackson Canyon	5,610	4,599	-1,011
Parashant Wash	2,832	4,190	1,338
Pumpkin Springs	12,630	12,622	-8
Peach Spring Canyon South	42,795	39,276	-3,519
Sanup	1,820	2,702	882
Separation Canyon, 1 km N of Colorado River	15,819	15,014	-804
Separation Canyon at Colorado River	16,377	16,130	-247
Suicide Point	2,093	1,275	-818
Three Springs	14,750	14,743	-7
Twin Point	3,347	1,245	-2,102
West End	1,688	1,496	-192

Δ indicates change in noise metric data from Alternative A

1 **Table 4.46 Alternative F Average Sound Level West End**
 2

Location Point Name	Alternative A				Alternative F															
	Time Audible (%)		Equivalent Sound Level		Peak Season								Off Peak Season							
					Time Audible (%)				Equivalent Sound Level (dBA)				Time Audible (%)				Equivalent Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Burnt Springs Canyon	70	75	46	47	75	4	69	-6	47	1	44	-3	73	2	66	-9	46	1	44	-3
Bat Cave	93	95	47	48	88	-5	83	-13	47	-1	46	-2	88	-5	81	-14	46	-1	45	-3
Grid Location Point 33	87	90	42	43	75	-12	65	-25	42	0	40	-3	77	-10	66	-24	43	1	40	-3
Whitmore Rapids	12	13	21	21	9	-3	16	2	33	12	37	15	5	-7	12	-1	32	11	36	14
Grid Location Point 28	14	16	17	18	41	28	52	36	26	9	28	10	25	47	31	25	8	28	10	
Grid Location Point 32	44	49	27	28	47	3	51	2	33	6	31	3	46	2	46	-2	34	7	31	3
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Separation Canyon	0	1	9	9	0	0	1	0	9	0	10	1	0	0	1	0	9	0	9	0
Granite Gorge	58	63	34	35	39	-19	37	-25	22	-12	21	-13	36	-22	32	-31	22	-12	21	-14
Grid Location Point 29	7	8	12	13	18	11	14	6	15	3	17	4	20	13	13	6	15	3	17	3
Grid Location Point 30	39	42	28	28	64	25	55	14	33	5	35	7	64	25	52	10	33	6	34	6
Grid Location Point 34	0	0	1	1	0	0	0	0	2	1	2	1	0	0	0	0	2	0	2	1
Granite Peak	2	2	17	18	21	19	17	15	28	12	27	9	22	20	16	14	29	12	27	9
Kelly Point	1	1	10	10	1	0	1	0	10	0	10	0	1	0	1	0	10	0	10	0
Jackson Canyon	18	20	24	25	26	9	17	-3	26	2	27	3	27	9	17	-3	26	2	27	3
Parashant Wash	12	14	33	33	7	5	11	-3	23	-10	26	-8	8	-4	9	-5	23	-10	25	-8
Pumpkin Springs	0	0	7	8	0	0	0	0	9	2	10	2	0	0	0	0	9	2	9	2
Peach Spring Canyon South	NA	NA	0	0	NA	NA	NA	NA	0	0	0	0	NA	NA	NA	NA	0	0	0	0
Sanup	79	83	38	38	62	-17	54	-29	34	-3	34	-4	64	-15	52	-31	36	-2	34	-5
Separation Canyon, 1km N of Colorado River	1	1	8	8	1	0	1	0	9	1	9	1	1	0	1	0	9	1	9	1
Separation Canyon at Colorado River	0	0	7	7	0	0	0	0	8	1	8	1	0	0	0	0	8	1	8	1
Suicide Point	15	17	22	23	44	30	48	31	40	18	37	14	44	29	43	26	41	20	36	14
Three Springs	1	2	8	9	13	12	9	7	15	6	13	4	14	12	8	7	14	6	13	4
Twin Point	19	22	23	23	53	33	54	32	40	18	38	14	55	35	49	27	42	19	37	14
West End	58	63	39	40	41	-17	29	-34	39	0	36	-4	43	-15	30	-33	39	0	37	-3

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

1 **Cumulative Impacts** **Alternative F** **Wilderness Character**

2
3 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
4 *actions. In this context, Cumulative Impacts include impacts on Soundscape from sounds of*

- 5 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
6 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
7 *3) ground-based noise sources, plus*
8 *4) noise from air-tour-and-related aircraft under Alternative F*
9

10 *That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 (Alternative F).*

11
12 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
13 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
14 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
15 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
16 *SFRA see Appendix D, Figures 91 to 94).*

17
18 *Noise from ground-based sources includes vehicles, building noise, machinery, and electronics, also impacts*
19 *Soundscape, but is mostly concentrated in the Developed Zone (2% of the park), although a small component*
20 *exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
21 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
22 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
23 *Audible capable of masking some aircraft noise.*

24
25 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
26 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
27 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
28 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
29 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
30 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
31 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
32 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
33 *Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the*
34 *park and SFRA; there are no areas in GCNP where the natural Soundscape is not adversely affected by aircraft*
35 *noise some of the time.*

36
37 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
38 *(Alternative F compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
39 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
40 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
41 *(Alternative F in this case).*

42
43 *Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in*
44 *Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season),*
45 *noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone,*
46 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
47 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
48 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
49 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
50 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

51
52 *Comparing noise impacts from just Alternative F by itself (Appendix D Tables 26 (Peak Season) and 31 (Off-*
53 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative F plus 1 plus 2) (Appendix D Tables 57 (Peak*
54 *Season) and 61 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*
55 *Cumulative Impacts and the impacts of Alternative F by itself. For the Proposed Wilderness Zone Cumulative*
56 *Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day*

1 *in 89 to 90% of the Zone, with Average Sound Level 25 to <35 dBA in 83 to 86% of the Zone, with 1% of the*
 2 *Zone below 25 dBA and 13 to 15% at 35 dBA or more. For the Proposed Wilderness Zone results for Alternative*
 3 *F by itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to*
 4 *10% of the Zone, with Average Sound Level 25 to <35 dBA in 14% of the Zone, with 68 to 70% of the Zone below*
 5 *25 dBA and 10 to 13% at 35 dBA or more.*

6
 7 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 8 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
 9 *routes; (b) Cumulative Impacts increase impacts of Alternative, and (c) reducing air-tour-and-related impacts*
 10 *under the Alternatives reduces Cumulative Impacts.*

11
 12 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 13 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 14 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 15 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 16 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts discussion*
 17 *in the Conclusions section below.*

18
 19 **Conclusion** **Alternative F** **Wilderness Character**

20
 21 Base Year Alternative F would generally result in negligible changes in impacts compared with Alternative A, but
 22 with quiet-technology incentives and conversion requirements, noise impacts would decrease Ten-Year Forecast.
 23 Alternative F would result in decreased opportunities for solitude and natural conditions altered in nearly half of the
 24 proposed Wilderness in the park, but Wilderness Character would improve over time. Base Year, nearly 50% of
 25 proposed Wilderness would have air-tour aircraft Percent Time Audible greater than 25% of the day predominantly
 26 in East and West Ends. Ten-Year Forecast Percent Time Audible would decrease, and the majority of Wilderness
 27 would experience air-tour aircraft Percent Time Audible less than 10% of the day. Average air-tour Average Sound
 28 Level would generally be low, less than 25 dBA. The greatest exposure to noise and visual impacts would occur in
 29 East and West Ends where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would
 30 be greater than 75% of the time. In Marble Canyon, Central areas, and West End's southern portions, Wilderness
 31 would be least impacted by air-tour operations as aircraft Average Sound Level would generally be less than 15
 32 dBA with Percent Time Audible less than 5%.

33
 34 *Conclusion Marble Canyon* *Alternative F* *Wilderness Character*
 35 Alternative F would result in no notable change in impacts from Alternative A, Base Year and Ten-Year Forecast.
 36 Off-Peak Season impacts would be reduced in Marble Canyon's southern part, resulting in a long-term negligible to
 37 minor beneficial change in impacts from Alternative A.

38
 39 *Conclusion East End* *Alternative F* *Wilderness Character*
 40 Base Year Peak Season, there would be no appreciable change in moderate to major adverse impacts from
 41 Alternative A at Location Points near the Little Colorado River confluence, Nankoweap Mesa, Saddle Mountain,
 42 and over North Rim. However, Ten-Year Forecast, although moderate to major adverse impacts would continue,
 43 there would be a long-term moderate to major beneficial change in impacts from Alternative A, with even greater
 44 reductions in impacts Off-Peak Season when Dragon Corridor would shift west.

45
 46 Impacts at Nankoweap River Location Point would continue to be minor adverse similar to Alternative A Peak and
 47 Off-Peak Season.

48
 49 Under Zuni Point Corridor, Base Year Peak Season, there would be moderate to major adverse impacts with
 50 negligible change in impacts from Alternative A. However, Base Year Off-Peak Season and Ten-Year Forecast Peak
 51 Season, although moderate to major adverse impacts would continue under the routes, there would be long-term
 52 moderate to major beneficial change in impacts compared to Alternative A due to a large decline in Percent Time
 53 Audible.

54
 55 Under Dragon Corridor, there would be moderate to major adverse impacts with negligible to minor change in
 56 impacts compared to Alternative A Base Year Peak Season. Off-Peak Season moderate to major adverse impacts

1 would shift seven miles west, and there would be long-term moderate to major beneficial change in impacts
 2 compared to Alternative A in areas where the Corridor was shifted from. Impacts would be reduced Ten-Year
 3 Forecast due to conversion to quiet-technology aircraft.
 4

5 Under Bright Angel Flight-Free Zone and areas away from air-tour routes, negligible to minor adverse impacts from
 6 air-tour aircraft would continue with negligible to major beneficial change in impacts compared to Alternative A.
 7

8 *Conclusion Central Alternative F Wilderness Character*

9 Alternative F would result in negligible to minor adverse impacts with negligible to moderate beneficial change in
 10 impacts to Wilderness Character compared to Alternative A at most Central area Location Points All Scenarios.
 11 However, Off-Peak Season some points closer to the shifted Dragon Corridor would experience up to moderate
 12 adverse impacts with up to moderate adverse change in impacts compared to Alternative A.
 13

14 *Conclusion West End Alternative F Wilderness Character*

15 Base Year and Ten-Year Forecast, Alternative F would result in moderate to major adverse impacts at Location
 16 Points under Green-4, Blue-2, and Blue Direct South, with up to moderate adverse change in impacts to moderate
 17 beneficial change in impacts to Wilderness Character compared to Alternative A, depending on location. Near
 18 Whitmore Rapids under Brown routes, there would be minor to major adverse impacts with up to moderate adverse
 19 to moderate beneficial change in impacts compared to Alternative A as a result of changes in configuration of Blue
 20 Direct North. In West End's southern portion away from air-tour routes, there would be negligible to minor adverse
 21 impacts with moderate adverse to moderate beneficial change from Alternative A, depending on location.
 22

23 *Cumulative Impacts Summary Alternative F Wilderness Character*

24 *As described in more detail in the Cumulative Impacts section above, Cumulative impacts would tend to increase*
 25 *impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts in*
 26 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 27 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 28 *and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison with the*
 29 *other Alternatives, Alternative F ranks third in lowest overall Cumulative Impacts behind Alternative E and the*
 30 *Modified NPS Preferred Alternative (Alternative A ranks last).
 31*

32 **MODIFIED NPS PREFERRED ALTERNATIVE WILDERNESS CHARACTER**

33
 34 Overall the *Modified* NPS Preferred Alternative would result in a beneficial change in impacts from Alternative A in
 35 Wilderness Character due to route changes, *Off-Peak Season closure of Zuni Point Corridor and North Rim*
 36 *routes*, and quiet-technology incentives and requirements.
 37

38 **Marble Canyon Modified NPS Preferred Alternative Wilderness Character**

39
 40 Marble Canyon *routes and the Narrows loop would be eliminated resulting* in air-tour aircraft Percent Time
 41 Audible less than 2% of the *day* and Average Sound Level less than 15 dBA. In Marble Canyon, there would
 42 *generally be negligible to minor adverse impacts with negligible to minor beneficial changes in impacts to*
 43 Wilderness Character compared to Alternative A as air-tour aircraft Average Sound Level would be low and rarely
 44 audible. Tables 4.47 and 4.48 present Slant Distance and Average Sound Level for Marble Canyon Location Points.
 45

46 *Marble Canyon Modified NPS Preferred Alternative Wilderness Character*

47 *All Scenarios*

48 In the park and adjacent Wilderness outside the park, impacts at representative **Marble Canyon Location Points**
 49 would be *negligible*, similar to Alternative A. However, aircraft Percent Time Audible would be generally less
 50 than Alternative A, 3% or less, and Average Sound Level would generally be zero to 13 dBA, a decrease of 3 to
 51 25 dBA compared to Alternative A. In most areas, aircraft would be much farther away from locations on the
 52 ground, ranging from approximately 18,000 to 60,000 meters and would not be visible from points on the
 53 ground. Improvements over Alternative A would occur at all Marble Canyon Location Points *due to removal of*
 54 *Marble Canyon air-tour routes*. This would result in aircraft sights and sounds that would have negligible
 55 impacts on natural conditions and opportunities for solitude or primitive and unconfined recreation; a negligible
 56 to minor long-term beneficial change in impacts compared with Alternative A.

Table 4.47 Modified NPS Preferred Alternative Slant Distances Marble Canyon

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669
Cliff Dwellers Lodge	3,695	56,620	52,925
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	53,548	50,590
Grid Location Point 5	2,335	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428

Δ indicates change in noise metric data from Alternative A

Table 4.48 Modified NPS Preferred Alternative Average Sound Level Marble Canyon

Location Point Name	Alternative A		Modified Preferred Alternative																	
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore-cast	Base Year	Fore-cast	Base Year	Δ	Fore-cast	Δ	Base Year	Δ	Fore-cast	Δ	Base Year	Δ	Fore-cast	Δ	Base Year	Δ	Fore-cast	Δ
North Canyon	3	3	24	25	0	-3	0	-3	2	-22	1	-24	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	-2	0	-3	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23	
Cliff Dwellers Lodge	1	1	8	10	0	1	-1	1	-5	0	-10	0	-1	0	-1	0	-6	0	-10	
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9	1	-2	1	-2	7	-8	7	-8
Grid Location Point 5	2	2	8	12	0	-2	0	-2	1	-7	0	-12	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

1 **East End** *Modified NPS Preferred Alternative* **Wilderness Character**

2
3 Beneficial effects to East End Wilderness, due to **1) seasonal closure** of Zuni Point Corridor short-loop routes **and**
4 **long-loop routes over North Rim, 2) elimination of the Nankoweap loop and movement of routes west of the Little**
5 **Colorado River confluence, and 3) the Dragon Corridor dogleg** are clearly seen in modeled results. Peak Season
6 impacts would be major adverse **under and near heavily used air-tour** routes with aircraft Average Sound Level 40
7 to 50 dBA and Percent Time Audible greater than 75% of the time **Peak Season**. Creation of a short-loop fixed-
8 wing route in Dragon Corridor would result in localized increases in aircraft audibility. **In areas away from Dragon**
9 **Corridor** there would be **major** beneficial change in impacts particularly in areas near **Zuni Point Corridor Off-Peak**
10 **Season** compared to Alternative A. East End as a whole would benefit from the additional one-hour curfew. Tables
11 4.49 and 4.50 present Percent Time Audible, Distances, and Average Sound Level for East End Location Points.

12
13 *East End* *Modified NPS Preferred Alternative* *Wilderness Character*
14 *Base Year Peak Season*

15 Noise conditions and effects on Wilderness near **Little Colorado River** and **Nankoweap River** Location Points
16 would improve compared to Alternative A, with adjustment of Black-1 and Green-1 routes away from the Little
17 Colorado River confluence. Air-tour aircraft Percent Time Audible would be less than one to 7%, a 7 to 27%
18 decrease from Alternative A. Aircraft Average Sound Level would be 15 to 26 dBA, a decrease of 17 to 19 dBA
19 compared to Alternative A. Aircraft would be farther than 2,000 meters from points on the ground. Negligible to
20 minor adverse impacts would occur, a long-term minor to major beneficial change in impacts compared to
21 Alternative A.

22
23 **Nankoweap Mesa** Location Point would be farther from Black-1 and Green-1 than in Alternative A, and aircraft
24 would be much less visible from points on the ground (**more than 5,000 meters greater distance**). Air-tour
25 aircraft Percent Time Audible would be 76% of the day (11% less than Alternative A) at Average Sound Level
26 of 31 dBA (12 dBA less than Alternative A). Aircraft sights and sounds would have moderate to major adverse
27 impacts on Wilderness Character, **and** there would be minor beneficial change in impacts from Alternative A.

28
29 **Outside park boundaries, because Marble Canyon routes would be eliminated, at Saddle Mountain**
30 Wilderness Area Location Point, impacts on Wilderness Character would be less than Alternative A Peak and
31 Off-Peak Season. Aircraft Percent Time Audible would be 37%, a decrease from Alternative A of 14%. Aircraft
32 Average Sound Level would be 22 dBA, a 15 dBA decrease from Alternative A. Aircraft would be much farther
33 from points on the ground than in Alternative A (**more than 4,800 meters further**). There would be modest
34 improvements in natural condition of Wilderness and greater opportunity for primitive recreation with fewer
35 interruptions. **Minor to moderate** adverse impacts would occur with long-term moderate beneficial change in
36 impacts compared to Alternative A.

37
38 **Across North Rim**, represented by **Grid Location Point 16**, there would be less impact from air-tour aircraft
39 than Alternative A. Air-tour aircraft Percent Time Audible would be 54%, a 26% decrease from Alternative A.
40 Aircraft Average Sound Level would be similar to Alternative A at 32 dBA. Aircraft would be greater than 2,000
41 meters from points on the ground. Moderate to major adverse impacts would occur, a long-term moderate to
42 major beneficial change in impacts compared to Alternative A, due to high reduction in aircraft Percent Time
43 Audible.

44
45 Beneath and near Dragon Corridor routes Base Year Peak Season, represented by Location Points **Hermit Basin,**
46 **Tower of Ra, 96 Mile Camp, Point Sublime, Eremita Mesa, and Grid Location Point 11,** air-tour aircraft
47 Percent Time Audible would be 50 to 100%, a decrease of up to 13% compared to Alternative A. Aircraft
48 Average Sound Level would be 20 to 42 dBA, a 2 dBA increase to a 22 dBA decrease **compared to Alternative**
49 **A**. In most areas, aircraft would be greater than 3,000 meters from the ground except at Tower of Ra where
50 aircraft would be at approximately 1,600 meters. Although there would be slight improvements in Wilderness
51 Character, natural conditions would be altered due to high level of Percent Time Audible. **Moderate to major**
52 adverse impacts would occur with negligible to minor beneficial change in impacts compared to Alternative A.

53
54 Beneath **Zuni Point Corridor** routes Base Year Peak Season, at areas represented by Location Points **Temple**
55 **Butte and Grid Location Points 14 and 15** air-tour aircraft Percent Time Audible would be 54 to 62%, an 8 to
56 9% decrease from Alternative A. Aircraft Average Sound Level would be 37 to 39 dBA, a zero to 10 dBA

1 increase from Alternative A. Aircraft would be visible from 1,300 meters to greater than 2,300 meters from
 2 points on the ground. Natural Wilderness conditions and opportunities for solitude would be altered by high
 3 levels of air-tour aircraft noise. Major adverse impacts would occur with mixed results ranging from *negligible*
 4 *to* minor beneficial change in impacts compared to Alternative A.
 5

6 Beneath **Bright Angel Flight-free Zone**, effects of air-tour aircraft would generally be similar to Alternative A.
 7 At areas represented by **Grid Location Points 12 and 13**, air-tour aircraft Percent Time Audible would be one to
 8 2% of the day, aircraft Average Sound Level would be **12 to 13** dBA, and aircraft would be greater than **7,000**
 9 meters from points on the ground. Negligible impacts from air-tour aircraft on Wilderness Character would occur
 10 with negligible change in impacts compared to Alternative A.
 11

12 **Toroweap/Shinumo Flight-free Zone's eastern edge**, represented by **Grid Location Point 18** and **Pasture**
 13 **Wash** Location Points, aircraft Percent Time Audible would be **91%** and **99%** respectively, with aircraft Average
 14 Sound Level of **19** and **27** dBA, respectively; a one to 31% increase in Percent Time Audible and a 3 to 7 dBA
 15 increase in Average Sound Level compared to Alternative A. Air-tour aircraft noise would frequently alter
 16 natural conditions and opportunities for solitude. *Moderate to major* adverse impacts would occur with minor to
 17 major adverse changes in impacts compared to Alternative A.
 18

19 *East End* *Modified NPS Preferred Alternative* *Wilderness Character*
 20 *Ten-Year Forecast Peak Season*

21 Areas near **Little Colorado River** and **Nankoweap River** Location Points would not be appreciably different
 22 (*zero to 4% decrease in Percent Time Audible and zero to 2 dBA decrease in Average Sound Level*) from Base
 23 Year Peak Season, *a 1 to 3% decrease in Percent Time Audible and a zero to 1 dBA decrease from Alternative*
 24 *A*. Negligible to minor adverse impacts would occur, a long-term negligible change in impacts compared to
 25 Alternative A.
 26

27 At **Nankoweap Mesa** Location Point air-tour aircraft Percent Time Audible would be **48%**, a **42%** decrease from
 28 Alternative A, and Average Sound Level would be 29 dBA, a 14 dBA decrease from Alternative A. Aircraft
 29 visibility would be similar to Base Year Peak Season. Natural ambient conditions would improve, and
 30 opportunities for solitude would increase with less interruption from aircraft noise. Moderate adverse impacts
 31 would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.
 32

33 At **Saddle Mountain** Location Point, air-tour aircraft Percent Time Audible would be 11%, a 42% decrease from
 34 Alternative A. Aircraft Average Sound Level would be 20 dBA, a 17 dBA decrease. Air-tour aircraft would be
 35 over 6,500 meters distant. There would be large improvements in natural condition of Wilderness and greater
 36 opportunity for solitude and primitive recreation with fewer interruptions. Minor adverse impacts would occur, a
 37 long-term moderate to major beneficial change in impacts compared to Alternative A.
 38

39 **Across North Rim** at **Grid Location Point 16**, impacts would further decline, continuing the beneficial change
 40 in impacts compared to Alternative A. Air-tour aircraft Percent Time Audible would be **39%**, a **45%** decline.
 41 Average Sound Level would be 24 dBA, a **10** dBA decrease. Aircraft would be greater than 2,000 meters from
 42 points on the ground. Moderate adverse impacts would occur, a long-term moderate to major beneficial change
 43 in impacts compared to Alternative A.
 44

45 Aircraft Percent Time Audible in **Dragon Corridor** areas would range **23** to 98% of the day, a 2 to **43%**
 46 decrease compared to Alternative A. Average Sound Level would range **14 to 38** dBA, a **4 to 25** dBA decline. In
 47 most areas, aircraft would be greater than 3,000 meters from the ground except at **Tower of Ra Location Point**
 48 where aircraft would be approximately **1,600** meters. At **Hermit Basin, Grid Location Point 11** and **96 Mile**
 49 **Camp Location Points**, there would be large improvements in natural conditions and increases in opportunities
 50 for solitude. Although there would be improvements in Wilderness Character, natural conditions would be
 51 altered due to high level of Percent Time Audible. *Minor* to major adverse impacts would occur, a minor to
 52 major beneficial change in impacts compared to Alternative A.
 53

54 **Zuni Point Corridor** Percent Time Audible would decrease **28 to 33%** compared to Alternative A, reducing
 55 time air-tours would be audible to **33 to 46%** of the day. Aircraft Average Sound Levels would be **35 to 36** dBA,
 56 a 2 dBA decrease to a 6 dBA increase compared to Alternative A. The amount of time natural conditions or

opportunities for solitude would be interrupted would decrease substantially Base Year to Ten-Year Forecast. **Moderate to major** adverse impacts would occur, **but with** a long-term moderate to major beneficial change in impacts compared to Alternative A.

The area beneath **Bright Angel Flight-free Zone** would not be appreciably different from Base Year Peak Season. Negligible impacts would occur with negligible change in impacts compared to Alternative A.

At **Grid Location Point 18** and **Pasture Wash** Location Points, air-tour aircraft Percent Time Audible would be 47 to 76%, a 13 to 22% decrease from Alternative A. Aircraft Average Sound Level would remain similar to Alternative A. Natural conditions and opportunities for solitude would be altered less often. Visibility of aircraft would **decrease by over 3,300 meters at Grid Location Point 18, and increase by over 3,400 meters at Pasture Wash compared** to Alternative A. **Minor to moderate to major** adverse impacts would occur, a long-term moderate beneficial change in impacts compared to Alternative A.

15	<i>East End</i>	<i>Modified NPS Preferred Alternative</i>	<i>Wilderness Character</i>
16	<i>Base Year Off-Peak Season</i>		

Impacts near **Nankoweap River** Location Point would not be appreciably different from Base Year Peak Season, **but impacts near Little Colorado River Location Point would decrease with a 7% decrease in Percent Time Audible and a 19 dBA decrease in Average Sound Level.** Negligible impacts would occur, a long-term **moderate to major** beneficial change in impacts compared to Alternative A.

At **Nankoweap Mesa** Location Point impacts would **be greatly reduced** from Base Year Peak Season (**75% decrease in Percent Time Audible, and 17 dBA decrease in Average Sound Level**). **Negligible** impacts would occur **Base Year Off-Peak Season** with a **major beneficial** change in impacts from Alternative A.

At **Saddle Mountain** Location Point air-tour aircraft Percent Time Audible would be **1%**, a **50%** decrease from Alternative A, and Average Sound Level would be **7 dBA**, a **30 dBA** decrease from Alternative A. Aircraft would be over 6,500 meters Distant from locations on the ground. This would represent large improvements in natural condition of Wilderness and greater opportunity for solitude and primitive recreation. **Negligible** impacts would occur, a long-term major beneficial change in impacts compared to Alternative A

Across North Rim at **Grid Location Point 16**, air-tour aircraft Percent Time Audible would be **13%**, a **67%** reduction compared to Alternative A. Aircraft would be greater than 2,000 meters from points on the ground. Aircraft Average Sound Level would be **12 dBA**, **20 dBA** less than Alternative A. **Minor** adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A, due to high reduction in aircraft Percent Time Audible.

Air-tour aircraft **beneath Dragon Corridor** Percent Time Audible would be **27 to 98%**, a **2 to 36%** decrease from Alternative A. Aircraft Average Sound Level would be **15 to 38 dBA**, a **3 to 29 dBA** decrease from Alternative A. Aircraft would be greater than **3,000** meters from points on the ground **except Tower of Ra at approximately 1,600 meters.** **Moderate to major** adverse impacts would occur, a long-term **negligible** to major beneficial change in impacts compared to Alternative A.

Beneath Zuni Point Corridor, impacts of aircraft Percent Time Audible (1%), Average Sound Level (6 to 14 dBA) and visibility (greater than 15 miles distance) would all be greatly reduced from Base Year Peak Season (**Percent Time Audible reduced by 53 to 61%, and Average Sound Levels reduced 25 to 32 dBA**). **Compared to Alternative A, Percent Time Audible is reduced 61 to 69% and Average Sound Level is reduced 14 to 31 dBA due to Off-Peak closure of Zuni Point Corridor.** **Negligible** impacts would occur with **moderate to major** beneficial change in impacts compared to Alternative A.

Beneath Bright Angel Flight-free Zone impacts would not be appreciably different from Base Year Peak Season. Negligible impacts would occur with negligible change in impacts compared to Alternative A.

Because Dragon Corridor short-loop routes would be **the only East End routes in use Off-Peak Season, Grid Location Point 18 and Pasture Wash** Location Points **would have 73 to 94%** aircraft Percent Time Audible, **5 to 18% less than** Alternative A. Aircraft Average Sound Level would be **17 to 24 dBA**, a **2 to 3 dBA** decrease

1 compared to Alternative A. Aircraft would be more than 5,000 meters from locations on the ground. Natural
 2 conditions and opportunities for solitude would be improved **a small amount**. **Minor** to major adverse impacts
 3 would occur, a long-term **negligible to** minor beneficial change in impacts compared to Alternative A.

4
 5 *East End* *Modified NPS Preferred Alternative* *Wilderness Character*

6 *Ten-Year Forecast Off-Peak Season*

7 Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year
 8 **Off-Peak** Season near **Little Colorado River** and **Nankoweap River** Location Points. Negligible impacts would
 9 occur, a long-term major beneficial change in impacts compared to Alternative A.

10
 11 At **Nankoweap Mesa** Location Point, Percent Time Audible, Average Sound Level, and Distance would not be
 12 appreciably different from **Base Year Off-Peak** Season. **Negligible** impacts would occur, a long-term major
 13 beneficial change in impacts compared to Alternative A.

14
 15 At **Saddle Mountain** Location Point, Percent Time Audible, Average Sound Level, and Distance would not be
 16 appreciably different from **Base Year Off-Peak** Season. **Negligible** impacts would occur, a long-term major
 17 beneficial change in impacts compared to Alternative A.

18
 19 **Across North Rim at Grid Location Point 16**, air-tour aircraft Percent Time Audible would be **20%**, a **64%**
 20 decrease from Alternative A. Average Sound Level would be **12 dBA**, a **22 dBA** decrease **from Alternative A**.
 21 Natural conditions would be greatly improved in areas along North Rim, with substantial increase in opportunity
 22 for solitude with **no** interruptions of low-**altitude aircraft overflights**. Minor to moderate adverse impacts would
 23 occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due to high
 24 reduction in aircraft Percent Time Audible.

25
 26 In **Dragon Corridor** areas, Distance would not differ from Base Year Off-Peak Season, **but** Percent Time
 27 Audible (**17 to 92%**) **would be reduced 6 to 40%**, and **Average Sound Level (15 to 35 dBA) would be reduced 2**
 28 **to 5 dBA from Base Year Off-Peak Season. Compared to Alternative A, these represent 8 to 61% reduction in**
 29 **Percent Time Audible, and a reduction of 6 to 27 dBA in Average Sound Level.** Minor to major adverse
 30 impacts would occur, but there would be long-term **minor** to major beneficial change in impacts compared to
 31 Alternative A.

32
 33 Under **Zuni Point Corridor**, Percent Time Audible, Average Sound Level, and Distance would not be
 34 appreciably different from **Base Year Off-Peak** Season. **Negligible** impacts would occur, **with** long-term major
 35 beneficial change in impacts compared to Alternative A.

36
 37 Beneath **Bright Angel Flight-free Zone** Percent Time Audible, Average Sound Level, and Distance would not
 38 be appreciably different from **Base Year Off-Peak** Season. Negligible impacts would occur with negligible
 39 change in impacts compared to Alternative A.

40
 41 At **Grid Location Point 18** and **Pasture Wash** Location Points aircraft Percent Time Audible would be **31 and**
 42 **64%**, a **29 to 34%** decrease from Alternative A, **with no appreciable change in Average Sound Level from**
 43 **Alternative A (15 to 20 dBA)**. Natural conditions would be markedly improved and there would be more
 44 opportunity for experiencing solitude and primitive recreation. Moderate adverse impacts would occur, a long-
 45 term moderate beneficial change in impacts compared to Alternative A.

1 **Table 4.49** *Modified NPS Preferred Alternative* **Slant Distances** **East End**

2

3

4

5

6

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Little Colorado River	1,629	2,474	845
Nankoweap Mesa	973	6,096	5,123
Nankoweap River	1,449	9,655	8,206
Dragon Corridor			
Hermit Basin	1,518	6,447	4,929
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,578	432
Eremita Mesa	1,034	4,277	3,243
North Rim			
Grid Location Point 16	2,589	2,591	2
The Basin	477	873	396
Grid Location Point 6	6,935	5,137	-1,798
Zuni Point Corridor			
Grid Location Point 14	687	1,412	725
Grid Location Point 15	1,637	2,344	707
Temple Butte	1,458	1,303	-155
Bright Angel Flight-Free Zone			
Grid Location Point 11	8,081	8,034	-47
Grid Location Point 12	9,014	9,012	-2
Grid Location Point 13	7,925	7,852	-73
Toroweap /Shinumo Flight-Free Zone			
Grid Location Point 18	8,449	5,106	-3,343
Pasture Wash	5,582	8,967	3,435
Point Sublime	3,760	4,076	316
Grid Location Point 7	8,888	7,436	-1,452
Bass Camp	13,358	13,352	-6
Rainbow Plateau	14,878	14,974	96
Grid Location Point 10	2,931	3,253	322
Outside the Park			
Saddle Mountain	1,716	6,546	4,830

Δ indicates change in noise metric data from Alternative A

1 **Table 4.50 Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Modified Preferred Alternative																			
	Alternative A				Peak Season								Off-Peak Season							
	Percent Time Audible (%)		Average Sound Level		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Little Colorado River/Nankoweap Area																				
Little Colorado River	34	37	43	43	7	-27	3	-34	26	-17	26	-17	0	-34	0	-37	7	-36	7	-36
Nankoweap Mesa	87	90	43	43	76	-11	48	-42	31	-12	29	-14	1	-86	2	-88	14	-29	15	-28
Nankoweap at River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	11	-23	12	-23
Dragon Corridor																				
Hermit Basin	99	100	42	42	96	-4	57	-43	20	-22	17	-25	79	-20	39	-61	17	-25	15	-27
96 Mile Camp	72	74	45	45	59	-13	41	-33	39	-6	37	-8	38	-34	25	-49	35	-10	33	-12
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	80	-17	67	-31	38	-6	35	-10
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	98	-2	92	-8	32	-17	29	-20
North Rim																				
Grid Location Point 16	80	84	33	34	54	-26	39	-45	32	-1	24	-9	0	-67	20	-64	12	-21	12	-22
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	37	-36	7	-68	19	-29	20	-28
Grid Location Point 6	52	56	19	20	64	12	26	-30	19	0	11	-9	24	-28	6	-50	9	-10	9	-11
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	62	-8	46	-24	39	6	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	56	-9	37	-32	39	11	35	6	1	-64	1	-68	14	-14	14	-15
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32
Bright Angel Flight Free Zone																				
Grid Location Point 11	55	56	18	18	50	-5	23	-33	20	2	14	-4	27	-28	17	-39	15	-3	12	-6
Grid Location Point 12	1	1	13	14	2	1	2	1	16	0	12	-1	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	1	0	2	-4	1	0	1	0	9	-3	9	-4
Toroweap/Shinumo Flight Free Zone																				
Grid Location Point 18	60	60	16	17	91	30	47	-16	19	3	17	0	73	13	31	-29	17	1	15	-2
Pasture Wash	98	98	20	21	99	0	76	-23	27	6	22	1	94	-4	64	-34	24	4	20	-1
Point Sublime	100	100	35	35	100	0	95	-5	35	-1	29	-6	97	-3	83	-17	32	-3	27	-8
Grid Location Point 7	1	1	7	8	3	3	0	0	9	2	7	-1	4	3	5	4	8	1	9	2
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	6	-1	3	-4
Rainbow Plateau	0	54	6	7	0	0	0	-54	9	3	6	-1	0	0	0	-54	7	1	7	1
Grid Location Point 10	92	92	25	25	93	0	28	-65	28	3	22	-3	73	-19	19	-73	26	1	23	-2
Outside the Park																				
Saddle Mountain	51	53	37	37	37	-14	11	-42	22	-14	20	-17	1	-50	1	-52	7	-30	7	-30

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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3

1 **Central** *Modified NPS Preferred Alternative* **Wilderness Character**

2
3 In the Central area, there would be little change in impacts from Alternative A as the area would remain relatively
4 quiet with Average Sound Level generally less than 15 dBA, and aircraft Percent Time Audible generally less than
5 15% of the time. Tables 4.51 and 4.52 present Percent Time Audible, Distance, and Average Sound Level for
6 Central area Location Points. Similar to Alternative A, Wilderness Character throughout most of the Central area
7 would be least affected by aircraft noise.

8
9 *Central* *Modified NPS Preferred Alternative* *Wilderness Character*
10 *Base Year Peak Season*

11 In **Central area Location Points** when *all East End* routes would be in use, aircraft Percent Time Audible
12 would generally be zero to 14% with aircraft Average Sound Level zero to 15 dBA with little change in impacts
13 compared to Alternative A, except **Grid Location Point 8**, where Percent Time Audible would be up to 21%
14 (*with 14 dBA*), an 18% *and 4 dBA* increase compared to Alternative A. Natural conditions would generally
15 persist in proposed Wilderness. Audible air-tour aircraft noise would be low, and natural conditions and
16 opportunities for solitude would not often be disrupted. Impacts would generally be negligible to minor adverse
17 with negligible to moderate beneficial change in impacts compared to Alternative A. However, at Grid Location
18 Point 8, impacts would be up to moderate adverse with *minor to* moderate adverse change in impacts from
19 Alternative A.

20
21 *Central* *Modified NPS Preferred Alternative* *Wilderness Character*
22 *Ten-Year Forecast Peak Season*

23 At **Central area Location Points** Percent Time Audible, Average Sound Level, and Distance would be *reduced*
24 *a negligible to minor amount* from Base Year Peak Season, except **Grid Location Point 8** (decrease of 20%
25 Percent Time Audible, and 4 dBA compared to Base Year). Negligible to minor adverse impacts would occur
26 with *negligible to moderate beneficial* change in impacts compared to Alternative A.

27
28 *Central* *Modified NPS Preferred Alternative* *Wilderness Character*
29 *Base Year Off-Peak Season*

30 At **Central area Location Points** Percent Time Audible, Average Sound Level, and Distance would not be
31 appreciably different from Base Year Peak Season, except **Grid Location Point 8 with an 9% decrease in**
32 **Percent Time Audible** compared to Base Year Peak Season. Impacts would generally be negligible to minor
33 adverse with negligible *to minor beneficial* change in impacts compared to Alternative A.

34
35 *Central* *Modified NPS Preferred Alternative* *Wilderness Character*
36 *Ten-Year Forecast Off-Peak Season*

37 At **Central area Location Points** Percent Time Audible, Average Sound Level, and Distance would not be
38 appreciably different from Base Year Peak Season, except **Grid Location Point 8** which have a 9% decrease in
39 Percent Time Audible. Impacts would generally be negligible to minor adverse with negligible to minor
40 beneficial change in impacts compared to Alternative A.

1
2
3**Table 4.51** *Modified Preferred Alternative* **Slant Distances** **Central**

Location Point Name	Alternative A	<i>Modified Preferred Alternative</i>	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
The Dome	13,109	13,119	10
Tuweep (GC009)	8,688	8,688	0
Tuweep (GC010)	14,322	12,923	-1,399
Hancock Knolls	30,162	30,166	4
1 km W of Kanab Point	18,850	18,857	7
Grid Location Point 8	13,765	14,619	854
Grid Location Point 9	11,103	19,140	8,037
Grid Location Point 20	22,053	22,095	42
Grid Location Point 21	20,393	20,401	8
Grid Location Point 22	26,089	26,095	6
Grid Location Point 23	29,326	27,482	-1,844
Grid Location Point 24	21,073	21,072	-1
Grid Location Point 25	20,188	20,216	28
Havasu Point	10,450	10,589	139
Kanab Point	19,021	19,029	8
Mt. Sinyala	7,272	7,302	30
Stone Creek	21,882	24,531	2,649
Surprise Valley	25,500	26,243	743
Toroweap Overlook	9,625	9,625	0
Upper Deer Creek	23,683	24,100	417

Δ indicates change in noise metric data from Alternative A

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1 **Table 4.52 Modified NPS Preferred Alternative Average Sound Level Central**

Location Point Name	Alternative A		Modified Preferred Alternative																	
	Alternative A		Peak Season								Off Peak Season									
	Percent Time Audible (%)		Average Sound Level		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
The Dome	1	1	16	16	1	0	1	0	12	-4	12	-4	1	0	1	0	12	-4	12	-4
Tuweep	12	14	15	16	12	-1	0	-14	15	0	16	0	15	3	0	-14	15	0	16	1
Tuweep	15	17	11	11	5	-10	0	-17	8	-3	9	-2	3	-12	0	-17	7	-4	8	-3
Hancock Knolls	2	2	10	10	2	0	2	0	10	0	9	-1	2	0	2	0	9	-1	9	-1
1 km W of Kanab Point	2	2	9	9	2	0	2	0	9	0	7	-2	2	0	2	0	7	-1	7	-2
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	10	0	10	7	1	-2	12	2	10	0
Grid Location Point 9	1	1	5	5	1	0	0	-1	6	1	4	-1	1	0	0	-1	5	0	3	-3
Grid Location Point 20	0	0	4	4	0	0	0	0	4	0	4	0	0	0	0	0	4	0	4	0
Grid Location Point 21	2	2	14	14	2	0	2	0	14	0	14	0	2	0	2	0	14	0	14	0
Grid Location Point 22	18	21	12	13	1	-17	1	-20	9	-3	9	-4	1	-17	1	-20	8	-4	8	-5
Grid Location Point 23	2	2	10	10	2	0	2	0	9	-1	9	-1	2	0	2	0	9	-1	9	-1
Grid Location Point 24	3	4	8	8	2	-1	2	-2	5	-3	6	-2	2	-2	2	-2	4	-4	5	-3
Grid Location Point 25	11	12	9	10	2	-9	2	-10	6	3	7	-3	2	-9	2	-10	6	-3	6	-4
Havasus Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	10	4	8	1	1	0	1	0	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	5	5
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Toroweap Overlook	0	0	13	14	0	0	0	0	14	1	14	0	0	0	0	0	13	0	14	1
Upper Deer Creek	1	1	1	1	1	0	1	0	2	1	1	-1	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

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1 **West End** **Modified NPS Preferred Alternative** **Wilderness Character**

2
3 In West End's northern portion, which includes **Z-shaped Route (realigned Blue Direct)**, Blue-2, and Green-4, impacts would be **moderate** adverse under and near routes with aircraft Average Sound Level of 40 to 50 dBA and Percent Time Audible greater than 65%. **Modified** NPS Preferred Alternative quiet-technology incentives and conversion requirements would provide some mitigation to these impacts with a decrease in affected area size. In West End's southern portion near Sanup Flight-free Zone Average Sound Level would be **0 to 15** dBA with aircraft Percent Time Audible less than **10%**. Tables 4.53 and 4.54 present Percent Time Audible, Distances, and Average Sound Level for West End Location Points.

10 *West End* *Modified NPS Preferred Alternative* *Wilderness Character*

11 *Base Year Peak and Off-Peak Season*

12 At Location Points **Burnt Springs Canyon, Bat Cave, and Grid Location Point 33** under Green-4 and Blue-2 routes, air-tour aircraft Percent Time Audible would be **61** to 93% with Average Sound Level ranging 42 to **45** dBA. Natural conditions and opportunities for solitude in proposed Wilderness would be interrupted often and at high sound levels. Major adverse impacts would continue with negligible change in impacts from Alternative A.

13
14
15
16
17
18 Locations near **Whitmore Rapids** Location Point under Brown routes, and further west along the river, would **receive more aircraft noise due to the Z-shaped Route (realigned Blue Direct) compared** to Alternative A. Moderate adverse impacts would **occur** with negligible **to minor adverse** change from Alternative A.

19
20
21
22 **Grid Location Point 32** would be **less** affected by air-tour aircraft **due to the shift to the Z-shaped Route (realigned Blue Direct) than** Alternative A. Air-tour aircraft Percent Time Audible would be **4%** at Average Sound Level of **21 dBA (compared to 44% Percent Time Audible and 27 dBA Average Sound Level under Alternative A)**. Air-tour aircraft would be greater than **18,000** meters away. Natural conditions would be **generally prevail** in Wilderness. **Negligible to moderate** adverse impacts would **occur** with negligible **to moderate beneficial** change in impacts compared to Alternative A.

28
29 *West End* *Modified NPS Preferred Alternative* *Wilderness Character*

30 *Ten-Year Forecast Peak and Off-Peak Season*

31 In Location Points **Burnt Springs Canyon, Bat Cave, and Grid Location Point 33**, **there would be a 5 to 25%** reduction in Percent Time Audible **(to 54 to 88%)** and **1 to 4** dBA reduction in Average Sound Level **(to 38 to 43 dBA) compared to Base Year Peak and Off-Peak Season (with similar levels as Ten-Year Forecast Peak and Off-Peak Season)**. **Compared to Alternative A, Percent Time Audible would decrease 7 to 35% and Average Sound Level would decrease 4 to 5 dBA**. **Moderate** adverse impacts would continue with a negligible **to moderate** beneficial change in impacts compared to Alternative A.

32
33
34
35
36
37 For locations near **Whitmore Rapids** Location Point under Brown routes, and further west along the river, change in Percent Time Audible **and** Average Sound Level would not be appreciably different from Base Year Peak **and Off-Peak** Season. Moderate adverse impacts would continue with negligible **to minor adverse** change in impacts compared to Alternative A.

38
39
40
41
42
43 At **Grid Location Point 32** aircraft Percent Time Audible **(59%) and Average Sound Level (22 dBA)** would not be appreciably different from Base Year **Peak and Off-Peak Season, but would be reduced 44% and 6 dBA compared to Alternative A due to the shift in locations of the Las Vegas-Grand Canyon Blue Direct routes**. **Negligible to minor** adverse impacts would **occur** with **moderate to major beneficial** change in impacts compared to Alternative A.

44
45
46
47
48
49 **In areas under and near the Z-shaped Route (realigned Blue Direct) included in the Modified NPS Preferred Alternative, impacts would be moderate to major adverse with moderate to major adverse change in impacts from Alternative A (that is, impacts of the Las Vegas-Grand Canyon routes would move to a new location). In the area of the current Blue Direct routes major beneficial change in impacts compared to Alternative A since the routes would be moved from those locations.**

1
2
3**Table 4.53** *Modified NPS Preferred Alternative* **Slant Distances** **West End**

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,134	1,134	0
Grid Location Point 33	1,105	1,105	2
Whitmore Rapids	1,804	1,804	0
Grid Location Point 28	8,327	21,438	13,111
Grid Location Point 32	2,016	18,618	16,602
Diamond Creek	27,108	33,411	6,303
Separation Canyon	16,020	16,020	0
Granite Gorge	2,397	1,687	-710
Grid Location Point 29	9,306	11,493	2,187
Grid Location Point 30	2,008	2,008	0
Grid Location Point 34	28,206	29,373	1,167
Granite Peak	5,264	12,090	6,826
Kelly Point	20,278	22,018	1,740
Jackson Canyon	5,610	5,640	30
Parashant Wash	2,852	2,852	0
Pumpkin Springs	12,630	10,635	7,065
Peach Spring Canyon South	42,795	42,795	0
Sanup	1,820	3,923	2,103
Separation Canyon, 1 km N of Colorado River	15,819	15,790	-29
Separation Canyon at Colorado River	16,377	16,328	-49
Suicide Point	2,093	13,927	11,834
Three Springs	14,750	22,770	8,020
Twin Point	3,347	6,213	2,866
West End	1,688	1,688	0

Δ indicates change in noise metric data from Alternative A

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1 **Table 4.54 Modified NPS Preferred Alternative Average Sound Level West End**

Location Points	Alternative A				Modified NPS Preferred Alternative															
	Time Audible (%)		Sound Level (dBA)		Peak Season								Off-Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	63	-7	58	-17	45	-1	43	-4	61	-9	54	-21	45	-1	42	-5
Bat Cave	93	95	47	48	93	0	88	-7	45	-2	43	-5	91	-2	85	-10	44	-3	43	-5
Grid Location Point 33	87	90	42	43	80	-7	55	-35	42	0	38	-5	81	-6	57	-33	42	0	38	-4
Whitmore Rapids	12	13	21	21	19	7	20	7	29	8	28	7	18	6	17	4	28	7	27	6
Grid Location Point 28	14	16	17	18	5	-9	3	-13	15	-2	17	-1	3	-11	3	-13	15	-2	17	-1
Grid Location Point 32	44	49	27	28	4	-40	5	-44	21	-6	22	-6	4	-40	5	-44	21	-6	22	-6
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Separation Canyon	0	1	9	9	0	0	1	0	9	0	9	0	0	0	1	0	9	0	9	0
Granite Gorge	58	63	34	35	55	-3	46	-17	34	0	32	-3	53	-5	44	-19	34	0	32	-3
Grid Location Point 29	7	8	12	13	5	-2	2	-6	10	-2	11	-2	5	-2	2	-6	10	-2	11	-2
Grid Location Point 30	39	42	28	28	34	-5	18	-24	27	-1	24	-4	37	-2	16	-26	28	1	24	-4
Grid Location Point 34	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0
Granite Peak	2	2	17	18	2	0	2	0	16	-1	16	-2	2	0	2	0	15	-2	16	-2
Kelly Point	1	1	10	10	1	0	1	0	10	0	10	0	1	0	1	0	10	0	10	0
Jackson Canyon	18	20	24	25	16	-2	6	-14	18	-6	16	-9	19	2	6	-14	19	-5	16	-9
Parashant Wash	12	14	33	33	11	-1	14	0	24	-9	24	-9	11	-1	12	-2	25	-8	24	-9
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	-1	0	0	0	0	7	0	7	-1
Peach Spring Canyon South	NA	NA	0	0	0	NA	0	0	4	4	4	4	NA	NA	NA	NA	0	0	0	0
Sanup	79	83	38	38	65	-7	26	-17	27	-11	22	-16	65	-14	25	-58	27	-11	21	-17
Separation Canyon, 1km N of Colorado River	1	1	8	8	1	0	1	0	8	0	8	0	1	0	1	0	8	0	8	0
Separation Canyon at Colorado River	0	0	7	7	0	0	0	0	7	0	7	0	0	0	0	0	7	0	7	0
Suicide Point	15	17	22	23	3	-2	4	-13	20	-2	21	-2	3	-12	4	-13	20	-2	21	-2
Three Springs	1	2	8	9	0	0	2	0	8	0	8	-1	1	0	2	0	8	0	8	-1
Twin Point	19	22	23	23	1	-8	4	-18	21	-2	21	-2	13	-6	4	-18	21	-2	21	-2
West End	58	63	39	40	53	-5	32	-31	39	0	36	-4	18	-40	17	-46	28	-11	27	-13

Δ indicates change in noise metric data from Alternative A

2 Forecast indicates Ten-Year forecast

1 **NPS Units in SFRA Outside GCNP** *Modified* NPS Preferred Alternative Wilderness Character

2
3 *Moving the Las Vegas-Grand Canyon routes to the Z-shaped Route (realigned Blue Direct) will move impacts*
4 *from some of the most remote and sensitive potential wilderness in Lake Mead National Recreation Area and*
5 *Grand Canyon-Parashant National Monument within the SFRA to less sensitive areas within and outside the*
6 *SFRA but areas still managed for wilderness characteristics in Grand Canyon-Parashant National Monument.*
7 *Moving the routes will also greatly reduce impacts on the Grand Canyon-Parashant National Monument*
8 *administrative site near the base of Mt. Dellenbaugh. Technically, routes can only be designated, and operators*
9 *can only be required to fly on designated routes within the SFRA. The area outside the SFRA is part of the*
10 *national airspace with different rules than within the SFRA, so Grand Canyon-related flights can choose where*
11 *to fly outside the SFRA consistent with regulations governing national airspace. Flight paths outside the SFRA*
12 *used in noise modeling for the Z-shaped Route (realigned Blue Direct) are paths considered most likely (and*
13 *consistent with routes considered by GCWG under Alternative E). Because flight paths outside the SFRA are*
14 *integrally connected with routes within the SFRA, they are also discussed in this section.*

15
16 *There are three designated Wilderness Areas in Lake Mead National Recreation Area west of the SFRA (Pinto*
17 *Valley, Jimbilnan, and Jumbo Spring Wilderness Areas) that might be overflowed by Grand Canyon tour aircraft*
18 *between the Las Vegas area and the Z-shaped Route (realigned Blue Direct); however, it is hoped those areas can*
19 *be avoided as an Air Tour Management Plan is developed for Lake Mead NRA. Also, the adaptive management*
20 *process included as part of the Modified NPS Preferred Alternative may offer opportunities to consider slight*
21 *modifications to the Z-shaped Route (realigned Blue Direct) if the modifications could reduce impacts on GCNP,*
22 *Lake Mead NRA, Grand Canyon-Parashant National Monument and/or other lands while still accomplishing*
23 *other goals and objectives for the routes.*

24
25 Impacts would be moderate to major *adverse directly under and near the Z-shaped Route (realigned Blue Direct).*
26 Average Sound Level would generally be 40 to 50 dBA, with high levels of aircraft Percent Time Audible. *Because*
27 *the Blue Direct routes are in a very different location in Alternative A,* these represent *moderate to major adverse*
28 *changes in location of impacts compared to Alternative A Base Year. In the area of the current Blue Direct routes*
29 *major beneficial change in impacts compared to Alternative A since the routes would be moved from those*
30 *locations.*

31
32 However, with *Modified* NPS Preferred Alternative quiet-technology incentives and conversion requirements, there
33 would be a decrease in size of affected areas Ten-Year Forecast.

34
35 Because there would be *no routes* in Marble Canyon under the *Modified* NPS Preferred Alternative, *impacts* to
36 Paria Canyon-Vermilion Cliffs Wilderness *and Saddle Mountain Wilderness* would be negligible, with *moderate to*
37 *major beneficial* changes in impacts compared to Alternative A Base Year and Ten-Year Forecast.

38
39 **Cumulative Impacts** *Modified* NPS Preferred Alternative Wilderness Character

40
41 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
42 *actions. In this context, Cumulative Impacts include impacts on Soundscape from sounds of*

- 43 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
44 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
45 *3) ground-based noise sources, plus*
46 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

47
48 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
49 *(Modified NPS Preferred Alternative).*

50
51 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
52 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
53 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
54 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
55 *SFRA see Appendix D, Figures 91 to 94).*

1 *Noise from ground-based sources includes vehicles, building noise, machinery, and electronics, also impacts*
2 *Soundscape, but is mostly concentrated in the Developed Zone (2% of the park), although a small component*
3 *exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
4 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
5 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
6 *Audible capable of masking some aircraft noise.*

7
8 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
9 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
10 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
11 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
12 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
13 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
14 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
15 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
16 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
17 *noise over most of the park and SFRA; there are no areas in GCNP where the natural Soundscape is not*
18 *adversely affected by aircraft noise some of the time.*

19
20 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
21 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
22 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
23 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
24 *Alternatives (Modified NPS Preferred Alternative in this case).*

25
26 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
27 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
28 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
29 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
30 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
31 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
32 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
33 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

34
35 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
36 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
37 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*
38 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
39 *by itself. For the Proposed Wilderness Zone Cumulative Impact results (Peak and Off-Peak Season Ten-Year*
40 *Forecast), All Aircraft are audible 60% or more of the day in 85 to 86% of the Zone, with Average Sound Level*
41 *25 to <35 dBA in 86 to 90% of the Zone, with zero to 1% of the Zone below 25 dBA and 9 to 12% at 35 dBA or*
42 *more. For the Proposed Wilderness Zone results for Modified NPS Preferred Alternative by itself (Peak and Off-*
43 *Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 7 to 11% of the Zone, with*
44 *Average Sound Level 25 to <35 dBA in 12% of the Zone, with 69 to 70% of the Zone below 25 dBA and 10 to*
45 *12% at 35 dBA or more.*

46
47 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
48 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
49 *and near air-tour routes; (b) Cumulative Impacts increase impacts of Alternative, and (c) reducing air-tour-and-*
50 *related impacts under the Alternatives reduces Cumulative Impacts.*

51
52 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
53 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
54 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
55 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*

1 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 2 *Cumulative Impacts discussion in the Conclusions section below.*

3
 4 **Conclusion** *Modified NPS Preferred Alternative* **Wilderness Character**

5
 6 Overall the *Modified* NPS Preferred Alternative would result in mostly beneficial changes in impacts to Wilderness
 7 Character compared to Alternative A. In Marble Canyon, Central areas, and West End's southern portions,
 8 Wilderness would be least impacted *year-round* by air-tour operations as Average Sound Level would generally be
 9 less than 15 dBA, with aircraft Percent Time Audible less than 5%. *The area near Zuni Point Corridor routes*
 10 *closed Off-Peak Season would also have negligible impacts.* Greatest exposure to noise and visual impacts in
 11 Wilderness would occur under and near open air-tour routes in East End (*especially Dragon Corridor year-round*)
 12 and West End's northwestern portions (*Blue-2 and Green-4*) where Average Sound Level would generally be *35 to*
 13 *45* dBA, and aircraft Percent Time Audible would generally be greater than *65%* of the time.

14
 15 Because the *Modified* NPS Preferred Alternative includes quiet-technology incentives and conversion requirements,
 16 noise impacts would decrease from Base Year to Ten-Year Forecast in the park as a whole.

17
 18 *Conclusion Marble Canyon* *Modified NPS Preferred Alternative* *Wilderness Character*
 19 Peak and Off-Peak Season, improvements over Alternative A would occur at Marble Canyon Location Points *due to*
 20 *elimination of Marble Canyon routes, with greatest improvement at North and South Canyon* Location Points.
 21 Negligible to minor adverse impacts would continue with an overall negligible to minor long-term beneficial change
 22 in impacts from Alternative A Ten-Year Forecast.

23
 24 *Conclusion East End* *Modified NPS Preferred Alternative* *Wilderness Character*
 25 Noise conditions and effects on Wilderness at Location Points **Little Colorado River** confluence and **Nankoweap**
 26 **River** would improve compared to Alternative A. Negligible to minor adverse impacts would continue with a
 27 *negligible change compared to Alternative A Peak Season, but a major* beneficial change in impacts from
 28 Alternative A *Off-Peak Season.*

29
 30 **Ten-Year Forecast** Peak Season, Nankoweap Mesa would be farther from Black-1 and Green-1 *with moderate to*
 31 *major beneficial change in impacts compared to Alternative A, but there would still be* moderate adverse impacts
 32 from aircraft on Wilderness Character. *Ten-Year Forecast Off-Peak Season, due to closure of Zuni Point Corridor*
 33 *routes, impacts would be negligible with* major beneficial change in impacts compared to Alternative A.

34
 35 In Saddle Mountain Wilderness Area, **Peak Season** impacts on Wilderness Character would be minor adverse with
 36 moderate to major beneficial change in impacts compared to Alternative A. *Off-Peak Season, impacts would be*
 37 *negligible with long-term major beneficial change in impacts compared to Alternative A, due to closure of Zuni*
 38 *Point Corridor and Marble Canyon routes.*

39
 40 Along North Rim, *Peak Season impacts would be* moderate adverse *under long-loop routes, but with a* long-term
 41 moderate to major beneficial change in impacts compared to Alternative A due to high reduction in aircraft Percent
 42 Time Audible *largely due to conversion to quiet-technology aircraft. Due to closure of long-loop routes Off-Peak*
 43 *Season, impacts would decrease to minor to moderate adverse, decreasing with increased distance from open*
 44 *Dragon Corridor routes, with a long-term moderate to major beneficial change in impacts compared to*
 45 *Alternative A.*

46
 47 *In* Dragon Corridor *areas with routes open year-round, minor to* major adverse impacts from air-tour aircraft on
 48 Wilderness Character would *occur* Peak and Off-Peak Season, *with minor to major* beneficial change in impacts
 49 compared to Alternative A Ten-Year Forecast.

50
 51 Beneath Zuni Point Corridor routes Peak Season there would be **moderate to** major adverse impacts with moderate
 52 *to major* beneficial change in impacts compared to Alternative A. Off-Peak Season, *due to closure of Zuni Point*
 53 *Corridor routes,* there would be *negligible* impacts with *long-term* major beneficial change in impacts compared to
 54 Alternative A.
 55

1 Beneath Bright Angel Flight-Free Zone All Scenarios, effects of air-tour aircraft would be similar to Alternative A
 2 with negligible impacts from air-tour aircraft on Wilderness Character, and negligible change in impacts compared
 3 to Alternative A.

4
 5 At Toroweap/Shinumo Flight-Free Zone's eastern edge Peak **and Off-Peak** Season there would be **minor to**
 6 **moderate** adverse impacts with moderate beneficial change in impacts compared to Alternative A.

7
 8 *Conclusion Central* **Modified NPS Preferred Alternative** *Wilderness Character*
 9 Peak **and Off-Peak** Season there would be negligible to minor adverse impacts with negligible to moderate
 10 **beneficial** change in impacts compared to Alternative A.

11
 12 *Conclusion West End* **Modified NPS Preferred Alternative** *Wilderness Character*
 13 For Location Points near Blue-2 and Green-4 (**Burnt Springs Canyon, Bat Cave, and Grid Location Point 33**),
 14 **moderate to** major adverse impacts would continue with negligible to **moderate** beneficial change in impacts
 15 compared to Alternative A **Peak and Off-Peak Season**. Near Whitmore Rapids Location Point and Brown routes,
 16 there would be moderate adverse impacts with negligible **to minor adverse** change in impacts from Alternative A
 17 **Peak and Off-Peak Season**. **Near the area of current Blue Direct routes under Alternative A (Grid Location Point**
 18 **32) there would be negligible to minor adverse impacts, a moderate to major beneficial change in impacts from**
 19 **Alternative A. In areas under and near the Z-shaped Route (realigned Blue Direct) included in the Modified NPS**
 20 **Preferred Alternative, impacts would be moderate to major adverse with moderate to major adverse** change in
 21 impacts from Alternative A (**that is, impacts of Las Vegas-Grand Canyon routes would move to a new location**).
 22 **In the area of the current Blue Direct routes major beneficial change in impacts compared to Alternative A since**
 23 **the routes would be moved from those locations.**

24
 25 *Cumulative Impacts Summary* **Modified NPS Preferred Alternative** *Wilderness Character*

26
 27 **As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase**
 28 **impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is, Ten-**
 29 **Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble**
 30 **Canyon, East End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and**
 31 **near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In**
 32 **comparison with the other Alternatives, Modified NPS Preferred Alternative ranks second behind Alternative E**
 33 **for the lowest overall Cumulative Impacts (Alternative A ranks last).**

34 35 ETHNOGRAPHIC RESOURCES

36 37 General Methodology

38
 39 Impacts of proposed action to Ethnographic Resources are analyzed for effects to Traditional Cultural Properties,
 40 tribal concerns, and various intangible and tangible resources valued by American Indian people traditionally
 41 associated with GCNP or land in the SFRA. For additional information about what resources may be affected and
 42 why, including the role of natural quiet in Traditional Cultural Practices and Properties, see Chapter 3, Ethnographic
 43 Resources. Impacts are described with respect to privacy (including protection of property and viewscapes
 44 information) and traditional observance, as well as policy and guidelines, in accordance with Section 106 of the
 45 National Historic Preservation Act (§106). Traditional Cultural Properties referred to below are Ethnographic
 46 Resources eligible for listing on the National Register of Historic Places. **For this EIS, Ethnographic Resources**
 47 **potentially eligible for National Register listing, but not yet evaluated for National Register eligibility, would be**
 48 **afforded the same level of protection as listed or eligible historic properties. Also, see the beginning of Chapter 4,**
 49 **General Methodology for discussion of overall methodology for impact analysis for all impact topics.**

50 51 General Assumptions

52 53 Methodology

54 55 Ethnographic Resources

56
 57 In the thresholds below, all aspects of impacts due to aircraft noise intensity and duration including, but not limited
 58 to, audibility, aircraft Average Sound Level (sound energy metrics), and timing are considered in the phrase *impacts*
 59 *due to the event*. Audibility is the ability of animals, including humans, with normal hearing, to hear a given sound.
 60 Audibility is affected by the hearing ability of animals and humans, other simultaneous interfering sounds or stimuli,

1 and sound frequency content and amplitude. Sound energy metrics include Average Sound Level and Time Above
2 decibel levels.

3
4 A measure of distance from points of ethnographic interest (Traditional Cultural Properties) to aircraft routes is used
5 as an indicator related to effects of aircraft in close proximity to cultural practitioners or sites, including visibility
6 and presence of aircraft to people on the ground, and of people on the ground to people in aircraft (issues related to
7 privacy and traditional observance). While there is usually close correlation between distance and sound intensity,
8 this measure of distance is included primarily to address effects other than aircraft noise.

9
10 Aircraft noise could seriously disrupt prayers, ceremonies, or other cultural practices. Since many cultural practices
11 are site specific, there could be times when practitioners could not be assured of either visual privacy or freedom
12 from aircraft noise. It is possible traditional practitioners might need to begin prayers or ceremonies repeatedly until
13 they can complete the prayer or ceremony without interruption. When traditional ceremonies or recitation of prayer
14 cannot be conducted in appropriate places at appropriate times, centuries-old traditional practices could be altered.
15 However, while Ethnographic Resources in areas under routes would be appreciably altered, the group's practices
16 and beliefs would be expected to survive.

17
18 Because each of the 11 tribes discussed in Chapter 3's Affected Environment has different religious and traditional
19 practices conducted largely in private at different times in different places, an accurate evaluation of benefits and/or
20 adverse effects of curfews on Ethnographic Resources would be impossible. Thus, possible effects of curfews will
21 be discussed only in the most general terms.

22 **Methodology**

Ethnographic Resources

23 ***Impact Intensity Threshold Descriptions***

24 **Threshold Levels**

25 *Negligible* Impacts due to the event at lowest levels of detection and barely perceptible. Aircraft audible less
26 than 5% of the 12-hour day used in this analysis

27 Distance from points of interest to aircraft routes greater than 2000 meters

28 Aircraft noise intensity in a specific area (Average Sound Level) less than 15 dBA

29 Impacts neither alter resource conditions, such as traditional access and site preservation, nor the
30 relationship between the resource and the traditionally associated group's body of practices and
31 beliefs

32 *Minor* Impacts due to the event slight but noticeable. Aircraft audible greater than ***or equal to*** 5% and
33 less than 10% of the 12-hour day

34 Distance from points of interest to aircraft routes is greater than 1000 meters and less than ***or***
35 ***equal to*** 2000 meters

36 Aircraft noise intensity in a specific area (Average Sound Level) greater than ***or equal to*** 15 dBA
37 and less than 25 dBA

38 Impacts neither appreciably alter resource conditions, such as traditional access and site
39 preservation, nor the relationship between the resource and the traditionally associated group's
40 body of practices and beliefs

41 *Moderate* Impacts due to the event apparent. Aircraft audible greater than ***or equal to*** 10% and less than 25%
42 of the 12-hour day

1		Distance from points of interest to aircraft routes greater than 500 meters and less than <i>or equal to</i>
2		1,000 meters
3		
4		Aircraft noise intensity in a specific area (Average Sound Level) greater than <i>or equal to</i> 25 dBA
5		and less than 35 dBA
6		Impacts appreciably alter resource conditions, such as traditional access and site preservation, or
7		the relationship between the resource and the traditionally associated group's body of practices
8		and beliefs, but the group's body of practices and beliefs survive
9		
10	<i>Major</i>	Impacts due to the event substantially alter resource conditions, such as traditional access and site
11		preservation, or the relationship between the resource and the traditionally associated group's
12		body of practices and beliefs, to the extent survival of a group's body of practices and/or beliefs is
13		jeopardized
14		
15		Aircraft audible greater than <i>or equal to</i> 25% of the 12-hour day
16		
17		Distance from points of interest to aircraft routes less than <i>or equal to</i> 500 meters
18		Aircraft noise intensity in a specific area (Average Sound Level) is greater than <i>or equal to</i> 35 dBA
19		
20		Impacts could result in substantial changes or destabilization to defining elements and resource
21		condition and an increase in exposure or vulnerability to natural elements
22		
23	Type of Impact	Ethnographic Resources
24		
25	<i>Adverse</i>	Impacts adversely alter resource conditions, or interfere with traditional access, site preservation,
26		or relationship between resource and traditionally associated group's body of practices and beliefs
27		
28	<i>Beneficial</i>	Impacts positively alter resource conditions, or facilitate or improve traditional access, site
29		preservation, or relationship between resource and traditionally associated group's body of
30		practices and beliefs. <i>Beneficial effects are usually described in terms of changes in impacts</i>
31		<i>compared to Alternative A</i>
32		
33	Context	
34		
35	<i>Localized</i>	Impacts restricted to specific sites
36		
37	<i>Regional</i>	Impacts occur to several specific resource sites or to one or more sites with cultural significance to
38		a large area of the general vicinity, or a single site with significance extending well beyond the
39		vicinity
40		
41	<i>Park</i>	Where appropriate, impacts on Ethnographic Resources analyzed consistent with park
42	<i>Management</i>	Management Zones
43	<i>Zone</i>	
44		
45	Duration	Ethnographic Resources
46		
47	<i>Short term</i>	Impacts that, in five years, no longer detectable as resource, access, site preservation, or
48		relationship returns to pre-disturbance condition or appearance
49		
50	<i>Long term</i>	Impacts do not allow resource, access, site preservation, or relationship to return to pre-
51		disturbance condition or appearance for more than five years, and/or for all practical purposes
52		would be considered permanent
53		

1 **Timing** Some traditional practices must be performed during specific times of year or season. Some
 2 Ethnographic Resources might be more vulnerable during spring growing season or at other times
 3 of year depending on tribal traditions.
 4

5 **ALTERNATIVE A** **NO ACTION** **ETHNOGRAPHIC RESOURCES**

6
 7 Under Alternative A, a range of aircraft noise intensities and audibility would affect Ethnographic Resources across
 8 the park and SFRA. Although Percent Time Audible and Average Sound Level would generally decrease Base Year
 9 to Ten-Year Forecast at all locations, impact intensity levels would be the same Base Year and Ten-Year Forecast.
 10

11 Traditional access and site preservation, prayers, ceremonies, and other cultural practices could be altered in nearly
 12 half the park and SFRA, Base Year and Ten-Year Forecast. As shown in Figure 4.6, 45% of the park would have
 13 air-tour aircraft Percent Time Audible greater than *or equal to* 25% of the day predominantly in East and West Ends
 14 under and near air-tour routes. Air-tour Average Sound Level would generally be low, less than 25 dBA, in about
 15 67% of the SFRA Base Year. Ten-Year Forecast aircraft noise would increase slightly in the park and SFRA.
 16 Greatest exposure to noise and visual impacts would occur East and West Ends under and adjacent to air-tour routes.
 17

18 *Marble Canyon* *Alternative A* *Ethnographic Resources*
 19 *Base and Ten-Year Forecast*

20 Based on noise modeling results including those shown in Tables 4.55 and 4.56, Marble Canyon would remain
 21 relatively quiet. The area on average would not be exposed to audible aircraft noise, and Average Sound Level
 22 would be less than 5 dBA. Steep canyon walls would reduce aircraft visibility, and aircraft would generally be
 23 more than 3,000 meters away from points on the ground. There would be negligible adverse visual and auditory
 24 impacts on Ethnographic Resources.
 25

26 Near **South Canyon** Location Point, aircraft Percent Time Audible would be 2 to 3% of the day with Average
 27 Sound Level 21 to 23 dBA. Near where fixed-wing Black routes intersect, aircraft would be closer than 1,000
 28 meters from points on the ground. This would result in noticeable aircraft sights and sounds that could intrude on
 29 traditional practices. However, these effects would be localized and intermittent, and would have negligible to
 30 minor long-term adverse impacts on Ethnographic Resources.
 31

32 **Table 4.55** **Alternative A** **Average Sound Level** **Marble Canyon**

Location Point Name	Alternative A			
	Percent Time Audible (Percent)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
South Canyon	2	3	21	23

35 **Table 4.56** **Alternative A** **Slant Distances** **Marble Canyon**

Location Point Name	Slant Distance (m)
South Canyon	816

36
 37
 38 *East End* *Alternative A* *Ethnographic Resources*
 39 *Base and Ten-Year Forecast*

40 As shown in Figures 4.6 and 4.7, greatest noise and visual impact exposure would occur East End where aircraft
 41 Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75%.
 42

43 Effects of air-tour aircraft on near **Little Colorado River** and **Nankoweap Mesa** Location Points would vary
 44 depending on proximity to Green-1 and Black-1. As shown in Tables 4.57 and 4.58, at Little Colorado River and
 45 **Temple Butte** Location Points air-tour aircraft Percent Time Audible would be 34 to 66% of the day at 37 to 43
 46 dBA. Aircraft would be greater than 1,400 meters away from points on the ground.
 47

1 The area near the Little Colorado River confluence is especially significant to the majority of tribes with Grand
2 Canyon cultural ties. Numerous historic and prehistoric routes (many still used by contemporary peoples) lead
3 into the canyon from this general area, and numerous special sites are in or adjacent to the canyon such as the
4 **Hopi** place of origin, Hopi Salt Mines, Zuni Pilgrimage Trail, and others. Quiet is needed for proper performance
5 of traditional activities such as singing, praying, contemplation, or healing ceremonies. Native people feel
6 interruptions may cause traditional ceremonies to be unsuccessful, and prayers may not have the desired effect.
7 Hualapai religious and ceremonial activities at Traditional Cultural Properties depend on an uninterrupted
8 viewshed so prayers can travel uninterrupted from one site to another (low aircraft flights should not block
9 prayers).

10 Some on-the-ground traditional activities may be visible from aircraft. As an example, native peoples or
11 individuals participating in pilgrimages to special places like the Hopi Salt Mines and Hopi place of origin,
12 Navajo worshipers engaging in traditional activities, or Hualapai who consider the canyon a physical and
13 spiritual landmark could be visible from aircraft. Onlookers from above may be highly distracting to traditional
14 practitioners, greatly reducing their sense of privacy and sanctity of worship. American Indians are also
15 concerned that curious onlookers may return later to a site, possibly damaging physical remains seen from the
16 air, increasing potential for unauthorized collecting or site damage. Fixed-wing aircraft and helicopters that make
17 a loop around the confluence area would be visible from the ground, and activities being conducted below would
18 be open to view from aircraft. Clarity of view and Average Sound Level would be reduced somewhat due to
19 aircraft elevation.

20
21
22 Existing curfews as described in Table 2.6 would have very slight benefits to Ethnographic Resources by
23 allowing practitioners to enter the canyon for traditional practices early in the morning while it is still cool and
24 quiet. However, timing and location of traditional practices may or may not correspond to arbitrary curfew times.
25 In addition, due to difficult terrain and time necessary to access areas in or adjacent to canyons, curfews would
26 generally not allow sufficient time to complete necessary religious activities during a quiet period.

27
28 At the confluence, as shown by the **Little Colorado River** Location Point in Tables 4.57 and 4.58, aircraft
29 Percent Time Audible would be 34 to 37% of the day at Average Sound Level of 43 dBA. Although air-tour
30 noise would be audible a high percent of the day at a noticeable level, this would not be expected to inhibit
31 survival of a group's practices and beliefs. This effect would be somewhat moderated by aircraft flying more
32 than 1,600 meters away from points on the ground, and by noise masking from ambient river sounds which
33 would tend to reduce these effects. Thus long-term adverse impacts on Ethnographic Resources in the confluence
34 area would be moderate.

35
36 **Little Colorado and Nankoweap River** Location Points would be farther away from air-tour routes, and air-
37 tour aircraft Percent Time Audible would be one to 8% of the day where natural ambient Average Sound Level
38 near the river is 25 to 65 dBA. Aircraft Average Sound Level would be 25 to 35 dBA. Aircraft would be more
39 than 1,400 meters away from points on the ground. Ambient river noise would mask much aircraft noise, but the
40 human ear can distinguish among different sounds, allowing aircraft to be heard. Adverse impacts from aircraft
41 on Ethnographic Resources would be long term minor. This is because river noise would mask some aircraft
42 noise, noise would be infrequent and sporadic, and there would be increased distance from aircraft.

43
44 Although the **Desert View** area is in Desert View Flight-free Zone, it contains developed areas and is near Zuni
45 Point Corridor. The area provides many opportunities for overlooking the canyon, and contains Tusayan
46 Museum, which houses cultural resources. Impacts to Ethnographic Resources in the vicinity could result from
47 aircraft Percent Time Audible of 76 to 79% of the day at Average Sound Level of 29 to 30 dBA. Aircraft would
48 be more than 5,000 meters away from points on the ground. The Bright Angel Point area is valued by visitors for
49 its spectacular viewsheds and trails affording canyon access. **Bright Angel Point** Location Point also represents
50 an area of ethnographic sites of special importance to American Indians; Bright Angel Trail was originally an
51 American Indian trail that afforded native people canyon access. Bright Angel Point Location Point would have
52 aircraft Percent Time Audible 47 to 48% of the day at Average Sound Level of 24 dBA. Aircraft would be
53 visible at distances greater than 6,000 meters. While some noise would be audible for nearly half the 12-hour
54 day, aircraft Average Sound Level and Distance would be less than other locations described above. Thus
55 impacts to Ethnographic Resources would be long term minor to moderate adverse.

In Alternative A, **Pasture Wash** Location Point reflects ethnographic sites in Toroweap/Shinumo Flight-free Zone's eastern portion, which is bounded by Dragon Corridor on the east and Fossil Canyon Corridor on the west. At Toroweap/Shinumo Flight-free Zone's eastern edge at **Pasture Wash** Location Point, aircraft Percent Time Audible would be 98% (virtually all day), but Distance (about 5,500 meters) and relatively low aircraft Average Sound Level of 20 to 21 dBA would result in long-term minor adverse impacts.

Table 4.57 Alternative A Average Sound Level East End

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
North Rim				
Bright Angel Point	47	48	24	24
Zuni Point Corridor				
Temple Butte	62	66	37	38
Little Colorado River/Nankoweap Area				
Little Colorado	1	1	25	25
Little Colorado River	34	37	43	43
Nankoweap River	7	8	34	35
Toroweap/Shinumo Flight Free Zone				
Pasture Wash	98	98	20	21

Table 4.58 Alternative A Slant Distances East End

Location Point Name	Slant Distance (m)
North Rim	
Bright Angel Point	6,235
Zuni Point Corridor	
Temple Butte	1,458
Little Colorado River/Nankoweap Area	
Little Colorado	1,637
Little Colorado River	1,620
Nankoweap River	1,449
Toroweap/Shinumo Flight Free Zone	
Pasture Wash	5,532

Central

Alternative A

Ethnographic Resources

Base Year and Ten-Year Forecast

As shown Figures 4.6 and 4.7, the **Central** area would be relatively quiet with little intrusion of air-tour aircraft sights and sounds. Based on modeled noise results, air-tour aircraft Average Sound Level would be generally less than 10 dBA, and Percent Time Audible would be less than 20%.

In the **Central** area, Ethnographic Resources would be least affected by aircraft-overflight noise. This area includes **Toroweap/Shinumo Flight-free Zone**, and is transected by two general-aviation corridors. In this remote part of the park, Percent Time Audible at **Upper Deer Creek, Surprise Valley, Mohawk Canyon, and Grid Location Point 08** Location Points would range one to 3%, with Average Sound Level zero to 11 dBA, a negligible effect. With exception of **Mohawk Canyon** Location Point where Distance would be a little over 3,000 meters, Central area visual effects would also be negligible because Distance from these points would range 13,000 to 25,500 meters.

1 **Table 4.59** **Alternative A** **Average Sound Level** **Central**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Grid Location Point 8	3	3	10	10
Mohawk Canyon	1	1	11	12
Surprise Valley	1	1	0	0
Upper Deer Creek	1	1	1	1

2 **Table 4.60** **Alternative A** **Slant Distances** **Central**

Location Point Name	Slant Distance (m)
Grid Location Point 8	13,765
Mohawk Canyon	3,009
Surprise Valley	25,500
Upper Deer Creek	23,683

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West End **Alternative A** **Ethnographic Resources**
Base Year and Ten-Year Forecast

Under Alternative A, a range of aircraft noise intensities and audibility would affect West End Ethnographic Resources. This area includes both extensive helicopter traffic for river access and Sanup Flight-free Zone. Based on modeled noise results, as shown in Figures 4.6 and 4.7, in **West End's northern portion**, aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%. In **West End's southern portion** under Sanup Flight-free Zone, farther removed from air-tour routes, impacts would be less with Average Sound Level 10 to 20 dBA and Percent Time Audible less than 20%.

The Hualapai revere the Colorado River as a significant spiritual landmark. **Meriwhitca Canyon** is also considered sacred, and this Location Point reflects numerous traditional ceremonial and other cultural sites the Hualapai use and monitor. Meriwhitca and **Granite Peak** Location Points have air-tour aircraft Percent Time Audible zero to 2% with Average Sound Level 7 to 18 dBA. Distance from aircraft to points on the ground would be more than 2,000 meters so, generally speaking, visual impacts would not be of primary concern. Adverse impacts to Ethnographic Resources would be long term negligible.

Ethnographic Resources and activities near **Burnt Springs Canyon** Location Point could be under Green-4 and Black-2 and would have aircraft Percent Time Audible 70% and Average Sound Level 46 dBA Base Year, increasing by one dBA Ten-Year Forecast. Aircraft would be within 1,300 meters of points on the ground. This sight Distance could be of concern to the Hualapai who believe a clear line of sight is needed for prayers to move uninterrupted from one site to another. Impacts to Ethnographic Resources would be long term moderate adverse.

1 **Table 4.61 Alternative A Average Sound Level West End**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Burnt Springs Canyon	70	75	46	47
Granite Peak	2	2	17	18
Meriwhitca	0	1	7	8
Pumpkin Springs	0	0	7	8

2 **Table 4.62 Alternative A Slant Distance West End**

Location Point Name	Slant Distance (m)
Burnt Springs Canyon	1,215
Granite Peak	5,264
Meriwhitca	15,742
Pumpkin Springs	12,630

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4
5 **Cumulative Impacts Alternative A Ethnographic Resources**

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7 Area of Potential Effect for this EIS is located in the Study Area as defined in Chapter 1, *and Ethnographic Resources as described in Chapter 3.*

8
9
10 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Ethnographic Resources from sounds of*

- 11
12 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
13 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
14 *3) ground-based noise sources, plus*
15 *4) noise from air-tour-and-related aircraft under Alternative A*

16
17 *That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).*

18
19 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the SFRA see Appendix D, Figures 91 to 94).*

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25 *On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person (some people are greatly bothered by high-altitude aircraft, some are not bothered at all, and most fall somewhere in-between). However, when high-altitude aircraft noise is added to all other intrusive noises and visual distractions present in and near the park, the resulting effect can diminish focus and sense of introspection of*
26
27 *American Indian religious practitioners. Tribes have also voiced concerns when sacred places are pointed out to visitors during an air tour, feeling this information might increase potential for on-the-ground damage at a later time. In locations close to the river, noise from aircraft above and outside the SFRA would be less noticeable, resulting in fewer impacts on practitioners and Ethnographic Resources. Potential for adverse impacts from aircraft increases at higher elevations on the ground (aircraft are more visible and more audible).*

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35 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts Ethnographic Resources, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
36

1 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
2 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
3 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
4 *Audible capable of masking some aircraft noise.*

5
6 *Quieter, less-used areas may be revered by native people, and can be disturbed by those hiking into them. All*
7 *these noises and visual intrusions combine to create distractions and lack of privacy for traditional practitioners.*

8
9 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
10 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
11 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
12 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
13 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
14 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
15 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
16 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
17 *Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the*
18 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*

19
20 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
21 *(Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
22 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
23 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
24 *(Alternative A in this case).*

25
26 *Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in*
27 *Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is*
28 *detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year*
29 *Forecast. Noise from ground-based sources was not able to be included in noise modeling for the EIS; however,*
30 *since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of*
31 *the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in*
32 *interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas*
33 *north of the park.*

34
35 *Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All*
36 *Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the*
37 *difference between Cumulative Impacts and impacts of Alternative A by itself. For the Entire Park Cumulative*
38 *Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the park, with*
39 *Average Sound Level 25 to <35 dBA in 85% of the park, with none of the park below 25 dBA, and 24% at 35 dBA*
40 *or more. For the Entire Park results for Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or*
41 *more of the day in 27% of the park, with Average Sound Level 25 to <35 dBA in 28% of the park, with 50% of the*
42 *park below 25 dBA, and 22% at 35 dBA or more.*

43
44 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
45 *including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour*
46 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
47 *impacts under the Alternatives reduces Cumulative Impacts.*

48
49 *When intrusive sounds are present more than half a day, practitioners might not have time to access sites or*
50 *complete prayers or other activities during a period of quiet. Additionally, places such as Bright Angel Point have*
51 *relatively high-visitation levels, contributing adverse impacts from noise and lack of privacy. However, although*
52 *aircraft and/or other intrusions would be audible large portions of the day in many areas, and traditional*
53 *practices frequently interrupted, a group's body of practices and beliefs would be expected to survive.*

54
55 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
56 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*

1 *Alternative (route locations/number/altitudes/quiet-technology conversion, etc.). When added to noise impacts of*
 2 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 3 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
 4 *in the Conclusions section below.*

6 Conclusion	Alternative A	Ethnographic Resources
7		
8 <i>Conclusion Marble Canyon</i>	<i>Alternative A</i>	<i>Ethnographic Resources</i>
9	Alternative A would result in long-term negligible to minor adverse impacts to Ethnographic Resources.	
10		
11 <i>Conclusion East End</i>	<i>Alternative A</i>	<i>Ethnographic Resources</i>
12	Alternative A would result in long-term minor to moderate adverse impacts to Ethnographic Resources.	
13		
14 <i>Conclusion Central</i>	<i>Alternative A</i>	<i>Ethnographic Resources</i>
15	Alternative A would result in negligible adverse impacts to Ethnographic Resources at Central area Location Points.	

16		
17 <i>Conclusion West End</i>	<i>Alternative A</i>	<i>Ethnographic Resources</i>
18	Alternative A would result in moderate adverse impacts to Ethnographic Resources at Location Points under Green-	
19	4 and Black-2. Negligible adverse impacts would result at Location Points near Meriwhitca and Granite Peak.	

21 Cumulative Impacts Summary	Alternative A	Ethnographic Resources
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22

23 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 24 *impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts in*
 25 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections of the park (Marble Canyon, East*
 26 *End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour*
 27 *routes, and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
 28 *comparison with the other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts*
 29 *(Alternative E ranks first in lowest Cumulative Impacts).*

31 ALTERNATIVE E	ALTERNATING SEASONAL USE	ETHNOGRAPHIC RESOURCES
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32

33 Changes in impact of air-tour aircraft noise are analyzed Base Year and Ten-Year Forecast. air-tour aircraft Percent
 34 Time Audible changes at some Location Points over Ten-Year Forecast as noted below.

35

36 Alternative E would increase park area beneath Flight-free Zones by alternating seasonal use of Zuni Point and
 37 Dragon Corridors, and by extending Bright Angel Flight-free Zone north to include Marble Canyon. A range of air-
 38 tour aircraft noise would continue to affect Ethnographic Resources throughout the park and SFRA. Seasonal route
 39 closures would decrease air-tour aircraft noise, resulting in beneficial changes to traditional practices on East End.
 40 Alternative E would also implement quiet technology and a maximum seven-hour flight time over eastern portions
 41 of the park further reducing adverse impacts Ten-Year Forecast.

42

43 Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area exposed
 44 to high Average Sound Level for long periods of the day. As shown in Figures 4.11 and 4.13, Ten-Year Forecast the
 45 majority of the SFRA (68% Peak Season, 71% Off-Peak Season) would have air-tour aircraft noise Percent Time
 46 Audible less than 5% of the day. Amount of area exposed to air-tours Percent Time Audible greater than *or equal to*
 47 25% of the day would be reduced to 16% and 14%, Peak and Off-Peak Seasons respectively, compared to 47% of
 48 the park in Alternative A. This would result in greatly reduced impacts on resources with greater areas of the park
 49 and SFRA protected from air-tour aircraft sights and sounds. Traditional access, site preservation, and the
 50 relationship between Ethnographic Resources and a group's body of practices and beliefs would be substantially
 51 improved.

1 ***Marble Canyon*** ***Alternative E*** ***Ethnographic Resources***

2

3 Based on modeled noise results, as shown in Tables 4.63 and 4.64, in 100% of Marble Canyon, aircraft Percent
4 Time Audible would be 5% or less. The entire area would experience Average Sound Level of 15 dBA or less.

5

6 ***Marble Canyon*** ***Alternative E*** ***Ethnographic Resources***

7 ***All Scenarios***

8 **Marble Canyon ethnographic Location Points** would be quieter than in Alternative A. Elimination of air-tour
9 routes by extension of Bright Angel Flight-Free Zone to include Marble Canyon would reduce in-canyon noise
10 and aircraft visibility. Air-tour aircraft Percent Time Audible would be less than Alternative A at less than one
11 percent, and Average Sound Level would be zero. No air-tour routes would be visible from points on the ground,
12 including Ethnographic Resources reflected by **South Canyon** Location Point. Improvements over Alternative A
13 would result in aircraft sights and sounds that would adversely affect Ethnographic Resources less than
14 Alternative A. Although negligible impacts would occur, there would be minor long-term beneficial changes in
15 impacts compared with Alternative A.

16

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1 **Table 4.63 Alternative E Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Alternative E															
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
South Canyon	2	3	21	23	0	-2	0	-2	0	-21	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3

4 **Table 4.64 Alternative E Slant Distances Marble Canyon**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
South Canyon	816		26,091	25,275

Δ indicates change in noise metric data from Alternative A

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East End *Alternative E* *Ethnographic Resources*

Under Alternative E, greatest exposure to noise and visual impacts would continue East End. Modeled noise results shown in Figures 4.10 to 4.13 indicate high levels of air-tour sounds (40 to 50 dBA) would occur frequently throughout the day (greater than 75% of the time) under and adjacent to active air-tour routes. However, air-tour sounds would be reduced beneath Dragon Corridor due to Peak Season closure and conversely, beneath Zuni Point Corridor Off-Peak Season resulting in substantial beneficial effects compared to Alternative A. Curfews included in Alternative E would benefit traditional practitioners in East End by reducing daily air-tour operating times by three hours. Because Alternative E includes quiet-technology incentives and conversion requirements, opportunities to access traditional sites and conduct traditional practices without disturbance from air-tour sounds would increase Base Year to Ten-Year Forecast across the Study Area as a whole. Beneficial changes would be seen in both Percent Time Audible and Average Sound Level.

East End *Alternative E* *Ethnographic Resources*
Base Year Peak Season

Effects of air-tour aircraft on ethnographic Location Points near **Little Colorado River** and **Nankoweap Mesa** would be similar to Alternative A. As shown in Tables 4.65 and 4.66, Peak Season Base Year, Little Colorado River and **Temple Butte** Location Points would have air-tour aircraft Percent Time Audible 36 to 75% of the day, and somewhat lower aircraft Average Sound Level of 39 and 38 dBA. Aircraft would be slightly closer to these ethnographic sites than in Alternative A, and between 1,000 and 2,000 meters away from points on the ground. Visual and auditory impacts on Ethnographic Resources from aircraft would occur because flight patterns would continue to loop around the Little Colorado confluence area. Native people would still have concerns about overhead observation of religious activities, the possibility of aircraft interfering with the path of prayers, and interruptions of prayers and traditional activities due to aircraft noise. Procurement of plants and other natural resources and the accompanying religious activities could be delayed or interrupted because of visibility and intrusive noise. These effects may cause some practitioners to abandon traditionally used sites; however, the relationship between the resource and the group's body of practices and beliefs would be expected to remain viable. Moderate adverse impacts would occur with a negligible change in impact compared to Alternative A.

Close to the river, at **Little Colorado** and **Nankoweap River** Location Points, aircraft Average Sound Level would be approximately 12 dBA and, due to nearness of river sounds, Percent Time Audible would be less than one percent, a decrease of up to 7% compared to Alternative A. Visible aircraft would be 1,500 to 9,000 meters Distant. Negligible impacts would occur with long-term negligible to minor beneficial change in impacts compared to Alternative A.

With elimination of Green-1A/Black-1A along North Rim, **Bright Angel Point** Location Point would have aircraft Percent Time Audible 5% of the day, a 42% decrease from Alternative A, with Average Sound Level of 13 dBA, an 11 dBA decrease. Aircraft would be visible at Distances greater than 2,000 meters. Bright Angel Point area is one of the park's more heavily visited areas where visitor-use noise also contributes to the amount of sound. Negligible impacts would occur with long-term moderate beneficial change in impacts to Ethnographic Resources compared to Alternative A.

At Toroweap/Shinumo Flight-free Zone's eastern edge at **Pasture Wash** Location Point, aircraft Percent Time Audible Peak Season would be 28%, a 70% decrease compared to Alternative A as a result of inactive Dragon Corridor routes. Aircraft Average Sound Level of 16 dBA would be a slight decrease from Alternative A levels. Although minor adverse impacts would occur, there would be long-term moderate beneficial impacts compared to Alternative A.

East End *Alternative E* *Ethnographic Resources*
Base Year Off-Peak Season

There would be little change at **Little Colorado** and **Nankoweap River** Location Points in amount of time aircraft would be audible compared to Alternative A. However, Average Sound Level would be reduced to less than one to 11 dBA, a 23 to 25 dBA decrease from Alternative A. Number of aircraft visible overhead (and accompanying noise) would be diminished due to elimination of Nankoweap loop on Green-1. At Little Colorado River and **Temple Butte** Location Points, air-tour aircraft Percent Time Audible would be less than one percent of the day, a 62% decrease at Temple Butte. Aircraft Average Sound Level would be 6 and 7 dBA, a

1 32 to 36 dBA decline from Alternative A. When audible, air-tour aircraft noise would be low. In most cases,
 2 traditional activities could be conducted without interference. Negligible impacts would occur with long-term
 3 minor to moderate change in beneficial impacts compared to Alternative A.
 4

5 When **Dragon Corridor** routes would be active, aircraft Percent Time Audible would be 80% of the day, a 19%
 6 decrease compared to Alternative A. Aircraft Average Sound Level of 20 dBA would be similar to Alternative
 7 A. Aircraft would be visible during this time similar to Alternative A, greater than 2,000 meters from locations
 8 on the ground. A number of American Indian religious activities require a lengthy period without interruption.
 9 Thus, 80% daytime audibility would make it difficult to successfully complete prayers, singing, or other
 10 traditional activities where quiet is vital. Near continual interruption of prayers may cause practitioners to seek
 11 other, more private areas. Some religious ceremonies are site-specific so there could be times when practitioners
 12 could not be assured freedom from aircraft noise. Although these moderate adverse impacts would occur under
 13 Alternative E, there would be minor to moderate beneficial change in impacts compared to Alternative A.
 14

15 At **Bright Angel Point** Location Point impacts would be similar to those described Base Year Peak Season.
 16

17 *East End* *Alternative E* *Ethnographic Resources*
 18 *Ten-Year Forecast Peak Season*

19 Impacts would be similar to Base Year Peak Season at **Little Colorado, Nankoweap River, Little Colorado**
 20 **River** and **Temple Butte** Location Points, although Percent Time Audible would decrease to 30% and 57%. At
 21 **Bright Angel Point** and **Pasture Wash** Location Points impacts would be similar to Base Year Peak Season.
 22

23 *East End* *Alternative E* *Ethnographic Resources*
 24 *Ten-Year Forecast Off-Peak Season*

25 At **Little Colorado, Nankoweap River, Little Colorado River** and **Temple Butte** Location Points, impacts
 26 would be similar to Base Year Off-Peak Season. Air-tour aircraft Percent Time Audible at **Pasture Wash**
 27 Location Point would decline to 31% of the day, a 67% decrease from Alternative A. Average Sound Level
 28 would decrease to 18 dBA. Although minor to moderate adverse impacts would occur under Alternative E at
 29 these location points, there would be minor to moderate beneficial change in impacts compared to Alternative A.
 30 At **Bright Angel Point** Location Point impacts would be similar to Base Year Peak Season.

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1 **Table 4.65 Alternative E Average Sound Level East End**

Location Point Name	Alternative E																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Time Level (dBA)				Percent Time Audible (%)				Average Time Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
North Rim																				
Bright Angel Point	47	48	24	24	5	-42	1	-47	13	-11	11	-13	1	-46	1	-47	11	-13	11	-13
Zuni Point Corridor																				
Temple Butte	62	66	37	38	75	12	57	-10	38	1	35	-2	1	-62	1	-66	6	-32	6	-32
Little Colorado River/Nankoweap Area																				
Little Colorado	1	1	25	25	0	-1	0	-1	12	-13	8	-17	0	-1	0	-1	0	-25	0	-25
Little Colorado River	34	37	43	43	36	2	30	-8	39	-4	34	-4	0	-34	0	-37	7	-36	7	-36
Nankoweap River	7	8	34	35	0	-7	0	-8	12	-23	12	-23	0	-7	0	-8	11	-23	12	-23
Toroweap/Shinumo Flight Free Zone																				
Pasture Wash	98	98	20	21	28	-70	31	-67	16	-5	7	-4	80	-19	31	-67	20	-1	18	-3

Δ indicates change in noise metric data from Alternative A.
Forecast indicates Ten-Year Forecast

2
3 **Table 4.66 Alternative E Slant Distances East End**
4

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
North Rim				
Bright Angel Point	6,235	9,323	3,287	
Zuni Point Corridor				
Temple Butte	1,458	1,038	-420	
Little Colorado River/Nankoweap Area				
Little Colorado	1,637	1,550	-87	
Little Colorado River	1,629	2,043	413	
Nankoweap River	1,449	9,063	7,615	
Toroweap/Shinumo Flight Free Zone				
Pasture Wash	5,532	10,990	5,458	

Δ indicates the change in noise metric data from Alternative A

1	Central	Alternative E	Ethnographic Resources
2			
3	Based on modeled noise results shown in Figures 4.10 to 4.13, in the Central area, there would be little change from		
4	Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 10 dBA and		
5	aircraft Percent Time Audible less than 5% of the time.		
6			
7	<i>Central</i>	<i>Alternative E</i>	<i>Ethnographic Resources</i>
8	<i>Base Year Peak Season</i>		
9	Similar to Alternative A, Ethnographic Resources and values throughout most of Central area would be least		
10	affected by aircraft noise. As shown in Table 4.67 and Table 4.68, at Location Points Upper Deer Creek,		
11	Surprise Valley, Mohawk Canyon, and Grid Location Point 08 when Dragon Corridor would not be in use,		
12	aircraft would be audible about one percent of the day, with aircraft Average Sound Level zero to 9 dBA.		
13	Aircraft would not be greatly visible from locations on the ground as they would range 3,000 to 26,000 meters		
14	away. Negligible impacts would occur with negligible change from Alternative A.		
15			
16	<i>Central</i>	<i>Alternative E</i>	<i>Ethnographic Resources</i>
17	<i>Ten-Year Forecast Peak and Off-Peak Season</i>		
18	<i>Base Year Off-Peak Season</i>		
19	Impact levels would be the same as Peak Season Base Year.		

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1 **Table 4.67 Alternative E Average Sound Level Central**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Time Level (dBA)				Percent Time Audible (%)				Average Time Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Grid Location Point 8	3	3	10	10	1	-2	1	-2	9	-1	10	0	2	-1	1	-2	10	1	11	1
Mohawk Canyon	1	1	11	12	0	-1	0	-1	8	-4	8	-4	0	-1	0	-1	8	-3	8	-3
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	0	1	1	1	0	1	0	0	-1	0	-1	0	1	0	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.68 Alternative E Slant Distances Central

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Grid Location Point 8	13,765	14,603	838
Mohawk Canyon	3,009	3,009	0
Surprise Valley	25,500	26,216	716
Upper Deer Creek	23,683	24,049	366

Δ indicates change in noise metric data from Alternative A

5
6
7

1 **West End** **Alternative E** **Ethnographic Resources**

2
3 Based on modeled noise results shown in Figures 4.10 to 4.13, West End air-tour routes near Blue-2 and Green-4
4 would continue to have localized long-term adverse impacts as aircraft Average Sound Level would be 40 to 50
5 dBA and Percent Time Audible would be greater than 65% of the time, similar to Alternative A. For areas near Blue
6 Direct, area of audibility would be reduced by approximately 50% due to the short distance the route travels over the
7 park resulting in substantial beneficial effects on traditional cultural practices in this portion of the park.

8
9 *West End* *Alternative E* *Ethnographic Resources*
10 *Base Year Peak Season*

11 Ethnographic Resources at **Meriwhitca** and **Granite Peak** Location Points would continue to have air-tour
12 aircraft impacts similar to Alternative A (audible a very short period and relatively low dBA). Negligible impacts
13 to Ethnographic Resources would occur with negligible change in impact compared to Alternative A.

14
15 **Burnt Springs Canyon** Location Point would be under Green-4/Black-2 routes, and adverse impacts to
16 Ethnographic Resources would be similar to those described in Alternative A. As shown in Table 4.69 and 4.70,
17 aircraft Percent Time Audible under these routes would be 70% at Average Sound Level 46 to 47 dBA. The
18 closest air-tour aircraft to the ground would be near Burnt Springs Canyon Location Point at 1,215 meters.
19 Adverse impacts would result from lack of a clear line of sight for prayers (visual effects), and from aircraft
20 noise that would interrupt traditional practices, possibly forcing religious leaders to move to another area. If
21 traditional practices are site-specific, and noise is too intrusive, relationship between resources and American
22 Indian practices and beliefs could be appreciably altered in this area; however, a group's practices and beliefs
23 would be expected to continue to survive. Moderate adverse impacts would occur with negligible change in
24 impacts from Alternative A.

25
26 *West End* *Alternative E* *Ethnographic Resources*
27 *Base Year Off-Peak Season*

28 Impacts at **Meriwhitca**, **Granite Peak**, and **Burnt Springs Canyon** Location Points would be similar to those
29 described Base Year Peak Season.

30
31 *West End* *Alternative E* *Ethnographic Resources*
32 *Ten-Year Forecast Peak Season*

33 Aircraft Percent Time Audible at **Burnt Springs Canyon** Location Point would be 62%, a 13% decrease
34 compared to Alternative A, and Average Sound Level would decrease to 43 dBA, a 4 dBA decrease. Modest
35 levels of air-tour aircraft background noise would be present for large portions of the day, resulting in frequent
36 interference with traditional cultural practices. Moderate adverse impacts would occur with negligible to minor
37 beneficial change in impacts compared to Alternative A. Impacts at **Meriwhitca** and **Granite Peak** Location
38 Points would be similar to Peak Season Base Year.

39
40 *West End* *Alternative E* *Ethnographic Resources*
41 *Ten-Year Forecast Off-Peak Season*

42 Impacts at **Burnt Springs Canyon**, **Meriwhitca** and **Granite Peak** Location Points would be similar to Base
43 Year Peak Season.

1 **Table 4.69 Alternative E Average Sound Level West End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Time Level (dBA)		Percent Time Audible (%)				Average Time Level (dBA)							
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	70	0	62	-13	46	0	43	-4	76	6	67	-8	47	1	44	-3
Granite Peak	2	2	17	18	2	0	2	0	15	-2	16	-2	2	0	2	0	15	-2	16	-2
Meriwhitca	0	1	7	8	0	0	1	0	7	0	7	0	2	1	1	0	8	1	8	1
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	0	0	0	0	0	7	0	8	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

4 **Table 4.70 Alternative E Slant Distances West End**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Burnt Springs Canyon	1,215	0	1,215	0
Granite Peak	5,264	0	16,588	11,324
Meriwhitca	15,742	0	7,833	-9,909
Pumpkin Springs	11,630	0	22,337	9,707

Δ indicates change in noise metric data from Alternative A

5
6

1 **Cumulative Impacts** **Alternative E** **Ethnographic Resources**

2
3 *Area of Potential Effect for this EIS is located in the Study Area as defined in Chapter 1, and Ethnographic*
4 *Resources as described in Chapter 3.*

5
6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
7 *actions. In this context, Cumulative Impacts include impacts on Ethnographic Resources from sounds of*

- 8 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
9 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
10 *3) ground-based noise sources, plus*
11 *4) noise from air-tour-and-related aircraft under Alternative E*

12
13 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 (Alternative E).*

14
15 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
16 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
17 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
18 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
19 *SFRA see Appendix D, Figures 91 to 94).*

20
21 *On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person*
22 *(some people are greatly bothered by high-altitude aircraft, some are not bothered at all, and most fall somewhere*
23 *in-between). However, when high-altitude aircraft noise is added to all other intrusive noises and visual*
24 *distractions present in and near the park, the resulting effect can diminish focus and sense of introspection of*
25 *American Indian religious practitioners. Tribes have also voiced concerns when sacred places are pointed out to*
26 *visitors during an air tour, feeling this information might increase potential for on-the-ground damage at a later*
27 *time. In locations close to the river, noise from aircraft above and outside the SFRA would be less noticeable,*
28 *resulting in fewer impacts on practitioners and Ethnographic Resources. Potential for adverse impacts from*
29 *aircraft increases at higher elevations on the ground (aircraft are more visible and more audible).*

30
31 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
32 *Ethnographic Resources, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
33 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
34 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
35 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
36 *Audible capable of masking some aircraft noise.*

37
38 *Quieter, less-used areas may be revered by native people, and can be disturbed by those hiking into them. All*
39 *these noises and visual intrusions combine to create distractions and lack of privacy for traditional practitioners.*

40
41 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
42 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
43 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
44 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
45 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
46 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
47 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
48 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
49 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
50 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*

51
52 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
53 *(Alternative E compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
54 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
55 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
56 *(Alternative E in this case).*

1 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 2 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
 3 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
 4 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 5 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 6 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 7 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 8 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

9
 10 *Comparing noise impacts from just Alternative E by itself (Appendix D Tables 16 (Peak Season) and 21 (Off-*
 11 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative E plus 1 plus 2) (Appendix D Tables 49 (Peak*
 12 *Season) and 53 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*
 13 *Cumulative Impacts and the impacts of Alternative E by itself. For the Entire Park Cumulative Impact results*
 14 *(Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 83% of the*
 15 *park, with Average Sound Level 25 to <35 dBA in 92 to 93% of the park, with 1% of the park below 25 dBA and 6*
 16 *to 7% at 35 dBA or more. For the Entire Park results for Alternative E by itself (Peak and Off-Peak Season Ten-*
 17 *Year Forecast), aircraft are audible 60% or more of the day in 3% of the park, with Average Sound Level 25 to*
 18 *<35 dBA in 6 to 9% of the park, with 74 to 81% of the park below 25 dBA and 5% at 35 dBA or more.*

19
 20 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 21 *including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour*
 22 *routes; (b) Cumulative Impacts increase the impacts of Alternative E, and (c) reducing air-tour-and-related*
 23 *impacts under the Alternatives reduces Cumulative Impacts.*

24
 25 *When intrusive sounds are present more than half a day, practitioners might not have time to access sites or*
 26 *complete prayers or other activities during a period of quiet. Additionally, places such as Bright Angel Point have*
 27 *relatively high-visitation levels, contributing adverse impacts from noise and lack of privacy. However, although*
 28 *aircraft and/or other intrusions would be audible large portions of the day in many areas, and traditional*
 29 *practices frequently interrupted, a group's body of practices and beliefs would be expected to survive.*

30
 31 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 32 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 33 *Alternative (route locations/number/altitudes, quiet technology conversion, etc.). When added to noise impacts of*
 34 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 35 *described for Alternative E would generally increase by one level as shown in the Cumulative Impacts discussion*
 36 *in the Conclusions section below.*

37 Conclusions

Alternative E

Ethnographic Resources

38
 39
 40 Overall in the park and SFRA, Base Year and Ten-Year Forecast, Alternative E would result in beneficial change in
 41 impacts compared with Alternative A due to reduced amount of area exposed to high Average Sound Level for long
 42 periods of the day. Substantially reduced impacts of aircraft noise in both Percent Time Audible and Average Sound
 43 Level would result in the majority of the park and SFRA allowing for improved traditional access, preservation of
 44 sites, and enhanced relationships between resources and an traditionally associated group's body of practices and
 45 beliefs. The majority of the SFRA would have air-tour aircraft noise Percent Time Audible less than 5% of the day,
 46 and air-tour aircraft Average Sound Level less than 15 dBA. Because Alternative E includes quiet-technology
 47 incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast.

48 49 *Conclusion Marble Canyon* 50 *All Scenarios*

Alternative E

Ethnographic Resources

51 Alternative E would reduce aircraft sights and sounds that would adversely affect Ethnographic Resources as a
 52 result of expansion of Bright Angle Flight-free Zone to include Marble Canyon. As a result there would be
 53 negligible impacts with minor long-term beneficial change in impacts compared with Alternative A Base Year and
 54 Ten-Year Forecast.

1 *Conclusion East End* *Alternative E* *Ethnographic Resources*
 2 *Base Year and Ten-Year Forecast Peak Season*

3 Peak Season Base Year at Little Colorado River and Temple Butte Location Points, there would be moderate
 4 adverse impacts with negligible change in impacts from air-tour aircraft on Ethnographic Resources compared to
 5 Alternative A.

6
 7 At Little Colorado and Nankoweap River Location Points negligible impacts from air-tour aircraft would continue
 8 with long-term negligible to minor beneficial change in impacts compared to Alternative A. Bright Angel Point
 9 Location Point would have negligible impacts with long-term moderate beneficial change in impacts compared to
 10 Alternative A. Pasture Wash Location Point would have minor adverse impacts with moderate beneficial change in
 11 impacts compared to Alternative A.

12
 13 *Conclusion East End* *Alternative E* *Ethnographic Resources*
 14 *Base Year and Ten-Year Forecast Off-Peak Season*

15 At all East End ethnographic Location Points, negligible to moderate adverse impacts from air-tour aircraft would
 16 continue but there would be a long-term minor to moderate beneficial change in impacts compared to Alternative A.

17
 18 *Conclusion Central* *Alternative E* *Ethnographic Resources*
 19 *Base Year and Ten-Year Forecast Peak and Off-Peak Season*

20 Alternative E would result in negligible impacts with negligible change in impacts to Ethnographic Resources at
 21 most Central area Location Points compared to Alternative A.

22
 23 *Conclusion West End* *Alternative E* *Ethnographic Resources*
 24 *All Scenarios*

25 Alternative E would result in negligible impacts with negligible changes in impacts, both visual and auditory, to
 26 Ethnographic Resources at West End Location Points away from air-tour routes. Other West End Location Points
 27 under and near Green-4/Black-2 routes would have negligible to moderate adverse impacts with negligible to minor
 28 beneficial change in impacts compared to Alternative A.

29
 30 *Cumulative Impacts Summary* *Alternative E* *Ethnographic Resources*

31
 32 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 33 *impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts in*
 34 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections of the park (Marble Canyon, East*
 35 *End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour*
 36 *routes, and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
 37 *comparison with the other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts followed*
 38 *by Modified NPS Preferred Alternative and Alternative F (Alternative A ranks last).*

39
 40 **ALTERNATIVE F** **MODIFIED CURRENT CONDITIONS** **ETHNOGRAPHIC RESOURCES**

41
 42 Base Year in the park and SFRA, Alternative F would result in negligible changes in impacts compared with
 43 Alternative A. With quiet-technology incentives and conversion requirements, noise impacts would decrease Ten-
 44 Year Forecast. Traditional cultural practices, site access and preservation, and the relationship between resources
 45 and a group's practices and beliefs would be interfered with or altered in nearly half the park and SFRA. Nearly
 46 50% of the park would have air-tour aircraft Percent Time Audible greater than or *equal to* 25% of the day
 47 predominantly in East and West Ends under and near air-tour routes.

48
 49 Ten-Year Forecast Peak Season Percent Time Audible would decrease to 34%. Off-Peak Season, it would be
 50 reduced to 25% of the park.

51
 52 Peak and Off-Peak Seasons Base Year and Ten-Year Forecast, average air-tour Average Sound Level would
 53 generally be low, less than 25 dBA, in about 68 to 70% of the SFRA.

54
 55 Greatest exposure to noise and visual impacts would occur in East End and West End's western portions nearest air-
 56 tour routes. In Marble Canyon, Central areas, and West End's southern portions, traditional cultural practices and

1 cultural sites would be least impacted by air-tour operations. Because Alternative F includes quiet-technology
 2 incentives and conversion, noise impacts would decrease from Base Year to Ten-Year Forecast.

3
 4 **Marble Canyon**

Alternative F

Ethnographic Resources

5
 6 Based on modeled noise results shown in Figures 4.18 to 4.21, Marble Canyon would remain relatively quiet with
 7 air-tour aircraft Percent Time Audible generally less than 5% of the time and Average Sound Level less than 15
 8 dBA. Ten-Year Forecast there would be a slight improvement in conditions compared to Alternative A. The area
 9 would remain relatively quiet, and traditional cultural practices could be conducted with few to no interruptions
 10 from air-tour aircraft.

11
 12 *Marble Canyon*

Alternative F

Ethnographic Resources

13 *All Scenarios*

14 As shown in Table 4.71, at **Marble Canyon Location Points**, effects of air-tour aircraft noise in Alternative F
 15 would be the same as Alternative A (relatively quiet with air-tour aircraft Percent Time Audible only about 2%
 16 of the day). Overhead visibility for those in the canyon would be reduced by the steep canyon walls, and for
 17 more distant aircraft, river sounds would help mask aircraft noise. Aircraft sights and sounds would affect
 18 Ethnographic Resources in the vicinity of **South Canyon** Location Point intermittently, particularly where fixed-
 19 wing flights on Black routes cross the canyon. There would be negligible impacts with negligible change in
 20 impacts compared to Alternative A.

21
 DRAFT
 Not Finalized
 FOIA Discretionary Release

1 **Table 4.71 Alternative F Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Time Level (dBA)				Percent Time Audible (%)				Average Time Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
South Canyon	2	3	21	23	2	0	2	0	21	0	21	-2	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.72 Alternative F Slant Distances Marble Canyon

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
South Canyon	816		822	7

Δ indicates change in noise metric data from Alternative A

DRAFT
Not Finalized
FOIA Discretionary Release

1 **East End** **Alternative F** **Ethnographic Resources**

2
3 Modifications to East End air-tour routes would be small resulting in Peak Season impacts similar to Alternative A.
4 As shown in Figures 4.18 to 4.21, Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time Audible
5 would be greater than 75% of the time.

6
7 Dragon Corridor's Off-Peak Season seven-mile western shift would essentially shift impacts seven-miles west. Due
8 to quiet-technology incentives and conversion, additional beneficial impacts would be expected from Base Year to
9 Ten-Year Forecast in both Percent Time Audible and Average Sound Level.

10 *East End* *Alternative F* *Ethnographic Resources*

11 *Base Year Peak Season*

12
13 Location Points near **Little Colorado River and Nankoweap Mesa** would be affected much the same as
14 described in Alternative A. Because so many of the cultural, geologic and natural features of the confluence area
15 are significant to tribes with ties to Grand Canyon, aircraft noise and visibility can intrude on performance of
16 traditional activities such as singing, praying, contemplation, resource gathering, or ceremonies. Native people
17 have concerns that such interruptions can result in unsuccessful traditional activities and ceremonies, and block
18 prayers or cause them to fail. Gathering of natural resources with accompanying traditional prayers also can be
19 delayed or interrupted, with adverse results. Concerns also have been raised over visibility (from aircraft) of
20 native people participating in pilgrimages or other traditional activities. Of special concern is the flight pattern
21 over the Confluence area.

22
23 There would be moderate adverse impacts with negligible change in impacts compared to Alternative A at **Little**
24 **Colorado River** and **Temple Butte** Location Points, as shown in Tables 4.73 and 4.74.

25
26 Impacts at the **Little Colorado** and **Nankoweap River** Location Points would be the same as Alternative A.
27 Aircraft Percent Time Audible would be one to 7% of the day at Average Sound Level of 25 to 34 dBA. Adverse
28 impacts from aircraft on Ethnographic Resources would occur with negligible change from Alternative A.

29
30 Effects of air-tour aircraft on Ethnographic Resources at **Bright Angel Point** Location Point would be similar to
31 those described for Alternative A. Aircraft Percent Time Audible would be 47% of the day at Average Sound
32 Level of 24 dBA. Aircraft would be visible at Distances greater than 6,000 meters. Minor to moderate adverse
33 impacts to Ethnographic Resources would occur with negligible change in impacts compared to Alternative A.

34
35 At **Toroweap/Shinumo Flight-free Zone's eastern edge at Pasture Wash** Location Point, effects of aircraft
36 would be similar or somewhat greater than Alternative A. Traditional cultural practices and access to sites would
37 be restricted to a large degree due to nearly continuous aircraft noise. Minor adverse impacts to Ethnographic
38 Resources would occur with negligible change from Alternative A.

39
40 *East End* *Alternative F* *Ethnographic Resources*

41 *Ten-Year Forecast Peak Season*

42 At **Little Colorado River** and **Temple Butte** Location Points air-tour aircraft Percent Time Audible would
43 decline to 25% and 45% of the day, respectively, a 12 to 22% decrease compared to Alternative A. Average air-
44 tour aircraft Average Sound Level would decline slightly to 37 and 31 dBA. Aircraft would continue to be
45 approximately 1,500 meters away from points on the ground. Although minor to moderate adverse impacts
46 would occur, there would be minor beneficial change in impacts compared to Alternative A.

47
48 There would be little change in Percent Time Audible at **Little Colorado** and **Nankoweap River** Location
49 Points; however, at Little Colorado Location Point there would be a 22 dBA decrease in Average Sound Level.
50 This would represent negligible impacts and long-term negligible to minor beneficial change in impacts
51 compared to Alternative A.

52
53 Air-tour aircraft Percent Time Audible at **Bright Angel Point** Location Point would decline to 12%, a 36%
54 decrease from Alternative A. Average Sound Level would decline to 18 dBA, a 6 dBA decrease. Traditional
55 cultural practices could be performed with substantially less interruption by aircraft noise that are relatively low.

1 Although minor adverse impacts would occur, there would be long-term minor to moderate beneficial changes in
2 impacts compared to Alternative A.

3
4 Aircraft Percent Time Audible at **Pasture Wash** Location Point would be greatly reduced at 20% of the day, a
5 78% decrease compared to Alternative A. Average Sound Level would be similar to Alternative A at 17 dBA.
6 There would be large improvement in opportunities to perform traditional activities without interruption, and for
7 site preservation due to reduction in amount of the day air-tour operations would be audible. Although minor
8 adverse impacts would occur, there would be long-term minor to moderate beneficial changes in impacts
9 compared to Alternative A.

10
11 *East End*

Alternative F

Ethnographic Resources

12 *Base Year Off-Peak Season*

13 Effects of aircraft at **Little Colorado River** and **Temple Butte** Location Points would be somewhat less than
14 Peak Season and less than Alternative A. Aircraft Percent Time Audible would be 17 to 37% of the day, a
15 decrease of 17 to 26% from Alternative A. Aircraft Average Sound Level would be 31 to 38 dBA, similar to
16 Alternative A. Aircraft would be approximately 1,500 meters away from points on the ground. Due to reduction
17 in amount of time air-tour aircraft would be audible, the ability to perform traditional activities without
18 interruption would be enhanced. Although minor to moderate adverse impacts would occur, there would be long-
19 term minor beneficial changes in impacts compared to Alternative A.

20
21 Air-tour aircraft would have little or no effect on **Little Colorado** and **Nankoweap River** Location Points.
22 Aircraft would rarely be audible at Average Sound Level of 3 to 20 dBA, a 14 to 22 dBA decrease compared to
23 Alternative A. Incremental reductions in air-tour sounds would result in beneficial changes in ability to conduct
24 traditional practices. Although adverse impacts would occur, there would be long-term negligible to minor
25 beneficial changes in impacts compared to Alternative A.

26
27 **Bright Angel Point** Location Point air-tour Percent Time Audible would decline to 2% of the day, a 45%
28 decrease from Alternative A. Average Sound Level would also be reduced to 13 dBA, an 11 dBA decrease.
29 Although negligible impacts could occur, there would be long-term minor to moderate beneficial changes in
30 impacts compared to Alternative A.

31
32 **Pasture Wash** Location Point impacts would be similar to Base Year Peak Season.

33
34 *East End*

Alternative F

Ethnographic Resources

35 *Ten-Year Forecast Off-Peak Season*

36 Air-tour aircraft Percent Time Audible and Average Sound Level at **Little Colorado River** and **Temple Butte**
37 Location Points would decline slightly, further enhancing Ethnographic Resources. Aircraft Percent Time
38 Audible would be 12 to 23% of the day; a decrease of 26 to 43% from Alternative A. Average Sound Level
39 would be 27 to 33 dBA, declining 10 to 11 dBA from Alternative A. Although minor adverse impacts would
40 occur, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.

41
42 **Bright Angel Point** Location Point impacts would be similar to Base Year Off-Peak Season.

43
44 **Pasture Wash** Location Point impacts would be similar to Ten-Year Forecast Peak Season.

1 **Table 4.73 Alternative F Average Sound Level East End**

Location Point Name	Alternative A				Alternative F																
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season								
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)						
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	
North Rim																					
Bright Angel Point	47	48	24	24	47	0	12	-36	24	0	18	-6	2	-45	2	-47	13	-11	11	-13	
Zuni Point Corridor																					
Temple Butte	62	66	37	38	62	0	45	-22	37	0	31	-7	37	-26	23	-43	31	-6	27	-11	
Little Colorado River/Nankoweap Area																					
Little Colorado	1	1	25	25	1	0	0	-1	25	0	3	-22	-1	0	-1	3	-22	0	-25		
Little Colorado River	34	37	43	43	34	0	25	-12	43	0	37	-6	17	-17	12	-26	38	-5	33	-10	
Nankoweap River	7	8	34	35	7	0	5	-4	34	0	33	0	-7	0	-8	20	-14	17	-18		
Toroweap/Shinumo Flight Free Zone																					
Pasture Wash	98	98	20	21	99	0	20	-78	22	1	17	-3	90	-8	58	-40	25	5	20	0	

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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Table 4.74 Alternative F Slant Distances East End

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
North Rim				
Bright Angel Point	6,235		6,235	-10
Zuni Point Corridor				
Temple Butte	1,458		1,458	0
Little Colorado River/Nankoweap Area				
Little Colorado	1,637		1,637	0
Little Colorado River	1,629		1,629	0
Nankoweap River	1,449		1,448	0
Toroweap/Shinumo Flight Free Zone				
Pasture Wash	5,532		5,532	0

Δ indicates change in noise metric data from Alternative A

5

1	Central	Alternative F	Ethnographic Resources
2			
3	Based on modeled noise results shown in Figures 4.18 to 4.21, in Central areas, there would be little change from		
4	Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 10 dBA and		
5	aircraft Percent Time Audible less than 5%.		
6			
7	<i>Central</i>	<i>Alternative F</i>	<i>Ethnographic Resources</i>
8	<i>Base Year Peak Season</i>		
9	Similar to Alternative A, Ethnographic Resources throughout most of the Central area would be least affected by		
10	aircraft noise. As shown by representative Central area Location Points in Table 4.75, aircraft Percent Time		
11	Audible would be less than one to 4% of the day, and Average Sound Level would be less than one to 11 dBA.		
12	Negligible impacts to Ethnographic Resources would occur with negligible change compared with Alternative A.		
13			
14	<i>Central</i>	<i>Alternative F</i>	<i>Ethnographic Resources</i>
15	<i>Ten-Year Forecast Peak Season</i>		
16	Central area Location Point impacts would be similar to Peak Season Base Year.		
17			
18	<i>Central</i>	<i>Alternative F</i>	<i>Ethnographic Resources</i>
19	<i>Base Year Off-Peak Season</i>		
20	Aircraft noise would increase along the Central area's eastern boundary due to Dragon Corridor's seven-mile		
21	shift west. As illustrated by Grid Location Point 8 , aircraft Percent Time Audible would be 25% of the day, an		
22	increase of 22% compared to Alternative A. Average Sound Level would remain low at 10 dBA. Aircraft would		
23	be more frequently heard or experienced although at low levels. Minor adverse impacts to Ethnographic		
24	Resources would represent a minor to moderate adverse change compared Alternative A.		
25			
26	<i>Central</i>	<i>Alternative F</i>	<i>Ethnographic Resources</i>
27	<i>Ten-Year Forecast Off-Peak Season</i>		
28	With implementation of quiet technology, aircraft Percent Time Audible would be at % of the day at Average		
29	Sound Level of 10 dBA. Negligible impacts would occur with negligible change compared to Alternative A.		

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1 **Table 4.75 Alternative F Average Sound Level Central**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Time Level (dBA)				Percent Time Audible (%)				Average Time Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Grid Location Point 8	3	3	10	10	4	1	1	-2	11	2	9	-1	25	22	3	0	10	0	10	0
Mohawk Canyon	1	1	11	12	0	-1	0	-1	8	-3	10	-2	0	-1	0	-1	8	-3	9	-3
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	0	1	1	1	0	1	1	1	0	1	0	1	0	1	1	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

4 **Table 4.76 Alternative F Slant Distances Central**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Grid Location Point 8	13,765	0	13,765	0
Mohawk Canyon	3,009	0	3,009	0
Surprise Valley	25,500	-6,385	19,115	-6,385
Upper Deer Creek	23,683	-2,752	20,931	-2,752

Δ indicates change in noise metric data from Alternative A

5
6

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1 **West End** **Alternative F** **Ethnographic Resources**

2
3 Based on modeled noise results shown in Figures 4.18 to 4.21, in West End's northern half, aircraft Average Sound
4 Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%. However, beneficial impacts
5 to Ethnographic Resources would be provided for locations where Green-4's southern portion would be eliminated,
6 and where Blue Direct South shifts to avoid Eagle and Guano Points. Because Alternative F includes quiet-
7 technology incentives and conversion, adverse impacts would be mitigated as aircraft convert Ten-Year Forecast.
8 Increased air-tour-related activity on Blue Direct would, however, adversely affect Ethnographic Resources on West
9 End's eastern side. In West End's southern portion near Sanup Flight-free Zone, aircraft noise would intrude little on
10 Ethnographic Resources.

11 *West End* *Alternative F* *Ethnographic Resources*
12
13 *Base Year Peak Season*

14 **Burnt Springs Canyon** Location Point would be located under Green-4/Black-2, as in Alternative A. At this
15 location, as shown in Table 4.77 aircraft Percent Time Audible would be 75% of the day at Average Sound Level
16 of 47 dBA, similar to Alternative A. Adverse impacts to Ethnographic Resources would result from lack of a
17 clear line of sight for prayers, and from aircraft noise that would interrupt traditional practices and possibly force
18 religions leaders to move to another area temporarily, or, in the worst case scenario, abandon use of a particular
19 area. Moderate adverse impacts would occur with negligible change in impacts compared to Alternative A.

20
21 Ethnographic Resources at **Meriwhitca** Location Point would have air-tour aircraft impacts similar to
22 Alternative A. Due to low frequencies of visible and audible flights, and relatively low decibel noise, impacts to
23 Ethnographic Resources would be negligible with negligible change in impacts compared to Alternative A.

24
25 **Granite Peak** Location Point would be beneath both Blue Direct North quiet technology route and Blue Direct
26 South. This would result in increased effects of air-tour aircraft compared with Alternative A. Air-tour aircraft
27 Percent Time Audible would be 21%, a 19% increase from Alternative A. Average Sound Level would be 28
28 dBA, a 12 dBA increase. Aircraft visibility at 5,257 meters from locations on the ground would be comparable to
29 visibility in Alternative A. Minor to moderate adverse impacts would occur with long-term minor adverse change
30 in impacts from Alternative A.

31 *West End* *Alternative F* *Ethnographic Resources*
32
33 *Base Year Off-Peak Season*

34 At **Burnt Springs Canyon** and **Meriwhitca** Location Points impacts similar to Base Year Peak Season.

35
36 *West End* *Alternative F* *Ethnographic Resources*
37 *Ten-Year Forecast Peak and Off-Peak Season*

38 Air-tour aircraft Percent Time Audible would be similar to Alternative A. Average Sound Level at **Burnt**
39 **Springs Canyon** Location Point would increase to 44 dBA, a 3 dBA decrease from Alternative A. Negligible to
40 moderate adverse impacts would occur with negligible change in impacts compared to Alternative A.

41
42 At **Meriwhitca** Location Point impacts similar to Base Year Peak Season.

1 **Table 4.77 Alternative F Average Sound Level West End**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Time Level (dBA)				Percent Time Audible (%)				Average Time Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	75	5	69	-6	47	1	44	-3	73	3	66	-9	46	0	44	-3
Granite Peak	2	2	17	18	21	19	17	15	28	12	27	9	22	20	16	14	29	12	27	9
Meriwhitca	0	1	7	8	0	0	1	0	8	1	8	1	0	0	1	0	7	1	8	1
Pumpkin Springs	0	0	7	8	0	0	0	0	9	2	10	2	0	0	0	0	9	2	9	2

Δ indicates change in noise metric data from Alternative A
 Forecast indicates a Ten-Year Forecast

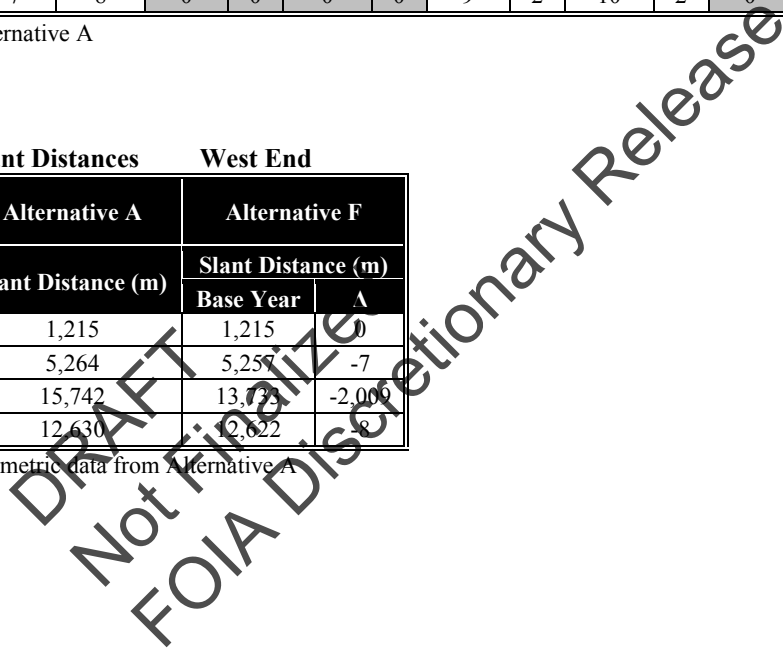
2
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4 **Table 4.78 Alternative F Slant Distances West End**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Burnt Springs Canyon	1,215	0	1,215	0
Granite Peak	5,264	-7	5,257	-7
Meriwhitca	15,742	-2,069	13,673	-2,069
Pumpkin Springs	12,630	-8	12,622	-8

Δ indicates change in noise metric data from Alternative A

5
6



1 **Cumulative Impacts** **Alternative F** **Ethnographic Resources**

2
3 *Area of Potential Effect for this EIS is located in the Study Area as defined in Chapter 1, and Ethnographic*
4 *Resources as described in Chapter 3.*

5
6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
7 *actions. In this context, Cumulative Impacts include impacts on Ethnographic Resources from sounds of*

- 8 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
9 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
10 *3) ground-based noise sources, plus*
11 *4) noise from air-tour-and-related aircraft under Alternative F*

12
13 *That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 (Alternative F).*

14
15 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
16 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
17 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
18 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
19 *SFRA see Appendix D, Figures 91 to 94).*

20
21 *On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person*
22 *(some people are greatly bothered by high-altitude aircraft, some are not bothered at all, and most fall somewhere*
23 *in-between). However, when high-altitude aircraft noise is added to all other intrusive noises and visual*
24 *distractions present in and near the park, the resulting effect can diminish focus and sense of introspection of*
25 *American Indian religious practitioners. Tribes have also voiced concerns when sacred places are pointed out to*
26 *visitors during an air tour, feeling this information might increase potential for on-the-ground damage at a later*
27 *time. In locations close to the river, noise from aircraft above and outside the SFRA would be less noticeable,*
28 *resulting in fewer impacts on practitioners and Ethnographic Resources. Potential for adverse impacts from*
29 *aircraft increases at higher elevations on the ground (aircraft are more visible and more audible).*

30
31 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
32 *Ethnographic Resources, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
33 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
34 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
35 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
36 *Audible capable of masking some aircraft noise.*

37
38 *Quieter, less-used areas may be revered by native people, and can be disturbed by those hiking into them. All*
39 *these noises and visual intrusions combine to create distractions and lack of privacy for traditional practitioners.*

40
41 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
42 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
43 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
44 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
45 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
46 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
47 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
48 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
49 *Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the*
50 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*

51
52 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
53 *(Alternative F compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
54 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
55 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
56 *(Alternative F in this case).*

1 *Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 2 *Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season),*
 3 *noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone,*
 4 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 5 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 6 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 7 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 8 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

9
 10 *Comparing noise impacts from just Alternative F by itself (Appendix D Tables 26 (Peak Season) and 31 (Off-*
 11 *Peak Season) Ten-Year Forecast) versus All Aircraft (#4 Alternative F plus #1 Above and #2 Outside) (Appendix*
 12 *D Tables 57 (Peak Season) and 61 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the*
 13 *difference between Cumulative Impacts and the impacts of Alternative F by itself. For the Entire Park*
 14 *Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more*
 15 *of the day in 87 to 89% of the park, with Average Sound Level 25 to <35 dBA in 84 to 86% of the park, with 1%*
 16 *of the park below 25 dBA and 15 to 18% at 35 dBA or more. For the Entire Park results for Alternative F by*
 17 *itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to 10% of*
 18 *the park, with Average Sound Level 25 to <35 dBA in 14% of the park, with 68 to 70% of the park below 25 dBA*
 19 *and 10 to 13% at 35 dBA or more.*

20
 21 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 22 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
 23 *routes; (b) Cumulative Impacts increase the impacts of Alternative F, and (c) reducing air-tour-and-related*
 24 *impacts under the Alternatives reduces Cumulative Impacts.*

25
 26 *When intrusive sounds are present more than half a day, practitioners might not have time to access sites or*
 27 *complete prayers or other activities during a period of quiet. Additionally, places such as Bright Angel Point have*
 28 *relatively high-visitation levels, contributing adverse impacts from noise and lack of privacy. However, although*
 29 *aircraft and/or other intrusions would be audible large portions of the day in many areas, and traditional*
 30 *practices frequently interrupted, a group's body of practices and beliefs would be expected to survive.*

31
 32 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 33 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 34 *Alternative (route locations/number/altitudes/quiet technology conversion, etc.). When added to noise impacts of*
 35 *the cumulative sources common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 36 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts discussion*
 37 *in the Conclusions section below.*

38
 39 **Conclusion** **Alternative F** **Ethnographic Resources**

40
 41 Base Year Alternative F would result in negligible changes in impacts compared with Alternative A. Traditional
 42 cultural practices, site access and preservation, and the relationship between resources and a group's practices and
 43 beliefs would be interfered with or altered in nearly half park and SFRA. Ten-Year Forecast these impacts would
 44 decline as result of quiet-technology incentives and conversion requirements. Greatest exposure to noise and visual
 45 impacts would occur in East End and West End's western portions nearest air-tour routes. In Marble Canyon,
 46 Central area, and West End's southern portions, traditional cultural practices and cultural sites would be least
 47 impacted by air-tour operations.

48
 49 *Conclusion Marble Canyon* *Alternative F* *Ethnographic Resources*
 50 *All Scenarios*

51 Marble Canyon Location Points would be little affected by aircraft sights and sounds, and there would be negligible
 52 impacts with negligible change in impacts on Ethnographic Resources compared to Alternative A.

1 *Conclusion East End* *Alternative F* *Ethnographic Resources*

2 *Base Year Peak Season*

3 There would be minor to moderate adverse impacts with negligible changes in impacts from air-tour aircraft noise
4 on Ethnographic Resources at Little Colorado River and Temple Butte Location Points compared to Alternative A.
5 At Little Colorado and Nankoweap River Location Points there would be negligible change in impacts.

7 *Conclusion East End* *Alternative F* *Ethnographic Resources*

8 *All Scenarios*

9 Impacts on Ethnographic Resources at Bright Angel Point and Pasture Wash Location Points would be minor to
10 moderate adverse similar to Alternative A. Ten-Year Forecast due to a large reduction in Percent Time Audible
11 there would be long-term minor to moderate beneficial change in impacts compared to Alternative A.

13 *Conclusion East End* *Alternative F* *Ethnographic Resources*

14 *Ten-Year Forecast Off-Peak Season*

15 At Little Colorado River and Temple Butte Location Points, reduction in aircraft Percent Time Audible and Average
16 Sound Level would result in minor adverse impacts with long-term minor to moderate beneficial change in impacts
17 compared to Alternative A. However, impacts at Little Colorado and Nankoweap River Location Points would be
18 negligible with negligible to minor beneficial changes in impacts compared to Alternative A.

20 *Conclusion Central* *Alternative F* *Ethnographic Resources*

21 *All Scenarios*

22 Alternative F would result in negligible impacts with negligible changes in impacts to Ethnographic Resources at
23 most Central area Location Points compared to Alternative A. There would be up to moderate adverse impacts with
24 minor to moderate adverse changes in impacts at areas along the Central area's eastern edge due to Dragon
25 Corridor's westward shift Off-Peak Season.

27 *Conclusion West End* *Alternative F* *Ethnographic Resources*

28 *All Scenarios*

29 Alternative F would result in negligible to moderate adverse impacts on Ethnographic Resources with greatest level
30 of impacts under and near Green-4 and Black-2 routes, and negligible to minor adverse changes in impacts
31 compared to Alternative A.

33 *Cumulative Impacts Summary* *Alternative F* *Ethnographic Resources*

35 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
36 *impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts in*
37 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections of the park (Marble Canyon, East*
38 *End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour*
39 *routes, and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
40 *comparison with the other Alternatives, Alternative F ranks third in lowest overall Cumulative Impacts behind*
41 *Alternative E and the Modified NPS Preferred Alternative (Alternative A ranks last).*

43 **MODIFIED NPS PREFERRED ALTERNATIVE**

ETHNOGRAPHIC RESOURCES

45 Overall the **Modified** NPS Preferred Alternative would result in beneficial changes from Alternative A due to
46 differences in route location, route altitude, and quiet-technology conversion.

48 **Based on modeled noise results from Tables 4.17 to 4.22, Base Year Peak Season GCNP area in which air-tour**
49 **aircraft Percent Time Audible would be greater than or equal to 25% would decrease slightly from 45% in**
50 **Alternative A to 43%, and would decline to 26% Base Year Off-Peak Season. Park area in which Average Sound**
51 **Level would be greater than or equal to 35 dBA would decrease from 16% in Alternative A Base Year to 12%**
52 **Base Year Peak Season, and 7% Base Year Off-Peak Season.**

54 Ten-Year Forecast **aircraft** Percent Time Audible **greater than or equal to 25%** would decline further to **27% Peak**
55 **Season and 15% Off-Peak Season (compared to Alternative A at 47%). Park area in which Average Sound Level**

1 would *be greater than or equal to 35 dBA would decline from 23% in Alternative A to 9% Peak Season, and 5%*
2 *Off-Peak Season Ten-Year Forecast.*

3
4 Base Year, disturbances to Ethnographic Resources would occur, but Ten-Year Forecast there would be
5 improvement as aircraft noise would be reduced allowing enhanced opportunities for traditional cultural practices
6 and site preservation.

7
8 **Marble Canyon** **Modified NPS Preferred Alternative** **Ethnographic Resources**

9
10 *Marble Canyon routes and the Nankoweap loop would be eliminated.* Based on modeled noise results shown in
11 Figures 4.26 to 4.29 and Tables 4.19 and 4.22, Marble Canyon would *be* quiet with air-tour aircraft Percent Time
12 Audible generally less than *1%*, and Average Sound Level *generally* less than *13dBA*.

13
14 *Marble Canyon* *Modified NPS Preferred Alternative* *Ethnographic Resources*
15 *All Scenarios*

16 Ethnographic Resources represented by **South Canyon** Location Point would be quiet, as shown in Table 4.79.
17 *Due to the elimination of air-tour routes in Marble Canyon and the Nankoweap loop*, air-tour aircraft Percent
18 Time Audible would be less than Alternative A, *a decrease of about three* percent, and aircraft Average Sound
19 Level would be less than one dBA, a decrease of 21 dBA from current conditions. Air-tour aircraft would be far
20 less visible from points on the ground *since slant distance would be 28,485 meters, a 27,669 meter increase*
21 *from Alternative A*. Thus there would be fewer distractions (visually *and/or* auditory) for American Indian
22 practitioners than in Alternative A. *Since no air-tour routes would be allowed through Marble Canyon* aircraft
23 sights and sounds that would adversely affect Ethnographic Resources *would be* less than Alternative A.
24 Although negligible impacts would occur, there would be long-term minor *to moderate* beneficial changes in
25 impacts compared to Alternative A.
26

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1 **Table 4.79** *Modified Preferred Alternative* Average Sound Level **Marble Canyon**

Location Point Name	Alternative A				<i>Modified NPS Preferred Alternative</i>															
					Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
South Canyon	2	3	21	23	0	-2	0	-3	0	-21	0	-23	0	-2	0	-3	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2

3

4 **Table 4.80** *Modified Preferred Alternative* Slant Distances **Marble Canyon**

Location Point Name	Alternative A		<i>Modified NPS Preferred Alternative</i>	
	Slant Distance (m)			
	Slant Distance (m)		Base Year	Δ
South Canyon	816		28,485	27,669

Δ indicates change in noise metric data from Alternative A

5

6

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1 **East End** *Modified NPS Preferred Alternative* **Ethnographic Resources**

2
3 Changes due to the *Modified* NPS Preferred Alternative, including curfews, *conversion to quiet-technology aircraft*
4 and seasonal closure *of Zuni Point Corridor and long-loop routes Off-Peak Season (November 15-March 31)*
5 would provide more quiet time for East End Ethnographic Resources. Religious practitioners would have more time
6 to complete prayers and other traditional cultural practices in privacy and quiet. There would be fewer distractions
7 from *nearby* aircraft.

8
9 *East End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
10 *Base Year Peak Season*

11 At **Little Colorado River** Location Point, changes in Green-1/Black-1 routes would move air-tour aircraft away
12 from Ethnographic Resources. Air-tour aircraft Percent Time Audible would be 7%, a 27% decrease from
13 Alternative A. Average Sound Level would *be 26* dBA, a 17 dBA decrease from Alternative A, with air-tour
14 aircraft visible at Distances greater than 2,000 meters from points on the ground. Although minor adverse
15 impacts would occur, there would be long-term minor to moderate beneficial changes in impacts compared to
16 Alternative A.

17
18 Impacts at **Temple Butte** Location Point would be similar to Alternative A. Air-tour aircraft on Green-1/Black-1
19 would result in aircraft Percent Time Audible 54% of the day, *a decrease of 8% from Alternative A* with
20 Average Sound Level of 37 dBA (*same as Alternative A*). Aircraft would be visible between 1,000 and 1,500
21 meters from points on the ground. Moderate adverse impacts from air-tour aircraft noise on Ethnographic
22 Resources would occur with negligible change from Alternative A.

23
24 **Bright Angel Point** Location Point would be exposed to aircraft noise slightly greater than in Alternative A. Air-
25 tour aircraft Percent Time Audible would be 57%, a 10% increase *from Alternative A*. Average Sound Level
26 would be 24 dBA, the same as Alternative A. Aircraft would be visible greater than 6,000 meters from points on
27 the ground. Minor to moderate adverse impacts from air-tour aircraft noise on Ethnographic Resources would
28 *occur with* long-term negligible to minor adverse *change in impacts* compared to Alternative A.

29
30 **Pasture Wash** Location Point would be similar to Alternative A with aircraft Percent Time Audible 99% of the
31 day with Average Sound Level of 27 dBA (*a 1% and 7 dBA increase from Alternative A*). Air-tour aircraft
32 visibility would decrease by 3,000 meters from Alternative A. Ability of groups or individuals to practice beliefs
33 and perform traditional activities *may* be inhibited by the sound of aircraft. There would be *minor to* moderate
34 adverse impacts with negligible change in impacts compared to Alternative A.

35
36 *East End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
37 *Base Year Peak and Off-Peak Season*

38 Changes to Green-1/Black-1 routes would move air-tour aircraft away from **Little Colorado and Nankoweap**
39 **River** Location Points, and impacts of air-tour aircraft on Ethnographic Resources would be reduced compared
40 with Alternative A. As shown in Table 4.81 air-tour aircraft Percent Time Audible would be less than one
41 percent of the day with Average Sound Level 7 to 15 dBA, which would be less than natural ambient Average
42 Sound Level. Air-tour aircraft would be visible at Distances greater than 8,000 meters from points on the ground.
43 Impacts to Ethnographic Resources would be negligible with long-term minor *to moderate* beneficial change in
44 impacts compared with Alternative A.

45
46 *East End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
47 *Base Year Off-Peak Season*

48 *Since Zuni Point Corridor and long-loop tour routes are closed Off-Peak Season (November 15-March 31)*
49 impacts at **Little Colorado River, Temple Butte, and Bright Angel Point** Location Points *would be negligible*
50 *with moderate to major beneficial changes from Alternative A. Percent Time Audible would be less than 4%*
51 *and Average Sound Level would be less than 13 dBA, a 34 to 61% decrease and a 11 to 36 dBA decrease from*
52 *Alternative A. Large reduction in daytime aircraft audibility would greatly improve potential to successfully*
53 *complete prayers, singing, or other traditional activities where quiet is vital.*

1 *East End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
 2 *Ten-Year Forecast Peak Season*
 3 Negligible impacts at **Little Colorado, Little Colorado River, and Nankoweap River** Location Points similar
 4 to those described Base Year Peak Season.

5
 6 Phasing-in of quiet technology on the long-loop tour over North Rim would reduce impacts at **Bright Angel**
 7 **Point** Location Point. Percent Time Audible would decline to 18%, a 30% decrease from Alternative A. Average
 8 Sound Level of **18** dBA, *would be* a **6** dBA decrease from Alternative A. Although minor adverse impacts would
 9 continue, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.
 10 Air-tour aircraft Average Sound Level at **Pasture Wash** Location Point would be similar to Alternative A *at* **22**
 11 *dBA*, but Percent Time Audible would decline to **76%**, a **22%** decrease. Overall this would provide some
 12 improvement in conditions in which to perform traditional cultural practices. Although minor to moderate
 13 adverse impacts would occur, there would be long-term minor *to moderate* beneficial changes in impacts
 14 compared to Alternative A.

15
 16 *East End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
 17 *Ten-Year Forecast Peak*

18 There would be reduction in aircraft Percent Time Audible at **Temple Butte** Location Point *to* **33%**, a **33%**
 19 decrease from Alternative A. Average Sound Level would be **36** dBA, similar to Alternative A which would
 20 result in a slight improvement to conditions in which traditional cultural practices would take place. Moderate
 21 adverse impacts would occur with long-term minor *to moderate* beneficial changes in impacts compared to
 22 Alternative A.

23
 24 *East End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
 25 *Ten-Year Forecast Off-Peak Season*

26 Impacts at **Little Colorado River, Little Colorado, Temple Butte, Nankoweap River, and Bright Angel Point**
 27 Location Points *would be* similar to Base Year *Off-Peak* Season.

28
 29 *East End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
 30 *Base Year and Ten-Year Forecast Off-Peak Season*

31 *Since the Dragon Corridor would be open year-round, conditions at Pasture Wash Location Point Off-Peak*
 32 *season would be similar to Peak Season as described above. Base Year there would be minor to moderate*
 33 *adverse impacts with negligible change in impacts compared to Alternative A. Ten-Year Forecast there would*
 34 *be minor to moderate adverse impacts, but there would be long-term minor to moderate beneficial changes in*
 35 *impacts compared to Alternative A.*

1 **Table 4.81 Modified Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative																
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season								
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Time Level (dBA)				Percent Time Audible (%)				Average Time Level (dBA)				
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	
North Rim																					
Bright Angel Point	47	48	24	24	57	10	18	-430	24	0	18	-6	4	-43	5	-43	13	-11	12	-12	
Zuni Point Corridor																					
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32	
Little Colorado River/Nankoweap Area																					
Little Colorado	1	1	25	25	0	-1	0	-1	7	-18	5	-20	-1	0	-1	0	-25	0	-25		
Little Colorado River	34	37	43	43	7	-27	3	-34	26	-17	26	-17	0	-34	0	-37	7	-36	7	-36	
Nankoweap River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	11	-23	12	-23	
Toroweap/Shinumo Flight Free Zone																					
Pasture Wash	98	98	20	21	99	1	76	-22	27	7	22	1	94	-4	64	-34	24	4	20	-1	

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4 **Table 4.82 Modified Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
North Rim			
Bright Angel Point	6,235	6,236	1
Zuni Point Corridor			
Temple Butte	1,458	1,303	-155
Little Colorado River/Nankoweap Area			
Little Colorado	1,637	8,607	6,970
Little Colorado River	1,629	2,474	845
Nankoweap River	1,449	9,655	8,206
Toroweap/Shinumo Flight Free Zone			
Pasture Wash	5,532	8,967	3,435

Δ indicates change in noise metric data from Alternative A

5

1 **Central** *Modified NPS Preferred Alternative* **Ethnographic Resources**

2
3 Based on modeled noise results shown in Figures 4.26 to 4.29, in the Central area, there would be little change from
4 Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 10 dBA, and
5 aircraft Percent Time Audible less than 5%.

6
7 *Central* *Modified NPS Preferred Alternative* *Ethnographic Resources*
8 *Base Year Peak Season*

9 Areas in the Central area's eastern portion, represented by **Grid Location Point 8**, would be exposed to higher
10 levels of aircraft noise due to active **East End** routes. At Grid Location Point 8, aircraft Percent Time Audible
11 would be 21%, an increase of 18% compared to Alternative A. Average Sound Level would also increase, but
12 remain low at 14 dBA. Aircraft would be more frequently heard or experienced although at relatively low levels.
13 Minor adverse impacts to Ethnographic Resources would **occur with** a minor adverse change in impact
14 compared **to** Alternative A.

15
16 *Central* *Modified NPS Preferred Alternative* *Ethnographic Resources*
17 *Base Year Peak and Off-Peak Season*

18 Similar to Alternative A, Ethnographic Resources throughout most of the Central area would be least affected by
19 aircraft noise. As shown in Table 4.83, at **Upper Deer Creek, Surprise Valley, and Mohawk Canyon** Location
20 Points, aircraft Percent Time Audible would be **zero to 1%** of the day, with Average Sound Level zero to **8** dBA.
21 Negligible impacts would occur with negligible change from Alternative A.

22
23 *Central* *Modified NPS Preferred Alternative* *Ethnographic Resources*
24 *Base Year Off-Peak Season*

25 At **Central area** Location Points, **represented by Grid Location Point 8 with** air-tour routes in **Dragon** Corridor
26 active **year-round**, noise impacts on Ethnographic Resources **would be similar to Alternative A**. Aircraft Percent
27 Time Audible would be **10%** of the day at **12 dBA, 7% and 2 dBA increased from** Alternative A. Traditional
28 cultural practices would rarely be disturbed or interrupted. Negligible **to minor adverse** impacts would occur,
29 **with** negligible **to minor adverse** change in impacts compared to Alternative A.

30
31 *Central* *Modified NPS Preferred Alternative* *Ethnographic Resources*
32 *Ten-Year Forecast Peak and Off-Peak Season*

33 With quiet-technology incentives and conversion requirements, aircraft Percent Time Audible at **Grid Location**
34 **Point 8** would be one percent at Average Sound Level of **10** dBA. Negligible impacts would occur with
35 negligible change in impacts compared to Alternative A.

36
37 *Central* *Modified NPS Preferred Alternative* *Ethnographic Resources*
38 *Ten-Year Forecast Off-Peak Season*

39 **Similar to Alternative A, Ethnographic Resources throughout most of the Central area would be little affected**
40 **by aircraft noise. At Upper Deer Creek, Surprise Valley, and Mohawk Canyon Location Points, aircraft**
41 **Percent Time Audible would be zero to 1% of the day, with Average Sound Level zero to 8 dBA. Negligible**
42 **impacts would occur with negligible change from Alternative A.**

1 **Table 4.83** *Modified NPS Preferred Alternative* **Average Sound Level** **Central**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	10	0	10	7	1	-2	12	2	10	0
Mohawk Canyon	1	1	11	12	0	-1	0	-1	8	-3	8	-4	0	-1	0	-1	8	-3	8	-4
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	0	1	1	1	0	1	1	2	1	1	0	1	0	1	1	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.84 *Modified Preferred Alternative* **Slant Distances** **Central**

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Grid Location Point 8	13,765	14,619	854
Mohawk Canyon	3,009	3,009	0
Surprise Valley	25,500	26,243	743
Upper Deer Creek	23,683	24,100	417

Δ indicates change in noise metric data from Alternative A

1 **West End** **Modified NPS Preferred Alternative** **Ethnographic Resources**

2
3 Modeled noise results (**Figures 4.26 to 4.29**) indicate impacts associated with West End air-tour routes would be
4 similar to Alternative A, with exception of **the area under and near Alternative A's Blue Direct South and North**
5 **route due to the shift to the Z-shaped Route (realigned Blue Direct) in the Modified NPS Preferred Alternative.** In
6 West End's northern portion Average Sound Level of 40 to 50 dBA, and aircraft Percent Time Audible greater than
7 65% would occur. **Modified** NPS Preferred Alternative quiet-technology incentives and conversion requirements
8 would provide some mitigation to these adverse effects **in the Ten-Year Forecast.** In West End's southern portion
9 near Sanup Flight-free Zone aircraft noise would intrude **very** little on Ethnographic Resources.

10 *West End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
11 *Base Year Peak and Off-Peak Season*

12 **Burnt Springs Canyon** Location Point would continue to be under Green-4/Black-2 routes as in Alternative A.
13 At this location, as shown in Table 4.85, aircraft Percent Time Audible would **range from 61 to 63%** of the day
14 at Average Sound Level of 45dBA, **7 to 9% less Percent Time Audible than** Alternative A, **but the same**
15 **Average Sound Level.** Adverse impacts to Ethnographic Resources would result from lack of a clear line of sight
16 for prayers, and from continuing aircraft noise, **which would disrupt the ability of groups or individuals to**
17 **practice beliefs and perform traditional activities. However, the groups' or individuals' beliefs and practices**
18 **would be expected to survive.** Moderate adverse impacts would occur with negligible **to minor beneficial** change
19 in impacts compared to Alternative A.
20

21
22 Ethnographic Resources at **Meriwhitca, Pumpkin Springs, and Granite Peak** Location Points would have air-
23 tour aircraft impacts similar to Alternative A. Due to low numbers of visible and audible flights, and relatively
24 low decibel levels, impacts to Ethnographic Resources would be negligible with negligible change in impacts
25 compared to Alternative A.
26

27 *West End* *Modified NPS Preferred Alternative* *Ethnographic Resources*
28 *Ten-Year Forecast Peak and Off-Peak Seasons*

29 Air-tour aircraft Percent Time Audible and Average Sound Level at **Burnt Springs Canyon** Location Point
30 would be **54 to 58% Percent Time Audible and 42 to 43 dBA Average Sound Level, a decrease of 17 to 21%**
31 **and 4 to 5 dBA compared** to Alternative A. Moderate adverse impacts would occur with negligible **to minor**
32 **beneficial** change in impacts compared to Alternative A.
33

34 Impacts at **Meriwhitca, Pumpkin Springs, and Granite Peak** Location Points would be negligible similar to
35 Base Year Peak Season **and Off-Peak Season.**

Table 4.85 Modified NPS Preferred Alternative Average Sound Level West End

Location Point Name	Alternative A		Modified NPS Preferred Alternative																	
			Peak Season								Off Peak Season									
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	63	-7	58	-17	45	-1	43	-4	61	-9	54	-21	45	-1	42	-5
Granite Peak	2	2	17	18	2	0	2	0	15	-2	16	-2	2	0	2	0	15	-2	16	-2
Meriwhitca	0	1	7	8	0	0	1	0	7	0	7	0	0	0	1	0	6	-1	7	0
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	-1	0	0	0	0	7	0	7	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

Table 4.86 Modified Preferred Alternative Slant Distances West End

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Granite Peak	5,264	12,090	6,826
Meriwhitca	15,742	15,742	0
Pumpkin Springs	12,630	19,695	7,065

Δ indicates change in noise metric data from Alternative A

1 **Cumulative Impacts** *Modified* NPS Preferred Alternative **Ethnographic Resources**

2
3 *Area of Potential Effect for this EIS is located in the Study Area as defined in Chapter 1, and Ethnographic*
4 *Resources as described in Chapter 3.*

5
6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
7 *actions. In this context, Cumulative Impacts include impacts on Ethnographic Resources from sounds of*

- 8 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
- 9 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
- 10 *3) ground-based noise sources, plus*
- 11 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

12
13 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
14 *(Modified NPS Preferred Alternative).*

15
16 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
17 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
18 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
19 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
20 *SFRA see Appendix D, Figures 91 to 94).*

21
22 *On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person*
23 *(some people are greatly bothered by high-altitude aircraft, some are not bothered at all, and most fall somewhere*
24 *in-between). However, when high-altitude aircraft noise is added to all other intrusive noises and visual*
25 *distractions present in and near the park, the resulting effect can diminish focus and sense of introspection of*
26 *American Indian religious practitioners. Tribes have also voiced concerns when sacred places are pointed out to*
27 *visitors during an air tour, feeling this information might increase potential for on-the-ground damage at a later*
28 *time. In locations close to the river, noise from aircraft above and outside the SFRA would be less noticeable,*
29 *resulting in fewer impacts on practitioners and Ethnographic Resources. Potential for adverse impacts from*
30 *aircraft increases at higher elevations on the ground (aircraft are more visible and more audible).*

31
32 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
33 *Ethnographic Resources, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
34 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
35 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
36 *Chapter 3, Soundscapes, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
37 *Audible capable of masking some aircraft noise.*

38
39 *Quieter, less-used areas may be revered by native people, and can be disturbed by those hiking into them. All*
40 *these noises and visual intrusions combine to create distractions and lack of privacy for traditional practitioners.*

41
42 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
43 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
44 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
45 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
46 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
47 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
48 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
49 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
50 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
51 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
52 *noise some of the time.*

53
54 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
55 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
56 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*

1 **would occur** from air-tour aircraft noise on Ethnographic Resources **with minor to moderate beneficial** changes in
 2 impacts compared to Alternative A. Ten-Year Forecast **Off-Peak Season, at Little Colorado, Little Colorado River,**
 3 **and Temple Butte Location Points**, there would be **negligible impacts with** a reduction in aircraft noise **due to**
 4 **closure on Zuni Point Corridor routes** resulting in **moderate to major** beneficial changes in impacts compared to
 5 Alternative A. **At** Pasture Wash Location Point Ten-Year Forecast Peak and Off-Peak Season, **there would be minor**
 6 **to moderate** adverse impacts with long-term minor **to moderate** beneficial change in impacts compared to
 7 Alternative A.

8
 9 *Conclusions Central Modified NPS Preferred Alternative Ethnographic Resources*
 10 *All Scenarios*

11 At Upper Deer Creek, Surprise Valley, **Grid Location Point 8**, and Mohawk Canyon Location Points, **there would**
 12 **be** negligible impacts to Ethnographic Resources **with** long-term negligible change in impacts compared with
 13 Alternative A.

14
 15 *Conclusions West End Modified NPS Preferred Alternative Ethnographic Resources*
 16 *All Scenarios*

17 At Burnt Springs Canyon Location Point impacts to Ethnographic Resources would be moderate adverse Ten-Year
 18 Forecast, with negligible to minor beneficial change in impact compared to Alternative A. At Meriwhitca, Granite
 19 Peak, and Pumpkin Springs Location Points, negligible impacts **would occur with** a negligible change in impacts
 20 from Alternative A.

21
 22 *Cumulative Impacts Summary Modified NPS Preferred Alternative Ethnographic Resources*

23
 24 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 25 *impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is, Ten-*
 26 *Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections of the*
 27 *park (Marble Canyon, East End, Central, West End) would tend to increase to major adverse Cumulative*
 28 *Impacts under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of*
 29 *the large Flight-free Zones. In comparison with the other Alternatives, Modified NPS Preferred Alternative ranks*
 30 *second behind Alternative E for the lowest overall Cumulative Impacts (Alternative A ranks last).*

31 VISITOR USE AND EXPERIENCE

32 General Assumptions and Methodology

33
 34 The phrase *applicable policies and/or objectives* in Threshold Descriptions for Visitor Use and Experience refers to
 35 1) Chapter 1's objectives, 2) applicable NPS management policies, objectives, and zoning for visitors to NPS lands
 36 in the Study Area, and 3) applicable policies and management objectives for visitors to non-NPS lands in the Study
 37 Area (Map 1.2).
 38
 39
 40

41 In the Thresholds below, all aspects of aircraft noise intensity and duration including, but not limited to aircraft
 42 Percent Time Audible, Average Sound Level, and timing are included in the term *aircraft noise intensity*. Audibility
 43 is the ability of animals and humans with normal hearing to hear a given sound. Audibility is affected by an
 44 individual's hearing ability, other simultaneous interfering sounds or stimuli, and by sound frequency content and
 45 amplitude. Sound energy metrics include Average Sound Level and Time Above decibel levels. When discussing
 46 areas in the SFRA outside the park boundary only Average Sound Level is evaluated to determine level of effect
 47 because **insufficient** ambient data was available to calculate Percent Time Audible. Analysis of Average Sound
 48 Level includes evaluation of data in the park and SFRA.
 49

50 A measure of Distance between visitor locations and aircraft routes is used as an indicator related to effects of
 51 aircraft being in close proximity to visitors, including aircraft visibility and presence to visitors on the ground, and
 52 of visitors on the ground to people in aircraft. This can affect perceptions of privacy, and conflicts between visitors.
 53 While there is usually a close correlation between Distance and sound intensity, this measure of Distance is included
 54 primarily to address effects other than aircraft noise (see Ground-Based Visitors discussion).
 55

1 Visitor Use and Experience is evaluated from two perspectives 1) ground-based visitors and 2) air-tour visitors.
 2 Definitions for impact type, context, duration, and timing apply to both visitor types; however, assessing impact
 3 intensity varies for the two visitor types. Separate conclusions are presented for effects of Alternatives on ground-
 4 based visitors and air-tour visitors. It also should be noted that this impact topic only considers Visitor Use and
 5 Experience, not number of visitors affected by Alternatives.

6
 7 In general, impact analyses take into consideration that more noise sources are present, and more noise impacts from
 8 all sources, including air-tour aircraft, are accepted in Developed Zone (2% of the park) than in other zones, based
 9 on each Zone's management objectives. Impacts are presented and compared to Alternative A for Base Year and
 10 Ten-Year Forecast Peak and Off-Peak Season. *Also, see the beginning of Chapter 4, General Methodology for*
 11 *discussion of overall methodology for impact analysis for all impact topics.*

13 Ground-Based Visitors

Visitor Use and Experience

15 Impacts to ground-based visitors depend primarily on opportunities to experience areas consistent with applicable
 16 policies and/or objectives. This includes considering how Alternatives affect desired conditions and setting of
 17 relevant park Management Zones or objectives of non-NPS lands. Level of detection and perceptibility of aircraft
 18 noise resulting from noise frequency and intensity levels contribute to this assessment. Further, intensity of impacts
 19 from Alternatives would be greater in areas where desired conditions/objectives provide more natural and
 20 contemplative settings (Wilderness Zone) versus more developed and social settings (Developed Zone). As shown in
 21 Figure 1, Appendix D, Dual-Zone Noise Standard, 10 dB were added to natural ambient sound levels in Developed
 22 Zones and some other areas to account for increased visitor activity and accepted presence of non-natural sound
 23 sources.

25 Air-tour Visitors

Visitor Use and Experience

27 Impacts to air-tour visitors are not related to sound produced *externally* by aircraft; thus, thresholds defined for
 28 ground-based visitors do not apply to air-tour visitors. In terms of impacts, air-tour Visitor Use and Experience
 29 depends primarily on access to opportunities for, and perceptions of, aerial viewing experiences. Access to
 30 opportunities for aerial viewing experiences varies due to Alternative actions in terms of geography, time of day and
 31 duration, plus consistency with applicable policies and/or objectives.

33 Access to opportunities for aerial viewing experiences does not lend itself to defining impact intensity thresholds, so
 34 thresholds are not defined for air-tour Visitor Use and Experience in this analysis. Instead, differences between
 35 Alternatives in impacts on air-tour Visitor Use and Experience are described on a comparative basis in terms of
 36 factors for intensity such as available flight hours, time of day considerations, number and variety of air-tour
 37 options, and geographic areas along tour routes. Impacts to air-tour Visitor Use and Experience are also described in
 38 terms of context, duration, and timing as defined below. In this way, Alternative impacts are evaluated and can be
 39 compared without impacts being described in terms of impact intensity thresholds.

41 Perceptions of aerial viewing experiences include 1) aspects like weather and turbulence not under control of air-
 42 tour operators, and 2) aspects mostly under control of individual air-tour operators such as aircraft type (including
 43 windows and seating), tour narration quality, cost, customer service, comfort, neatness/cleanliness, and safety
 44 perceptions. These aspects affecting perceptions of aerial viewing experiences vary primarily by individual air-tour
 45 operators and their business decisions, not directly due to Alternative actions. Thus, they are not included in detailed
 46 analysis for Visitor Use and Experience, but a few are evaluated in Chapter 4, Socioeconomic Environment if
 47 operators are expected to adjust business decisions due to the Alternatives.

49 Impact Intensity Threshold Descriptions

Visitor Use and Experience

51 Threshold Levels

53 *Negligible* Impacts due to the event at lowest levels of detection and barely perceptible on ground-based
 54 visitors, including access to opportunities for visitors to experience desired conditions or setting in
 55 accordance with applicable policies and/or objectives

1		Distance from points of interest to aircraft routes is greater than 2,000 meters
2		
3		Aircraft noise intensity (Average Sound Level) in a specific area less than 15 dBA
4		
5		Aircraft noise rarely audible, i.e., aircraft are audible less than 5% of the 12-hour day used in this analysis
6		
7		
8	<i>Minor</i>	Impacts due to the event small on ground-based visitors, including access to opportunities for visitors to experience desired conditions or setting in accordance with applicable policies and/or objectives
9		
10		
11		
12		Distance from points of interest to aircraft routes greater than 1,000 meters and less than <i>or equal to</i> 2,000 meters
13		
14		
15		Aircraft noise intensity (Average Sound Level) in a specific area greater than <i>or equal to</i> 15 dBA and less than 25 dBA
16		
17		
18		Aircraft noise audible for a small portion of applicable times, i.e., aircraft audible greater than <i>or equal to</i> 5% and less than 10% of the 12-hour day
19		
20		
21	<i>Moderate</i>	Impacts due to the event at an intermediate-level on ground-based visitors, including access to opportunities for visitors to experience desired conditions or setting in accordance with applicable policies and/or objectives
22		
23		
24		
25		Distance from points of interest to aircraft routes greater than 500 meters and less than <i>or equal to</i> 1,000 meters
26		
27		
28		Aircraft noise intensity (Average Sound Level) in a specific area greater than <i>or equal to</i> 25 dBA and less than 35 dBA
29		
30		
31		Aircraft noise audible for an intermediate portion of applicable time periods, i.e., aircraft audible greater than <i>or equal to</i> 10% and less than 25% of the 12-hour day
32		
33		
34	<i>Major</i>	Impacts due to the event large on ground-based visitors, including access to opportunities for visitors to experience desired conditions or setting in accordance with applicable policies and/or objectives
35		
36		
37		
38		Distance from points of interest to aircraft routes less than <i>or equal to</i> 500 meters
39		
40		Aircraft noise intensity (Average Sound Level) in a specific area greater than <i>or equal to</i> 35 dBA
41		
42		Aircraft noise audible for a large portion of applicable times, i.e., aircraft audible greater than <i>or equal to</i> 25% of the 12-hour day
43		
44		

Type of Impact**Visitor Use and Experience**

45		
46		
47	<i>Adverse</i>	Impacts detract from Visitor Use and Experience, including opportunities to experience desired conditions or setting in accordance with applicable management objectives
48		
49		
50	<i>Beneficial</i>	Impacts enhance Visitor Use and Experience, including opportunities to experience desired conditions or setting in accordance with applicable management objectives. <i>Beneficial effects are usually described in terms of changes in impacts compared to Alternative A</i>
51		
52		
53		
54		
55		
56		

1 **Context**

- 2
- 3 *Regional* Impacts affect visitors over a widespread area, such as the majority of the park or Special Flight
- 4 Rules Area, or multiple backcountry use areas, attraction sites, trails or flight routes
- 5
- 6 *Localized* Impacts affect visitors over a small area (e.g., a single backcountry use area) or a specific site,
- 7 such as an overlook or attraction site, or a specific trail or flight route
- 8
- 9 *Park* A given noise generally has greatest intensity impact in NPS areas in the Wilderness
- 10 *Management* Zone, then Non-Wilderness Zone, and least in the Developed Zone. For example, an
- 11 *Zone* aircraft Average Sound Level consistent with the moderate intensity level definition in the
- 12 Wilderness Zone may be considered a minor intensity impact in the Developed Zone, and minor-
- 13 to-moderate in the Non-Wilderness Zone considered, depending on other factors including
- 14 duration and timing

15 **Duration**

- 16
- 17 *Short Term* Impacts associated with individual, infrequent, and/or non-repetitive actions impact a minor
- 18 portion of an average visit, affecting Visitor Use and Experience only during and shortly after
- 19 specified actions
- 20
- 21 *Long Term* Impacts persist well beyond completion of individual actions, affecting majority of an average
- 22 visit. Impacts considered long-term if actions are frequent or repetitive over more than a few days,
- 23 or if they affect visitation patterns
- 24

- 25 **Timing** Time of day, frequency of occurrence, seasonality (coinciding with different visitation periods),
- 26 and sensitive times (quiet times near sunrise and sunset) can be important in assessing impacts to
- 27 Visitor Use and Experience, and are discussed in the analysis when relevant
- 28

29 **ALTERNATIVE A NO ACTION/CURRENT CONDITIONS VISITOR USE AND EXPERIENCE**

30

31 Under Alternative A, a range of aircraft noise intensities and audibility would affect visitor opportunities to

32 appreciate natural sounds. Backcountry visitors in and around Marble Canyon would be little affected by air-tour

33 sounds. Aircraft noise would be concentrated over East End visitors where Zuni Point and Dragon Corridors are

34 heavily used. East End air-tour aircraft noise have potential to affect the greatest percentage of visitors, as this

35 includes the most accessible, most visited, and most developed park areas. Visitors in Wilderness or hiking Central

36 area trail corridors would have most of the day to appreciate natural sounds. West End visitors would be exposed to

37 a mixture of air-tour and natural sounds.

38

39 **Marble Canyon Alternative A Visitor Use and Experience**

40 **Ground-Based Visitors**

41

42 As shown Figures 4.8 to 4.9, modeled noise results indicate Marble Canyon would generally experience aircraft

43 Average Sound Level less than 10 dBA and Percent Time Audible less than 5% of the day. **Marble Canyon Dam**

44 **Site and South Canyon** Location Points represent Marble Canyon Visitor Use and Experience. Both sites are

45 located in areas where visitors expect opportunities to experience solitude and primitive and unconfined recreation.

46 Visitors would generally be pursuing river and backcountry activities in challenging terrain with relatively high

47 expectations for connecting to natural sights and sounds. Under continued current management, there would be

48 long-term negligible to minor adverse impacts on Visitor Use and Experience at these locations.

49 As shown in Table 4.87, near **Marble Canyon Dam Site** Location Point, air-tour noise would rarely be perceptible.

50 Air-tour aircraft noise levels would be low at 3 to 21 dBA. The opportunity to experience natural quiet and solitude

51 would be maintained for visitors at this location. Aircraft would be at Distances in excess of nearly 4,000 meters.

52 Thus, there would be limited impacts to natural sounds appreciation, and no interference with visitor conversations

53 on the ground under continued current conditions. Because air-tour aircraft would rarely be audible, and aircraft

54 would be visible occasionally at Distances over 2,000 meters, impacts on Visitor Use and Experience and

55 appreciation of park resources would be negligible.

56

At **South Canyon** Location Point, air-tour sound Percent Time Audible would be 2%, with Average Sound Level 21 dBA. The opportunity to appreciate natural quiet and solitude would be largely maintained at this location, with natural and aircraft noise mixing, and aircraft audible short, infrequent intervals. Aircraft would occasionally be visible at Distances of 816 meters. Occasional audibility of aircraft and potential to see aircraft in relatively close proximity could disturb some visitors. Overall, there would be long-term minor adverse effect to Visitor Use and Experience at **South Canyon** Location Point.

Marble Canyon Ground-Based Visitors Alternative A Visitor Use and Experience
Visitors Outside the Park within the SFRA

As shown in Figures 4.8 and 4.9, backcountry visitors adjacent to Marble Canyon in **Paria Canyon-Vermilion Cliffs Wilderness** or on the **Navajo Nation** could be affected by air-tour overflight sounds. Aircraft Average Sound Level in these areas would range zero to 10 dBA. Mixing of aircraft noise at 10 dBA with natural sounds would likely result in periods of low audibility and negligible impacts on visitors outside the park.

Table 4.87 Alternative A Sound Levels and Slant Distances Marble Canyon

Location Point Name	Alternative A				Slant Distance (m)
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Forecast	Base Year	Forecast	
Marble Canyon Dam Site	0	0	3	4	3,845
South Canyon	2	3	21	23	816

Forecast indicates Ten-Year Forecast

East End Ground-Based Visitors Alternative A Visitor Use and Experience

As shown in Figures 4.8 and 4.9, East End visitors would be exposed to a wide range of air-tour aircraft noise (Table 4.88). North and South Rim Developed Zone areas are accessed by paved park roads, and many popular East End trail routes are accessed from the rims. East End includes all three Management Zones: Wilderness, Non-Wilderness, and Developed. As described above, East End air-tour sounds have greatest potential to affect visitors because visitor use is concentrated in this area. East End modeled noise results indicate that under and adjacent to air-tour routes there would be high levels of air-tour sounds (40 to 50 dBA) frequently throughout the day (greater than 75%). Audibility and sound levels decrease in areas away from routes, such as in Bright Angel Flight-free Zone.

East End Ground-Based Visitors Alternative A Visitor Use and Experience
Developed Zone

Sound levels in park developed frontcountry areas are generally dependent on amount of visitor use and vehicle traffic and patterns. Other sources of non-natural sounds include visitors (walking, talking), buildings, maintenance activities, generators, and domestic animals. In a 2008 study of GCNP frontcountry locations (NPS 2008a), highest sound levels were associated with the busiest visitor areas such as Village Loop Road, Mather Point, and South Entrance Road. At these and similar areas on North and South Rims, sounds were approximately 20 to 30 dBA higher than in backcountry of the same habitat type. For example, background sound levels in warm and cold desert scrub habitats are approximately 17 dBA, and generally consist of wind, birds, and insects. In addition, level of existing sounds at frontcountry sites was often high enough to mask aircraft noise because aircraft noise occur in similar frequency bands as motors and vehicles. Thus, Developed Zone visitors would have limited opportunities to experience natural sounds, as this setting provides a mix of human and natural habitat sound conditions.

East End Ground-Based Visitors
Developed Zone South Rim Alternative A Visitor Use and Experience

As shown in Table 4.88, general Visitor Use and Experience on South Rim is represented by several Location Points including Desert View, Lipan Point, Tusayan Museum, and El Tovar. Desert View overlooks the canyon near the park's East Entrance. Lipan Point is a canyon overlook on South Rim west of Desert View. Tusayan Museum is approximately 200 meters south of Highway 64, and over 1,000 meters from the canyon rim west of Lipan Point. This cultural resource museum is accessed by a one-way loop road, and has a small parking area. The sites are heavily visited for their canyon views, and experience traffic and other visitor-associated sounds for the vast

1 majority of the day during summer season. The locations also have similar air-tour sound levels due to their
 2 proximity to Zuni Point Corridor routes. Under Alternative A, air-tour sound Percent Time Audible would be
 3 approximately 64 to 75% of the day, with daily air-tour Average Sound Level 29 to 35 dBA. Visitors may frequently
 4 hear aircraft noise, and aircraft would be visible for short period, at Distances in excess of 2,000 meters. In these
 5 developed areas, visitors tend to be somewhat less sensitive to such intrusions. The combination of aircraft being
 6 audible for a high percentage of the day, noticeable at a modest sound level and visible beyond 2,000 meters would
 7 result in localized moderate adverse impacts on Visitor Use and Experience.

8
 9 Grand Canyon Village is developed with roads, hotels, restaurants, and parking areas. Near **El Tovar** Location
 10 Point, aircraft Percent Time Audible would be 95% of the day, with Average Sound Level of 19 dBA. However, this
 11 busy frontcountry area has combined natural and human-caused sound level of 37 to 47 dBA. Thus, air-tour sound
 12 would mix with existing background noise, and could occasionally be intrusive, reducing visitor opportunities to
 13 appreciate natural conditions portions of the day. Aircraft would be visible for short periods at Distances in excess of
 14 5,000 meters. Combination of long periods of aircraft audibility at low sound levels in a developed setting, with low
 15 aircraft visibility would result in moderate adverse impacts on Visitor Use and Experience.

16
 17 *East End Ground-Based Visitors*

18 *Developed Zone Phantom Ranch Alternative A Visitor Use and Experience*

19 **Phantom Ranch** lies along North Kaibab Trail, near the Colorado River. This location provides a range of visitor
 20 amenities, including food service, camping, and a lodge. Phantom Ranch area is not generally affected by air-tour
 21 sound, being beneath Bright Angel Flight-free Zone and near Bright Angel Creek and the Colorado River. As shown
 22 in Table 4.88, air-tour sounds Percent Time Audible would be less than 4% of the day, with Average Sound Level of
 23 12 dBA. Opportunities to appreciate natural conditions would be present most of the day. Air-tour aircraft visibility
 24 would be quite low, with aircraft seen infrequently and in excess of 10,000 meters. The low percentage of time
 25 aircraft would be audible, relatively low sound level, and low aircraft visibility would result in long-term negligible
 26 impacts on Visitor Use and Experience near Phantom Ranch.

27
 28 *East End Ground-Based Visitors*

29 *Developed Zone North Rim Alternative A Visitor Use and Experience*

30 **Bright Angel Point, Cape Royal, and Point Imperial** Location Points represent effects on North Rim frontcountry
 31 Visitor Use and Experience. Bright Angel Point is a popular canyon overlook, accessed via paved trail from North
 32 Rim Lodge. Cape Royal and Point Imperial offer majestic views, and are located east of the main North Rim
 33 developed area, accessible via paved roads. As shown in Table 4.88, at these Cape Royal and Point Imperial
 34 Location Points, air-tour sound Percent Time Audible would be 47 and 66% of the day, with sound levels 24 and 38
 35 dBA. Air-tour aircraft would be visible at Distances of 2,000 meters. In these ponderosa pine and juniper habitats,
 36 sound levels would be 37 to 58 dBA. The mixing of air-tour noise with background sounds would result in aircraft
 37 being audible the majority of the day. The combination of aircraft being audible for a high percentage of the day, at
 38 a noticeable level, and visible beyond 2,000 meters would result in short- and long-term localized moderate adverse
 39 impacts on Visitor Use and Experience.

40
 41 *East End Ground-Based Visitors*

42 *Non-Wilderness Zone Alternative A Visitor Use and Experience*

43 Human-caused sounds are less prevalent in the Non-Wilderness Zone than in the Developed Zone (Ambrose 2008).
 44 Noise-free intervals, ranging up to 26 minutes, did occur in these areas. Visitors to Non-Wilderness Zones have over
 45 half the day to appreciate natural sounds associated with a variety of habitat types, including intervals free of
 46 human-caused noise. Thus, expectations for opportunities to experience natural sounds and sights would be higher
 47 here than in the Developed Zone.

48
 49 South Rim Non-Wilderness visitor use is represented by **Cedar Ridge** Location Point near the top of the South
 50 Kaibab Trail and accessible from the developed South Rim. As shown in Table 4.88, visitors near this location
 51 would experience air-tour noise Percent Time Audible 81% of the day Base Year, with an Average Sound Level of
 52 19 dBA. Modest levels of air-tour aircraft noise would be present most of the day, resulting in lost opportunities to
 53 appreciate natural quiet at these sites. Air-tour aircraft would be at Distances in excess of 9,000 meters. Impacts
 54 from air-tour aircraft on Visitor Use and Experience would be long term moderate to major adverse.

1 *East End Ground-Based Visitors*2 *Wilderness Zone**Alternative A**Visitor Use and Experience*

3 As shown in Figures 4.8 and 4.9, East End Wilderness Zone visitors could expect a wide range of exposure to air-
4 tour noise. Percent Time Audible would range zero to virtually 100% of the day. Air-tour aircraft Average Sound
5 Level would range zero to 45 dBA. As described above, these visitors are seeking access to solitude and primitive
6 recreation conditions, and expect to encounter limited human-caused sounds and sights in the backcountry.

7
8 As shown in Table 4.88, visitors near **Little Colorado River** and **Nankoweap Mesa** Location Points would have
9 air-tour aircraft Percent Time Audible 34% and 87% of the day, and Average Sound Level of 43 dBA. Aircraft
10 would be visible 1,000 to 2,000 meters from the ground. This level of human-caused sights and sounds may interfere
11 with opportunities to appreciate natural sounds and park resources near these locations. In particular, sensitive
12 visitors and those with high expectations for solitary and primitive recreation experiences may be impacted. Impacts
13 from aircraft on Visitor Use and Experience would be long term moderate to major adverse.

14
15 As shown in Table 4.88, close to the river, such as **Nankoweap River** Location Point, aircraft Average Sound Level
16 would be 34 dBA, with Percent Time Audible approximately 7% of the day where natural sound levels near the
17 river are 25 to 65 dBA. Here, the high sound level caused by the river and low periods of aircraft audibility would
18 result in a low level of interference with appreciation of park resources. Visibility of aircraft in this vicinity would
19 be low with aircraft nearly 1,500 meters away from points on the ground. Impacts from aircraft on Visitor Use and
20 Experience would be long term minor adverse.

21
22 Visitor Use and Experience beneath Dragon Corridor are represented by conditions at **Hermit Basin, 96 Mile**
23 **Camp, Point Sublime,** and **Pasture Wash** Location Points. These Location Points are all affected by air-tour
24 aircraft noise from under and near air-tour routes. Visitors pursue a range of activities in this area, from viewing at
25 promontories (both North and South Rims), use of four-wheel drive roads, and accessing remote sites by long hikes
26 and river trips into the canyon. As shown in Table 4.88, these sites receive air-tour noise Percent Time Audible 72 to
27 virtually 100% of the day, with Average Sound Level 20 to 45 dBA. Aircraft would be visible for much of the day at
28 Distances of 1,500 meters or more. Air-tour aircraft would interfere with wilderness visitors' ability to appreciate
29 natural sounds and experience solitude for much of the day. Backcountry visitors may find this level of air-tour
30 aircraft noise disruptive, and it may interfere with the opportunity to experience primitive recreation and appreciate
31 park resources. The combination of nearly continuous aircraft noise at 20 dBA and above with high aircraft visibility
32 would result in localized long-term moderate to major adverse impacts on Visitor Use and Experience.

33
34

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1 **Table 4.88 Alternative A Sound Levels and Slant Distances East End**

Location Point Name	Alternative A				Slant Distance (m)
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Forecast	Base Year	Forecast	
South Rim					
Desert View	76	79	29	30	5,098
Tusayan	64	67	35	36	2,016
El Tovar	95	96	19	20	5,854
Bright Angel Flight Free Zone					
Phantom Ranch	3	4	12	12	11,027
Cedar Ridge	81	82	19	19	9,827
North Rim					
Point Imperial	66	68	38	39	2,292
Bright Angel Point	47	48	24	24	6,235
Cape Royal	59	61	25	26	4,038
Zuni Point Corridor					
Lipan Point	74	77	34	35	2,890
Little Colorado River/Nankoweap Area					
Nankoweap Mesa	87	90	43	43	973
Nankoweap at River	7	8	34	35	1,449
Little Colorado River	34	37	43	43	1,629
Dragon Corridor					
Hermit Basin	99	100	42	42	1,518
96 Mile Camp	72	74	45	45	1,573
Toroweap /Shinumo Flight Free Zone					
Point Sublime	100	100	35	35	3,760
Pasture Wash	98	98	20	21	5,532

Forecast indicates Ten-Year Forecast

2
3
4 **East End Alternative A Visitor Use and Experience**
5 **Ground-Based Visitors Outside the Park within the SFRA**

6
7 The Navajo Nation and Kaibab National Forest bound East End. Within Navajo lands, visitors would be pursuing
8 backcountry activities in a remote area. As shown in Figures 4.8 and 4.9, air-tour aircraft Average Sound Level
9 would range zero to 30 dBA. Air-tour sounds would mix with, and occasionally be audible, and could interfere with,
10 opportunities to appreciate natural sounds. Visitors in this area would experience short-term minor to moderate
11 adverse impacts from air-tour sounds.

12
13 In the Kaibab National Forest at GCNP's southeast corner, air-tour aircraft Average Sound Level would range 35
14 to 50 dBA. Most visitors are using motorized transportation, and many are near Grand Canyon Airport. The
15 vegetative community is old conifer forest, which has a background sound level of approximately 31 dBA. Thus,
16 air-tour sounds would be audible portions of each day, and may occasionally compete with other human-generated
17 sounds associated with development and visitor services. Air-tour aircraft fly directly over the USFS Ten-X
18 Campground area when using Grand Canyon Airport. The result would be short-term minor to moderate adverse
19 impacts on Visitor Use and Experience.

20
21 **Central Ground-Based Visitors Alternative A Visitor Use and Experience**

22
23 As shown in Figures 4.8 and 4.9, Central area would be relatively quiet with little intrusion of air-tour aircraft sights
24 and sounds. Based on modeled noise results, air-tour aircraft Average Sound Level would be generally less than 10
25 dBA and Percent Time Audible would be less than 20% of the time. Under Blue Direct routes in the SFRA, air-tour
26 sights and sounds would be greater with Average Sound Level ranging 40 to 50 dBA. Wilderness and Non-
27 Wilderness Zone visitors near Upper Deer Creek and Toroweap Overlook in the Central area would be largely
28 unaffected by air-tour aircraft noise under Alternative A because this part of the park is largely under Flight-free
29 Zones and away from air-tour routes. Low levels of sound and aircraft visibility would result in few impacts on
30 visitor opportunities to appreciate park sounds and resources in this area.

*Central Ground-Based Visitors Alternative A Visitor Use and Experience
Non-Wilderness Zone*

As shown in Table 4.89, visitors near **Toroweap Overlook** Location Point would be exposed to air-tour aircraft Average Sound Level of 13 dBA, but Percent Time Audible would be zero. At this location, desert scrub background sound levels average 17 dBA. Natural conditions in this habitat would predominate. Aircraft would occasionally be visible from Distances in excess of 9,000 meters. With no audibility, and low visibility, effects on visitor appreciation of park resources would be minimally affected, resulting in negligible impacts on backcountry visitors.

*Central Ground-Based Visitors Alternative A Visitor Use and Experience
Wilderness Zone*

Visitors near **Upper Deer Creek** Location Point would be exposed to very little air-tour noise. As shown in Table 4.89, aircraft Percent Time Audible would be one percent or less of the day at an Average Sound Level of one dBA. In addition, aircraft would be at Distances in excess of 23,000 meters. Natural sound levels of desert scrub habitat are about 17 dBA. Air-tour aircraft would have few, if any, effects on backcountry Visitor Use and Experience and appreciation of natural sights and sounds, and would result in negligible impacts.

**Central Alternative A Visitor Use and Experience
Ground-Based Visitors Outside the Park within the SFRA**

In **Kaibab National Forest and BLM lands north of the park**, visitors pursue a range of recreation activities. Hiking, camping, mountain biking, hunting, and horseback riding are among the most popular pursuits. The Forest is also used for commercial services such as logging, mining, and ranching. Visitors in the Kaibab National Forest and other adjacent lands north of the park would not likely be affected by air-tour overflight sounds. As shown in Figures 4.8 and 4.9, air-tour Average Sound Level would range zero to 10 dBA. Mixing of aircraft and natural sounds would likely result in low audibility and negligible impacts on ground-based visitors outside the park.

South of the park, in **Havasupai and Hualapai Reservation lands**, air-tour aircraft Average Sound Level would range widely, from zero to 55 dBA. Aircraft noise would be concentrated beneath Blue Direct flight routes near the SFRA's southern boundary. Central area visitors pursue a variety of activities, using motorized vehicles to explore the area, and traveling to Supai Village by mule, foot, or helicopter. Thus, in this SFRA southern portion, natural conditions would occasionally be dominated by aircraft noise, and the opportunity to appreciate natural sounds would be lost for periods. This would result in long-term minor to moderate adverse impacts.

Table 4.89 Alternative A Sound Levels and Slant Distances Central

Location Point Name	Alternative A				Slant Distance (m)
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Forecast	Base Year	Forecast	
Upper Deer Creek		0	1	1	23,683
Toroweap Overlook		1	13	1	9,625

Forecast indicates Ten-Year Forecast

West End Ground-Based Visitors Alternative A Visitor Use and Experience

Based on modeled noise results shown in Figures 4.8 and 4.9, West End under and near Blue-2, Green-4, and Blue Direct routes, adverse impacts would result from aircraft Average Sound Level 40 to 50 dBA and Percent Time Audible greater than 65%. In West End's southern portion (Sanup Flight-free Zone), farther removed from air-tour routes, adverse impacts would be less, with aircraft Average Sound Level 10 to 20 dBA and Percent Time Audible less than 20%. For lands outside the park directly under and within five miles of Blue Direct routes and other busy air-tour areas, adverse impacts would result from Average Sound Level ranging 40 to 50 dBA. The SFRA remainder outside park boundaries would experience Average Sound Level less than 25 dBA.

Under Alternative A, West End visitor locations would receive a wide range of exposure to air-tour aircraft noise. Percent Time Audible would be zero to 93%; Average Sound Level would range zero to 47 dBA.

West End Ground-Based Visitors Alternative A Visitor Use and Experience Wilderness Zone

Whitmore Rapids, Parashant Wash, and Separation Canyon Location Points represent visitor sites commonly used by river rafters. Beaches at these sites provide areas for camping and equipment staging. At these locations, as shown in Table 4.90, air-tour aircraft Percent Time Audible would be zero to 12% of the day, with Average Sound Level 7 to 33 dBA. Opportunity to experience natural sounds would be maintained throughout most of the day, but intrusions would occur that could interrupt appreciation of park sounds and resources. Distance of air-tour aircraft would range 1,800 meters to over 16,000 meters. Impacts to Visitor Use and Experience would be long-term minor adverse.

At **Bat Cave** Location Point, air-tour aircraft noise Percent Time Audible would be 93%, with Average Sound Level 47 dBA. Opportunity to experience natural quiet would be rare at this location. Aircraft would be visible at Distances just over 1,000 meters. Combination of aircraft noise and visibility would result in daylong, reduced opportunities to appreciate park sounds and resources at this location. Impacts on Wilderness visitors would be long term major adverse.

West End Alternative A Visitor Use and Experience Ground-Based Visitors Outside the Park within the SFRA

In **Grand Canyon-Parashant National Monument** to the north, visitors are generally dispersed, and pursue a range of activities including off-road and recreational vehicle use, hiking, and camping, and use remote airstrips. As shown in Figures 4.8 and 4.9, near Bar Ten airstrip, visitors would experience air-tour sounds, but air-tours would only be one component of air traffic at this site. Along the park’s northern boundary, sounds from Blue Direct would be heard at Average Sound Level of 25 to 50 dBA. Aircraft would be audible above natural sounds for at least portions of the day, resulting in minor to moderate adverse impacts in this area.

The **Hualapai Reservation** bounds GCNP’s southwest corner. Visitors here are generally pursuing canyon-related experiences developed by the tribe based around Grand Canyon West, such as the Sky Walk. Along the canyon rim in this area, air-tour sounds would be generally absent, with Average Sound Level zero to 15 dBA. Air-tour sounds would mix with natural sounds, and would be audible for a small portion of the day. This may be perceptible, but would not result in measurable loss of opportunities to appreciate natural sounds. Impacts on Visitor Use and Experience would be negligible.

The **Hualapai Reservation** and **Lake Mead National Recreation Area** join GCNP on the far West End. Lake Mead receives 9.5 million visitors each year, and visitors pursue activities from motor boating and houseboat cruising to backcountry hiking and camping. In this area, air-tour aircraft noise would range 20 to over 50 dBA. Air-tour sounds would be audible above natural sounds for some or much of the day, and opportunities to appreciate natural sounds would be reduced. This would result in long-term minor to moderate adverse impacts on Visitor Use and Experience in these areas.

Table 4.90 Alternative A Sound Levels and Slant Distances West End

Location Point Name	Alternative A				Slant Distance (m)
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Forecast	Base Year	Forecast	
Whitmore Rapids	12	13	21	21	1,804
Parashant Wash	12	14	33	33	2,852
Separation Canyon at Colorado River	0	0	7	7	16,377
Bat Cave	93	95	47	47	1,134

Forecast indicates Ten-Year Forecast

Air-tour Visitors Alternative A Visitor Use and Experience

Alternative A would provide the same variety of Grand Canyon air-tour experiences as currently available. All routes would be available throughout the year, with varying tour durations, price points, and scenic highlights (see Chapter 2’s Alternative A description).

1 Black routes in Marble Canyon would cross the canyon multiple times to provide river views for passengers on both
2 sides of the plane. An entry and exit route would be available near South Canyon.

3
4 East End, air-tour visitors would have access to long- and short-loop tours year-round. Zuni Point Corridor routes
5 would include overflights of Little Colorado River confluence and Nankoweap Basin. Long-loop tour routes that
6 encircle Bright Angel Flight-free Zone would include views of geologic highlights. Tours of longer duration provide
7 high levels of visitor satisfaction by providing increased time over the canyon for viewing. *Helicopter visitors are*
8 *well below the rim near and south of Point Imperial, and also in the northern part of the Dragon Corridor.*

9
10 West End, Blue Direct routes between Las Vegas and Grand Canyon Airport would provide canyon viewing with
11 limited opportunities to view the Colorado River. Loop routes would continue to provide canyon and river views for
12 those visiting from the Las Vegas area. Visitors to Hualapai Tribal Lands may participate in air tours to and from
13 Grand Canyon West as well as helicopter tours to the river near Quartermaster Canyon (Over the Edge Flights).

14
15 **Cumulative Impacts** **Alternative A** **Visitor Use and Experience**
16 **Ground-Based Visitors**

17
18 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
19 *actions. In this context, Cumulative Impacts include impacts on Visitor Use and Experience from sounds of*

- 20 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
21 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
22 *3) ground-based noise sources, plus*
23 *4) noise from air-tour-and-related aircraft under Alternative A*

24
25 *That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).*

26
27 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
28 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
29 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
30 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
31 *SFRA see Appendix D, Figures 91 to 94).*

32
33 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
34 *Visitor Use and Experience, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
35 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
36 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
37 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
38 *Audible capable of masking some aircraft noise.*

39
40 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
41 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
42 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
43 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
44 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
45 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
46 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
47 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
48 *Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the*
49 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*

50
51 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
52 *(Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
53 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
54 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
55 *(Alternative A in this case).*

1 *Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 2 *Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is*
 3 *detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year*
 4 *Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS;*
 5 *however, since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas*
 6 *(2% of the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in*
 7 *interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas*
 8 *north of the park.*

9
 10 *Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All*
 11 *Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the*
 12 *difference between Cumulative Impacts and impacts of Alternative A by itself. For the Entire Park Cumulative*
 13 *Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the park, with*
 14 *Average Sound Level 25 to <35 dBA in 85% of the park, with none of the park below 25 dBA, and 24% at 35 dBA*
 15 *or more. For the Entire Park results for Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or*
 16 *more of the day in 27% of the park, with Average Sound Level 25 to <35 dBA in 28% of the park, with 50% of the*
 17 *park below 25 dBA, and 22% at 35 dBA or more.*

18
 19 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 20 *including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour*
 21 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
 22 *impacts under the Alternatives reduces Cumulative Impacts.*

23
 24 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 25 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 26 *Alternative (route locations/number/altitudes/quiet technology conversion, etc.). When added to noise impacts of*
 27 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 28 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
 29 *in the Conclusions section below.*

Conclusion Ground-Based Visitors	Alternative A	Visitor Use and Experience
<i>Conclusion Marble Canyon</i>	<i>Alternative A</i>	<i>Visitor Use and Experience</i>
The No Action Alternative would result in long-term negligible to minor adverse impacts on Visitor Use and Experience in Marble Canyon. Cumulative Impacts on Visitor Use and Experience near Marble Canyon would be long term moderate adverse.		
<i>Conclusion East End Developed Zone</i>	<i>Alternative A</i>	<i>Visitor Use and Experience</i>
The No Action Alternative would result in long-term negligible to moderate adverse impacts on Visitor Use and Experience in East End developed areas. Cumulative Impacts on Visitor Use and Experience would be long term minor to moderate adverse.		
<i>Conclusion East End Non-Wilderness Zone</i>	<i>Alternative A</i>	<i>Visitor Use and Experience</i>
The No Action Alternative would result in long-term moderate to major adverse impacts on Non-Wilderness Visitor Use and Experience.		
<i>Conclusion East End Wilderness Zone</i>	<i>Alternative A</i>	<i>Visitor Use and Experience</i>
The No Action Alternative would result in long-term minor to major adverse impacts on East End Wilderness Visitor Use and Experience.		
<i>Conclusion Central</i>	<i>Alternative A</i>	<i>Visitor Use and Experience</i>
The No Action Alternative would result in negligible impacts on Visitor Use and Experience.		

1 *Conclusion West End* *Alternative A* *Visitor Use and Experience*
 2 The No Action Alternative would result in minor to major adverse impacts on West End Visitor Use and Experience.

3
 4 **Cumulative Impacts Summary** *Alternative A* *Visitor Use and Experience*

5
 6 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 7 *impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts in*
 8 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 9 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 10 *and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison with the*
 11 *other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts (Alternative E ranks first in*
 12 *lowest Cumulative Impacts).*

13
 14 **Conclusion** **Alternative A** **Visitor Use and Experience**
 15 **Air-tour Visitors**

16
 17 Alternative A provides a wide range of opportunities for air-tour visitors year-round, and scenic views would be
 18 available for aerial viewing from a variety of routes.

19
 20 **ALTERNATIVE E** **ALTERNATING SEASONAL USE** **VISITOR USE AND EXPERIENCE**

21
 22 Alternative E would increase park area beneath Flight-free Zones by alternating seasonal use of Zuni Point and
 23 Dragon Corridors, and by extending Bright Angel Flight-free Zone north to include Marble Canyon. A range of air-
 24 tour aircraft noise would continue to affect Visitor Use and Experience throughout the park. Seasonal route closures
 25 would decrease air-tour aircraft noise, resulting in beneficial changes to ground-based East End Visitor Use and
 26 Experience. Alternative E would also fully implement quiet-technology aircraft with a maximum seven hours daily
 27 flight time in East End flight corridors.

28
 29 **Marble Canyon Ground-Based Visitors** **Alternative E** **Visitor Use and Experience**

30
 31 As shown in Figures 4.14 to 4.17, Marble Canyon would remain relatively quiet with aircraft Average Sound Level
 32 less than 10 dBA and Percent Time Audible less than 5%. In the park, Marble Canyon Location Points would
 33 experience beneficial changes compared to Alternative A, and would generally be free of air-tour aircraft noise and sights.

34
 35 *Marble Canyon Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
 36 *All Scenarios*

37 Bright Angel Flight-free Zone would be extended north to Lees Ferry, thereby eliminating air-tours and related
 38 flights from Marble Canyon. Consequently, aircraft Average Sound Level would be reduced throughout the year.
 39 In Base Year Peak Season, at **Marble Canyon Dam Site** Location Point, as shown in Tables 4.91 and 4.92,
 40 Percent Time Audible would remain zero percent, with Average Sound Level falling 3 dBA to zero. At **South**
 41 **Canyon** Location Point, Percent Time Audible would decrease from 2% of the day to zero, and Average Sound
 42 Level would decrease from 21 dBA to zero. Aircraft would be over 17,000 meters distant from these locations.
 43 The small increment of reduced Percent Time Audible, compared to Alternative A, would result in air-tour
 44 aircraft rarely being heard. Opportunities to experience natural conditions and solitude would improve over
 45 Alternative A. Negligible impacts would occur with long term negligible to minor beneficial change in impacts
 46 compared to Alternative A.

47
 48 *Marble Canyon* *Alternative E* *Visitor Use and Experience*
 49 *Ground-Based Visitors Outside the Park within the SFRA*
 50 *All Scenarios*

51 With extension of Bright Angel Flight-free Zone northward to include all of Marble Canyon, Average Sound
 52 Level in areas of **Saddle Mountain** and **Paria Canyon-Vermilion Cliffs Wilderness Areas** and the **Navajo**
 53 **Nation** adjacent to the park would be unaffected by air-tour overflight sounds. As shown in Figure 4.14, Base
 54 Year Peak Season, Average Sound Level in these areas ranges zero to 5 dBA. For All Scenarios, mixing of
 55 aircraft noise with low level natural sounds would likely result in air-tours rarely being audible, resulting in
 56 negligible impacts with a negligible change in impacts compared to Alternative A.

1 **Table 4.91 Alternative E Sound Levels Marble Canyon**

Location Point Name	Alternative A		Alternative E																	
			Peak Season								Off Peak Season									
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4
South Canyon	2	3	21	23	0	-2	0	-2	0	-21	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.92 Alternative E Slant Distances Marble Canyon

Location Point Name	Alternative A		Alternative E	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
Marble Canyon Dam Site	3,845		17,396	13,551
South Canyon	816		26,091	25,275

Δ indicates change in noise metric data from Alternative A

5
6
7

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1 **East End** **Alternative E** **Visitor Use and Experience**

2
3 Under Alternative E, greatest exposure to noise and visual impacts would continue East End. Modeled noise results
4 shown in Figures 4.14 to 4.17 indicate under and adjacent to active air-tour routes there would be high Average
5 Sound Level of air-tour sounds (40 to 50 dBA) frequently throughout the day (Percent Time Audible greater than
6 75% of the time). However, air-tour sounds would be reduced beneath Dragon Corridor due to closure during Peak
7 Season and conversely, beneath Zuni Point Corridor due to closure during Off-Peak Season. This would result in
8 substantial beneficial effects compared to Alternative A. Alternative E curfews would benefit ground-based visitors
9 in all East End Management Zones by reducing daily operating times. Because Alternative E includes quiet-
10 technology incentives and conversion requirements, opportunities to appreciate natural sounds would increase Base
11 Year to Ten-Year Forecast. Although adverse impacts on Visitor Use and Experience would continue, beneficial
12 changes would be seen in both Percent Time Audible and Average Sound Level.

13
14 *East End Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
15 *Developed Zone South Rim*
16 *Base Year Peak Season*

17 At **Desert View, Lipan Point, and Tusayan Museum** Location Points air-tour aircraft noise would increase
18 modestly Base Year Peak Season when Zuni Point Corridor is in use and air-tour flights are concentrated in this
19 route. At these sites, as shown in Tables 4.93 and 4.94, air-tour Percent Time Audible would rise from 64 to
20 76%, to 84 to 88% of the day. Average Sound Level would rise by a modest 3 to 7 dBA. These increases in
21 Percent Time Audible and Average Sound Level would reduce already limited opportunities to appreciate natural
22 quiet at these Developed Zone sites. However, aircraft visibility would increase at the various visitor locations,
23 with Distance to aircraft exceeding 2,000 meters at Desert View Location Point, nearly 1,000 meters at Lipan
24 Point Location Point, and less than 500 meters at Tusayan Museum Location Point. Although Developed Zone
25 Visitor Use and Experience is affected by a combination of natural and human-caused sounds, Alternative E
26 Peak Season would introduce additional air-tour aircraft noise. Impacts would be moderate adverse. Compared to
27 Alternative A, this would further limit opportunities for visitors to experience natural sounds and appreciate park
28 resources, resulting in long-term minor to moderate adverse changes to Visitor Use and Experience at these sites.

29
30 Visitors near **El Tovar** Location Point would see dramatic reductions in air-tour aircraft noise because Dragon
31 Corridor is not in use Peak Season. Air-tour Percent Time Audible would fall from 95% of the day to 8%.
32 Average Sound Level would be reduced from 19 to 7 dBA. This would provide additional opportunities to
33 experience natural sounds in this Developed Zone. Aircraft visibility would increase by 3,500 meters. Although
34 negligible impacts to Visitor Use and Experience from air-tour aircraft would occur, these changes would be
35 long-term minor to moderate beneficial compared to Alternative A.

36
37 *East End Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
38 *Developed Zone South Rim*
39 *Ten-Year Forecast Peak Season*

40 Compared to Alternative A at **Desert View, Lipan Point, and Tusayan Museum** Location Points, Percent Time
41 Audible would fall from 64 to 76%, to 50 to 62%. Average Sound Level would vary somewhat, but would be
42 similar to Alternative A at 26 to 40 dBA. Although moderate to major adverse impacts would continue, this
43 would result in negligible to minor beneficial changes to Visitor Use and Experience compared to Alternative A.

44
45 At **El Tovar** Location Point, Percent Time Audible would decrease from 96 to 9% and Average Sound Levels
46 would decrease from 20 to 12 dBA, negligible impacts with long-term moderate to major beneficial changes in
47 impacts from Alternative A.

1 *East End Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
 2 *Developed Zone South Rim*
 3 *Base Year Off-Peak Season*

4 Air-tour sounds at **Desert View** and **Tusayan Museum** Location Points would be reduced as air-tour operations
 5 move to Dragon Corridor. Visitors in this area would experience large reductions in air-tour aircraft Percent
 6 Time Audible and Average Sound Level. Percent Time Audible would decrease to zero to 6% of the day from
 7 Alternative A levels of 64 to 76%. Average Sound Level would also decrease 23 to 33 dBA, resulting in Average
 8 Sound Level of 3 to 6 dBA. Although negligible impacts would occur, these conditions would increase
 9 opportunities for visitors to experience natural sounds at these sites, producing long-term moderate beneficial
 10 changes in impacts to Visitor Use and Experience compared to Alternative A.

11
 12 At **El Tovar** Location Point, Dragon Corridor dogleg would be in use and air-tour aircraft would move west.
 13 Only quiet-technology aircraft would be in use early and late in the operating day. This would dramatically
 14 reduce air-tour Percent Time Audible in this area. Aircraft Percent Time Audible would be 34% of the day at 11
 15 dBA, down from 95% of the day at 19 dBA under Alternative A. Visitors in this area would have additional
 16 opportunities to experience natural sounds Off-Peak Season. Although some minor adverse effects to Visitor Use
 17 and Experience would persist, Alternative E Off-Peak Season would result in long-term moderate beneficial
 18 changes in impacts to Visitor Use and Experience compared to Alternative A.

19
 20 *East End Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
 21 *Developed Zone South Rim*
 22 *Ten-Year Forecast Off-Peak Season*

23 **El Tovar** Location Point would experience further decreases in air-tour aircraft noise. Air-tour Percent Time
 24 Audible would be 11% of the day at 10 dBA, down from 96% of the day at 20 dBA under Alternative A. Air-
 25 tour sounds would mix with natural and human-caused sounds, resulting in low audibility, and increased
 26 opportunities to experience natural sounds. Although minor adverse impacts would continue, conditions at **El**
 27 **Tovar, Desert View, Lipan Point, and Tusayan Museum** Location Points would represent long term moderate
 28 beneficial changes in impacts compared to Alternative A.

29
 30 *East End* *Alternative E* *Visitor Use and Experience*
 31 *Developed Zone Phantom Ranch*
 32 *All Scenarios*

33 Under Alternative E, air-tour aircraft noise at **Phantom Ranch** would be reduced from their already low levels.
 34 As shown in Tables 4.93 and 4.94, Percent Time Audible and Average Sound Level would decrease to
 35 approximately one percent of the day at 6 to 7 dBA compared to 3 to 4% and 12 dBA under Alternative A.
 36 Aircraft would be at Distances of 10,000 meters. It is unlikely visitors would perceive these small beneficial
 37 changes (2% and 5 dBA). However, opportunities to experience combined natural and human-made sound
 38 conditions would be largely uninterrupted. If aircraft were audible, it would be for brief, infrequent periods.
 39 These represent negligible impacts with negligible changes in impacts compared to Alternative A.

40
 41 *East End* *Alternative E* *Visitor Use and Experience*
 42 *Developed Zone North Rim*
 43 *Base Year Peak Season*

44 Extension of Bright Angel Flight-free Zone northward would reduce air-tour aircraft noise, and **Bright Angel**
 45 **Point** and **Point Imperial** Location Points would see marked decreases in both Percent Time Audible and air-
 46 tour Average Sound Level. As shown in Tables 4.93 and 4.94 aircraft Percent Time Audible would be 5 to 31%
 47 of the day, at Average Sound Level 11 to 13 dBA. This is a reduction of 34 to 42% Percent Time Audible and 24
 48 to 38 dBA from Alternative A. Visitors in this vicinity would experience reduced impacts from air-tour aircraft.
 49 Although minor adverse impacts would occur, Alternative E would result in long-term minor to moderate
 50 beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

51
 52 At **Cape Royal** Location Point, Zuni Point Corridor use would increase aircraft noise compared to Alternative A.
 53 Air-tour Percent Time Audible would be 77% of the day at an Average Sound Level of 26 dBA, compared to
 54 59% of the day at 25 dBA under Alternative A. Aircraft would be at Distances of 6,000 meters. The increased
 55 portion of the day flights are audible would reduce visitor opportunities to appreciate natural sounds, but the

1 increase in sound level would not likely be noticeable. This would result in moderate adverse impacts with long-
2 term negligible to minor adverse changes to Visitor Use and Experience compared to Alternative A.

3
4 *East End* *Alternative E* *Visitor Use and Experience*
5 *Developed Zone North Rim*
6 *Ten-Year Forecast Peak and Off-Peak Season*

7 At **Bright Angel Point** and **Point Imperial** Location Points, air-tour aircraft Percent Time Audible would be
8 reduced to one percent at 8 to 11 dBA. These values are decreased 47 to 66% Percent Time Audible at 24 to 38
9 dBA from Alternative A. Visitors would have increased opportunities to appreciate natural sounds throughout
10 the day in these areas, with negligible impacts and long-term moderate beneficial changes in impacts to Visitor
11 Use and Experience compared to Alternative A. Similar levels of aircraft noise and Percent Time Audible of one
12 percent would also occur at this location Ten-Year Forecast Off-Peak Season.

13
14 Conditions at **Cape Royal** Location Point Ten-Year Forecast Peak Season show reduced air-tour sounds with
15 Percent Time Audible 25% of the day at Average Sound Level 20 dBA, a reduction from Alternative A of 36%
16 and 6 dBA. Reduction in Percent Time Audible would produce minor to moderate adverse impacts with long-
17 term minor beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

18
19 *East End* *Alternative E* *Visitor Use and Experience*
20 *Developed Zone North Rim*
21 *Base Year and Ten-Year Forecast Off-Peak Season*

22 **Cape Royal** Location Point would receive reduced levels of air-tour aircraft noise as operators move to Dragon
23 Corridor. Sound levels would decrease to Percent Time Audible one percent of the day at an Average Sound
24 Level of 11 dBA, down from 59% and 25 dBA under Alternative A (a 58% and 14 dBA reduction). Visitors
25 would have opportunities to appreciate natural sounds at this developed site throughout the day. Negligible
26 impacts would occur with long-term moderate beneficial changes in impacts to Visitor Use and Experience
27 compared to Alternative A.

28
29 *East End* *Alternative E* *Visitor Use and Experience*
30 *Non-Wilderness Zone*
31 *Base Year Peak Season*

32 Alternative E would reduce air-tour aircraft noise due to Zuni Point Corridor use and Dragon Corridor dogleg
33 implementation. At **Cedar Ridge** Location Point, as shown in Tables 4.93 and 4.94, aircraft Percent Time
34 Audible would be 40% of the day at an Average Sound Level of 14 dBA. This compares to 81% of the day at 19
35 dBA under Alternative A, a reduction of 41% and 5 dBA. Aircraft would be at Distances of approximately
36 13,000 meters. Although minor to moderate adverse impacts would occur, increased opportunity to appreciate
37 natural sounds would result in long-term moderate to major beneficial changes in impacts to Visitor Use and
38 Experience compared to Alternative A.

39
40 *East End* *Alternative E* *Visitor Use and Experience*
41 *Non-Wilderness Zone*
42 *Base Year Off-Peak Season*

43 At **Cedar Ridge** Location Point, aircraft Percent Time Audible would be reduced by 56% and Average Sound
44 Level 7 dBA from Alternative A. Visibility of aircraft from the ground would be the same as Base Year Peak
45 Season. Although minor adverse impacts would occur, increased opportunity to appreciate natural sounds would
46 result in long-term minor to major beneficial changes in impacts to Visitor Use and Experience compared to
47 Alternative A.

48
49 *East End* *Alternative E* *Visitor Use and Experience*
50 *Non-Wilderness Zone*
51 *Ten-Year Forecast Peak and Off-Peak Season*

52 Air-tour aircraft noise at **Cedar Ridge** Location Point would decrease. Due to quiet-technology conversion,
53 Percent Time Audible would fall to 4% of the day with Average Sound Level of 11 dBA. This represents a
54 reduction of 77% and 8 dBA compared to Alternative A. Although negligible impacts would occur, changes in
55 impacts to Visitor Use and Experience would be long-term minor to major beneficial changes in impacts
56 compared to Alternative A.

1 **East End** **Alternative E** **Visitor Use and Experience**
 2 **Wilderness Zone**

3
 4 East End Wilderness visitors could expect a wide range of exposure to air-tour noise. Percent Time Audible would
 5 range zero to virtually 100% of the day. Air-tour Average Sound Level would range zero to 45 dBA.

6
 7 *East End* *Alternative E* *Visitor Use and Experience*
 8 *Wilderness Zone*
 9 *Base Year Peak Season*

10 As shown in Tables 4.93 and 4.94, visitors near the **Little Colorado River** and **Nankoweap Mesa** Location
 11 Points would be exposed to air-tour sound levels similar to Alternative A. Aircraft Percent Time Audible would
 12 be 36 to 78%, at Average Sound Level of 23 to 39 dBA. This represents a decrease of 7 to 9% Percent Time
 13 Audible, and 4 to 20 dBA in Average Sound Level. Aircraft would be more Distant than in Alternative A and
 14 greater than 2,000 meters away from points on the ground. These modest changes would provide a small
 15 increment of increased opportunities to appreciate natural sounds and experience solitude in these areas.
 16 Although moderate to major adverse effects would continue, compared to Alternative A this would result in
 17 long-term minor beneficial changes in impacts to Visitor Use and Experience.

18
 19 Under Alternative E, visitors near **Nankoweap River** Location Point would experience reduced air-tour sounds
 20 compared to Alternative A. Percent Time Audible would drop from 7% to zero, and Average Sound Level would
 21 decrease from 34 dBA to 12 dBA. Because this area is close to the river, aircraft would be less audible. Aircraft
 22 would be distant, at more than 7,000 meters. Negligible impacts with long-term minor beneficial changes in
 23 impacts compared to Alternative A.

24
 25 Base Year Peak Season under Alternative E, Wilderness visitors near **Hermit Basin, 96 Mile Camp, Point**
 26 **Sublime**, and **Pasture Wash** Location Points would have increased opportunities to appreciate natural sounds of
 27 the river and desert scrub habitats, solitude, and primitive recreation. This would provide an experience more
 28 consistent with expectations of backcountry visitors. Dragon Corridor would not be in use, resulting in reduced
 29 air-tour aircraft noise at locations beneath or near this route. Percent Time Audible would decrease 54 to 87%
 30 from Alternative A. Average Sound Level would decrease 5 to 37 dBA from Alternative A. Aircraft would be
 31 visible 1,700 to 11,000 meters in the Distance. Impacts would be negligible to moderate adverse. Peak Season, at
 32 Pasture Wash Location Point, long-term beneficial change in Average Sound Level compared to Alternative A
 33 would be negligible; otherwise backcountry visitors at these locations would experience long-term major
 34 beneficial changes compared to Alternative A.

35
 36 *East End* *Alternative E* *Visitor Use and Experience*
 37 *Wilderness Zone*
 38 *Ten-Year Forecast Peak Season*

39 **Nankoweap Mesa** Location Point Percent Time Audible would decline 45% with a decrease in Average Sound
 40 Level of 24 dBA. Aircraft would be at Distances beyond 6,000 meters. There would be increased opportunities
 41 for Visitor Use and Experience more consistent with Wilderness expectations, including solitude and primitive
 42 recreation. Alternative E would produce negligible impacts with long-term moderate to major beneficial changes
 43 in impacts to Visitor Use and Experience compared to Alternative A.

44
 45 Ten-Year Forecast Peak Season conditions for visitors **Hermit Basin, 96 Mile Camp, and Point Sublime**
 46 Location Points beneath or near Dragon Corridor would be improved compared to Alternative A. Percent Time
 47 Audible would range zero to 31%, a 67 to 83% reduction. Average Sound Level would range 8 to 17 dBA, a 4 to
 48 37 dBA reduction. Backcountry visitors would have marked improvement in opportunities to appreciate natural
 49 sounds and solitude. Impacts would be negligible to moderate adverse. Changes in impacts compared to
 50 Alternative A would be long term major beneficial, except **Pasture Wash** where change in Average Sound Level
 51 would be negligible compared to Alternative A.

1 *East End* *Alternative E* *Visitor Use and Experience*
 2 *Wilderness Zone*
 3 *Base Year Off-Peak Season*
 4 Operations would move to Dragon Corridor with only quiet-technology aircraft early and late in the operating
 5 day, and visitors would be less affected by air-tour aircraft noise. At locations near the **Little Colorado River**
 6 and **Nankoweap Mesa** Location Points, air-tour aircraft Percent Time Audible would be one percent of the day
 7 or less with aircraft Average Sound Level of 14 dBA. This represents an 86% reduction in Percent Time Audible,
 8 and a 29 dBA reduction in Average Sound Level. Backcountry visitors could appreciate natural sounds of desert
 9 scrub and river virtually all day. When audible, air-tour aircraft noise levels would be low. Although negligible
 10 impacts would occur, there would be long-term moderate to major beneficial changes in impacts compared to
 11 Alternative A.

12
 13 At 96 Mile Camp Location Point, air-tour aircraft Percent Time Audible would be 26% with an Average Sound
 14 Level of 37 dBA, a reduction of 46% and 7 dBA. At Hermit Basin, Pasture Wash, and Point Sublime Location
 15 Points, air-tour aircraft Percent Time Audible would be 71 to 89% of the day, with Average Sound Level 20 to
 16 29 dBA. This represents a reduction in Percent Time Audible of 11 to 28%, and in Average Sound Level of one
 17 to 19 dBA. Backcountry visitors would have increased opportunities to experience natural sounds and solitude in
 18 this area. Moderate to major adverse impacts would occur with long-term minor to major beneficial changes in
 19 impacts compared to Alternative A.

20
 21 *East End* *Alternative E* *Visitor Use and Experience*
 22 *Wilderness Zone*
 23 *Ten-Year Forecast Off-Peak Season*

24 Change in Percent Time Audible, Average Sound Level, and aircraft visibility from the ground at **Little**
 25 **Colorado River** and **Nankoweap Mesa** Location Points would be similar to Base Year Off-Peak Season.
 26 Although moderate to major adverse impacts would occur, long-term there would be moderate to major
 27 beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

28
 29 Conditions at **Hermit Basin, Pasture Wash, Point Sublime, and 96 Mile Camp** Location Points would also
 30 result in improved conditions for backcountry visitors. Percent Time Audible would range 17 to 63%, a 37 to
 31 67% decrease from Alternative A. Average Sound Level would range 18 to 34 dBA, a 3 to 24 dBA decrease
 32 from Alternative A. This would result in minor to major adverse impacts with long-term minor to major
 33 beneficial changes in impacts for visitors in this area compared to Alternative A.

34
 35 *East End* *Alternative E* *Visitor Use and Experience*
 36 *Wilderness Zone*
 37 *Base Year Off-Peak Season and Ten-Year Forecast Peak and Off-Peak Season*

38 Near **Nankoweap River** Location Point, change in aircraft Percent Time Audible, Average Sound Level, and
 39 visibility would be nearly the same as Base Year Peak Season. Although negligible impacts would occur, long-
 40 term there would be minor beneficial changes in impacts compared to Alternative A.

41
 42 **East End** **Alternative E** **Visitor Use and Experience**
 43 **Ground-Based Visitors Outside the Park within the SFRA**
 44 *Base Year and Ten-Year Forecast Peak Season*

45 Areas of the **Navajo Nation** and **Kaibab National Forest** beneath and near Zuni Point Corridor would continue
 46 to be affected by air-tour sounds. As shown in Figures 4.14 and 4.15, aircraft Average Sound Level would range
 47 35 to 50 dBA. Air-tour sounds would be audible. Visitors in these areas would experience moderate adverse
 48 impacts with long-term minor to moderate adverse changes in impacts compared to Alternative A.

49
 50

1 *East End Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
2 *Visitors Outside the Park within the SFRA*
3 *Base Year and Ten-Year Forecast Off-Peak Season*

4 With operations only in Dragon Corridor, air-tour sounds would be virtually eliminated from **Navajo lands** and
5 **areas east of Grand Canyon Village** resulting in negligible impacts with long-term moderate beneficial changes
6 in impacts compared to Alternative A.

7
8 Use of Dragon Corridor would generate air-tour aircraft noise **west of Grand Canyon Village outside the park.**
9 Air-tour sounds between Grand Canyon Airport and the park would average 30 to 50 dBA. Air-tour sounds
10 would be audible above natural sounds for some or much of the day. Moderate adverse impacts would occur with
11 visitors in this area experiencing negligible change in impacts compared to Alternative A.
12
13

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1 **Table 4.93 Alternative E Sound Levels East End**

Location Point Name	Alternative E																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
South Rim																				
Desert View	76	79	29	30	87	12	53	-26	32	3	26	-3	6	-70	8	-71	6	-23	5	-25
Tusayan	64	67	35	36	84	20	50	-18	42	7	40	4	0	-63	0	-67	3	-33	2	-33
El Tovar	95	96	19	20	8	-88	9	-86	7	-12	8	-12	34	-61	11	-85	11	-8	10	-10
Bright Angel Flight Free Zone																				
Phantom Ranch	3	4	12	12	1	-2	1	-3	7	-5	6	-6	1	-2	1	-3	7	-5	6	-6
Cedar Ridge	81	82	19	19	40	-41	4	-78	14	-5	11	-8	23	-55	4	-78	12	-7	11	-8
North Rim																				
Point Imperial	66	68	38	39	31	-34	1	-67	11	-28	8	-31	1	-65	1	-67	6	-32	6	-32
Bright Angel Point	47	48	24	24	5	-42	1	-47	13	-11	11	-13	1	-46	1	-47	11	-13	11	-13
Cape Royal	59	61	25	26	77	18	25	-36	26	1	20	-6	1	-57	1	-60	11	-15	11	-15
Zuni Point Corridor																				
Lipan Point	74	77	34	35	88	14	62	-16	40	5	36	1	8	-66	12	-65	7	-27	5	-30
Little Colorado River/Nankoweap Area																				
Nankoweap Mesa	87	90	43	43	78	-9	45	-45	23	-20	19	-24	1	-86	2	-88	14	-29	15	-28
Nankoweap at River	7	8	34	35	0	-7	0	-8	0	-23	12	-23	0	-7	0	-8	11	-23	12	-23
Little Colorado River	34	37	43	43	36	2	30	-8	39	-4	34	-8	0	-34	0	-37	7	-36	7	-36
Dragon Corridor																				
Hermit Basin	99	100	42	42	13	87	16	-8	10	-32	10	-32	71	-28	32	-67	23	-19	18	-24
96 Mile Camp	72	74	45	45	0	71	0	-74	8	-37	8	-37	26	-46	17	-57	37	-7	34	-11
Toroweap /Shinumo Flight Free Zone																				
Point Sublime	100	100	35	35	46	-54	29	-71	16	-20	17	-18	89	-11	63	-37	29	-6	25	-11
Pasture Wash	98	98	20	21	28	-70	31	-67	16	-5	17	-4	80	-19	31	-67	20	-1	18	-3

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

1 **Table 4.94 Alternative E Slant Distances East End**

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
South Rim			
Desert View	5,098	2,993	-2,104
Tusayan	2,016	450	-1,566
El Tovar	5,854	9,426	3,572
Bright Angel Flight Free Zone			
Phantom Ranch	11,027	9,999	-1,028
Cedar Ridge	9,827	12,925	3,098
North Rim			
Point Imperial	2,292	13,405	11,113
Bright Angel Point	6,235	9,522	3,287
Cape Royal	4,038	6,132	2,094
Zuni Point Corridor			
Lipan Point	2,890	955	-1,935
Little Colorado River/Nankoweap Area			
Nankoweap Mesa	973	6,114	5,140
Nankoweap at River	1,449	9,063	7,615
Little Colorado River	1,629	2,043	413
Dragon Corridor			
Hermit Basin	1,518	3,605	2,088
96 Mile Camp	1,573	1,724	151
Toroweap/Shinumo Flight Free Zone			
Point Sublime	3,760	3,760	0
Pasture Wash	5,532	10,990	5,458

Δ indicates change in noise metric data from Alternative A

2
3
4 **Central Ground-Based Visitors Alternative E Visitor Use and Experience**

5
6 Based on modeled noise results shown in Figures 4.14 to 4.17, in the Central area there would be little change from
7 Alternative A as conditions would remain relatively quiet with Average Sound Level generally less than 10 dBA and
8 aircraft Percent Time Audible less than 5% of the time.

9
10 *Central Alternative E Visitor Use and Experience*

11 *Wilderness Zone*

12 *Base Year Peak and Off-Peak Season and Ten-Year Forecast Peak Season*

13 Conditions at **Upper Deer Creek** Location Point would remain largely unchanged from Alternative A as shown
14 in Tables 4.95 and 4.96. Percent Time Audible under All Scenarios would be zero to one percent, and Average
15 Sound Level would be zero to one dBA. Air-tour aircraft would be at Distances in excess of 20,000 meters. Low
16 audibility and sound level in this scrub habitat would virtually eliminate effects of air-tours on visitors, resulting
17 in negligible impacts with negligible change in impacts compared to Alternative A.

18
19 *Central Alternative E Visitor Use and Experience*

20 *Wilderness Zone*

21 *Ten-Year Forecast Off-Peak Season*

22 At **Upper Deer Creek** Location Point, change in Percent Time Audible would be one percent, Average Sound
23 Level would decrease by 14 dBA, and aircraft visibility from the ground would be the same as Base Year Peak
24 Season. Negligible impacts would continue with negligible change in impacts compared to Alternative A.

1 *Central* *Alternative E* *Visitor Use and Experience*
 2 *Non-Wilderness Zone*
 3 *All Scenarios*

4 Conditions at **Toroweap Overlook** Location Point would vary little. As shown in Tables 4.95 and 4.96, Base
 5 Year Peak Season, Percent Time Audible would remain zero. Air-tour aircraft would be over 9,000 meters.
 6 Visitors would have uninterrupted opportunities to experience and appreciate natural sounds and park resources.
 7 Negligible impacts would occur with negligible change in impacts compared to Alternative A.
 8

9 *Central* *Alternative E* *Visitor Use and Experience*
 10 *Ground Based Visitors Outside the Park within the SFRA*
 11 *All Scenarios*

12 As shown in Figure 4.14, in **Kaibab National Forest**, north of the park, there would be negligible impacts and
 13 negligible change in impacts compared to Alternative A.
 14

15 South of the park, air-tour sounds over **Havasupai and Hualapai Reservation lands** would be reduced Peak and
 16 Off-Peak Season compared to Alternative A. Blue Direct South would be eliminated, and non-air-tour flights
 17 would be required to fly outside the SFRA. Near the SFRA southern boundary, air-tour sounds would average 25
 18 to 45 dBA. Thus, along the SFRA southern boundary, natural sounds would occasionally be dominated by
 19 aircraft noise. This would result in long-term minor to moderate adverse impacts with negligible changes in
 20 impacts outside the park compared to Alternative A.
 21
 22

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1 **Table 4.95 Alternative E Sound Levels Central**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Upper Deer Creek	1	0	1	14	1	0	1	1	0	-1	0	-13	1	0	1	1	0	-1	0	-13
Toroweap Overlook	0	1	13	1	0	0	0	-1	14	1	15	14	0	0	0	-1	15	2	16	15

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.96 Alternative E Slant Distances Central

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Upper Deer Creek	23,683	24,049	366
Toroweap Overlook	9,625	9,625	0

Δ indicates change in noise metric data from Alternative A

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1 **West End Ground-Based Visitors** **Alternative E** **Visitor Use and Experience**

2
3 Based on modeled noise results shown in Figures 4.14 to 4.17, West End, adverse impacts would result from aircraft
4 Average Sound Level 40 to 50 dBA and Percent Time Audible greater than 65% in areas under Blue-2 and Green-4.
5 For areas near Alternative A's Blue Direct routes, area of audibility would be reduced by approximately 50% due to
6 the route's short travel Distance over the park. In West End's southern portion under and near Sanup Flight-free
7 Zone, aircraft Average Sound Level would be 10 to 20 dBA with Percent Time Audible less than 20%. For lands
8 outside the park directly under and within five miles of Alternative E's Blue Direct North and other busy air-tour
9 corridors, adverse impacts would result from Average Sound Level ranging 40 to 50 dBA. The remainder of the
10 SFRA outside park boundaries would experience Average Sound Level less than 25 dBA.

11
12 *West End Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
13 *Base Year Peak Season*

14 As shown in Tables 4.97 and 4.98, under Alternative E, Blue-2 and Green-4 air-tour routes would be unchanged
15 from Alternative A, and impacts would also be the same. Based on Location Point data, Percent Time Audible
16 would range zero to 92%. Average Sound Level would range zero to 47 dBA at **Whitmore Rapids** and **Bat**
17 **Cave** Location Points. At Whitmore Rapids and Bat Cave Location Points, impacts would be moderate adverse
18 with negligible change from Alternative A. At **Parashant Wash** Location Point, minor adverse impacts would
19 occur with negligible change compared to Alternative A. There would be negligible impacts with negligible
20 change in impacts at **Separation Canyon** Location Point compared to Alternative A.

21
22 *West End Ground-Based Visitors* *Alternative E* *Visitor Use and Experience*
23 *Base Year Off-Peak Season and Ten-Year Forecast Peak and Off-Peak Season*

24 Degree of change in aircraft Percent Time Audible, Average Sound Level, and Distance at **Whitmore Rapids**,
25 **Bat Cave**, **Parashant Wash**, and **Separation Canyon** Location Points would be similar to Base Year Peak
26 Season. Minor to moderate adverse impacts would continue with negligible change compared to Alternative A.

27
28 **West End** **Alternative E** **Visitor Use and Experience**
29 **Ground-Based Visitors Outside the Park within the SFRA**

30 *All Scenarios*

31 Air-tour operations using Blue Direct North would be expected to travel north of the SFRA boundary in less
32 remote areas of **Lake Mead National Recreation Area** and **Grand Canyon-Parashant National Monument**,
33 where management objectives include fewer expectations of natural quiet. Sounds from Blue Direct North would
34 be Average Sound Level 25 to 50 dBA as shown in Figures 4.14 and 4.16. Thus, impacts Base Year Peak and
35 Off-Peak Season would be minor to moderate adverse with negligible change in impacts compared to Alternative A.

36
37 **Outside the park's southwest corner and far western boundary**, air-tour sound conditions would continue to
38 have negligible to moderate adverse impacts with negligible change from Alternative A.

1 **Table 4.97 Alternative E Sound Levels West End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Whitmore Rapids	12	13	21	21	20	8	21	8	28	7	28	6	24	12	25	12	30	9	28	7
Parashant Wash	12	14	33	33	11	-1	14	1	25	-8	24	-9	14	2	18	4	27	-6	25	-8
Separation Canyon at Colorado River	0	0	7	7	0	0	0	0	7	0	7	0	0	0	0	0	7	0	7	0
Bat Cave	93	95	47	47	92	-1	84	-12	47	0	46	0	96	3	88	-8	48	0	46	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.98 Alternative E Slant Distances West End

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Whitmore Rapids	1,804	2,512	708
Parashant Wash	2,852	6,359	3,507
Separation Canyon at Colorado River	6,377	16,329	-49
Bat Cave	1,134	1,134	0

Δ indicates change in noise metric data from Alternative A

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1 **Air-tour Visitors** **Alternative E** **Visitor Use and Experience**

2
3 Alternative E would provide the least variety of air-tour choices of proposed Alternatives. Many options currently
4 available would be eliminated, no long-loop air-tours would be available, and viewing a variety of scenic landscapes
5 would be reduced. Bright Angel Flight-free Zone would extend northward to include Marble Canyon, effectively
6 eliminating air-tours from that area.

7
8 East End routes would be limited to one of two seasonal choices of short-loop tours in either Zuni Point or Dragon
9 Corridor depending on month of visit. Routes in Zuni Point Corridor (Peak Season) would include viewing of the
10 Little Colorado River confluence, but would eliminate Nankoweap Basin. Routes in Dragon Corridor (Off-Peak
11 Season) would include North Rim views. However, no route connecting Zuni Point Corridor to Dragon Corridor
12 would be available. Thus, opportunities for longer routes some visitors prefer would be eliminated.

13
14 On Blue Direct North between Las Vegas and Grand Canyon, the canyon would be visible as the route passes over
15 the Colorado River near Parashant Wash and Andrus Canyon, and as it continues west toward Lake Mead. Blue
16 Direct South would be eliminated, and transportation and repositioning flights would travel outside the SFRA.

17
18 West End Blue-2 and Green-4 routes would continue unchanged from Alternative A with no change in impacts on
19 air-tour Visitor Use and Experience in this part of the park.

20
21 **Cumulative Impacts** **Alternative E** **Visitor Use and Experience**
22 **Ground-Based Visitors**

23
24 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
25 *actions. In this context, Cumulative Impacts include impacts on Visitor Use and Experience from sounds of*

- 26 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
27 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
28 *3) ground-based noise sources, plus*
29 *4) noise from air-tour-and-related aircraft under Alternative E*

30
31 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 (Alternative E).*

32
33 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
34 *Alternatives with Average Sound Level generally 15 to 33 dBA and Percent Time Audible that varies throughout*
35 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
36 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
37 *SFRA see Appendix D, Figures 91 to 94).*

38
39 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
40 *Visitor Use and Experience, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
41 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
42 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
43 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
44 *Audible capable of masking some aircraft noise.*

45
46 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
47 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
48 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
49 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
50 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
51 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
52 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
53 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
54 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
55 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*

1 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 2 *(Alternative E compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 3 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 4 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 5 *(Alternative E in this case).*

6
 7 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 8 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
 9 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
 10 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 11 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 12 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 13 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 14 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

15
 16 *Comparing noise impacts from just Alternative E by itself (Appendix D Tables 16 (Peak Season) and 21 (Off-*
 17 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative E plus 1 plus 2) (Appendix D Tables 49 (Peak*
 18 *Season) and 53 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*
 19 *Cumulative Impacts and the impacts of Alternative E by itself. For the Entire Park Cumulative Impact results*
 20 *(Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 83% of the*
 21 *park, with Average Sound Level 25 to <35 dBA in 92 to 93% of the park, with 1% of the park below 25 dBA and 6*
 22 *to 7% at 35 dBA or more. For the Entire Park results for Alternative E by itself (Peak and Off-Peak Season Ten-*
 23 *Year Forecast), aircraft are audible 60% or more of the day in 3% of the park, with Average Sound Level 25 to*
 24 *<35 dBA in 6 to 9% of the park, with 74 to 81% of the park below 25 dBA and 5% at 35 dBA or more.*

25
 26 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 27 *including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour*
 28 *routes; (b) Cumulative Impacts increase the impacts of Alternative E, and (c) reducing air-tour-and-related*
 29 *impacts under the Alternatives reduces Cumulative Impacts.*

30
 31 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 32 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 33 *Alternative (route locations/number/altitudes/quiet technology conversion, etc.). When added to noise impacts of*
 34 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 35 *described for Alternative E would generally increase by one level as shown in the Cumulative Impacts discussion*
 36 *in the Conclusions section below.*

37
 38 **Conclusion Ground-Based Visitors Alternative E Visitor Use and Experience**

39
 40 *Conclusion Marble Canyon Alternative E Visitor Use and Experience*
 41 *Alternative E would result in long-term negligible to minor beneficial change in impacts compared to Alternative A*
 42 *for Marble Canyon visitors.*

43
 44 *Conclusion East End Alternative E Visitor Use and Experience*
 45 *Developed Zone*

46 *Ten-Year Forecast Alternative E would result in long-term minor to moderate beneficial change in impacts*
 47 *compared to Alternative A to Developed Zone Visitor Use and Experience as air-tour sounds are reduced by*
 48 *seasonal route use and quiet-technology implementation.*

49
 50 *Conclusion East End Alternative E Visitor Use and Experience*
 51 *Non-Wilderness Zone*

52 *Ten-Year Forecast Alternative E would result in long-term negligible to major beneficial change in impacts*
 53 *compared to Alternative A to Non-Wilderness Zone Visitor Use and Experience as air-tour sounds are reduced by*
 54 *seasonal route use and quiet-technology implementation.*

1 *Conclusion East End* *Alternative E* *Visitor Use and Experience*
 2 *Wilderness Zone*

3 Ten-Year Forecast Alternative E would result in long-term negligible to major beneficial change in impacts
 4 compared to Alternative A to Wilderness Visitor Use and Experience as air-tour sounds are reduced by seasonal
 5 route use and quiet-technology implementation.

7 *Conclusion Central* *Alternative E* *Visitor Use and Experience*

8 Under Alternative E, impacts to Central area Visitor Use and Experience would not be appreciably different from
 9 Alternative A.

11 *Conclusion West End* *Alternative E* *Visitor Use and Experience*

12 Under Alternative E, impacts to West End Visitor Use and Experience would change negligibly compared to
 13 Alternative A.

15 **Cumulative Impacts Summary** *Alternative E* *Visitor Use and Experience*

16 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 17 *impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts in*
 18 *all three Zone (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 19 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 20 *and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison with the*
 21 *other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts followed by Modified NPS*
 22 *Preferred Alternative and Alternative F (Alternative A ranks last).*

25 **Conclusion Air-tour Visitors** **Alternative E** **Visitor Use and Experience**

27 Alternative E would provide the least variety of opportunities for air-tour visitors of proposed Alternatives. Seasonal
 28 route closures and elimination of long-loop tours would make Alternative E least desirable of the Alternatives for
 29 some air-tour visitors.

31 **ALTERNATIVE F** **MODIFIED CURRENT CONDITION** **VISITOR USE AND EXPERIENCE**

33 Under Alternative F, a range of aircraft noise intensities and audibility would continue to affect park visitors. As
 34 shown in Figures 4.22 to 4.25, greatest exposure to noise and visual impacts would occur in East End and West
 35 End's western portions where Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time Audible
 36 would be greater than 75%. Dragon Corridor's Off-Peak Season western shift would provide some limited seasonal
 37 benefits. Marble Canyon, Central area, and West End's southern portions would be least impacted by air-tour
 38 operations as Average Sound Level would be less than 15 dBA, and aircraft Percent Time Audible would be less
 39 than 5%. Alternative F would also include quiet-technology conversion that would provide reduction in Percent
 40 Time Audible and Average Sound Level.

42 **Marble Canyon Ground-Based Visitors** **Alternative F** **Visitor Use and Experience**

44 Based on modeled noise results shown in Figures 4.22 to 4.25, Marble Canyon would remain relatively quiet with
 45 air-tour aircraft Percent Time Audible generally less than 5% and Average Sound Level less than 15 dBA.
 46 Modifications to East End air-tour routes would have little effect in Marble Canyon Peak Season compared to
 47 Alternative A. The greatest degree of change would be a 21 to 23 dBA decrease in Average Sound Level during
 48 Peak and Off-Peak Seasons at South Canyon Location Point.

50 *Marble Canyon Ground-Based Visitors* *Alternative F* *Visitor Use and Experience*

51 *Base Year and Ten-Year Forecast Peak Season*

52 Under Alternative F, air-tour operations over Marble Canyon impacts on Visitor Use and Experience would be
 53 similar to those described for Alternative A. Throughout the year, **Marble Canyon Location Points** would
 54 generally be free of air-tour aircraft sights and sounds. As shown in Tables 4.99 and 4.100, **Marble Canyon**
 55 **Dam Site** Location Point would have zero Percent Time Audible at Average Sound Level of 3 dBA. At **South**
 56 **Canyon** Location Point, Percent Time Audible would be 2% at an Average Sound Level of 21 dBA. Impacts on

1 Visitor Use and Experience at these locations would be negligible with negligible change in impacts compared to
2 Alternative A.

3

4 *Marble Canyon Ground-Based Visitors Alternative F*
5 *Base Year and Ten-Year Forecast Off-Peak Season*

Visitor Use and Experience

6 Air-tour aircraft would no longer be audible at **South Canyon**, with Percent Time Audible falling from 2% to
7 zero, and Average Sound Level falling from 21 dBA to zero. Adverse impacts would not continue at either
8 location as air-tour noise would not interrupt visitor opportunities to appreciate natural sounds. Visitors would
9 experience negligible impacts with long-term minor beneficial changes compared to Alternative A.

10

11 *Marble Canyon Alternative F*
12 *Ground-Based Visitors Outside the Park within the SFRA*
13 *All Scenarios*

Visitor Use and Experience

14 **Outside the park in the Marble Canyon area**, air-tour sound conditions would remain generally unchanged
15 from Alternative A. As shown Figures 4.22 to 4.25, there would be negligible impacts with negligible change in
16 impacts compared to Alternative A.

17

18

19

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1 **Table 4.99 Alternative F Sound Levels Marble Canyon**

Location Point Name	Alternative A				Alternative F															
					Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	3	0	2	-1	0	0	0	0	0	-3	0	-4
South Canyon	2	3	21	23	2	0	2	0	21	0	21	-2	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3 **Table 4.100 Alternative F Slant Distances Marble Canyon**

Location Point Name	Alternative A		Alternative F	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
Marble Canyon Dam Site	3,845		3,846	1
South Canyon	816		822	7

Δ indicates change in noise metric data from Alternative A

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1 **East End Ground-Based Visitors** **Alternative F** **Visitor Use and Experience**

2
3 As shown Figures 4.22 to 4.25, under Alternative F greatest exposure to noise and visual impacts occur East End.
4 Based on modeled noise results, Peak Season modifications to East End air-tour routes would be small, resulting in
5 impacts similar to Alternative A. Average Sound Level would be 40 to 50 dBA and aircraft Percent Time Audible
6 would be greater than 75%. The seven-mile Dragon Corridor western shift Off-Peak Season moves impacts, but
7 does not diminish impact levels. Beneficial effects to East End's middle and east side include a 20 to 40% reduction
8 in Percent Time Audible from Alternative A. Because Alternative F would implement quiet technology, air-tour
9 sounds would decrease Base Year to Ten-Year Forecast.

10 *East End* *Alternative F* *Visitor Use and Experience*

11 *Developed Zone* South Rim

12 *Base Year Peak Season*

13 Under Alternative F, there would be little change in air-tour sounds for visitors at **Desert View, Tusayan, and**
14 **Lipan Point** Location Points. Interference with opportunities to appreciate natural sound would result in
15 moderate adverse impacts with negligible change in impacts to compared to Alternative A.

16 *East End* *Alternative F* *Visitor Use and Experience*

17 *Developed Zone* South Rim

18 *Ten-Year Forecast Peak Season*

19 There would be reductions in air-tour noise as shown in Tables 4.101 and 4.102 at **Desert View and Tusayan**
20 **Museum** Location Points where Percent Time Audible would decrease by 36%, and Average Sound Level
21 would fall by 8 dBA. At **Lipan Point** Location Point, Percent Time Audible would decrease by 28 to 49%, and
22 Average Sound Level would fall from 34 to 27 dBA. Conditions at **El Tovar** Location Point would include a
23 dramatic decline in Percent Time Audible from 95 to 12% of the day, with a modest reduction in Average Sound
24 Level from 19 to 13 dBA. Visitors would have increased opportunities to experience combined natural and
25 human-caused sounds, but given the background sound level of 39 to 49 dBA, improvements may not be as
26 dramatic as the decrease in Percent Time Audible alone would imply. Although minor to major adverse
27 conditions would occur, compared to Alternative A, these changes in impacts would be long term negligible to
28 major beneficial.

29 *East End* *Alternative F* *Visitor Use and Experience*

30 *Developed Zone* South Rim

31 *Base Year Off-Peak Season*

32 Visitors on eastern South Rim would experience varying decreases in air-tour sounds compared to Alternative A.
33 At **Desert View** Location Point, Percent Time Audible would decline 76% to 46%, and Average Sound Level
34 would fall 29 to 24 dBA. At **Lipan Point** Location Point, Percent Time Audible would decline 74% to 45%, and
35 Average Sound Level would fall 34 to 29 dBA. At **Tusayan Museum** Location Point, Percent Time Audible
36 would decline 64% to 36%, and Average Sound Level would fall 35 to 29 dBA. Although Percent Time Audible
37 declines notably for these locations, decibel levels remain similar to Alternative A. Thus, although Percent Time
38 Audible would decrease, visitors may not notice the change. Although moderate to major adverse impacts would
39 continue, changes in impacts would be long term minor beneficial compared to Alternative A.

40 Near **El Tovar** Location Point, Percent Time Audible would decline by 76% from 95 to 19%, and Average
41 Sound Level would fall 19 to 8 dBA. Drastic reduction in Percent Time Audible may be appreciated by visitors.
42 Although minor adverse impacts would continue, changes in impacts would be long term moderate beneficial
43 compared to Alternative A.

44 *East End* *Alternative F* *Visitor Use and Experience*

45 *Developed Zone* South Rim

46 *Ten-Year Forecast Off-Peak Season*

47 At **Desert View** Location Point, Percent Time Audible would decline from 76% to 19%, and Average Sound
48 Level would fall from 29 to 18 dBA. At **Lipan Point** Location Point, Percent Time Audible would decline from
49 74% to 22%, and Average Sound Level would fall from 34 to 24 dBA. At **Tusayan Museum** Location Point,
50 Percent Time Audible would decline from 64% to 15%, and Average Sound Level fall from 35 to 24 dBA.

1 Although moderate adverse impacts would persist, changes in impacts would be long term moderate beneficial
2 compared to Alternative A.

3
4 At **El Tovar** Location Point, aircraft Percent Time Audible would be 8% of the day at an Average Sound Level
5 of 8 dBA, compared to 95% of the day at 19 dBA under Alternative A. As described above, visitors would have
6 opportunities to experience the area without aircraft noise most of the day, leading to negligible impacts.
7 Compared to Alternative A, changes in impacts would be long term moderate beneficial.

8
9 *East End* *Alternative F* *Visitor Use and Experience*

10 *Developed Zone* Phantom Ranch

11 *Base Year Peak Season*

12 Under Alternative F, as shown in Tables 4.101 and 4.102, air-tour aircraft noise at Phantom Ranch Location
13 Point would remain unchanged from Alternative A. Aircraft Percent Time Audible would be less than 4% of the
14 day at Average Sound Level of 12 dBA, and would be 10,000 meters Distant. Thus, negligible impacts would
15 occur with no change in impacts from Alternative A.

16
17 *East End* *Alternative F* *Visitor Use and Experience*

18 *Developed Zone* Phantom Ranch

19 *Ten-Year Forecast Peak Season*

20 Percent Time Audible would decrease from less than 4% to zero and Average Sound Level from 12 to 7 dBA.
21 Air-tour aircraft would rarely be audible, leading to negligible impacts with negligible change in impacts
22 compared to Alternative A.

23
24 *East End* *Alternative F* *Visitor Use and Experience*

25 *Developed Zone* Phantom Ranch

26 *Base Year and Ten-Year Forecast Off-Peak Season*

27 **Phantom Ranch** Location Point would have slightly reduced air-tour noise compared to Alternative A. Percent
28 Time Audible would decrease from less than 4% to one percent; Average Sound Level would fall from 12 to 6
29 dBA. Visitors would have opportunities to experience the area without aircraft noise most of the day. Aircraft
30 would be audible for brief, infrequent periods. Negligible impacts would occur with negligible change in impacts
31 compared to Alternative A.

32
33 *East End* *Alternative F* *Visitor Use and Experience*

34 **Developed Zone North Rim**

35 *Base Year Peak Season*

36 Air-tour aircraft noise level and audibility would remain unchanged from Alternative A at **Point Imperial**,
37 **Bright Angel Point**, and **Cape Royal** Location Points. As shown in Tables 4.101 and 4.102 aircraft Percent
38 Time Audible would be 47 to 66% of the day, at Average Sound Level of 24 to 38 dBA. Combination of aircraft
39 audible for a high percentage of the day, at levels less than background sounds would lead to moderate adverse
40 impact with negligible change in impacts from Alternative A.

41
42 *East End* *Alternative F* *Visitor Use and Experience*

43 *Developed Zone North Rim*

44 *Ten-Year Forecast Peak Season*

45 Air-tour aircraft at **Point Imperial** Location Point Percent Time Audible would decrease from 68% to 25% but
46 Average Sound Level would decrease by only 2 dBA to 37 dBA. At **Bright Angel Point** Location Point, Percent
47 Time Audible would decrease from 48% to 12%, with Average Sound Level falling from 24 to 18 dBA. Percent
48 Time Audible at **Cape Royal** Location Point would decrease from 61% to 17%, and Average Sound Level would
49 fall from 26 to 19 dBA. This results from shifting helicopter routes west of Dragon Corridor. Although ambient
50 conditions may mask air-tour aircraft noise, these large reductions in Percent Time Audible could improve visitor
51 experience. Although moderate adverse impacts would occur, changes in impacts would be long term minor
52 beneficial compared to Alternative A.

1 *East End* *Alternative F* *Visitor Use and Experience*
 2 Developed Zone North Rim
 3 Base Year Off-Peak Season
 4 Air-tour sounds at **Point Imperial** Location Point would decrease from 66% to 28% and Average Sound Level
 5 would fall from 38 to 18 dBA. At **Bright Angel Point** Location Point, Percent Time Audible would decrease
 6 from 47 to 2%, with Average Sound Level falling from 24 to 13 dBA. At **Cape Royal** Location Point, Percent
 7 Time Audible would decrease from 59 to 31%, and Average Sound Level would fall from 25 to 21 dBA.
 8 Although ambient conditions may mask air-tour aircraft noise, large reductions in Percent Time Audible could
 9 improve visitor experience. Negligible to moderate adverse impacts would occur with long-term minor beneficial
 10 changes in impacts compared to Alternative A.

11 *East End* *Alternative F* *Visitor Use and Experience*
 12 Developed Zone North Rim
 13 Ten-Year Forecast Off-Peak Season

14 **Point Imperial, Cape Royal, and Bright Angel Point** Location Points would have reduced aircraft noise
 15 compared to Alternative A. At Bright Angel Point Location Point, Percent Time Audible would decrease from 47
 16 to 2%, with Average Sound Level fall from 24 to 11 dBA. At Cape Royal Location Point, Percent Time Audible
 17 would decrease from 59 to 7%, and Average Sound Level would fall from 25 to 16 dBA. At Point Imperial
 18 Location Point, Percent Time Audible would decrease from 68 to 2%, with Average Sound Level falling from 39
 19 to 14 dBA. Visitors would have opportunities to appreciate ambient sound conditions throughout much the day,
 20 with occasional aircraft noise at low volumes. Negligible to minor adverse impacts would occur with long term
 21 minor to moderate beneficial changes in impacts compared to Alternative A.

22 **East End** **Alternative F** **Visitor Use and Experience**
 23 **Non-Wilderness Zone**
 24 Base Year Peak Season

25 Air-tour operations would have the same impacts on Visitor Use and Experience near **Cedar Ridge** Location
 26 Point as Alternative A. As shown in Tables 4.101 and 4.102, aircraft Percent Time Audible would be 81% of the
 27 day at Average Sound Level of 19 dBA. Aircraft would be visible at Distances in excess of 2,000 meters.
 28 Moderate to major adverse impacts would occur with no change in impacts compared to Alternative A.

29 *East End* *Alternative F* *Visitor Use and Experience*
 30 *Non-Wilderness Zone*
 31 *Ten-Year Forecast Peak and Off-Peak Season*

32 **Cedar Ridge** Location Point shows great reduction in air-tour sounds Percent Time Audible, and a modest
 33 reduction in Average Sound Level. Aircraft Percent Time Audible would be 5% at 13 dBA, down from 82% and
 34 19 dBA. Visitors would have opportunities to experience ambient sounds most of the day, with occasional
 35 aircraft noise at low volumes. Negligible impacts would occur, but increased opportunity to appreciate natural
 36 sounds would result in long-term moderate to major beneficial changes in impacts compared to Alternative A.

37 *East End* *Alternative F* *Visitor Use and Experience*
 38 *Non-Wilderness Zone*
 39 *Base Year Off-Peak Season*

40 Air-tour sounds would decrease from Peak Season near **Cedar Ridge** Location Point because air-tour operations
 41 move to Dragon Corridor. Air-tour aircraft Percent Time Audible would be 20% of the day at 14 dBA, down
 42 from 81% and 19 dBA. Visitors would have opportunities to appreciate natural sounds most of the day, with
 43 occasional aircraft noise at low volumes. Although minor adverse impacts would occur, , this would result in
 44 long-term moderate to major beneficial changes in impacts compared to Alternative A.

45 **East End** **Alternative F** **Visitor Use and Experience**
 46 **Wilderness Zone**

47 Visitors could expect a wide range of exposure to air-tour noise. Percent Time Audible would range from less than
 48 one percent to over 90% of the day. Air-tour Average Sound Level would range 10 to 43 dBA.

54

1 *East End* *Alternative F* *Visitor Use and Experience*
 2 *Wilderness Zone*
 3 *Base Year Peak Season*

4 All East End Wilderness Location Points (shown in Tables 4.101 and 4.102 as **Nankoweap River, Nankoweap**
 5 **Mesa, Little Colorado River, Hermit Basin, 96 Mile Camp, Point Sublime, and Pasture Wash**) would have
 6 air-tour aircraft noise and sights unchanged from Alternative A (minor to major adverse impacts) because air-
 7 tour routes the same as those currently in place would be used ten months of the year.
 8

9 *East End* *Alternative F* *Visitor Use and Experience*
 10 *Wilderness Zone*
 11 *Ten-Year Forecast Peak Season*

12 Generally modest reductions in Percent Time Audible and Average Sound Level would occur, and opportunities
 13 to experience natural sounds and solitude would improve. At **Nankoweap River** Location Point, Ten-Year
 14 Forecast would result in minimal change from Base Year. Compared to Alternative A, Percent Time Audible
 15 would decrease from 8 to 5%, and Average Sound Level would remain relatively unchanged at 33 dBA
 16 compared to 35 dBA under Alternative A. At **Nankoweap Mesa, Little Colorado River, Hermit Basin, 96**
 17 **Mile Camp, Point Sublime, and Pasture Wash** Location Points, modest reductions in air-tour noise would
 18 occur. At Nankoweap Mesa Location Point, Percent Time Audible would decrease from 90 to 68%, and Average
 19 Sound Level would fall from 43 to 39 dBA. At Little Colorado River Location Point, Percent Time Audible
 20 would decrease from 37 to 25%, and Average Sound Level would fall from 43 to 37 dBA. At Hermit Basin
 21 Location Point, Percent Time Audible would decrease from 100 to 89%, and Average Sound Level would fall
 22 from 42 to 37 dBA. At 96 Mile Camp Location Point, Percent Time Audible would decrease from 74 to 47%,
 23 and Average Sound Level would fall from 45 to 41 dBA. At Point Sublime Location Point, Percent Time
 24 Audible would decrease from 100 to 94%, and Average Sound Level would fall from 35 to 30 dBA. At Pasture
 25 Wash Location Point, Percent Time Audible would decrease from 98 to 20% and Average Sound Level would
 26 fall from 21 to 17 dBA. Reductions in air-tour sounds would result in minor to major adverse impacts with minor
 27 beneficial changes in impacts compared to Alternative A, as reduced noise would be less dominant.
 28

29 *East End* *Alternative F* *Visitor Use and Experience*
 30 *Wilderness Zone*
 31 *Base Year Off-Peak Season*

32 Dragon Corridor would be shifted west Off-Peak Season. East End backcountry visitors would experience
 33 markedly reduced air-tour sounds, while visitors closer to Zuni Point Corridor would see only modest reductions.
 34 At **Nankoweap Mesa** Location Point, Percent Time Audible would decrease from 87 to 53%, and Average
 35 Sound Level would fall from 43 to 29 dBA. At **Little Colorado River** Location Point, Percent Time Audible
 36 would decrease from 34 to 17%, and Average Sound Level would fall from 43 to 38 dBA. At **Hermit Basin**
 37 Location Point, Percent Time Audible would decrease from 99 to 60%, and Average Sound Level would fall
 38 from 42 to 23 dBA. Changes at **96 Mile Camp** Location Point would include a Percent Time Audible decrease
 39 from 72 to one percent, and Average Sound Level would fall from 45 to 13 dBA. At **Point Sublime** Location
 40 Point, Percent Time Audible would decrease from 100 to 89%, and Average Sound Level would fall from 35 to
 41 19 dBA. At **Pasture Wash** Location Point, Percent Time Audible would decrease from 98 to 90%, and Average
 42 Sound Level would rise modestly from 20 to 25 dBA. These overall reductions in air-tour sounds would result in
 43 moderate to major adverse impacts (except **96 Mile Camp** Location Point where impacts would be negligible),
 44 with long-term minor beneficial changes in impacts compared to Alternative A.
 45

46 *East End* *Alternative F* *Visitor Use and Experience*
 47 *Wilderness Zone*
 48 *Ten-Year Forecast Off-Peak Season*

49 There would be reduced air-tour sounds compared to Alternative A. At **Nankoweap Mesa** Location Point,
 50 Percent Time Audible would decrease from 90 to 33%, and Average Sound Level would fall from 43 to 25 dBA.
 51 At **Little Colorado River** Location Point, Percent Time Audible would decrease from 37 to 12%, and Average
 52 Sound Level would fall from 43 to 33 dBA. At **Hermit Basin** Location Point, Percent Time Audible would
 53 decrease from 100 to 32%, and Average Sound Level would fall from 42 to 19 dBA. At **96 Mile Camp** Location
 54 Point, Percent Time Audible would decrease from 74% to zero, and Average Sound Level would fall from 45 to
 55 10 dBA. At **Point Sublime** Location Point, Percent Time Audible would decrease from 100 to 24%, and
 56 Average Sound Level would fall from 35 to 17 dBA. At **Pasture Wash** Location Point, Percent Time Audible

1 would decrease from 98 to 58%, and Average Sound Level would fall from 21 to 20 dBA. Although negligible
 2 and moderate adverse impacts would occur, these changes in impacts would be long term moderate to major
 3 beneficial compared to Alternative A.

4
 5 **East End** **Alternative F** **Visitor Use and Experience**

6 **Ground-Based Visitors Outside the Park within the SFRA**

7 *Base Year Peak Season*

8 *Ten-Year Forecast Peak and Off-Peak Season*

9 As shown in Figure 4.22, impacts would be minor to moderate adverse with negligible change in impacts on
 10 visitors to **Navajo lands** east of the park and in **Kaibab National Forest** at GCNP's southeast corner compared
 11 to Alternative A.

12
 13 *East End* *Alternative F* *Visitor Use and Experience*

14 *Ground-Based Visitors Outside the Park within the SFRA*

15 *Base Year Off-Peak Season*

16 As operations move to Dragon Corridor, effects to visitor use on **Navajo lands** east of the park and in **Kaibab**
 17 **National Forest** at GCNP's southeast corner would be reduced, with Average Sound Level ranging zero to 25
 18 dBA; approximately 5 dBA less than under current management. This would produce long-term minor to
 19 moderate adverse impacts with negligible change in impacts compared to Alternative A for visitors in this area.

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 21
 22
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1 **Table 4.101 Alternative F Sound Levels East End**

Location Point Name	Alternative A				Alternative F																
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season				Off Peak Season				Percent Time Audible (%)				Average Sound Level (dBA)				
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	
South Rim																					
Desert View	76	79	29	30	77	1	43	-36	29	0	21	-8	46	-30	19	-60	24	-6	18	-12	
Tusayan	64	67	35	36	64	0	32	-36	35	0	28	-8	36	-28	15	-52	29	-6	24	-12	
El Tovar	95	96	19	20	95	0	12	-84	19	0	13	-6	19	-76	8	-88	11	-8	8	-11	
Bright Angel Flight Free Zone																					
Phantom Ranch	3	4	12	12	3	0	1	-3	12	0	7	-5	1	-2	1	-3	7	-4	6	-6	
Cedar Ridge	81	82	19	19	81	0	5	-78	19	0	13	-6	20	-61	5	-77	14	-5	12	-7	
North Rim																					
Point Imperial	66	68	38	39	66	0	25	-43	38	0	37	-2	28	-38	2	-66	18	-20	14	-25	
Bright Angel Point	47	48	24	24	47	0	12	-36	24	0	18	2	-45	2	-47	13	-11	11	-13		
Cape Royal	59	61	25	26	59	0	17	-44	25	0	19	-7	31	-28	7	-54	21	-5	16	-10	
Zuni Point Corridor																					
Lipan Point	74	77	34	35	74	0	49	-28	34	0	27	-7	45	-29	22	-55	29	-5	24	-11	
Little Colorado River/Nankoweap Area																					
Nankoweap Mesa	87	90	43	43	87	0	68	-22	43	0	39	-4	53	-34	33	-57	29	-14	25	-18	
Nankoweap at River	7	8	34	35	7	0	5	-4	34	0	33	-2	0	-7	0	-8	20	-14	17	-18	
Little Colorado River	34	37	43	43	34	0	25	-12	43	0	37	-6	17	-17	12	-26	38	-5	33	-10	
Dragon Corridor																					
Hermit Basin	99	100	42	42	99	0	89	-1	42	0	37	-5	60	-39	32	-68	23	-19	19	-23	
96 Mile Camp	72	74	45	45	72	0	47	-27	45	0	41	-4	1	-70	0	-74	13	-31	10	-35	
Toroweap/Shinumo Flight Free Zone																					
Point Sublime	100	100	35	35	100	0	94	-6	35	0	30	-6	89	-10	24	-75	19	-16	17	-18	
Pasture Wash	98	98	20	21	99	0	20	-78	22	1	17	-3	90	-8	58	-40	25	5	20	0	

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3

1 **Table 4.102 Alternative F Slant Distances East End**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
South Rim				
Desert View	5,098	5,098	0	
Tusayan	2,016	2,016	0	
El Tovar	5,854	5,857	3	
Bright Angel Flight Free Zone				
Phantom Ranch	11,027	10,961	-66	
Cedar Ridge	9,827	9,837	10	
North Rim				
Point Imperial	2,292	2,343	50	
Bright Angel Point	6,235	6,225	-10	
Cape Royal	4,038	4,038	0	
Zuni Point Corridor				
Lipan Point	2,890	2,890	0	
Little Colorado River/Nankoweap Area				
Nankoweap Mesa	973	970	-3	
Nankoweap at River	1,449	1,448	0	
Little Colorado River	1,629	1,629	0	
Dragon Corridor				
Hermit Basin	1,518	1,656	139	
96 Mile Camp	1,573	1,573	0	
Toroweap /Shinumo Flight Free Zone				
Point Sublime	3,760	3,609	-151	
Pasture Wash	5,532	5,532	0	

Δ indicates change in noise metric data from Alternative A

2
3
4 **Central Ground-Based Visitors Alternative F Visitor Use and Experience**

5
6 Based on modeled noise results shown in Figures 4.22 to 4.25, there would be little change from Alternative A as
7 the area would remain relatively quiet with Average Sound Level generally less than 10 dBA and aircraft Percent
8 Time Audible less than 5%. Under Alternative F, All Scenarios Central area visitors would be largely unaffected by
9 air-tour sounds. This condition would be unchanged from Alternative A.

10
11 *Central Alternative F Visitor Use and Experience*

12 *Wilderness Zone*

13 *All Scenarios*

14 As shown in Tables 4.103 and 4.104, conditions at **Upper Deer Creek** Location Point would remain unchanged
15 from Alternative A. Percent Time Audible All Scenarios would be zero to one percent and Average Sound Level
16 would be zero to one dBA. Air-tour aircraft would be at Distances in excess of 20,000 meters. Low Percent Time
17 Audible and Average Sound Level would produce negligible impacts with negligible change in impacts
18 compared to Alternative A.

19
20 *Central Alternative F Visitor Use and Experience*

21 *Non-Wilderness Zone Visitors*

22 *All Scenarios*

23 Conditions at **Toroweap Overlook** Location Point would vary little. As shown in Tables 4.103 and 4.104,
24 Percent Time Audible would remain approximately zero, while Average Sound Level would increase from 13 to
25 17 dBA. Air-tour aircraft would be over 9,000 meters distant. Because Percent Time Audible is zero, visitors
26 would not hear air-tour aircraft, and visibility would be low. Visitors would have uninterrupted opportunities to
27 experience and appreciate natural sounds and park resources. Negligible impacts would occur with negligible
28 changes in impacts compared to Alternative A.

1 **Central** **Alternative F** **Visitor Use and Experience**
2 **Ground-Based Visitors Outside the Park within the SFRA**

3 *All Scenarios*

4 As shown in Figures 4.22 and 4.23, north of the park in **Kaibab National Forest and other adjacent lands**,
5 there would be negligible impacts with negligible change in impacts to visitors compared to Alternative A.

6
7 South of the park, in **Havasupai and Hualapai lands**, because Blue Direct routes are further south than
8 Alternative A, aircraft noise would spread to a larger area outside the park. Sound levels would be the same as
9 described for Alternative A with a larger area near the Study Area's southern boundary receiving high sound
10 levels. Opportunity to appreciate natural sounds would be reduced in the area, producing minor to moderate
11 adverse impacts with a long-term minor adverse change in impacts compared to Alternative A.
12
13
14

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1 **Table 4.103 Alternative F Sound Levels Central**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Upper Deer Creek	1	0	1	14	1	0	1	1	1	0	1	-13	1	0	1	1	1	0	1	-13
Toroweap Overlook	0	1	13	1	0	0	0	-1	17	4	20	19	0	0	0	-1	16	3	19	18

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.104 Alternative F Slant Distances Central

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Upper Deer Creek	23,683		20,930	-2,752
Toroweap Overlook	9,625		9,625	0

Δ indicates change in noise metric data from Alternative A

5
6

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1 **West End Ground-Based Visitors** **Alternative F** **Visitor Use and Experience**

2
3 Based on modeled noise results, West End near Blue-2, Green-4 and Blue Direct routes, aircraft Average Sound
4 Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65% of the time. Quiet-technology
5 conversion would reduce some impacts over time. In West End's southern portion near Sanup Flight-free Zone,
6 Average Sound Level would be 10 to 20 dBA with aircraft Percent Time Audible less than 20%.

7
8 *West End Ground-Based Visitors* *Alternative F* *Visitor Use and Experience*
9 *Base Year Peak Season*

10 West End visitors would see small increments of change in air-tour sounds. As shown in Tables 4.105 and 4.106,
11 **Whitmore Rapids** Location Point Percent Time Audible would decrease from 12 to 9%, and Average Sound
12 Level would rise from 21 to 33 dBA. At **Parashant Wash** Location Point, Percent Time Audible would decrease
13 from 12 to 7%, and Average Sound Level would fall from 33 to 23 dBA. At **Separation Canyon** Location Point,
14 Percent Time Audible would remain unchanged at zero, and Average Sound Level would rise from 7 to 8 dBA.
15 At **Bat Cave** Location Point, Percent Time Audible would fall from 93 to 88%, and Average Sound Level would
16 remain unchanged at 47 dBA. This would result in negligible to minor adverse impacts, except Bat Cave where
17 impacts would be major adverse, with long-term negligible to minor beneficial changes in impacts compared to
18 Alternative A.

19
20 *West End Ground-Based Visitors* *Alternative F* *Visitor Use and Experience*
21 *Ten-Year Forecast Peak Season*

22 At **Whitmore Rapids** Location Point, Percent Time Audible would increase from 13 to 16%, and Average
23 Sound Level would rise from 21 to 37 dBA compared to Alternative A. At **Parashant Wash** Location Point,
24 Percent Time Audible would decrease from 14 to 11%, and Average Sound Level would fall from 33 to 26 dBA.
25 At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average
26 Sound Level would rise from 7 to 8 dBA. At **Bat Cave** Location Point, Percent Time Audible would fall from 95
27 to 83%, and Average Sound Level would fall from 47 to 46 dBA. This would result in negligible to moderate
28 adverse impacts, except Bat Cave where impacts would be major adverse, with negligible change in impacts
29 compared to Alternative A.

30
31 *West End Ground-Based Visitors* *Alternative F* *Visitor Use and Experience*
32 *Base Year Off-Peak Season*

33 At **Whitmore Rapids** Location Point, Percent Time Audible would decrease from 12 to 5%, and Average Sound
34 Level would rise from 21 to 32 dBA compared to Alternative A. At **Parashant Wash** Location Point, Percent
35 Time Audible would decrease from 12 to 8%, and Average Sound Level would fall from 33 to 23 dBA. At
36 **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average Sound
37 Level would rise from 7 to 8 dBA. At **Bat Cave**, Percent Time Audible would fall from 93 to 88%, and Average
38 Sound Level would fall from 47 to 46 dBA. This would result in negligible to minor adverse impacts, except at
39 Bat Cave where impacts would be major adverse, with negligible change in impacts compared to Alternative A.

40
41 *West End Ground-Based Visitors* *Alternative F* *Visitor Use and Experience*
42 *Ten-Year Forecast Off-Peak*

43 At **Whitmore Rapids** Location Point, Percent Time Audible would decrease from 13 to 12%, and Average
44 Sound Level would rise from 21 to 36 dBA compared to Alternative A. At **Parashant Wash** Location Point,
45 Percent Time Audible would decrease from 14 to 9%, and Average Sound Level would fall from 33 to 25 dBA.
46 At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average
47 Sound Level would rise from 7 to 8 dBA. At **Bat Cave** Location Point, Percent Time Audible would fall from 95
48 to 81%, and Average Sound Level would fall from 47 to 45 dBA. This would result in negligible to major
49 adverse impacts with negligible change in impacts compared to Alternative A.

50
51 **West End** **Alternative F** **Visitor Use and Experience**
52 **Ground-Based Visitors outside the Park within the SFRA**

53
54 Alterations to Blue Direct routes that carry visitors to and from Las Vegas would shift air-tour noise impacts to more
55 noise-sensitive areas of **Lake Mead National Recreation Area** and **Grand Canyon-Parashant National**
56 **Monument** for ground-based visitors.

1 *West End* *Alternative F* *Visitor Use and Experience*
2 *Ground-Based Visitors outside the Park within the SFRA*
3 *All Scenarios*

4 As shown in Figures 4.22 to 4.25, negligible to moderate adverse impacts on Visitor Use and Experience **outside**
5 **West End** would continue with negligible change in impacts compared to Alternative A.
6
7
8

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1 **Table 4.105 Alternative F Sound Levels West End**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Whitmore Rapids	12	13	21	21	9	-3	16	2	33	12	37	15	5	-7	12	-1	32	11	36	14
Parashant Wash	12	14	33	33	7	-5	11	-3	23	-10	26	-8	8	-4	9	-5	23	-10	25	-8
Separation Canyon at Colorado River	0	0	7	7	0	0	0	0	8	1	8	1	0	0	0	0	8	1	8	1
Bat Cave	93	95	47	47	88	-5	83	-13	47	-1	46	-1	88	-5	81	-14	46	-1	45	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.106 Alternative F Slant Distances West End

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Whitmore Rapids	1,804	1,804	0
Parashant Wash	2,852	4,190	1,338
Separation Canyon at Colorado River	16,377	16,130	-247
Bat Cave	1,134	936	-198

Δ indicates change in noise metric data from Alternative A

5
6

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Air-tour Visitors **Alternative F** **Visitor Use and Experience**

Alternative F would maintain a variety of East End air-tour visitor options, increase air-tour components of Blue Direct routes to and from Las Vegas, and slightly change, somewhat, tour opportunities far West End. Overall, this Alternative is comparable to Alternative A in its ability to provide a variety of air-tour options for visitors.

East End air-tour routes would generally be the same as for Alternative A, and offer a wide range of tour options throughout the year. Dragon Corridor would move west in Off-Peak Season, but this would not notably diminish visitor opportunities to view the canyon and river.

Alterations to Blue Direct routes that carry visitors to and from Las Vegas would provide additional time over the canyon and river compared to current routes. Air-tour Visitor Use and Experience on these routes would include additional time to view park resources from a different perspective than other Alternatives.

West End, quiet-technology aircraft would fly southeast along the river and loop back along the river to the northwest, whereas non-quiet non-quiet-technology aircraft would fly along the river to the southeast and exit the park, reducing river views for non-quiet-technology aircraft. This would somewhat reduce West End viewing opportunities compared to Alternative A.

Cumulative Impacts **Alternative F** **Visitor Use and Experience**

Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Visitor Use and Experience from sounds of

- 1) high-altitude aircraft at or above 18,000 feet MSL, plus*
- 2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
- 3) ground-based noise sources, plus*
- 4) noise from air-tour-and-related aircraft under Alternative F*

That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 (Alternative F).

Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All Alternatives with Average Sound Level generally 18 to 35 dBA and Percent Time Audible that varies throughout the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the SFRA see Appendix D, Figures 91 to 94).

Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts Visitor Use and Experience, but is mostly concentrated in the Developed Zone (2% of the park), although a small component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire management activities, and mining activities outside the park. Noise from ground-based sources is discussed in Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time Audible capable of masking some aircraft noise.

Noise from ground-based sources is usually very localized. Even though there is some spread into some backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above. Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.

Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives (Alternative F compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly

1 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 2 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 3 *(Alternative F in this case).*

4
 5 *Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 6 *Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season),*
 7 *noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone,*
 8 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 9 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 10 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 11 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 12 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

13
 14 *Comparing noise impacts from just Alternative F by itself (Appendix D Tables 26 (Peak Season) and 31 (Off-*
 15 *Peak Season) Ten-Year Forecast) versus All Aircraft (#4 Alternative F plus #1 Above and #2 Outside) (Appendix*
 16 *D Tables 57 (Peak Season) and 61 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the*
 17 *difference between Cumulative Impacts and the impacts of Alternative F by itself. For the Entire Park*
 18 *Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more*
 19 *of the day in 87 to 89% of the park, with Average Sound Level 25 to <35 dBA in 84 to 86% of the park, with 1%*
 20 *of the park below 25 dBA and 15 to 18% at 35 dBA or more. For the Entire Park results for Alternative F by*
 21 *itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to 10% of*
 22 *the park, with Average Sound Level 25 to <35 dBA in 14% of the park, with 68 to 70% of the park below 25 dBA*
 23 *and 10 to 13% at 35 dBA or more.*

24
 25 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 26 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
 27 *routes; (b) Cumulative Impacts increase the impacts of Alternative F, and (c) reducing air-tour-and-related*
 28 *impacts under the Alternatives reduces Cumulative Impacts.*

29
 30 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 31 *sections and Conclusions described for each Alternative by itself due mainly to differences in elements of each*
 32 *Alternative (route locations/number/altitudes, quiet-technology conversion, etc.). When added to noise impacts of*
 33 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 34 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts discussion*
 35 *in the Conclusions section below.*

36
 37 **Conclusion** **Alternative F** **Visitor Use and Experience**
 38 **Ground-Based Visitors**

39
 40 *Conclusion Marble Canyon* *Alternative F* *Visitor Use and Experience*
 41 *Ten-Year Forecast, Alternative F would result in long-term negligible to minor beneficial change in impacts on*
 42 *Visitor Use and Experience in Marble Canyon compared to Alternative A.*

43
 44 *Conclusion East End* *Alternative F* *Visitor Use and Experience*
 45 *Developed Zone*

46 *Ten-Year Forecast, Alternative F would result in long-term negligible to moderate beneficial changes in impacts*
 47 *compared to Alternative A for Visitor Use and Experience as air-tour sounds would be reduced by seasonal Dragon*
 48 *Corridor route use and quiet-technology conversion.*

49
 50 *Conclusion East End* *Alternative F* *Visitor Use and Experience*
 51 *Non-Wilderness Zone*

52 *Ten-Year Forecast, Alternative F would result in long-term moderate to major beneficial changes in impacts to*
 53 *Visitor Use and Experience as air-tour sounds are reduced by seasonal route use and quiet-technology*
 54 *implementation.*

1 *Conclusion East End* *Alternative F* *Visitor Use and Experience*
 2 *Wilderness Zone*

3 Ten-Year Forecast, Alternative F would result in long-term minor to major beneficial changes in impacts to
 4 Wilderness Visitor Use and Experience as air-tour sounds would be reduced by seasonal route use and quiet-
 5 technology implementation.

6
 7 *Conclusion Central* *Alternative F* *Visitor Use and Experience*

8 Under Alternative F, there would be negligible change in impacts to Wilderness Visitor Use and Experience
 9 compared to Alternative A near Central area Location Points.

10
 11 *Conclusion West End* *Alternative F* *Visitor Use and Experience*

12 Ten-Year Forecast Alternative F, there would be negligible change in impacts to West End Wilderness Visitor Use
 13 and Experience from Alternative A.

14
 15 **Cumulative Impacts Summary** *Alternative F* *Visitor Use and Experience*

16
 17 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 18 *impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts in*
 19 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 20 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 21 *and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison with the*
 22 *other Alternatives, Alternative F ranks third in lowest overall Cumulative Impacts behind Alternative E and the*
 23 *Modified NPS Preferred Alternative (Alternative A ranks last).*

24
 25 **Conclusion Air-tour Visitors** *Alternative F* *Visitor Use and Experience*

26
 27 Alternative F would provide air-tour opportunities similar to Alternative A for East End visitors. Blue Direct routes
 28 would differ from other Alternatives. A range of tours would be available year-round, and scenic views would be
 29 available for aerial viewing on a variety of routes.

30
 31 **Modified NPS Preferred Alternative** *Visitor Use and Experience*

32
 33 Under the *Modified* NPS Preferred Alternative, a range of air-tour aircraft Average Sound Level and Percent Time
 34 Audible would affect Visitor Use and Experience. Beneficial *changes in* impacts would occur East End *with* quiet-
 35 technology *implementation, route modifications to reduce impacts, and Zuni Point short- and long-loop closure in*
 36 *Off-Peak Season*. This Alternative would also establish longer curfews, with visitors in all Management Zones
 37 benefitting from the additional hour without air-tour noise.

38
 39 As shown in Figures 4.30 to 4.33, air-tour sound impacts on visitors would vary. Marble Canyon would *be very*
 40 quiet *with elimination of Marble Canyon routes*, and areas of concentrated air-tour aircraft noise would be limited
 41 mainly to *under and near active* East and West End *routes where* Average Sound Level would be 40 to 55 dBA,
 42 and aircraft Percent Time Audible would be greater than 65%.

43
 44 **Marble Canyon** *Modified NPS Preferred Alternative* *Visitor Use and Experience*

45 **Ground-Based Visitors**

46 *All Scenarios*

47 Based on modeled noise results, **Marble Canyon** Location Points would *be very* quiet *due to elimination of air-*
 48 *tour routes through Marble Canyon* with air-tour aircraft Percent Time Audible generally less than 1% and
 49 Average Sound Level less than 13 dBA.

50
 51 As shown in Tables 4.107 and 4.108, Average Sound Level would decrease from Alternative A, and air-tour
 52 aircraft would *generally* not be audible Base Year or Ten-Year Forecast Peak or Off-Peak Season. Aircraft
 53 *would be greater than* 10,000 meters, a Distance greater than in Alternative A. Impacts to Visitor Use and
 54 Experience at these locations would be negligible with a negligible to minor beneficial change in impacts from
 55 Alternative A.

56

1 **Marble Canyon** *Modified NPS Preferred Alternative* **Visitor Use and Experience**
2 **Ground-Based Visitors Outside the Park within the SFRA**

3 *All Scenarios*

4 As described for Alternative A and shown in Figures 4.30 to 4.33, backcountry visitors in **lands adjacent to**
5 **Marble Canyon** would be little affected by air-tour overflight sounds. *In all scenarios*, Average Sound Level
6 would *be mostly close to* zero dBA *and Percent Time Audible would also be mostly zero*. Impacts would be
7 negligible with negligible *to minor beneficial* change in impacts from Alternative A on ground-based visitors
8 outside the park.
9
10

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Table 4.107 Modified NPS Preferred Alternative Sound Levels Marble Canyon

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
					Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4
South Canyon	2	3	21	23	0	-2	0	-3	0	-21	0	-23	0	-2	0	-3	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

Table 4.108 Modified Preferred Alternative Slant Distances Marble Canyon

Location Point Name	Alternative A		Modified Preferred Alternative	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
Marble Canyon Dam Site	3,845		18,273	14,428
South Canyon	816		28,485	27,669

Δ indicates change in noise metric data from Alternative A

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1 **Ground-Based Visitors** *Modified NPS Preferred Alternative* **Visitor Use and Experience**
 2 **East End**

3 Under the *Modified* NPS Preferred Alternative, long-term beneficial effects on East End Visitor Use and Experience
 4 would result from quiet-technology implementation, seasonal *closure of Zuni Point Corridor and long-loop tour*
 5 *route Off-Peak Season (November 15-March 31), route modifications to reduce impacts*, and extended curfew
 6 hours.

7
 8 *East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 9 *Developed Zone South Rim*
 10 *Base Year Peak Season*

11 There would be no perceptible changes in air-tour sounds for South Rim East End visitors. As shown in Tables
 12 4.109 and 4.110, at **Desert View** Location Point, Percent Time Audible would decrease from 76 to **71%**, and
 13 Average Sound Level would remain unchanged at 29 dBA. At **Lipan Point** Location Point, Percent Time
 14 Audible would increase slightly from 74 to **76%**, and Average Sound Level would *remain unchanged at* 34
 15 dBA. At **Tusayan Museum** Location Point, Percent Time Audible would *remain unchanged at* 64%, and
 16 Average Sound Level would *remain unchanged at* 35 dBA. At **El Tovar** Location Point, Percent Time Audible
 17 would fall from 95 to 93%, and Average Sound Level would increase from 19 to 20 dBA. Visitors would not
 18 likely notice these minimal changes. Aircraft would be visible at Distances in excess of 2,000 meters. Impacts
 19 would be moderate adverse with negligible change in impacts compared to Alternative A.

20
 21 *East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 22 *Developed Zone South Rim*
 23 *Ten-Year Forecast Peak Season*

24 Reductions in air-tour noise would occur along South Rim's East End. At **Desert View** Location Point, Percent
 25 Time Audible would decrease from 79 to 41%, and Average Sound Level would fall from **30 to 23** dBA. At
 26 **Lipan Point** Location Point, Percent Time Audible would decrease from **77 to 46%**, and Average Sound Level
 27 would fall from 35 to **28** dBA. At **Tusayan Museum** Location Point, Percent Time Audible would decrease
 28 from 67 to **38%**, and Average Sound Level would *decrease from 36 to 29* dBA. Visitors would experience a
 29 modest increase in amount of day they could experience ambient conditions. Although moderate adverse impacts
 30 would occur, there would be long term minor to moderate beneficial change in impacts compared to Alternative A.

31
 32 Conditions at **El Tovar** Location Point show a dramatic decline in Percent Time Audible from 96 to **23%**, with a
 33 modest reduction in Average Sound Level from 20 to 14 dBA. Visitors would have increased opportunities to
 34 experience natural sounds, but, improvements may not be as dramatic as decrease in Percent Time Audible alone
 35 would imply. Negligible *to minor adverse* impacts would occur with long-term moderate beneficial change in
 36 impacts compared to Alternative A.

37
 38 *East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 39 *Developed Zone South Rim*
 40 *Base Year Off-Peak Season*

41 Visitors on South Rim's East End would experience *dramatically less* air-tour sounds compared to Alternative A
 42 *since Zuni Point Corridor and long-loop tour routes would be closed*. At **Desert View** Location Point, Percent
 43 Time Audible would *decrease* from 76 to **4%**, and Average Sound Level would *decrease from 29 to 7* dBA. At
 44 **Lipan Point** Location Point, Percent Time Audible would *decrease dramatically* from 74 to **zero%**, and Average
 45 Sound Level would *decrease from 34 to 9* dBA. At **Tusayan Museum** Location Point, Percent Time Audible
 46 would *decrease* from 64 to **0%**, and Average Sound Level would fall from 35 to 4 dBA. *Off-Peak Season there*
 47 *would be a dramatic decrease in noise in South Rim's East End. Visitors would have increased opportunities*
 48 *to experience natural sounds*. There would be *negligible impacts* with long-term *moderate to major beneficial*
 49 change in impacts compared to Alternative A.

50
 51 *Although Zuni Point Corridor and long-loop air-tour routes would be closed Off-Peak Season, Dragon*
 52 *Corridor tour routes would be open. Therefore, visitors would still experience noise at El Tovar Location*
 53 *Point but Percent Time Audible would decline from 95 to 66%, with a modest reduction in Average Sound*
 54 *Level from 19 to 15 dBA. Visitors would have some increased opportunities to experience natural sounds, but*
 55 *improvements would not be as dramatic as Location Points on East End's eastern side. Moderate adverse*
 56 *impacts would occur with long-term moderate beneficial change in impacts compared to Alternative A.*

1 *East End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 2 *Developed Zone South Rim*
 3 *Ten-Year Forecast Off-Peak Season*

4 **Percent Time Audible and Average Sound Level at Desert View, Lipan Point, and Tusayan Museum Location**
 5 **Points are similar to Base Year Off-Peak Season. There would be negligible impacts with long-term moderate**
 6 **to major beneficial change in impacts compared to Alternative A.**

7
 8 Percent Time Audible at **El Tovar** Location Point would decline by **83%** from 96 to **13%**, and Average Sound
 9 Level would fall from 20 to **13** dBA. Visitors could appreciate drastic reduction in Percent Time Audible,
 10 although change in Average Sound Level would be modest. There would be negligible impacts with long-term
 11 moderate **to major** beneficial change in impacts compared to Alternative A.

12
 13 *East End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 14 *Developed Zone Phantom Ranch*
 15 *Base Year Peak and Off-Peak Season*

16 **Ten-Year Forecast Peak and Off-Peak Season**

17 At **Phantom Ranch** Location Point, air-tour aircraft Percent Time Audible would be further reduced from low
 18 levels occurring under Alternative A. Phantom Ranch is located near Bright Angel Creek and the Colorado River
 19 where background sound levels can be high. Visibility of air-tour aircraft would be quite low, with aircraft in
 20 excess of 11,000 meters All Scenarios. As shown in Tables 4.109 and 4.110 **Base Year Peak Season** air-tour
 21 aircraft Percent Time Audible would be 2% with Average Sound Level 10 dBA, down from 3% and 12 dBA in
 22 Alternative A, **with lower levels in other scenarios.**

23
 24 Phantom Ranch visitors would have largely uninterrupted opportunities to appreciate sounds and sights similar to
 25 Alternative A conditions. **In all scenarios there would be** negligible impacts with negligible change in impacts
 26 compared to Alternative A.

27
 28 *East End Ground-Based Visitors* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 29 *Developed Zone North Rim*
 30 *Base Year Peak Season*

31 North Rim overlook areas (**Bright Angel Point, Point Imperial, and Cape Royal** Location Points) would have
 32 mixed exposures to air-tour aircraft noise under the **Modified** NPS Preferred Alternative. As shown in Tables
 33 4.109 and 4.110, compared to Alternative A, **Bright Angel Point** Location Point would have increased Percent
 34 Time Audible at **57%**, and **the same** Average Sound Level at 24 dBA. Aircraft would be at Distances in excess
 35 of 6,000 meters (unchanged from Alternative A). At **Bright Angel Point** Location Point, small increases in air-
 36 tour aircraft noise may be perceptible to some visitors, resulting in moderate adverse impacts with long-term
 37 minor adverse change in impacts compared to Alternative A.

38
 39 For visitors near **Point Imperial** Location Point, Percent Time Audible would decrease from Alternative A from
 40 66 to **44%**, with reduced Average Sound Level from 38 to 18 dBA. Although moderate adverse impacts would
 41 occur, this would result in minor to moderate beneficial change in impacts compared to Alternative A.

42
 43 At **Cape Royal** Location Point, a variety of changes would take place under the **Modified** NPS Preferred
 44 Alternative. In general, air-tour aircraft noise would increase due to proximity of proposed fixed-wing and
 45 helicopter routes. Percent Time Audible would increase from Alternative A's 59% to **68%**, with Average Sound
 46 Level rising **slightly** from 25 to 27 dBA. Aircraft would continue at Distances beyond 4,000 meters. The small
 47 loss of opportunities to experience combined natural and human-caused sounds would result in **minor to** major
 48 adverse impacts with long-term minor adverse change in impacts compared to Alternative A.

49
 50 *East End Ground-Based Visitors* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 51 *Developed Zone North Rim*
 52 *Ten-Year Forecast Peak Season*

53 Sound conditions at **Bright Angel Point** Location Point would improve relative to Alternative A as a result of
 54 quiet-technology conversion. Percent Time Audible would be 18%, at Average Sound Level of **18** dBA, down
 55 from 48% Percent Time Audible and Average Sound Level of 24 dBA under Alternative A. This reduction
 56 would improve opportunities for visitors to appreciate natural sounds approximately one-third of the day.

1 Although minor adverse impacts would occur, this would result in long-term moderate *to major* beneficial
2 changes in impacts at this location compared to Alternative A.

3
4 Further reduction in air-tour sounds would occur near **Point Imperial** Location Point with Percent Time Audible
5 falling from Alternative A's 68% to 11%, and Average Sound Level decreasing from 39 to 16 dBA. Although
6 minor adverse impacts would occur, changes in impacts in this area would be long-term moderate *to major*
7 beneficial compared to Alternative A.

8
9 At **Cape Royal** Location Point, air-tour sounds would decrease, with Percent Time Audible falling from
10 Alternative A's 61 to **28%**, and Average Sound Level reduced modestly from 26 to **21** dBA. Although moderate
11 adverse impacts would occur, this would result in *moderate* beneficial change in impacts compared to
12 Alternative A.

13
14 *East End Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience*
15 *Developed Zone North Rim*
16 *Base Year Off-Peak Season*

17 Visitors near **Bright Angel Point** Location Point would experience a *dramatic decrease* in Percent Time
18 Audible from 47 to **4%** from Alternative A to *Modified NPS Preferred*, respectively. Average Sound Level
19 would decrease from 24 to **13** dBA. *Visitors would have largely uninterrupted opportunities to appreciate*
20 *natural sounds. This would result in negligible impacts with moderate to major beneficial change in impacts*
21 *compared to Alternative A.*

22
23 For visitors near **Point Imperial** Location Point, Percent Time Audible would *dramatically* decrease from
24 Alternative A's 66 to one percent, with reduced Average Sound Level from 38 to **7** dBA. *This would result in*
25 *negligible* impacts *with major* beneficial change in impacts compared to Alternative A.

26
27 Visitors near **Cape Royal** Location Point would experience *decreases* in air-tour sounds. Aircraft Percent Time
28 Audible would be *one percent, down* from 59%. Average Sound Level would also *decrease* from 25 to **11** dBA.
29 Visitors near this location would *not* experience air-tour sounds most of the day. This would result in *negligible*
30 impacts with long-term *major beneficial* changes in impacts compared to Alternative A.

31
32 *East End Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience*
33 *Developed Zone North Rim*
34 *Ten-Year Forecast Off-Peak Season*

35 Conditions at **Bright Angel Point** Location Point would improve relative to Alternative A. Percent Time
36 Audible would decrease relative to Alternative A from 48 to **5%**; Average Sound Level would fall from 24 to **12**
37 dBA. This would provide improvement in visitor opportunities to appreciate ambient sound conditions. Aircraft
38 would continue to be at Distances greater than 6,000 meters. *This would result in negligible impacts with* long-
39 term moderate *to major* beneficial changes in impacts compared to Alternative A.

40
41 **Point Imperial** Location Point Percent Time Audible would decrease from **68** to *one percent*, and Average
42 Sound Level would fall from Alternative A's 39 to **7** dBA. *This would provide improvement in visitor*
43 *opportunities to appreciate ambient sound conditions.* Although negligible impacts would occur, changes in
44 impacts to in this area would be long term *major* beneficial compared to Alternative A.

45
46 Conditions at **Cape Royal** Location Point would improve. Percent Time Audible would decrease from 61% in
47 Alternative A to *one percent*, and Average Sound Level would *decrease to 12 dBA from 26 dBA in Alternative*
48 *A. This would provide improved visitor opportunities to appreciate ambient sound conditions,* resulting in
49 *negligible* impacts with *major beneficial* change in impacts compared to Alternative A.

50
51 *East End Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience*
52 *Non-Wilderness Zone*
53 *Base Year Peak Season*

54 **Cedar Ridge** Location Point would generally see mixed changes in air-tour sounds under the *Modified NPS*
55 *Preferred Alternative.* As shown in Tables 4.109 and 4.110, locations near Cedar Ridge Location Point would
56 experience small increases in air-tour Percent Time Audible, up from 81 to 89% of the day, with Average Sound

1 Level remaining unchanged at 19 dBA. **Distances would be greater than 12,000 meters.** These moderate to
2 major **adverse** impacts represent a negligible change in impacts compared to Alternative A.

3
4 *East End Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience*
5 *Non-Wilderness Zone*
6 *Ten-Year Forecast Peak Season*

7 A dramatic decline in air-tour sounds near **Cedar Ridge** Location Point would occur with quiet-technology
8 conversion. Percent Time Audible would decrease from **82** to 6% of the day, and Average Sound Level would
9 fall from 19 to 14 dBA. Aircraft would be at Distances of nearly 12,000 meters. Although negligible to minor
10 adverse impacts would occur, this would result in long-term major beneficial changes in impacts compared to
11 Alternative A.

12
13 *East End Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience*
14 *Non-Wilderness Zone*
15 *Base Year Off-Peak Season*

16 Percent Time Audible at **Cedar Ridge** Location Point would decrease from 81% in Alternative A to **56%**, and
17 Average Sound Level would fall modestly from 19 to **15**dBA. Aircraft would be at Distances in excess of 12,000
18 meters. Air-tour sounds would remain audible over half the day, with sound levels remaining relatively
19 unchanged. Although moderate adverse impacts would occur, this would result in minor to moderate beneficial
20 changes in impacts compared to Alternative A.

21
22 *East End Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience*
23 *Non-Wilderness Zone*
24 *Ten-Year Forecast Off-Peak Season*

25 Conditions at **Cedar Ridge** Location Point would improve markedly with quiet-technology conversion. Percent
26 Time Audible would decrease from 82% in Alternative A to **6%**, and Average Sound Level would fall from 19 to
27 13 dBA. Although **negligible to** minor adverse impacts would occur, this would result in long-term major
28 beneficial changes in impacts compared to Alternative A.

29
30 **East End Modified NPS Preferred Alternative Visitor Use and Experience**
31 **Wilderness Zone**

32
33 As shown in Figures 4.30 to 4.33 and Tables 4.17 to 4.23, East End Wilderness Zone could expect a wide range of
34 exposure to air-tour noise. Percent Time Audible sound would range to 100% of the day with air-tour aircraft noise
35 levels **greater than 35 dBA up to 100% of the day.**

36
37 *East End Modified NPS Preferred Alternative Visitor Use and Experience*
38 *Wilderness Zone*
39 *Base Year Peak Season*

40 Locations along the river represented by **Nankoweap River** and **Little Colorado River** Location Points shown
41 in Tables 4.109 and 4.110 would see decreases in aircraft noise as air-tours move west of the Little Colorado
42 Confluence. Near Nankoweap River Location Point, Percent Time Audible would decrease from 7% to zero, and
43 Average Sound Level would fall from 34 to 15 dBA. At **Little Colorado River** Location Point, Percent Time
44 Audible would decrease from 34 to 7%, and Average Sound Level would fall from 43 to **26** dBA. Aircraft would
45 be over **2,400** meters Distant. Thus, opportunities to appreciate the area without air-tour aircraft noise would
46 increase compared to Alternative A. Although **negligible to** minor adverse impacts would occur, changes in
47 impacts would be long-term minor to moderate beneficial compared to Alternative A.

48
49 Visitors near **Hermit Basin, Point Sublime, and Pasture Wash** Location Points would experience a variety of
50 changes in air-tour sounds. Operations would use Dragon Corridor, **Zuni Point Corridor and long loop**, and air-
51 tour sounds would be similar to those described for Alternative A. At Hermit Basin Location Point, Percent Time
52 Audible would be 96% compared to 99% under Alternative A. However, Average Sound Level would fall from
53 42 to 20 dBA. At Point Sublime Location Point, conditions would remain unchanged at 100% Percent Time
54 Audible with Average Sound Level remaining at 35 dBA. At Pasture Wash Location Point, air-tour sounds
55 would increase slightly from 98% to 99% Percent Time Audible with Average Sound Level rising from 20 to 27
56 dBA. Dominance of air-tour aircraft noise would continue, virtually eliminating opportunities to experience the

1 area without air-tour aircraft noise *during flight hours between curfews*, and resulting in an experience
 2 inconsistent with expectations for visitors *to these areas*. Impacts would be *minor to major* adverse, *generally*
 3 similar to Alternative A, resulting in negligible changes in impacts.

4
 5 *East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 6 *Wilderness Zone*
 7 *Base Year Off-Peak Season*

8 At **Nankoweap River** Location Point, Percent Time Audible would fall from 7% to zero, and Average Sound
 9 Level would decrease from 34 to **11** dBA compared to Alternative A. At **Little Colorado River** Location Point,
 10 Percent Time Audible would fall from 34% to **zero** compared to Alternative A, a decrease of **34%** compared to
 11 Alternative A. Average Sound Level would fall from 43 to 7 dBA. Visitors would have opportunities to
 12 experience the area without air-tour aircraft noise most of the day. Negligible impacts would occur, *and* changes
 13 in impacts would be long-term moderate *to major* beneficial compared to Alternative A.

14
 15 Near **Hermit Basin** Location Point, Percent Time Audible would decrease from 99% in Alternative A to **79%**, a
 16 **20%** reduction; Average Sound Level would fall from 42 to **17** dBA, a **25** dBA reduction compared to
 17 Alternative A. Near **Pasture Wash** Location Point, Percent Time Audible would decrease from 98 to **94%**, and
 18 Average Sound Level would *slightly rise* from 20 to **24** dBA. These changes would *slightly* reduce air-tour
 19 noise, *an* improvement resulting in conditions *progressing towards* Wilderness Zone expectations. Although
 20 moderate adverse impacts would occur, changes in impacts would be long term *minor to* moderate beneficial
 21 compared to Alternative A.

22
 23 At **Point Sublime** Location Point, Percent Time Audible would *decrease* from 100% in Alternative A to **97%**
 24 under the *Modified* NPS Preferred, and Average Sound Level from 35 to **32** dBA. *Moderate to major* adverse
 25 impacts would occur, *with negligible* changes in impacts compared to Alternative A.

26
 27 *East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 28 *Wilderness Zone*
 29 *Base Year Peak and Off-Peak Season*

30 *High levels of air-tour sounds at Nankoweap Mesa Location Point would be reduced somewhat under the*
 31 *Modified NPS Preferred Alternative. Air-tour Percent Time Audible would be 76% Peak to one percent Off-*
 32 *Peak, down from 87% under Alternative A. Average Sound Level would range 31 dBA Peak to 14 dBA Off-*
 33 *Peak, down from 43 dBA under Alternative A. Air-tour aircraft would be at Distances in excess of 6,000*
 34 *meters Peak and much further away Off-Peak. Reduction in air-tour sounds would provide additional*
 35 *opportunities to appreciate the area without air-tour aircraft noise along one of the park's most challenging*
 36 *and rugged visitor trails. Although moderate to major adverse impacts would occur Peak season, negligible*
 37 *impacts would occur Off-Peak Season. This would result in long-term minor to moderate beneficial change in*
 38 *impacts Peak Season, and long-term moderate to major beneficial change in impacts compared to Alternative A.*

39
 40 *East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 41 *Wilderness Zone*
 42 *Ten-Year Forecast Peak and Off-Peak Season*

43 Impact levels at **Nankoweap River** and **Little Colorado River** Location Points *would be reduced from* Base
 44 Year *to Ten-Year Forecast and reduced Peak Season to* Off-Peak Season. *Ten-Year Forecast Peak Season*
 45 *Percent Time Audible would be zero to 3%, and Average Sound Level would be 13 to 26 dBA, reduced from 8*
 46 *to 37% and 35 to 43 dBA in Alternative A. Ten-Year Forecast Off-Peak Season Percent Time Audible would*
 47 *be zero to 3%, and Average Sound Level would be 7 to 26 dBA, reduced from 8 to 37% and 35 to 43 dBA in*
 48 *Alternative A. Impacts Peak Season would be negligible to minor adverse impacts, long-term minor to*
 49 *moderate beneficial changes in impacts compared to Alternative A. Impacts Off-Peak Season would be*
 50 *negligible with moderate to major beneficial changes in impacts compared to Alternative A.*

51
 52 Further reductions in air-tour noise near **Nankoweap Mesa** Location Point would occur with Percent Time
 53 Audible reduced *to 48% Peak and 2% Off-Peak, a reduction of 42 to 88%* compared to **90%** in Alternative A.
 54 Average Sound Level *would* fall from 43 dBA in Alternative A to **29 dBA Peak and 15 dBA Off-Peak**. Thus,
 55 aircraft would be audible about half the day *Peak Season, and only 2% of the day Off-Peak Season. Peak*
 56 *Season*, moderate adverse impacts would occur, *and* changes in impacts would be long term minor to moderate

1 beneficial compared to Alternative A. **Off-Peak Season, negligible impacts would occur, and changes in**
 2 **impacts would be long term major beneficial compared to Alternative A.**

3
 4 *East End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 5 *Wilderness Zone*

6 *Ten-Year Forecast Peak Season*

7 Visitors in areas near **Hermit Basin, Point Sublime, and Pasture Wash** Location Points would experience a
 8 variety of changes in air-tour sounds. Operations would use Dragon Corridor, **Zuni Point Corridor and long-**
 9 **loop routes** and air-tour sounds would be *somewhat* similar to those for Alternative A. At **Hermit Basin**
 10 Location Point, aircraft Percent Time Audible would be **57%**, compared to 100% under Alternative A, and
 11 Average Sound Level would fall from 42 to **17** dBA, a notable improvement resulting in conditions more
 12 consistent with Wilderness Zone visitor expectations. Although moderate adverse impacts would occur, changes
 13 in impacts would be long term moderate to major beneficial compared to Alternative A.

14
 15 Near **Point Sublime** Location Point Percent Time Audible would fall from 100 to **95%**, and Average Sound
 16 Level would decrease from 35 to **29** dBA **compared to Alternative A**. Air-tour aircraft noise dominance would
 17 continue, **with few** opportunities to experience the area without air-tour aircraft noise **during the day**, and
 18 resulting in an experience inconsistent with expectations for Wilderness Zone visitors. **Moderate** adverse impacts
 19 would occur, **with long-term negligible to minor beneficial** changes in impacts compared to Alternative A.

20
 21 Air-tour Percent Time Audible at **Pasture Wash** Location Point would decrease from 98 to **76%** with Average
 22 Sound Level **increasing slightly from 21 to 22** dBA. Visitors would experience increased opportunities to
 23 experience the area without air-tour aircraft noise. Although **minor** to major adverse impacts would occur,
 24 **changes in** impacts would be long term **minor** beneficial compared to Alternative A.

25
 26 *East End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 27 *Wilderness Zone*

28 *Ten-Year Forecast Off-Peak Season*

29 Near **Hermit Basin** Location Point, Percent Time Audible would decrease from 100% in Alternative A to **39%**,
 30 with a corresponding reduction of Average Sound Level from 42 to **15**dBA. Visitors near **Pasture Wash**
 31 Location Point would experience similar improvements, with air-tour Percent Time Audible reduced from 98 to
 32 **64%**, and a reduction in Average Sound Level from 21 to **20** dBA. At **Point Sublime** Location Point, Percent
 33 Time Audible would be reduced from 100 to **83%** of the day, and Average Sound Level would fall from 35 to
 34 **27**dBA. There would be a marked increase in opportunities to experience the area without air-tour aircraft noise,
 35 more consistent with expectations for solitude and primitive recreation in Wilderness. Although **minor to**
 36 moderate adverse impacts would occur, changes in impacts would be long term **moderate** beneficial compared to
 37 Alternative A.

38
 39 *East End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 40 *Wilderness Zone*

41 *Base Year and Ten-Year Forecast Peak Season*

42 Visitors near **96 Mile Camp** Location Point **Base Year** would experience a drop in air-tour Percent Time
 43 Audible from 72% in Alternative A to 59%, with Average Sound Level declining from 45 to 39 dBA. Ten-Year
 44 Forecast Peak Season, greater reductions would occur with Percent Time Audible falling from 74 to 41% and
 45 Average Sound Level decreasing from 45 to 37 dBA. Average Sound Level would remain relatively high, but
 46 decrease in Percent Time Audible would improve opportunities to experience the area without air-tour aircraft
 47 noise. Although **moderate to** major adverse impacts would occur, changes in impacts would be long term minor
 48 to moderate beneficial compared to Alternative A.

49
 50 *East End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 51 *Wilderness Zone*

52 *Base Year and Ten-Year Forecast Off-Peak Season*

53 Opportunities for visitors to experience the area without air-tour aircraft noise would increase noticeably at **96**
 54 **Mile Camp** Location Point. Compared to Alternative A, Percent Time Audible would decrease from 72 to **38%**
 55 **Base Year, and from 74% to 25% Ten-Year Forecast**. Average Sound Level would diminish from 45 dBA **in**
 56 **Alternative A, Base Year and Ten-Year Forecast, to 35 dBA Base Year and 33 dBA Ten-Year Forecast**. This

1 represents a marked improvement in conditions, and would lead to an experience more consistent with
 2 expectations for this Wilderness Zone location. Although *moderate to major adverse impacts would occur Base*
 3 *Year, impacts would decrease to moderate* adverse impacts *Ten-Year Forecast, with* long-term *moderate to*
 4 major beneficial change in impacts compared to Alternative A.

5
 6 **East End** *Modified NPS Preferred Alternative* **Visitor Use and Experience**
 7 **Ground-Based Visitors Outside the Park within the SFRA**

8 *All Scenarios*

9 *Peak Season*, modest, localized reductions in air-tour aircraft noise would result from elimination of *Marble*
 10 *Canyon, Little Colorado, and Nankoweap Loop routes, and from shifting routes west of the Little Colorado*
 11 *River confluence*. As shown in Figures 4.30 to 4.33, air-tour aircraft Average Sound Level would range *10* to 25
 12 dBA in adjacent *Navajo lands* where limited visitor numbers *and residents* would *benefit from reduced noise*
 13 *due to changes in routes*. *Off-Peak Season, with closure of Zuni Point Corridor and long-loop routes, air*
 14 *tour-related aircraft noise would be virtually eliminated in the SFRA east of the park*.

15
 16 In **Kaibab National Forest** at the park's southeast corner, air-tour aircraft *would be at low altitudes above*
 17 *ground with* Average Sound Level 35 to 55 dBA *Peak Season, but would drop to very low noise levels Off-*
 18 *Peak Season when Zuni Point Corridor is closed*. Many visitors are in developed areas *or at-large camping*
 19 using motorized transportation, and *east of* Grand Canyon Airport. Thus, air-tour sounds and other human-
 20 generated sounds associated with development and visitor services would be audible portions of each day. There
 21 would be minor to *major* adverse impacts *Peak Season* with negligible change in impacts from air-tour sounds
 22 compared to Alternative A, *and negligible to minor adverse impacts Off-Peak Season with moderate to major*
 23 *beneficial change in impacts compared to Alternative A*.

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1 **Table 4.109 Modified NPS Preferred Alternative Sound Levels East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative																
					Peak Season								Off Peak Season								
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)				
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	
South Rim																					
Desert View	76	79	29	30	71	-5	41	-38	29	0	23	-7	4	-72	6	-73	8	-21	7	-23	
Tusayan	64	67	35	36	64	0	38	-29	35	0	29	-7	0	-64	0	-67	4	-31	4	-32	
El Tovar	95	96	19	20	93	-2	23	-73	20	1	14	-6	66	-29	13	-83	15	-4	13	-7	
Bright Angel Flight Free Zone																					
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	7	-5	1	-2	1	-3	7	-5	7	-5	
Cedar Ridge	81	82	19	19	89	8	6	-76	19	1	14	-5	6	-25	6	-76	15	-4	13	-6	
North Rim																					
Point Imperial	66	68	38	39	47	-19	11	-57	18	-20	16	-23	1	-65	1	-67	7	-31	7	-32	
Bright Angel Point	47	48	24	24	57	10	18	-30	24	0	18	-6	4	-43	5	-43	13	-11	12	-12	
Cape Royal	59	61	25	26	68	9	28	-33	27	2	21	-5	1	-58	1	-60	11	-14	12	-14	
Zuni Point Corridor																					
Lipan Point	74	77	34	35	76	2	46	-31	34	0	28	-7	0	-74	0	-77	9	-25	8	-27	
Little Colorado River/Nankoweap Area																					
Nankoweap Mesa	87	90	43	43	76	-11	48	-10	31	-12	29	-14	1	-86	2	-88	14	-29	15	-28	
Nankoweap at River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	11	-23	12	-23	
Little Colorado River	34	37	43	43	7	-27	3	-34	26	-17	26	-17	0	-34	0	-37	7	-36	7	-36	
Dragon Corridor																					
Hermit Basin	99	100	42	42	96	1	57	43	20	-22	17	-25	79	-20	39	-61	17	-25	15	-27	
96 Mile Camp	72	74	45	45	59	-13	41	-33	39	-6	37	-8	38	-34	25	-49	35	-10	33	-12	
Toroweap /Shinumo Flight Free Zone																					
Point Sublime	100	100	35	35	100	0	95	-5	35	0	29	-6	97	-3	83	-17	32	-3	27	-8	
Pasture Wash	98	98	20	21	99	1	76	-22	27	7	22	1	94	-4	64	-34	24	4	20	-1	

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

1 **Table 4.110 Modified Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
South Rim			
Desert View	5,098	5,195	97
Tusayan	2,016	2,018	3
El Tovar	5,854	10,914	5,060
Bright Angel Flight Free Zone			
Phantom Ranch	11,027	11,313	286
Cedar Ridge	9,827	12,261	2,434
North Rim			
Point Imperial	2,292	2,754	462
Bright Angel Point	6,235	6,236	2
Cape Royal	4,038	4,026	-12
Zuni Point Corridor			
Lipan Point	2,890	2,894	3
Little Colorado River/Nankoweap Area			
Nankoweap Mesa	973	6,096	5,123
Nankoweap at River	1,449	9,655	8,206
Little Colorado River	1,629	2,474	845
Dragon Corridor			
Hermit Basin	1,518	6,447	4,929
96 Mile Camp	1,573	3,168	1,595
Toroweap /Shinumo Flight Free Zone			
Point Sublime	3,760	4,076	316
Pasture Wash	5,532	8,967	3,435

Δ indicates the change in noise metric data from Alternative A.

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Central Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience

As shown in Figures 4.30 to 4.33 and Tables 4.111 and 4.112, in the Central area there would be little change from Alternative A as the area would remain *mostly* quiet with aircraft Average Sound Level generally less than 10 dBA and Percent Time Audible *mostly* less than 5%.

*Central Modified NPS Preferred Alternative Visitor Use and Experience
Wilderness Zone
All Scenarios*

Conditions at **Upper Deer Creek** Location Point would remain largely unchanged from Alternative A. As shown in Tables 4.111 and 4.112, Percent Time Audible All Scenarios would be zero to one percent, and Average Sound Level would be zero to 2 dBA. Air-tour aircraft would be at Distances in excess of 24,000 meters. There would be negligible impacts with negligible change in impacts compared to Alternative A.

*Central Modified NPS Preferred Alternative Visitor Use and Experience
Non-Wilderness Zone
All Scenarios*

Conditions at **Toroweap Overlook** Location Point would vary little. As shown in Tables 4.111 and 4.112, Percent Time Audible would be zero with Average Sound Level **13** to 14 dBA. Air-tour aircraft would be at over 9,000 meters. Visitors would have uninterrupted opportunities to experience the area without air-tour aircraft noise. Thus, impacts would be negligible with negligible change in impacts compared to Alternative A.

1 **Central** *Modified NPS Preferred Alternative* **Visitor Use and Experience**
2 **Ground-Based Visitors Outside the Park within the SFRA**

3 *All Scenarios*

4 Because air-tour routes are south of the Central area, visitors in to **Kaibab National Forest, BLM lands, and**
5 **other adjacent lands north of the park** would experience few air-tour aircraft noise. As shown in Figures 4.30
6 to 4.33, air-tour sounds would *mostly* range zero to 10 dBA. There would be negligible impacts with negligible
7 changes in impacts on visitors north of the park compared to Alternative A.

8
9 **South of the park**, shown in Figures 4.30 to 4.33, on **Havasupai and Hualapai Indian Reservation lands, and**
10 **Kaibab National Forest lands**, air-tour aircraft Average Sound Level would range widely, from zero to 50 dBA.
11 Aircraft noise would mostly be in the zero to 25 dBA range except beneath *the Z-shaped Route (realigned Blue*
12 *Direct)*. Thus, near the Central area's southern edge, natural sounds would *sometimes* be dominated by aircraft
13 noise, and opportunity to experience the area without air-tour aircraft noise would be interrupted. This would
14 result in minor to moderate adverse impacts and negligible change in impacts compared to Alternative A.
15
16

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1 **Table 4.111 Modified NPS Preferred Alternative Sound Levels Central**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Upper Deer Creek	1	0	1	14	1	0	1	1	2	1	1	-13	1	0	1	1	1	0	1	-13
Toroweap Overlook	0	1	13	1	0	0	0	-1	14	1	14	13	0	0	0	-1	13	0	14	13

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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Table 4.112 Modified Preferred Alternative Slant Distances Central

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Upper Deer Creek	23,683	24,100	417
Toroweap Overlook	9,625	9,625	0

Δ indicates change in noise metric data from Alternative A

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1 **Ground-Based Visitors** *Modified NPS Preferred Alternative* **Visitor Use and Experience**
 2 **West End**

3
 4 As shown in Figures 4.30 to 4.33, modeled noise results indicate impacts associated with West End air-tour routes
 5 would be generally be *the same as* Alternative A. **West End's northwestern portion** (near Blue-2/Green-4),
 6 impacts would be major adverse with Average Sound Level 40 to 55 dBA and aircraft Percent Time Audible greater
 7 than 65%. Quiet-technology incentives and conversion requirements would provide some mitigation of these long-
 8 term adverse impacts *in Ten-Year Forecast. Within Sanup Flight-free Zone* Average Sound Level would be *less*
 9 *than* 10 dBA with aircraft Percent Time Audible less than 5%. *Air-tour-related aircraft noise would increase in*
 10 *West End's northeastern area in the Andrus-Parashant Canyon area, but would greatly decrease in the area*
 11 *north of Sanup Flight-free Zone due to shift of the current Blue Direct North and South routes northward to the*
 12 *Z-shaped Route (realigned Blue Direct).*

13
 14 *Ground-Based Visitors* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 15 *West End*
 16 *Base Year Peak Season*

17 **Whitmore Rapids** Location Point Percent Time Audible would *increase from 12 to 19%, and* Average Sound
 18 Level would *increase from 21 to 29 dBA compared to Alternative A probably due to the shift to the Z-shaped*
 19 *Route (realigned Blue Direct).* Aircraft Distance would be approximately 1,800 meters. At **Parashant Wash**
 20 Location Point, Percent Time Audible would decrease from 12 to 11%, Average Sound Level would fall from 33
 21 to 24 dBA, and aircraft Distance would be over 2,800 meters. At **Separation Canyon** Location Point, Percent
 22 Time Audible would remain unchanged at zero, Average Sound Level would remain unchanged at 7 dBA, and
 23 aircraft Distance would be over 16,000 meters. At **Bat Cave** Location Point Percent Time Audible would remain
 24 at 93%, Average Sound Level would *decrease slightly* from 47 to 45 dBA, and aircraft Distance *would be the*
 25 *same as* Alternative A. These represent limited changes in opportunities to experience the area without air-tour
 26 aircraft noise. Negligible to *moderate* adverse impacts would occur, except Bat Cave where impacts would be
 27 major adverse. These represent negligible changes in impacts compared to Alternative A, *except Whitmore*
 28 *Rapids where changes would be negligible to minor adverse.*

29
 30 *Ground-Based Visitors* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 31 *West End*
 32 *Ten-Year Forecast Peak Season*

33 At **Whitmore Rapids** Location Point, Percent Time Audible would *increase from 13 to 20% compared to*
 34 *Alternative A,* and Average Sound Level would *increase from 21 to 28 dBA compared to Alternative A*
 35 *probably due to the shift to the Z-shaped Route (realigned Blue Direct).* At **Parashant Wash** Location Point,
 36 Percent Time Audible would remain at 14%, and Average Sound Level would fall from 33 to 24 dBA *compared*
 37 *to Alternative A.* At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at
 38 zero, and Average Sound Level would remain *unchanged* at 7 dBA. Changes *from Alternative A* would be
 39 greatest at **Bat Cave** Location Point where Percent Time Audible would fall from 95 to 88%, and Average
 40 Sound Level would *decrease from 47 to 43dBA, probably due mostly to quiet technology conversion.* These
 41 represent limited changes in opportunities to experience the area without air-tour aircraft noise. Negligible to
 42 *moderate* adverse impacts would occur, except Bat Cave where impacts would be major adverse, with negligible
 43 changes in impacts compared to Alternative A, *except Whitmore Rapids where changes would be negligible to*
 44 *minor beneficial.*

45
 46 *Ground-Based Visitors* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 47 *West End*
 48 *Base Year Off-Peak Season*

49 At **Whitmore Rapids** Location Point, Percent Time Audible would *increase from 12 to 18% compared to*
 50 *Alternative A,* and Average Sound Level would *increase from 21 to 28 dBA compared to Alternative A.* At
 51 **Parashant Wash** Location Point, Percent Time Audible would *be similar to Alternative A at 11%,* and Average
 52 Sound Level would *decrease slightly* from 33 to 25 dBA. At **Separation Canyon** Location Point, Percent Time
 53 Audible would remain unchanged at zero, and Average Sound Level would remain 7 dBA. At **Bat Cave**
 54 Location Point, Percent Time Audible would fall from 93 to 91%, and Average Sound Level would *fall* from 47
 55 to 44 dBA. These represent limited changes in opportunities to experience the area without air-tour aircraft noise.
 56 Negligible to *moderate* adverse impacts would occur, except Bat Cave where impacts would be major adverse,

1 with negligible changes in impacts compared to Alternative A, *except Whitmore Rapids where changes would*
 2 *be negligible to minor adverse.*

3
 4 *Ground-Based Visitors Modified NPS Preferred Alternative Visitor Use and Experience*
 5 *West End*

6 *Ten-Year Forecast Off-Peak Season*

7 At **Whitmore Rapids** Location Point, Percent Time Audible would increase 4% from Alternative A (*to 17%*),
 8 and Average Sound Level would *increase* from 21 to 27 dBA. At **Parashant Wash** Location Point, Percent
 9 Time Audible would decrease from 14 to *12%*, and Average Sound Level would fall from 33 to 24 dBA
 10 compared to Alternative A. **Separation Canyon** Location Point would see no change with Percent Time Audible
 11 remaining at zero and Average Sound Level at 7 dBA. At **Bat Cave** Location Point, Percent Time Audible would
 12 fall from 95 to *85%*, and Average Sound Level would *decrease* from 47 to 43 dBA compared to Alternative A.
 13 These are limited changes in opportunities to experience the area without air-tour aircraft noise. Negligible to
 14 moderate adverse impacts would occur, except Bat Cave where impacts would be major adverse, with negligible
 15 to minor beneficial change in impacts compared to Alternative A *except Whitmore Rapids where changes*
 16 *would be negligible to minor beneficial.*

17
 18 *West End Modified NPS Preferred Alternative Visitor Use and Experience*
 19 *Ground-Based Visitors Outside the Park within the SFRA*

20 *All Scenarios*

21 *As shown in Figures 4.30 to 4.33, moving Las Vegas-Grand Canyon routes to the Z-shaped Route (realigned*
 22 *Blue Direct) will move impacts from some of the most remote and sensitive potential wilderness in Lake Mead*
 23 *National Recreation Area and Grand Canyon-Parashant National Monument within the SFRA to less*
 24 *sensitive areas within and outside the SFRA, but in Grand Canyon-Parashant National Monument areas still*
 25 *managed for wilderness characteristics. Moving the routes will also greatly reduce impacts on the*
 26 *administrative site for Grand Canyon-Parashant National Monument near the base of Mt. Dellenbaugh.*
 27 *Technically, operators can only be required to fly on designated routes within the SFRA. The area outside the*
 28 *SFRA is part of the national airspace with different rules than the SFRA, so Grand Canyon-related flights*
 29 *can choose where they fly outside the SFRA consistent with regulations governing national airspace. Flight*
 30 *paths outside the SFRA used in noise modeling for the Z-shaped Route (realigned Blue Direct) are paths*
 31 *considered most likely (and consistent with routes considered by GCWG under Alternative E). Because flight*
 32 *paths outside the SFRA are integrally connected with routes within the SFRA, they are also discussed in this*
 33 *section.*

34
 35 *There are three designated Wilderness Areas in Lake Mead National Recreation Area (NRA) west of the*
 36 *SFRA (Pinto Valley, Jumbilnan, and Jumbo Spring Wilderness Areas) that might be overflown by Grand*
 37 *Canyon tour aircraft between the Las Vegas area and the Z-shaped Route (realigned Blue Direct); however, it*
 38 *is hoped those areas can be avoided as an Air Tour Management Plan is developed for Lake Mead NRA. Also,*
 39 *the monitoring and adaptive management process included as part of this EIS's Modified NPS Preferred*
 40 *Alternative may offer opportunities to consider slight modifications to the Z-shaped Route (realigned Blue*
 41 *Direct) if modifications could reduce impacts on GCNP, Lake Mead NRA, Grand Canyon -Parashant*
 42 *National Monument, and/or other lands while still accomplishing other goals and objectives for the routes.*

43
 44 *Impacts would be moderate to major adverse directly under and near the Z-shaped Route (realigned Blue*
 45 *Direct). Average Sound Level would generally be 40 to 50 dBA, with high levels of aircraft Percent Time*
 46 *Audible. Because Blue Direct routes are in a very different location in Alternative A, these represent moderate*
 47 *to major adverse changes in location of impacts compared to Alternative A Base Year (and major beneficial*
 48 *changes in impacts in the areas of current Blue Direct North and South). In the area of the current Blue*
 49 *Direct routes major beneficial change in impacts compared to Alternative A since the routes would be moved*
 50 *from those locations. However, with Modified NPS Preferred Alternative quiet-technology incentives and*
 51 *conversion requirements, there would be a decrease in size of affected areas Ten-Year Forecast along the Z-*
 52 *shaped Route (realigned Blue Direct).*

53
 54 On the **Hualapai Indian Reservation**, *in areas south of the* Sanup Flight-Free Zone, air-tour sounds would be
 55 generally absent with Average Sound Level *less than 10 dBA due to the shift of Las Vegas-Grand Canyon*
 56 *traffic northward to the Z-shaped Route (realigned Blue Direct). Air-tour sounds would generally not be*

1 audible *south of the Flight-free Zone*. Negligible impacts would occur with negligible to minor beneficial
2 change in impact compared to Alternative A.
3

4 At the SFRA's far West End, the **Hualapai Indian Reservation** and small portions of **Lake Mead National**
5 **Recreation Area** would receive air-tour aircraft Average Sound Level from 20 to over 50 dBA. Air-tour sounds
6 would be audible for much of the day, and *there would be few* opportunities *during peak days* to experience the
7 area without aircraft noise. *Minor to major* adverse impacts would occur with negligible change in impact
8 compared to Alternative A.
9

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1 **Table 4.113 Modified NPS Preferred Alternative Sound Levels West End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Whitmore Rapids	12	13	21	21	19	7	20	7	29	8	28	7	18	6	17	4	28	7	27	6
Parashant Wash	12	14	33	33	11	-1	14	0	24	-9	24	-9	11	-1	12	-2	25	-8	24	-9
Separation Canyon at Colorado River	0	0	7	7	0	0	0	0	7	0	7	0	0	0	0	0	7	0	7	0
Bat Cave	93	95	47	47	93	0	88	-7	45	-2	43	-4	91	-2	85	-10	44	-3	43	-3

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

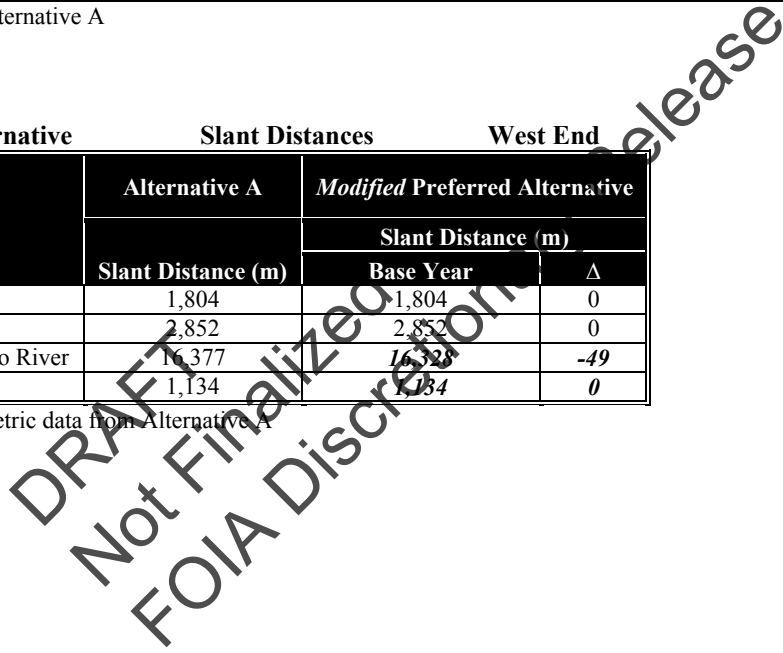
2
3
4

Table 4.114 Modified Preferred Alternative Slant Distances West End

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Whitmore Rapids	1,804	1,804	0
Parashant Wash	2,852	2,852	0
Separation Canyon at Colorado River	16,377	16,328	-49
Bat Cave	1,134	1,134	0

Δ indicates change in noise metric data from Alternative A

5
6



1 **Air-tour Visitors** **Modified NPS Preferred Alternative** **Visitor Use and Experience**
2

3 The *Modified* NPS Preferred Alternative would provide air-tour visitors a wide variety of highly desirable
4 opportunities to view park resources. This Alternative retains spectacular routes, much as in Alternative A, *although*
5 *there would not be as many route options for air-tour visitors as in Alternative A*. The Marble Canyon *fixed-wing*
6 routes would be *eliminated* to protect park and tribal resources. *Because of this, any flights between Grand Canyon*
7 *Airport and Page, Arizona would fly outside the SFRA rather than mostly over Grand Canyon as current. Under*
8 *the Modified NPS Preferred Alternative most flights currently using Marble Canyon routes would have to fly*
9 *outside the SFRA because they currently fly the routes during morning curfew hours, and no flights would be*
10 *allowed during curfew hours East End or Marble Canyon. Such flights would be over Painted Desert, Echo*
11 *Cliffs, and Vermilion Cliffs scenic landscapes, but views of Grand Canyon would be at an angle from the side*
12 *rather than directly underneath as with current Marble Canyon routes. Eliminating Marble Canyon routes along*
13 *with Black-2 and Black-3 routes from the south and east would reduce options for air-tour visitors from and/or to*
14 *the southeast, east, and northeast, in return for greatly reduced air-tour impacts on resources and ground-based*
15 *visitor experiences East End and Marble Canyon.*

16
17 East End long- and short-loop *air-tour options would continue to be available Peak Season (April 1 to November*
18 *14, 7.5 months). There would also be an additional, new, fixed-wing short-loop route option in Dragon Corridor,*
19 *thus, there would be more East End short- and long-loop tour options than current Peak Season. However, only*
20 *Dragon Corridor short-loop tours (fixed-wing and helicopter) would be available East End Off-Peak Season*
21 *(November 15 to March 31, 4.5 months), coinciding with most of the no-motor season on the Colorado River*
22 *through the park. Although this closure would limit options for air-tour visitors Off-Peak Season, most of this is*
23 *a period of low Grand Canyon visitation with winter storms that can cancel many scheduled flights.*

24
25 *Excellent views of the Little Colorado River confluence would still be available from Green-1 and Black-1 routes,*
26 *but instead of flying directly over sensitive resources and ground-based visitors in the confluence area, routes*
27 *would remain west of the confluence. The Nankoweap loop north of Zuni Point Corridor would be eliminated,*
28 *shortening distance and time over the canyon on Zuni Point Corridor routes and on Zuni Point Corridor segment*
29 *of the long-loop tour over North Rim. However, this would be compensated for on long-loop tours (and short-*
30 *loop Dragon Corridor tours) by the dogleg in Dragon Corridor which would provide more distance and time*
31 *directly over the canyon than current in that area.*

32
33 *East End routes altitudes would be adjusted so flights would be at or above nearby rim levels, and no longer as*
34 *much as 1,000 feet below North Rim as on current routes. Adjusting route altitudes so helicopter flights would no*
35 *longer be below North Rim overlooks and terrain would reduce the “thrill ride” component of many current*
36 *helicopter flights that feature flying very close to cliffs and other terrain features, that ride updrafts straight up*
37 *directly next to canyon walls to gain altitude to cross North Rim, or that dramatically dive 1,000 feet from above*
38 *North Rim southbound into Dragon Corridor. In return for the loss of some of the drama from current helicopter*
39 *flight practices, increased route altitudes near North Rim would provide a more expansive viewing platform from*
40 *which the spatial relationships, topography, and geology of the Canyon can be better seen and understood.*

41 *However, there would be fewer opportunities for close views of rocks and plants at eye level and above, and cliffs*
42 *would be viewed from the top rather than lower. Pilots would have long distances in which to climb away from*
43 *North Rim areas which tend to cause turbulence that can be unpleasant for air-tour visitors. No flights below the*
44 *rim would also greatly reduce adverse impacts of air tours on the experience of ground-based visitors at North*
45 *Rim overlooks who would no longer be looking down on aircraft, and of rock climbers and hikers on terrain*
46 *features sometimes flown by very close.*

47
48 *Curfew changes would result in one hour less each day available for air tours in late afternoon, which would*
49 *require changes in scheduling for tour operators and visitors traveling to meet air tours. Short term, this could*
50 *cause some people to miss an air tour; however, Grand Canyon history strongly suggests scheduling issues will*
51 *be worked out very quickly.*

52
53 While the current *Blue Direct North and South routes* would be eliminated, *they would be replaced by the Z-*
54 *shaped Route (realigned Blue Direct) which would provide opportunities for people on both aircraft sides to view*
55 *the canyon and river for more time and distance directly over Grand Canyon than current routes (15 nautical*

1 *miles vs. the current 10.5), while providing greatly reduced air-tour impacts on park resources, including*
 2 *proposed Wilderness and ground-based visitors.*

3
 4 West End, Green and Blue routes *would be the same as currently used in Alternative A, so they would provide the*
 5 *same desirable opportunities to view West End park resources and scenery as today.*

6
 7 *In summary, there would be fewer route options for air-tour visitors under the Modified NPS Preferred*
 8 *Alternative than under Alternative A, but there would still be many high quality air-tour options that would*
 9 *provide a variety of spectacular opportunities for viewing and understanding Grand Canyon's geology,*
 10 *topography, and spatial relationships. There would be less of the thrill ride aspect of many current helicopter*
 11 *flight options.*

12
 13 **Cumulative Impacts** **Modified NPS Preferred Alternative** **Visitor Use and Experience**
 14 **Ground-Based Visitors**

15
 16 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 17 *actions. In this context, Cumulative Impacts include impacts on Visitor Use and Experience from sounds of*

18 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*

19 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*

20 *3) ground-based noise sources, plus*

21 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

22
 23 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
 24 *(Modified NPS Preferred Alternative).*

25
 26 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 27 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 28 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 29 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 30 *SFRA see Appendix D, Figures 91 to 94).*

31
 32 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 33 *Visitor Use and Experience, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 34 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 35 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 36 *Chapter 3, Soundscapes, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 37 *Audible capable of masking some aircraft noise.*

38
 39 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 40 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 41 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 42 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 43 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 44 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 45 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 46 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 47 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
 48 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
 49 *noise some of the time.*

50
 51 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 52 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
 53 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
 54 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
 55 *Alternatives (Modified NPS Preferred Alternative in this case).*

1 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
 2 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
 3 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
 4 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
 5 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
 6 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
 7 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
 8 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the*
 9 *park.*

10
 11 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
 12 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
 13 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*
 14 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
 15 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
 16 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
 17 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
 18 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
 19 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
 20 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

21
 22 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 23 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
 24 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
 25 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

26
 27 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 28 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 29 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 30 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 31 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 32 *Cumulative Impacts discussion in the Conclusions section below.*

33
 34 **Conclusion** *Modified NPS Preferred Alternative* **Visitor Use and Experience**
 35 **Ground-Based Visitors**

36
 37 *Conclusion Marble Canyon* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 38 *Ten-Year Forecast Peak and Off-Peak Season, the Modified NPS Preferred Alternative would result in negligible*
 39 *impacts in Marble Canyon with negligible to minor beneficial change in impacts from Alternative A on Visitor Use*
 40 *and Experience.*

41
 42 *Conclusion East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 43 *Developed Zone*

44 *Ten-Year Forecast Peak Season, the Modified NPS Preferred Alternative would result in negligible to moderate*
 45 *adverse impacts with long-term negligible to major beneficial changes in impacts compared to Alternative A for*
 46 *Developed Zone areas as air-tour sounds would be reduced by seasonal route use and quiet-technology conversion.*
 47 *Ten-Year Forecast Off-Peak Season, the Modified NPS Preferred Alternative would result in negligible impacts*
 48 *with long-term moderate to major beneficial changes in impacts compared to Alternative A due to Off-Peak*
 49 *closure of Zuni Point Corridor and long-loop tour routes.*

50
 51 *Conclusion East End* *Modified NPS Preferred Alternative* *Visitor Use and Experience*
 52 *Non-Wilderness Zone*

53 *Ten-Year Forecast Peak and Off-Peak Season, the Modified NPS Preferred Alternative would result in negligible to*
 54 *minor adverse impacts with long-term major beneficial change in impacts compared to Alternative A to Non-*
 55 *Wilderness Zone Visitor Use and Experience as air-tour sounds are reduced by seasonal route use, route*
 56 *modifications and quiet-technology conversion.*

1 *Conclusion East End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*
 2 *Wilderness Zone*

3 Ten-Year Forecast **Peak Season**, the **Modified NPS Preferred Alternative** would result in negligible to major
 4 adverse impacts with long-term negligible to major beneficial change in impacts compared to Alternative A as air-
 5 tour sounds would be reduced by quiet-technology conversion. **Ten-Year Forecast Off-Peak Season, the Modified**
 6 **NPS Preferred Alternative would result in negligible to moderate impacts with long-term moderate to major**
 7 **beneficial changes in impacts compared to Alternative A due to Off-Peak closure of Zuni Point Corridor and**
 8 **long-loop tour routes, and route modifications.**

9
 10 *Conclusion Central* **Modified NPS Preferred Alternative** *Visitor Use and Experience*

11 Ten-Year Forecast **Peak and Off-Peak Season**, the **Modified NPS Preferred Alternative would result in negligible**
 12 **impacts with long-term negligible changes in impacts** from Alternative A near Central area Location Points.

13
 14 *Conclusion West End* **Modified NPS Preferred Alternative** *Visitor Use and Experience*

15 Ten-Year Forecast **Peak and Off-Peak Season**, the **Modified NPS Preferred Alternative would result in negligible**
 16 **to moderate** (except Bat Cave **Location Point** where impacts would be major) adverse impacts to West End Ground-
 17 Based Visitor Use and Experience with negligible to minor beneficial change in impacts from Alternative A.

18
 19 **Conclusion** **Modified NPS Preferred Alternative** **Visitor Use and Experience**
 20 **Air-tour Visitors**

21
 22 The **Modified NPS Preferred Alternative** would *continue to provide a wide variety of highly desirable air-tour*
 23 *opportunities for air-tour visitors roughly similar but fewer in number compared to Alternatives A and F, but a*
 24 *much greater number and variety than Alternative E. East End Peak Season (7.5 months) Dragon and Zuni*
 25 *Point Corridor short-loop tours and a long-loop tour over North Rim would be available similar to current, plus*
 26 *an additional fixed-wing short-loop route would be added in Dragon Corridor. Off-Peak Season (4.5 months)*
 27 *only Dragon Corridor short-loop tour routes would be open during a period of generally lower park visitation*
 28 *and coinciding with most of the no-motor season on the Colorado River. There would be less thrill ride aspect of*
 29 *East End helicopter tours as route altitudes would be adjusted to be at or above North Rim terrain, rather than*
 30 *below the rim as current. Las Vegas-Grand Canyon routes would be shifted so the new Z-shaped Route*
 31 *(realigned Blue Direct) would reduce impacts on the ground but provide more distance and time directly over the*
 32 *canyon than current routes. West End tour options would be the same as Alternative A.*

33
 34 *Cumulative Impacts Summary* **Modified NPS Preferred Alternative** *Visitor Use and Experience*

35
 36 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 37 *impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is, Ten-*
 38 *Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble*
 39 *Canyon, East End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and*
 40 *near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In*
 41 *comparison with the other Alternatives, Modified NPS Preferred Alternative ranks second behind Alternative E*
 42 *for the lowest overall Cumulative Impacts (Alternative A ranks last).*

43
 44 **WILDLIFE**

45
 46 **General Methodology**

47
 48 As described in Chapter 3, area of analysis for wildlife includes the park, as well as the SFRA and throughout the
 49 Study Area. To the extent habitat and species occurrences correlate, impacts to Wildlife are expected to be similar in
 50 the entire Study Area. Effects of aircraft noise and proximity to Wildlife and their habitat are analyzed in the context
 51 of natural variability and ecosystem integrity, as well as effects on individuals and populations. Responses to
 52 impacts may be species-specific. A list of species that occur in specific habitats is provided in Chapter 3, Wildlife.
 53 The analysis relies on Contour Analysis and a representative Location Point analysis for Percent Time Audible and
 54 Average Sound Level in the park and SFRA. Location Point noise data is usually presented as a range to provide an
 55 understanding of level of effect for specific areas influenced by air-tour operations. In addition, spatial analysis
 56 using noise contour data (Chapter 4, Methodology) was conducted to determine amount of wildlife habitat,

1 represented in acres within a range of metric values (Average Sound Level and Percent Time Audible). Appendix F
 2 provides spatial analysis results for Wildlife. Results for Percent Time Audible are provided only for areas in the
 3 park as limited ambient data was available outside the park, so audibility could not be calculated there. Therefore,
 4 when discussing areas in the SFRA but outside the park boundary, only Average Sound Level is evaluated to
 5 determine level of effect. Average Sound Level analysis includes evaluation of data within the park and SFRA.
 6 Results are presented for each geographic area (Marble Canyon, East End, Central, and West End). *Also, see the*
 7 *beginning of Chapter 4, General Methodology for discussion of overall methodology for impact analysis for all*
 8 *impact topics.*
 9

10 General Assumptions

Wildlife

11
 12 In the thresholds below, all aspects of aircraft noise intensity and duration including, but not limited to, audibility,
 13 aircraft Average Sound Level and timing are considered. Audibility is the ability of animals and humans with
 14 normal hearing to hear a given sound, and is affected by the animal's hearing ability, other simultaneous interfering
 15 sounds or stimuli, and by sound frequency content and amplitude and whether the sound contains information the
 16 animal has learned to pay attention to or ignore.

17
 18 As calculated for this EIS, Percent Time Audible relates to human hearing (audibility), which is used here as a
 19 surrogate for sounds heard by wildlife, understanding different animals hear sounds at different sound frequencies
 20 and levels, and some hear sounds at frequencies humans cannot. Use of human audibility as a surrogate for impacts
 21 related to wildlife audibility is reasonable for this impact analysis because the type of noise generated by aircraft
 22 mostly falls within the human hearing range, and wildlife of interest in this analysis can also hear quite well in the
 23 human hearing range even though some can also hear in ranges humans cannot.

24
 25 A measure of Distance between representative Location Points and aircraft routes is used as an indicator related to
 26 effects of aircraft being in close proximity to wildlife or habitats, including aircraft visibility and presence to wildlife
 27 on the ground. While there is usually a close correlation between Distance and sound intensity, this Distance
 28 measure is included primarily to address effects other than aircraft noise.
 29

30 Although wildlife would tend to habituate⁶⁰ to frequent audible aircraft with lower Average Sound Level,
 31 habituation in natural areas in a national park is an adverse impact (Barber, Turina, and Fristrup 2009/2010). *Some*
 32 *wildlife species are site specific and, if noise disturbance does not drive wildlife species out of an area, they may*
 33 *develop a tolerance for that noise, however, that's not to say the tolerance does not carry ecological costs.*
 34 *According to Management Policies 2006, "Natural systems in the national park system, and the human*
 35 *influences upon them, will be monitored to detect change. The Service will evaluate possible causes and effects of*
 36 *changes that might cause impacts on park resources and values. The Service will use the results of monitoring*
 37 *and research to understand the detected change and to develop appropriate management actions." "Biological or*
 38 *physical processes altered in the past by human activities may need to be actively managed to restore them to an*
 39 *natural condition or to maintain the closest approximation of the natural condition when a truly natural system*
 40 *is no longer attainable" (General Management Concepts 4.1). "Whenever possible, natural processes will be*
 41 *relied upon to maintain native plant and animal species and influence natural fluctuations in populations of*
 42 *these species" (NPS Management Policies 2006, Management of Native Plants and Animals 4.4.2).*
 43

44 Impact Intensity Threshold Descriptions

Wildlife

45
 46 Professional judgment and knowledge of Grand Canyon wildlife and habitat was applied in using intensity
 47 thresholds described below to make impact determinations for Wildlife where data related to specific situations fell
 48 into more than one intensity threshold (negligible, minor, moderate, major). For example, where Percent Time
 49 Audible is at levels considered major in the thresholds (greater than 25% Percent Time Audible), but Average Sound
 50 Level and Distance are at levels considered negligible (less than or equal to 15 dBA and greater than or equal to
 51 2,000 meters), then impact level would generally be considered moderate adverse, when reasonably consistent with
 52 other portions of thresholds for moderate levels (observable and measurable impacts, no risk of extirpation, changes
 53 outside natural variability, etc.), absent any over-riding information more relevant to impact determination
 54 indicating a different level.

⁶⁰Habituate: become accustomed to, or tolerant of, in this case, noise

1 Similarly, where Percent Time Audible is at levels considered moderate in the thresholds (greater than 10% and less
 2 than or equal to 25% Percent Time Audible), but Average Sound Level and Distance are at levels considered
 3 negligible (less than or equal to 15 dBA and greater than or equal to 2,000 meters), then impact level would
 4 generally be considered minor adverse, when reasonably consistent with other portions of thresholds for minor
 5 levels (observable or measurable impacts, changes not outside natural variability and no effects at the population
 6 level, etc.), absent any over-riding information more relevant to impact determination indicating a different level.

8 **Threshold Levels**

Wildlife

9		
10	<i>Negligible</i>	Impacts due to the event have no observable effects to wildlife or its habitat
11		
12		Impacts outside critical periods such as breeding season
13		
14		Distance from points of interest to aircraft routes greater than 2,000 meters
15		
16		Aircraft noise rarely audible (aircraft Percent Time Audible less than 5% of the 12-hour day in this
17		analysis)
18		
19		Aircraft noise intensity in a specific area is less than 15 dBA
20		
21	<i>Minor</i>	Impacts due to the event observable or measurable to individuals of a wildlife or localized habitats
22		
23		Severity and timing of changes to parameter measurements not outside natural variability and have
24		no effects on species at the population level, including distributions, behaviors, habitat or
25		ecosystem processes
26		
27		Impacts outside critical periods such as breeding season
28		
29		Distance from points of interest to aircraft routes greater than 1,000 meters and less than <i>or equal</i>
30		<i>to</i> 2,000 meters
31		
32		Aircraft noise audible for a small portion of applicable time periods (aircraft Percent Time Audible
33		greater than <i>or equal to</i> 5% and less than 10% of the 12-hour day)
34		
35		Aircraft noise intensity in a specific area greater than <i>or equal to</i> 15 dBA and less than 25 dBA
36		
37	<i>Moderate</i>	
38		Impacts due to the event observable and measurable to individuals or a population of wildlife or
39		its habitat
40		No species at risk of being extirpated
41		
42		Severity and timing of changes to parameter measurements sometimes fall outside natural
43		variability, and changes within natural variability might be long term
44		
45		Measurable changes occur from natural variability (which could be from displacement) on
46		species' populations including numbers, structure, distributions, behaviors, genetic variability, or
47		other demographic factors
48		
49		Some impacts affect critical periods, key habitat, ecosystem processes, or activities necessary for
50		survival, but effects are temporary and populations expected to return to pre-disturbance
51		conditions, and to remain indefinitely stable and viable
52		
53		Distance from points of interest to aircraft routes greater than 500 meters and less than <i>or equal to</i>
54		1,000 meters
55		

1		Aircraft noise audible for an intermediate portion of applicable time periods (aircraft Percent Time Audible greater than <i>or equal to</i> 10% and less than 25% of the 12-hour day)
2		
3		
4		Aircraft noise intensity in a specific area greater than <i>or equal to</i> 25 dBA and less than 35 dBA
5		
6	<i>Major</i>	
7		Impacts due to the event are readily measurable to a population of wildlife or its habitat
8		
9		Severity and timing of changes to parameter measurements often outside natural variability by a large amount or for long periods. Changes within natural variability might be long term or permanent
10		
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13		Population numbers, structure, distributions, behaviors, genetic variability, habitat, other demographic factors, or reproduction could have large long-term changes from natural variability, and may not rebound to pre-disturbance conditions or remain stable and viable
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17		In severe adverse cases, species at risk of extirpation, key ecosystem processes could be disrupted, or habitat for one or more species rendered non-functional
18		
19		
20		Substantial impacts could occur during critical time periods
21		
22		Distance from points of interest to aircraft routes less than <i>or equal to</i> 300 meters
23		
24		Aircraft noise is audible for a large portion of applicable time periods (aircraft Percent Time Audible greater than <i>or equal to</i> 25% of the 12-hour day)
25		
26		
27		Aircraft noise intensity in a specific area greater than <i>or equal to</i> 35 dBA
28		
29	Type of Impact	Wildlife
30		
31	<i>Adverse</i>	Impacts adversely affect size, continuity, or integrity of wildlife or habitat outside the normal range of variability, move habitat areas away from desired conditions, or impede normal breeding, foraging, or resting behavior, or lead to a loss of nesting, foraging, or dispersal habitat. Other examples are events that could result in direct mortality, temporal or spatial displacement of wildlife from habitat, habitat fragmentation, or reduction of habitat quality
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37	<i>Beneficial</i>	Impacts positively affect size, continuity, or integrity of individual wildlife or habitat, move habitat areas toward desired conditions, enhance normal breeding, foraging, or resting behavior, or lead to an increase in nesting, foraging, or dispersal habitat. Beneficial effects are usually described in terms of changes in impacts compared to Alternative A
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42	Context	Wildlife
43		
44	<i>Regional</i>	Impacts affect a large part of the population or a widespread area of suitable habitat or species' range within the park or SFRA
45		
46		
47	<i>Localized</i>	Impacts are confined to a small part of the population or to a small percentage of suitable habitat or species' range within the park or SFRA
48		
49		
50	<i>Park Management Zone</i>	Although impacts to wildlife and habitat do not differ greatly across park Management Zones, the way those impacts are assessed may vary across zones. For example, an aircraft Average Sound Level consistent with the moderate intensity level definition in the Wilderness Zone may be considered a minor intensity impact in the Developed Zone because management objectives may allow greater impacts in developed areas
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1 **Duration**

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3 *Short Term* Impacts to an individual, population, or habitat area last up to one year

4

5 *Long Term* Impacts to an individual, population, or habitat area last longer than one year

6

7 **Timing** Impacts could occur year-round, but wildlife would typically be most sensitive to impacts during

8 spring and summer months when breeding, incubation, and birthing/hatching occur. Certain

9 species may exhibit high sensitivity levels during rearing of young. Some species may also be

10 more vulnerable late fall or winter when heavy snowfall may limit food supplies or otherwise

11 place them in a weakened state. In addition, species may be more sensitive to disturbance during

12 the time they are most active (e.g., owls and bats most active feeding at night while passerine birds

13 most active during daylight hours)

14

15 **ALTERNATIVE A**

NO ACTION

WILDLIFE

16

17 Under Alternative A, a range of aircraft noise intensities and audibility would affect wildlife and habitat. Although

18 there would be an increase Base Year to Ten-Year Forecast in aircraft operations and Average Sound Level, the

19 increases would generally not change impact intensity levels (i.e., a moderate adverse impact would generally

20 remain moderate adverse).

21

22 Wildlife would experience noise from air-tour aircraft that would disturb individuals, affect behaviors, population

23 numbers, and species distributions in nearly half the Study Area Base Year and Ten-Year Forecast. Forty-five

24 percent of the park would have air-tour aircraft Percent Time Audible 25% or more of the day predominantly in East

25 and West Ends under and near air-tour routes. Average air-tour Average Sound Level would generally be low, less

26 than 25 dBA, in about 67% of the SFRA Base Year. Aircraft noise would increase slightly with increased operations

27 Ten-Year Forecast. Greatest exposure to noise and visual impacts would occur near heavily-used air-tour routes

28 where aircraft Average Sound Level would be 40 to 50 dBA and Percent Time Audible greater than 75%. However,

29 there would also be large habitat areas in Marble Canyon and the Central area relatively undisturbed by air-tours.

30

31 **Marble Canyon**

Alternative A

Wildlife

32

33 The predominant plateau habitat in the Marble Canyon area is old-desert scrub. This habitat is used by species such

34 as mule deer, bighorn, bald eagle (winter), and peregrine falcon. Based on contour data, in 87% of old-desert scrub

35 habitat, aircraft Percent Time Audible would be 5% or less. In 2% of the habitat, aircraft Percent Time Audible

36 would be greater than 25% in the entire habitat. Average Sound Level would be 25 dBA or less. The other

37 predominant Marble Canyon habitat is river/riparian used by song birds, sparrows, warblers, ducks, skunks, foxes,

38 and a variety of reptiles and amphibians. In the canyon along the river where background sounds from rapids can be

39 loud, 94% of Marble Canyon habitat would experience air-tour Percent Time Audible 5% or less of the day, and

40 Average Sound Level in 77% of river/riparian habitat would be 15 dBA or less. These conditions are reflected in

41 Location Point data.

42

43 *Marble Canyon*

Alternative A

Wildlife

44 *Base Year and Ten-Year Forecast*

45 Location Point data, as shown in Tables 4.115 and 4.116, indicates Marble Canyon would be quiet with air-tour

46 aircraft Percent Time Audible zero to 3% of the day. Average Sound Level would be zero to 25 dBA with higher

47 levels in Marble Canyon's southern portion. Aircraft would generally be more than 2,000 meters away from

48 points on the ground. In few locations (**North and South Canyon** Location Points), aircraft would be 800 to

49 1,000 meters from points on the ground. In most Marble Canyon areas, Wildlife and habitat would be exposed to

50 very infrequent noise at very low sound levels which would have little to no effect on species activities,

51 behaviors, or populations. Impacts to Wildlife and habitat would be short-term negligible to minor adverse.

1 **TABLE 4.115 ALTERNATIVE A AVERAGE SOUND LEVEL MARBLE CANYON**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Cliff Dwellers Lodge	1	1	6	10
Grid Location Point 1	0	0	15	17
Grid Location Point 2	2	3	16	19
Grid Location Point 3	3	3	14	16
Grid Location Point 4	0	0	0	2
Grid Location Point 5	2	2	8	12
Marble Canyon Dam Site	0	0	3	4
North Canyon	3	3	24	25
South Canyon	2	3	21	23

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Table 4.116 Alternative A Slant Distances Marble Canyon

Location Point Name	Slant Distance (m)
Cliff Dwellers Lodge	3,695
Grid Location Point 1	1,665
Grid Location Point 2	858
Grid Location Point 3	2,958
Grid Location Point 4	4,585
Grid Location Point 5	2,335
Marble Canyon Dam Site	3,845
North Canyon	999
South Canyon	816

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East End

Alternative A

Wildlife

Wildlife habitat located under **Zuni Point and Dragon Corridors** is mostly piñon-juniper at higher elevations, with cold-desert scrub and riparian habitats at lower elevations. Species found in piñon-juniper habitats include piñon and scrub jays, ravens, jack rabbits, elk, foxes, mountain lions, squirrels, lizards, and snakes. Those in cold-desert scrub include pocket gophers, Great Basin and Sonoran gopher snakes, desert cottontail, and bighorn. **Along North and South Rims**, habitat is mostly ponderosa pine and old-conifer forest that supports species such as flammulated and great horned owls, turkeys, hairy woodpeckers, ravens, deer mouse, coyotes, porcupines, and bobcats.

In the majority of piñon-juniper (83%), cold-desert scrub (78%), ponderosa pine (80%), and old-conifer forest (98%) habitats, air-tours would be frequently audible, and animals exposed to aircraft noise greater than 25% of the day. Habitats would be exposed to a variety of Average Sound Level. However, most habitat would be exposed to low Average Sound Level of 25 dBA or less (piñon-juniper 67%, ponderosa 73%, old-conifer forest 56%, and cold-desert scrub 59% of the habitat). In 58% of the river/riparian habitat aircraft Percent Time Audible would be greater than 25% of the day and Average Sound Level would be 25 dBA or more in 48% of the habitat.

As shown in Table 4.117, aircraft noise beneath **Zuni Point and Dragon Corridors and across North Rim (Green-1A)** would result in areas of nearly continuous noise. In these areas, air-tour noise would affect Wildlife and habitat a large part of the day. Wildlife habitats beneath Zuni Point and Dragon Corridors include piñon-juniper and cold-desert scrub. Areas represented by Location Points **Hermit Basin, 96 Mile Camp, Point Sublime, Point Imperial, Tower of Ra, Grid Location Points 15 and 16, Lipan Point, and Tusayan Museum** would have aircraft noise Percent Time Audible and Average Sound Level (64 to 100% Percent Time Audible and up to 49 dBA with median 28 dBA), but would not have aircraft closer than 1,000 meters (Table 4.118). In some areas, represented by Location Points **The Basin, Grid Location Point 14, and southeast of Moran Point**, air-tour aircraft would be 450 to 690 meters from the ground. In old-conifer forest areas under Black-1 and Green-1 along South Rim, air-tour aircraft would be less than 500 meters from ground locations when aircraft use Grand Canyon Airport. Given persistent air-tour noise in areas under routes, and close proximity of flights particularly in areas

1 along the canyon rim, there would be potential to disrupt normal wildlife behavior patterns such as breeding,
 2 feeding, or sheltering that may result in reduced species populations. For example, falcons are known to occur in
 3 reduced densities beneath current air-tour routes which may indicate nearly continuous noise at high levels is
 4 restricting wildlife use of suitable habitat (NPS 2010c). Impacts to wildlife would be short and long term moderate
 5 to major adverse under East End tour routes.

6
 7 *East End*

Alternative A

Wildlife

8 *Base Year and Ten-Year Forecast*

9 Close to the river, such as **Nankoweap River** Location Point, air-tour aircraft Average Sound Level would be 34
 10 to 35 dBA, but could sometimes be masked by loud river background sound, and Percent Time Audible would be
 11 7 to 8% of the day. Aircraft visibility would be low with aircraft generally more than 1,400 meters away from
 12 points on the ground. Individuals may be disturbed temporarily and infrequently, and would be expected to
 13 resume normal activities after an aircraft event. Impacts from aircraft on Wildlife and habitat would be generally
 14 be short term minor adverse near the river.

15
 16 **Beneath Bright Angel Flight-free Zone**, air-tour aircraft noise would vary widely. Wildlife and habitat near air-
 17 tour corridors would experience almost continuous noise and moderate to major adverse impacts. **Grid Location**
 18 **Points 12 and 13** and **Phantom Ranch** Location Points amid Bright Angel Flight-free Zone would have Percent
 19 Time Audible less than 5% with aircraft Average Sound Level of 12 to 14 dBA. Aircraft would be at Distances
 20 greater than 7,000 meters. Impacts to wildlife habitats amid Bright Angel Flight-free Zone would be negligible.

21
 22 Similar impacts would occur in Toroweap/Shinumo Flight-free Zone's eastern portion represented by Location
 23 Points **Point Sublime** and **Grid Location Point 10**. Near Dragon Corridor, wildlife and habitat would
 24 experience aircraft Average Sound Level 25 to 35 dBA with Percent Time Audible nearly 92 to 100% of the day,
 25 and moderate to major adverse impacts would generally occur. Areas further west of Dragon Corridor and north
 26 of Brown-6, represented by **Bass Camp** and **Rainbow Plateau** Location Points, air-tour aircraft Average Sound
 27 Level decreases to approximately 6 to 7 dBA, and Percent Time Audible would be less than one percent; impacts
 28 to Wildlife and habitat would be negligible.

29
 30 Based on contour data maps (Appendix D), in areas outside the park boundary along the SFRA's eastern
 31 boundary, east of Desert View Flight-free Zone, and areas south of Toroweap/Shinumo Flight-free Zone, aircraft
 32 Percent Time Audible would generally be greater than 65% of the day with Average Sound Level 35 dBA or
 33 less. Impacts to wildlife in these areas would be long-term minor to moderate adverse.

1 **Table 4.117 Alternative A Average Sound Level East End**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Little Colorado River/Nankoweap Area				
Nankoweap River	7	8	34	35
Nankoweap Mesa	87	90	43	43
Dragon Corridor				
96 Mile Camp	72	74	45	45
Tower of Ra	97	98	44	45
Eremita Mesa	100	100	49	49
Hermit Basin	99	100	42	42
North Rim				
Cape Royal	59	61	25	26
Point Imperial	66	68	38	39
Bright Angel Point	47	48	24	24
The Basin	73	75	48	48
Grid Location Point 16	80	84	33	34
Zuni Point Corridor				
Grid Location Point 14	70	74	34	34
Grid Location Point 15	65	69	28	29
Temple Butte	62	66	37	38
Lipan Point	74	77	34	35
South Rim				
Tusayan Museum	64	67	35	36
El Tovar	95	96	19	20
Zuni Alpha	43	46	46	46
Ten X Meadow	64	68	49	49
1.5 km SE of Moran Point	64	68	41	41
Bright Angel Flight Free Zone				
Cedar Ridge	81	82	19	19
Grid Location Point 11	56	56	18	18
Grid Location Point 12	1	1	13	14
Grid Location Point 13	1	1	12	13
Phantom Ranch	3	4	12	12
Toroweap /Shinumo Flight Free Zone				
Grid Location Point 10	92	92	25	25
Grid Location Point 18	60	60	16	17
Point Sublime	100	100	35	35
Bass Camp	0	0	7	7
Rainbow Plateau	0	0	6	7

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1 **Table 4.118 Alternative A Slant Distances East End**

Location Point Name	Slant Distance (m)
Little Colorado River/Nankoweap Area	
Nankoweap River	1,449
Nankoweap Mesa	973
Dragon Corridor	
96 Mile Camp	1,573
Tower of Ra	1,147
Eremita Mesa	1,034
Hermit Basin	1,518
North Rim	
Cape Royal	4,038
Point Imperial	2,292
Bright Angel Point	6,235
The Basin	477
Grid Location Point 16	2,589
Zuni Point Corridor	
Grid Location Point 14	687
Grid Location Point 15	1,637
Temple Butte	1,458
Lipan Point	2,890
South Rim	
Tusayan Museum	2,016
El Tovar	5,854
Zuni Alpha	573
Ten X Meadow	540
1.5 km SE of Moran Point	448
Bright Angel Flight Free Zone	
Cedar Ridge	9,827
Grid Location Point 11	8,081
Grid Location Point 12	9,014
Grid Location Point 13	7,925
Phantom Ranch	11,027
Toroweap /Shinumo Flight Free Zone	
Grid Location Point 10	2,931
Grid Location Point 18	8,449
Point Sublime	3,760
Bass Camp	13,358
Rainbow Plateau	14,878

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Central Alternative A Wildlife

The Central area is composed of cold- and old-desert scrub, piñon-juniper, and river/riparian habitat. Overall Wildlife and habitat would be exposed to very little aircraft noise. As shown in Appendix F, Base Year and Ten Year Forecast, aircraft Percent Time Audible would be 5% of the day or less in the majority of habitat: 85 to 88% of cold- and old-desert scrub, 75 to 77% of piñon-juniper, and 96% of river/riparian habitats. Average Sound Level would also be relatively low in these habitats with 100% of cold-desert scrub and 75% of old-desert scrub exposed to aircraft Average Sound Level 25 dBA or less. River/riparian and piñon-juniper habitats would experience Average Sound Level 15 dBA or lower.

1 *Base Year and Ten-Year Forecast*
 2 *Central*

Alternative A

Wildlife

3 **In the Central area**, Wildlife and habitat would be little affected by aircraft overflight noise. This area
 4 comprises Toroweap/Shinumo Flight-free Zone’s middle and western portions, as well as Fossil Canyon and
 5 Tuckup General Aviation Corridors. In this remote area, Percent Time Audible would range zero to 25%, with
 6 Average Sound Level up to 27 dBA (Table 4.119). **South of the park boundary within the SFRA**, Wildlife and
 7 habitat would be most affected in areas beneath Blue Direct routes and Brown-1, Brown-4, and Brown-6. Areas
 8 near Brown-1 and Brown-6 would experience air-tour aircraft Average Sound Level 7 dBA to 27 dBA as
 9 represented by **South Supai Canyon** and **Havatagvitch Canyon** Location Points, and air-tour aircraft would be
 10 1,480 to 3,668 meters from the ground as shown in Table 4.120. Near Brown-1, toward the west, aircraft Percent
 11 Time Audible would be 22 to 25% of the day at Average Sound Level 22 dBA based on **Prospect Canyon**
 12 Location Point. In this location, air-tour aircraft would be over 3,800 meters from the ground.

13
 14 **In the majority of the Central area**, there would be limited presence of air-tour noise and low Average Sound
 15 Level, with air-tour aircraft far from locations on the ground. In these areas, there would be little potential for
 16 Wildlife and habitat disturbance. Some individuals may be disturbed for short-periods but would be expected to
 17 return to normal behaviors after air-tour activity with no population level changes. In areas close to air-tour
 18 routes, effect on wildlife of air-tour operations may increase with potential to disrupt normal behavior patterns
 19 such as breeding, feeding, or sheltering. Impacts to Wildlife and habitat would generally be short term negligible
 20 to minor adverse, with impacts up to moderate adverse close to air-tour routes.

21 **Table 4.119 Alternative A Average Sound Level Central**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Havatagvitch Canyon	1	1	7	8
Supai Village	0	0	5	13
Coyote Canyon	0	0	16	16
Mohawk Canyon MOHAWK	1	1	11	12
Mohawk Canyon MOHCAN	2	2	11	12
Prospect Canyon	22*	22	22	22
The Dome	1	1	16	16
Fossil Canyon	2	2	12	12
Grid Location Point 21	2	2	14	14
Grid Location Point 22	18	21	12	13
Grid Location Point 25	11	12	9	10
Grid Location Point 9	1	1	5	5
South Supai Canyon	6	7	27	27

23
 24

1 **Table 4.120 Alternative A Slant Distances Central**

Location Point Name	Slant Distance (m)
Havatagvitch Canyon	3,668
Supai Village	163
Coyote Canyon	7,651
Mohawk Canyon	3,009
Mohawk Canyon	6,304
Prospect Canyon	1,550
The Dome	13,109
Fossil Canyon	10,346
Grid Location Point 21	20,393
Grid Location Point 22	26,089
Grid Location Point 25	20,188
Grid Location Point 9	11,103
South Supai Canyon	1,480

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4 **West End Alternative A Wildlife**

5
6 Under Alternative A, a range of aircraft noise intensities and audibility would affect Wildlife and habitats due to
7 heavy helicopter traffic for river access, West End air tours, and direct-flight routes between Las Vegas and Grand
8 Canyon Airport. A large West End wildlife habitat area would be relatively quiet under **Vanup Flight-free Zone**.
9

10 West End is a mixture of warm- and cold-desert shrub, piñon-juniper, and riparian habitat along the river. West End
11 Wildlife and habitat would be exposed to varying levels of aircraft noise depending on route proximity. As shown in
12 Appendix F, aircraft Percent Time Audible would be greater than 25% of the day in 36% of piñon-juniper habitat;
13 44% of warm-desert; and 28% of river/riparian habitat river due to masking of sounds by the river. However in areas
14 away from routes, a large amount of habitat would experience very infrequent aircraft noise. Aircraft Percent Time
15 Audible would be 5% of the day or less in 36% of West End piñon-juniper habitat, in 45% of West End warm-desert
16 scrub habitat; and 59% of West End river/riparian habitat. Average Sound Level would remain low (25 dBA or less)
17 in 83% of West End piñon-juniper, 69% of warm desert, and 68% of river/riparian habitats.
18

19 *West End Alternative A Wildlife*
20 *Base Year and Ten-Year Forecast*

21 As shown in Tables 4.121 and 4.122, Location Points **Burnt Springs Canyon, Bat Cave, and Grid Location**
22 **Point 33** near Green-4, Blue-2, and Blue Direct routes would have aircraft Percent Time Audible 70 to 95% of
23 the day with Average Sound Level 42 to 48 dBA. Aircraft would be 1,100 to 1,220 meters from points on the
24 ground. There would be potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering.
25 Wildlife may avoid these areas for suitable adjacent habitats. Higher aircraft Average Sound Level may result in
26 localized changes in population numbers and structure. In areas under West End tour routes, impacts to Wildlife
27 and habitat would be short and long term moderate to major adverse.
28

29 Areas near Brown routes, represented by **Whitmore Rapids** and **Parashant Wash** Location Points, would have
30 aircraft Percent Time Audible 12 to 14% and Average Sound Level 20 to 33 dBA. At higher elevations in shrub
31 and ponderosa pine habitat such as **Andrus Canyon** Location Point, air-tour aircraft Percent Time Audible
32 would be 22 to 24% of the day. Aircraft would be 1,400 to 1,800 meters from points on the ground. Wildlife and
33 habitat may be disturbed infrequently during the day by air-tour aircraft noise slightly above background
34 conditions; however, normal activities would be expected to recover after disturbance with no population level
35 impacts. Wildlife under Brown routes would experience long-term minor to moderate adverse impacts.
36

37 Areas near Blue Direct routes, including **Grid Location Points 27 and 32, Mt. Dellenbaugh, and Shivwits Fire**
38 **Camp** Location Points would experience air-tour Average Sound Level 26 to 41 dBA with Percent Time
39 Audible 20 to 44% of the day. Habitat is a mixture of old-desert scrub and old piñon-juniper. At higher elevation
40 plateau locations, air-tour aircraft would be 800 to 3,300 meters from the ground. Impacts to Wildlife and habitat
41 would be long term moderate to major adverse under Blue Direct routes.

1 Wildlife and habitat found below Sanup Flight-free Zone and south toward the SFRA boundary would be
 2 minimally affected by air-tour operations. Aircraft Percent Time Audible would be less than 5% of the day at
 3 Average Sound Level 8 dBA and less as represented by **Pumpkin Springs** and **Diamond Creek** Location
 4 Points. Impacts to Wildlife and habitat would be negligible at these locations.
 5

6 **Table 4.121 Alternative A Average Sound Level West End**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Burnt Springs Canyon	70	75	46	47
Bat Cave	93	95	47	48
Grid Location Point 33	87	90	42	43
Whitmore Rapids	12	13	21	21
Grid Location Point 27	20	23	26	27
Grid Location Point 28	14	16	17	18
Grid Location Point 31	37	41	42	43
Mt. Dellenbaugh	29	32	41	42
Shivwits Fire Camp	35	39	38	38
Grid Location Point 32	44	49	27	28
Granite Peak	2	2	17	18
NPS Administration site	44	49	31	32
Castle Peak	27	30	18	48
Parashant Wash	12	14	33	33
Diamond Creek	0	0	0	0
Pumpkin Springs	0	0	7	8
Meriwhitca	0	1	7	8
Andrus Canyon	22	24	17	17

7
 8 **Table 4.122 Alternative A Slant Distances West End**

Location Point Name	Slant Distance (m)
Burnt Springs Canyon	1,215
Bat Cave	1,134
Grid Location Point 33	1,105
Whitmore Rapids	1,804
Grid Location Point 27	3,388
Grid Location Point 28	8,327
Grid Location Point 31	502
Mt. Dellenbaugh	824
Shivwits Fire Camp	1,669
Grid Location Point 32	2,016
Granite Peak	5,264
NPS Administration site	3,719
Castle Peak	8,629
Parashant Wash	2,852
Diamond Creek	27,108
Pumpkin Springs	12,630
Meriwhitca	15,742
Andrus Canyon	1,393

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 11

1 **Cumulative Impacts**2 **Alternative A**3 **Wildlife**

4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*

5 *actions. In this context, Cumulative Impacts include impacts on Wildlife from sounds of*

6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*

7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*

8 *3) ground-based noise sources, plus*

9 *4) noise from air-tour-and-related aircraft under Alternative A*

10 *That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).*

11
12 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*

13 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*

14 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*

15 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*

16 *SFRA see Appendix D, Figures 91 to 94).*

17
18 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*

19 *Wildlife, but is mostly concentrated in the Developed Zone (2% of the park), although a small component exists*

20 *in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire management*

21 *activities, and mining activities outside the park. Noise from ground-based sources is discussed in Chapter 3,*

22 *Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time Audible*

23 *capable of masking some aircraft noise.*

24
25 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*

26 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*

27 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*

28 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*

29 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*

30 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*

31 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*

32 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*

33 *Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the*

34 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*

35 *Because they would be audible a very high percentage of the day, the combination of aircraft noise from all*

36 *sources would generally be the overriding cumulative noise influence on Wildlife and habitat.*

37
38 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*

39 *(Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*

40 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*

41 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*

42 *(Alternative A in this case).*

43
44 *Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in*

45 *Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is*

46 *detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year*

47 *Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS;*

48 *however, since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas*

49 *(2% of the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in*

50 *interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas*

51 *north of the park.*

52
53 *Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All*

54 *Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the*

55 *difference between Cumulative Impacts and impacts of Alternative A by itself. For the Entire Park Cumulative*

56 *Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the park, with*

1 *Average Sound Level 25 to <35 dBA in 85% of the park, with none of the park below 25 dBA, and 24% at 35 dBA*
 2 *or more. For the Entire Park results for Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or*
 3 *more of the day in 27% of the park, with Average Sound Level 25 to <35 dBA in 28% of the park, with 50% of the*
 4 *park below 25 dBA, and 22% at 35 dBA or more.*

5
 6 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 7 *including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour*
 8 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
 9 *impacts under the Alternatives reduces Cumulative Impacts.*

10
 11 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 12 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 13 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 14 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 15 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
 16 *in the Conclusions section below.*

17
 18 **Conclusion** **Alternative A** **Wildlife**

19
 20 In the park and SFRA wildlife would experience noise from air-tour aircraft that would disturb individuals, affect
 21 behaviors, population numbers, and species distributions in nearly half the Study Area Base Year and Ten-Year
 22 Forecast. Greatest exposure to noise and visual impacts would occur near East and West End heavily-used air-tour
 23 routes where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater
 24 than 75% of the time. However, there would also be large habitat portions that would go relatively undisturbed in
 25 Marble Canyon and the Central area.

26
 27 *Conclusion* *Alternative A* *Wildlife*
 28 *Marble Canyon*

29 Ten-Year Forecast Alternative A would generally result in short-term negligible to minor adverse impacts on Marble
 30 Canyon Wildlife and habitat.

31
 32 *Conclusion* *Alternative A* *Wildlife*
 33 *East End*

34 Ten-Year Forecast there would be short- and long-term impacts to Wildlife and habitats East End ranging moderate
 35 to major adverse in areas beneath and adjacent to air-tour routes. In areas away from air-tour routes including
 36 beneath Bright Angel Flight-free Zone impacts would generally be short term negligible to minor adverse.

37
 38 *Conclusion* *Alternative A* *Wildlife*
 39 *Central*

40 Ten-Year Forecast Alternative A would generally result in short-term negligible to minor adverse impacts on
 41 Central area Wildlife and habitats, with impacts up to moderate adverse in areas near air-tour routes.

42
 43 *Conclusion* *Alternative A* *Wildlife*
 44 *West End*

45 Ten-Year Forecast Alternative A would result in short- and long-term moderate to major adverse impacts to wildlife
 46 located under and near Green-4, Blue-2, and Blue Direct routes. Short-term minor to moderate adverse impacts
 47 would result at Location Points near Brown routes. Impacts under Sanup Flight-free Zone and south of the park in
 48 the SFRA would be negligible.

49
 50 **Cumulative Impacts Summary** **Alternative A** **Wildlife**

51
 52 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 53 *impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts in*
 54 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 55 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 56 *and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison with the*

1 *other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts (Alternative E ranks first in*
 2 *lowest Cumulative Impacts).*

3

4 **ALTERNATIVE E**

ALTERNATING SEASONAL USE

WILDLIFE

5

6 See Alternative A for species and habitat descriptions.

7

8 Overall Alternative E would result in beneficial changes in impacts compared with Alternative A due to reduced
 9 area exposed to high Average Sound Level and Percent Time Audible for long periods. Ten-Year Forecast, the
 10 majority of habitat (68% Peak Season, 71% Off-Peak Season) would have air-tour aircraft noise Percent Time
 11 Audible less than 5% of the day. Wildlife habitat exposed to air-tour aircraft noise Percent Time Audible greater than 25% would
 12 be reduced to 16 and 14%, Base Year Peak and Off-Peak Seasons respectively, compared to 47% in Alternative A.
 13 Ten-Year Forecast Peak and Off-Peak Seasons, 51 to 53% of SFRA habitat would have air-tour aircraft Average
 14 Sound Level less than 15 dBA. This would result in greatly reduced impacts on Wildlife and habitat with greater
 15 areas of the park protected from air-tour aircraft sights and sounds. Wildlife habitat would be improved, and fewer
 16 disturbances to wildlife would occur over the majority of the park and SFRA.

17

18 **Marble Canyon**

Alternative E

Wildlife

19

20 *Marble Canyon*

Alternative E

Wildlife

21 *All Scenarios*

22 Predominant Marble Canyon habitats are old-desert scrub and river/riparian. Based on contour data as shown in
 23 Appendix F, in 100% of these Marble Canyon habitats, aircraft Percent Time Audible would be 5% or less of the
 24 day. Almost the entire habitat would experience Average Sound Level of 15 dBA or less.

25

26 Under Alternative E, Marble Canyon would be in Bright Angel Flight-free Zone. As shown in Tables 4.123 and
 27 4.124, air-tour aircraft Percent Time Audible would be less than 5% and Average Sound Level would be below
 28 13 dBA, a zero to 16 dBA decrease from Alternative A. Aircraft would be barely audible and at very low levels.
 29 There would generally be no air-tour aircraft visible from most points on the ground. Improvements over
 30 Alternative A would occur at all Marble Canyon Location Points, and most at **North and South Canyon**
 31 Location Points. Wildlife would rarely be disturbed by air-tour aircraft operations. Negligible impacts would
 32 occur, a short-term negligible to minor beneficial change in impacts to Wildlife and habitat compared with
 33 Alternative A.

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1 **Table 4.123 Alternative E Average Sound Level Marble Canyon**

Location Point Name	Alternative E																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	0	-6	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-2	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-8	7	-9	1	-2	1	-2	7	-8	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	0	-8	0	-12	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	0	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-2	0	-3	0	-24	0	-25	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-2	0	-21	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4

Table 4.124 Alternative E Slant Distances Marble Canyon

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	50,287	46,591
Grid Location Point 1	1,663	65,834	64,169
Grid Location Point 2	858	54,066	53,208
Grid Location Point 3	2,958	44,163	41,205
Grid Location Point 4	4,585	63,986	59,401
Grid Location Point 5	2,335	43,729	41,394
Marble Canyon Dam Site	3,845	17,396	13,551
North Canyon	999	36,247	35,248
South Canyon	816	26,091	25,275

1 **East End** **Alternative E** **Wildlife**

2
3 In the majority of East End, Wildlife and habitat would experience a decrease in adverse effects from air-tour
4 operations at some point during the year depending on seasonal air-tour corridor use.

5
6 Wildlife habitat located under Zuni Point and Dragon Corridors is mostly piñon-juniper at higher elevations, with
7 cold-desert scrub and riparian habitats at lower elevations. Along North and South Rims, habitat is mostly ponderosa
8 pine and old-conifer forest.

9
10 *East End* *Alternative E* *Wildlife*
11 *Base Year Peak Season*

12 As shown in Appendix F, Wildlife and habitats would experience aircraft Percent Time Audible greater than
13 25% of the day in most old-conifer forest habitat (95%), likely due to the habitat being near Grand Canyon
14 Airport. Aircraft Percent Time Audible would be greater than 25% in 41% of piñon-juniper, 44% of cold-desert
15 scrub, 17% of ponderosa pine forest, and 31% of riparian habitat.

16
17 As shown in Tables 4.125 and 4.126 areas where air-tour operations would have highest level of effect would be
18 under and adjacent to **Zuni Point Corridor**, represented by **Temple Butte, Grid Location Point 14**, and
19 **Tusayan Museum** Location Points. This results from high air-tour noise Percent Time Audible during the day of
20 75 to 84%, an 11 to 20% increase from Alternative A. Air-tour Average Sound Level would be 38 to 42 dBA, an
21 increase of one to 7 dBA from Alternative A. Air-tour aircraft would be closer to points on the ground than
22 Alternative A at Temple Butte (450 meters closer) and Tusayan Museum (1,566 meters closer) Location Points.
23 Because routes would become active rather abruptly, there may be a higher level of reaction, and some
24 individuals could abandon area use resulting in potential localized population changes. Under and near Zuni
25 Point Corridor there would be moderate to major adverse impacts with short-term minor to moderate adverse
26 change in impacts compared to Alternative A.

27
28 Dragon Corridor routes would not be in use and aircraft Percent Time Audible **under and near Dragon**
29 **Corridor** would be zero to 13% of the day, a decrease of 71 to 96% compared to Alternative A at **Hermit Basin,**
30 **Tower of Ra**, and **96 Mile Camp** Location Points. Air-tour aircraft Average Sound Level would be 8 to 10 dBA,
31 a decrease of 32 to 37 dBA from Alternative A. Due to substantial reduction in time and level of audible aircraft
32 noise and visual impact, wildlife would experience near natural conditions with limited to no disruption in
33 behaviors as a result of air-tour operations. Because Wildlife daily activities and behaviors in the Dragon
34 Corridor area would be less often interrupted due to air-tour aircraft, negligible to minor adverse impacts would
35 occur resulting in short-term major beneficial change in impacts from Alternative A.

36
37 In **Bright Angel Flight-free Zone** and **Toroweap/Shinumo Flight-free Zone's eastern portion**, there would be
38 a decline in air-tour noise. When Zuni Point Corridor is in use, air-tour aircraft Percent Time Audible at **Grid**
39 **Location Point 11** would decline from 55% of the day in Alternative A to 6% under Alternative E, a decrease of
40 49%. Average Sound Level would be 9 dBA, a 9 dBA decrease. This would expand the East End area where
41 substantially fewer disruptions would occur to wildlife. Negligible impacts would occur, a short-term moderate
42 to major beneficial change in impacts compared to Alternative A in the Flight-Free Zones and areas west of
43 routes due to high reduction in Percent Time Audible. The middle of Flight-free Zones would remain quiet, as
44 represented by **Grid Location Points 12 and 13**, and would experience negligible to minor adverse impacts with
45 negligible change in impacts from Alternative A.

46
47 *East End* *Alternative E* *Wildlife*
48 *Ten-Year Forecast Peak Season*

49 As shown in Table 4.125 air-tour aircraft Percent Time Audible at **Zuni Point Corridor** Location Points
50 (**Temple Butte, Grid Location Point 14**, and **Tusayan Museum**) would decline to 50 to 66%, an 8 to 18%
51 decrease from Alternative A, due to conversion to quiet-technology aircraft. Average aircraft noise levels would
52 range 35 to 40 dBA, similar to Alternative A. Aircraft Distance would be the same as Base Year. Given the
53 Percent Time Audible decrease, there may be less of a wildlife reaction to routes abruptly becoming active.
54 Although moderate to major adverse impacts would continue under and near Zuni Point Corridor, there would be
55 short-term minor beneficial change in impacts compared to Alternative A. However, changes that may occur to
56 populations as routes become active reduce level of expected benefit from decline in aircraft audibility.

1 Under and near Dragon Corridor (**Tower of Ra, Hermit Basin, and 96 Mile Camp** Location Points), impacts
2 would be similar to Base Year Peak Season.

3
4 At **Grid Location Points 11, 12 and 13** impacts would be almost the same as Base Year Peak Season.

5
6 *East End* *Alternative E* *Wildlife*
7 *Base Year Off-Peak Season*

8 Aircraft noise would decrease in all habitats except old-conifer forest. When Zuni Point Corridor becomes
9 inactive, amount of old-conifer forest habitat exposed to aircraft noise more than 25% of the day decreases
10 dramatically to 18%, with over two-thirds of the habitat experiencing aircraft noise less than 5% of the day.

11
12 Dragon Corridor would be in use, and air-tour aircraft Percent Time Audible at **Tower of Ra and Hermit Basin**
13 Location Points would be 61 and 71% of the day, respectively, a decrease of 28 to 36% from Alternative A. Air-
14 tour aircraft Average Sound Level at Hermit Basin and Tower of Ra Location Points would be 23 and 46 dBA, a
15 decrease of 19 dBA from Alternative A at Hermit Basin, and an increase of 2 dBA at Tower of Ra. At **96 Mile**
16 **Camp** along the river, Percent Time Audible would decline to 26% of the day from 72% in Alternative A,
17 although Average Sound Level would remain relatively high at 37 dBA. Air-tour aircraft would be further from
18 locations on the ground than in Alternative A. Although Percent Time Audible and Average Sound Level
19 decline, they would still be high, so animals may avoid areas under and near routes as more suitable areas would
20 be available without interference from aircraft sights and sounds. Moderate to major adverse impacts would
21 occur, but there would be a short-term moderate beneficial change in impacts from Alternative A.

22
23 Routes in **Zuni Point Corridor** would be inactive, so air-tour aircraft Percent Time Audible would be one
24 percent of the day or less, a 62 to 69% decrease from Alternative A. Average Sound Level would be 3 to 7 dBA,
25 a 62 to 69 dBA reduction. Visual impacts from air-tour aircraft would be eliminated during this period. Wildlife
26 would experience very quiet conditions with little to no air-tour aircraft disturbance. Negligible impacts would
27 occur under and near Zuni Point Corridor, a short-term major beneficial change in impacts compared to
28 Alternative A.

29
30 When Dragon Corridor air-tour routes would be active, areas in **Bright Angel Flight-free Zone close to air-**
31 **tour routes** (represented by **Grid Location Point 11**) would experience aircraft noise 23% of the day, a 32%
32 decrease from Alternative A, at 12 dBA, a 6 dBA decline due to fewer aircraft operations and higher altitudes
33 air-tour aircraft would be required to fly. Although air-tour noise would still be present, reduction in noise would
34 result in an increased amount of area and habitat available for wildlife with fewer disturbances from aircraft
35 noise. This would represent moderate adverse impacts with a short-term moderate to major beneficial change in
36 impacts compared to Alternative A due to large reduction in Percent Time Audible. The middle of Bright Angel
37 Flight-free Zone would remain quiet as represented by **Grid Location Points 12 and 13** with negligible impacts
38 and negligible change from Alternative A.

39
40 *East End* *Alternative E* *Wildlife*
41 *Ten-Year Forecast Off-Peak Season*

42 In areas under and near Zuni Point Corridor (Location Points **Temple Butte, Grid Location Point 14, and**
43 **Tusayan Museum**), there would be negligible impacts with major beneficial change in impacts compared to
44 Alternative A similar to Base Year Off-Peak Season.

45
46 Ten-Year Forecast there would be a further decline in Percent Time Audible and Average Sound Level from
47 conversion to quiet-technology aircraft. Percent Time Audible in areas near and under Dragon Corridor (**Hermit**
48 **Basin, Tower of Ra, and 96 Mile Camp** Location Points) would be 17 to 49%; a decline of 49 to 67% from
49 Alternative A. Average Sound Level would range 18 to 44 dBA, a one to 24 dBA decrease. These improvements
50 would be substantial in areas where aircraft Percent Time Audible is greatly reduced, such as near 96 Mile Camp
51 along the river. Although moderate adverse impacts would occur, this would be a short-term moderate to major
52 beneficial change in impacts from Alternative A.

53
54 Beneficial changes in impacts in **Bright Angel Flight-free Zone** at **Grid Location Points 11, 12 and 13**, would
55 generally be similar to Base Year Off-Peak Season, except there would be a reduction to 16% Percent Time
56 Audible for Grid Location Point 11 (a 7% decrease from Base Year, and a 41% decrease compared to Alternative

1 A), due primarily to conversion to quiet-technology aircraft. This would result in moderate adverse impacts with
2 moderate to major beneficial change from Alternative A near air-tour routes, and negligible impacts with
3 negligible change from Alternative A away from routes and amid Bright Angel Flight-free Zone.
4

5 *East End*

Alternative E

Wildlife

6 *Ten-Year Forecast Peak and Off-Peak Season*

7 As shown in Appendix F, amount of habitat exposed to aircraft noise 25% or more Percent Time Audible would
8 decrease from Base Year: old-conifer forest (49% Peak Season; 10% Off-Peak); piñon-juniper (22% Peak
9 Season; 20% Off-Peak); cold-desert scrub (32% Peak Season; 10% Off-Peak); ponderosa pine forest (one
10 percent Peak Season; one percent Off-Peak); and river/riparian (20% Peak Season; 5% Off-Peak). The majority
11 of all habitats would be exposed to Average Sound Level 15 dBA or less.
12
13
14
15

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1 **Table 4.125 Alternative E Average Sound Level East End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Little Colorado River/Nankoweap Area																				
Nankoweap River	7	8	34	35	0	-7	0	-8	12	-23	12	-23	0	-7	0	-8	11	-23	12	-23
Nankoweap Mesa	87	90	43	43	78	-9	45	-45	23	-20	19	-24	1	-86	2	-88	14	-29	15	-28
Dragon Corridor																				
96 Mile Camp	72	74	45	45	0	-71	0	-74	8	-37	8	-37	26	-46	17	-57	37	-7	34	-11
Tower of Ra	97	98	44	45	1	-96	1	-97	8	-36	8	-37	61	-36	49	-49	46	2	44	-1
Eremita Mesa	100	100	49	49	67	-33	49	-50	21	-29	22	-28	93	-7	78	-21	41	-9	38	-12
Hermit Basin	99	100	42	42	13	-87	16	-83	10	-32	10	-32	28	-32	32	-67	23	-19	18	-24
North Rim																				
Cape Royal	59	61	25	26	77	18	25	-36	26	1	20	-6	1	-57	1	-60	11	-15	11	-15
Point Imperial	66	68	38	39	31	-34	1	-67	11	-28	8	-31	1	-65	1	-67	6	-32	6	-32
Bright Angel Point	47	48	24	24	5	-42	1	-47	13	-11	1	-23	1	-46	1	-47	11	-13	11	-13
The Basin	73	75	48	48	1	-72	1	-74	5	-42	5	-43	14	-59	1	-74	7	-41	6	-42
Grid Location Point 16	80	84	33	34	17	-63	23	-61	12	-21	13	-21	17	-63	27	-57	12	-21	13	-21
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	81	11	66	-8	39	1	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	34	-31	11	-68	18	-16	16	-13	1	-64	1	-68	14	-15	14	-14
Temple Butte	62	66	37	38	75	12	57	-10	38	1	35	-2	1	-62	1	-66	6	-32	6	-32
Lipan Point	74	77	34	35	88	14	62	-16	40	5	36	1	8	-66	12	-65	7	-27	5	-30
South Rim																				
Tusayan Museum	64	67	35	36	84	20	50	-18	42	7	40	4	0	-63	0	-67	3	-33	2	-33
El Tovar	95	96	19	20	8	-88	9	-86	7	-12	8	-12	34	-61	11	-85	11	-8	10	-10
Zuni Alpha	43	46	46	46	63	20	38	-8	52	6	50	4	0	-43	0	-46	2	-43	3	-43
Ten X Meadow	64	68	49	49	76	12	54	-15	48	-1	46	-4	21	-44	15	-54	18	-31	20	-30
1.5 km SE of Moran Point	64	68	41	41	81	18	61	-7	53	12	51	10	4	-60	6	-62	5	-36	4	-37
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	40	11	4	-78	14	-5	11	-8	25	-55	4	-78	12	-7	11	-8
Grid Location Point 11	55	56	18	18	6	-49	8	-49	9	-9	9	-9	23	-32	16	-41	12	-6	11	-7
Grid Location Point 12	1	1	13	14	1	0	1	0	12	-1	12	-2	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	0	0	1	0	10	-2	9	-4	1	0	1	0	8	-4	8	-5
Phantom Ranch	3	4	12	12	1	-2	1	-3	7	-5	6	-6	1	-2	1	-3	7	-5	6	-6
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	0	-92	0	-92	9	-16	10	-15	44	-48	0	-92	19	-6	14	-11
Grid Location Point 18	60	60	16	17	1	-59	1	-60	6	-10	6	-10	34	-26	5	-55	11	-5	9	-7
Point Sublime	100	100	35	35	46	-54	29	-71	16	-20	17	-18	89	-11	63	-37	29	-6	25	-11
Bass Camp	0	0	7	7	0	0	0	0	0	-7	1	-7	0	0	0	0	3	-4	1	-6
Rainbow Plateau	0	0	6	7	0	0	0	0	2	-4	3	-4	0	0	0	0	3	-3	4	-3

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

1 **Table 4.126 Alternative E Slant Distances East End**

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	9,063	7,615
Nankoweap Mesa	973	6,114	5,140
Dragon Corridor			
96 Mile Camp	1,573	1,724	151
Tower of Ra	1,147	511	-637
Eremita Mesa	1,034	756	-277
Hermit Basin	1,518	3,605	2,088
North Rim			
Cape Royal	4,038	6,132	2,094
Point Imperial	2,292	13,405	11,113
Bright Angel Point	6,235	9,522	3,287
The Basin	477	3,923	3,446
Grid Location Point 16	2,589	12,983	10,394
Zuni Point Corridor			
Grid Location Point 14	687	1,591	904
Grid Location Point 15	1,637	5,133	3,496
Temple Butte	1,458	1,038	-420
Lipan Point	2,890	955	-1,935
South Rim			
Tusayan Museum	2,016	450	-1,566
El Tovar	5,854	9,426	3,572
Zuni Alpha	573	707	-267
Ten X Meadow	540	689	-151
1.5 km SE of Moran Point	445	251	-198
Bright Angel Flight Free Zone			
Cedar Ridge	9,827	12,925	3,098
Grid Location Point 11	8,081	6,862	-1,219
Grid Location Point 12	9,014	11,236	2,222
Grid Location Point 13	7,925	9,042	1,117
Phantom Ranch	11,027	9,999	-1,028
Toroweap /Shinumo Flight Free Zone			
Grid Location Point 10	2,931	2,931	0
Grid Location Point 18	8,449	6,672	-1,777
Point Sublime	3,760	3,760	0
Bass Camp	13,358	13,358	0
Rainbow Plateau	14,878	14,878	0

Δ indicates change in noise metric data from Alternative A

2
3

1	Central	Alternative E	Wildlife
2			
3	The Central area is composed of cold- and old-desert scrub, piñon-juniper, and river/riparian habitat. Overall		
4	Wildlife and habitat would be exposed to very little aircraft noise similar to Alternative A. As shown in Appendix F		
5	and Ten-Year Forecast, aircraft Percent Time Audible would be 5% of the day or less in the majority of habitats: 97		
6	to 99% of cold- and old-desert scrub, 94% of piñon-juniper, and 98% of river/riparian habitats. Nearly all Central		
7	habitats (98 to 100%) would be exposed to aircraft noise levels of 15 dBA or less.		
8			
9	<i>Central</i>	<i>Alternative E</i>	<i>Wildlife</i>
10	<i>Base Year Peak Season</i>		
11	There would be little difference in sound metrics compared to Alternative A. As shown in Tables 4.127 and		
12	4.128 air-tour aircraft Percent Time Audible would be less than 5% of the day (except Prospect Canyon		
13	Location Point at 15%), with air-tour aircraft Average Sound Level 3 to 18 dBA. Air-tour aircraft would be		
14	greater than 7,000 meters from locations on the ground. Daily wildlife behaviors such as foraging, resting,		
15	breeding, and nesting would be little affected by air-tour aircraft.		
16			
17	South of the GCNP boundary, Wildlife and habitat would be most affected in areas beneath Brown-1 and Brown-		
18	6. Areas near these routes as represented by South Supai Canyon and Havatagvitch Canyon Location Points		
19	would experience aircraft Average Sound Level 7 to 18 dBA, a one to 9 dBA decrease compared to Alternative		
20	A. Aircraft Percent Time Audible would be one percent of the day or less, similar to Alternative A. At		
21	Havatagvitch Canyon Location Point, aircraft would be nearly 1,200 meters more Distant than in Alternative A.		
22	Near Brown-1, aircraft Percent Time Audible would be approximately 15% of the day at 18 dBA based on		
23	Prospect Canyon Location Point. Negligible impacts would occur with negligible change in impacts from		
24	Alternative A.		
25			
26	<i>Central</i>	<i>Alternative E</i>	<i>Wildlife</i>
27	<i>Base Year Off-Peak Season</i>		
28	<i>Ten-Year Forecast Peak and Off-Peak Season</i>		
29	Impacts would be similar to Base Year Peak Season, generally negligible with negligible change in impacts		
30	compared to Alternative A.		

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1 **Table 4.127 Alternative E Average Sound Level Central**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Havatagvitch Canyon	1	1	7	8	1	0	1	0	7	-1	7	-1	1	1	1	0	8	1	8	0
Supai Village	0	0	5	13	0	0	0	0	5	-1	5	-8	1	1	1	0	26	20	24	11
Coyote Canyon	0	0	16	16	0	0	0	0	16	0	16	0	0	0	0	0	16	0	16	0
Mohawk Canyon	1	1	11	12	0	-1	0	-1	8	-4	8	-4	0	-1	0	-1	8	-3	8	-3
Mohawk Canyon	2	2	11	12	0	-2	0	-2	5	-6	6	-6	0	-2	0	-2	6	-6	6	-6
Prospect Canyon	22	25	22	22	15	-8	16	-9	18	-4	18	-4	19	-3	20	-6	19	-2	19	-4
The Dome	1	1	16	16	1	0	1	0	12	-4	12	-4	1	0	1	0	12	-4	13	-3
Fossil Canyon	2	2	12	12	1	-1	1	-1	9	-3	9	-3	2	0	1	-1	10	-2	10	-3
Grid Location Point 21	2	2	14	14	2	0	2	0	13	-1	14	-1	2	0	2	0	14	-1	14	-1
Grid Location Point 22	18	21	12	13	1	-17	1	-19	8	-4	9	-4	1	-17	1	-19	9	-3	9	-3
Grid Location Point 25	11	12	9	10	2	-9	2	-10	7	-3	7	-3	2	-9	2	-10	7	-3	7	-3
Grid Location Point 9	1	1	5	5	1	0	1	0	3	-2	3	-2	1	0	1	0	4	-1	3	-2
South Supai Canyon	6	7	27	27	1	-5	2	-5	4	-9	19	-9	2	-4	2	-5	21	-6	20	-7

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2

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1 **Table 4.128 Alternative E Slant Distances Central**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
Havtagvitch Canyon	3,668	4,905	1,237	
Supai Village	163	163	0	
Coyote Canyon	7,651	7,651	0	
Mohawk Canyon	3,009	3,009	0	
Mohawk Canyon	6,304	6,304	0	
Prospect Canyon	1,550	1,550	0	
The Dome	13,109	13,109	0	
Fossil Canyon	10,346	12,399	2,054	
Grid Location Point 21	20,393	20,393	0	
Grid Location Point 22	26,089	26,089	0	
Grid Location Point 25	20,188	20,188	0	
Grid Location Point 9	11,103	19,384	8,281	
South Supai Canyon	1,480	1,480	0	

Δ indicates change in noise metric data from Alternative A

2
3
4 **West End Alternative E Wildlife**

5
6 West End is a mixture of warm- and cold-desert scrub, piñon-juniper, and riparian habitat along the river. As shown
7 in Appendix F, in cold-desert scrub habitat, Base Year 62% of habitat would be exposed to aircraft Percent Time
8 Audible greater than 25% of the day. Amount of piñon-juniper and river/riparian habitat exposed to high levels of
9 audible noise (Percent Time Audible) would be 17 and 27%, respectively, Base Year. Because warm-desert scrub
10 habitat is found under Blue-2 and Green-4, this habitat would also be exposed to high sound levels, as 14% of the
11 habitat would experience Average Sound Level greater than 35 dBA (decreased to 6% Ten-Year Forecast), and 40%
12 of the habitat would experience Percent Time Audible greater than 25% (decreasing slightly to 33% Ten-Year
13 Forecast). Wildlife in this habitat could be disturbed often during daily activities. Given the persistence of air-tour
14 noise during the day, some wildlife could abandon or avoid the area under air-tour routes.

15
16 *West End Alternative E Wildlife*
17 *All Scenarios*

18 Wildlife located under **Sanip Eight-free Zone** and **areas near the south SFRA boundary** would be negligibly
19 affected by air-tour operations. Air-tour aircraft would rarely be audible at Average Sound Level of zero to 8
20 dBA as reflected in Location Point data at **Diamond Creek** and **Pumpkin Springs**. Impacts would be negligible
21 with negligible change from Alternative A.

22
23 *West End Alternative E Wildlife*
24 *Base Year Peak Season*

25 Wildlife and habitat near Green-4 and Blue-2 (represented by **Burnt Springs Canyon, Bat Cave, and Grid**
26 **Location Point 33** Location Points) would be exposed to air-tour aircraft impacts similar to those described in
27 Alternative A. As shown in Table 4.129 and 4.130 air-tour aircraft Percent Time Audible would be 70 to 92% of
28 the day at Average Sound Level 42 to 47 dBA. Daily animal activities would be disrupted frequently which may
29 result in abandoning or avoiding otherwise suitable habitat that could affect population levels. Short-term major
30 adverse impacts would occur under air-tour routes with negligible to minor beneficial change in impacts
31 compared to Alternative A.

32
33 **Whitmore Rapids** and **Parashant Wash** Location Points near Brown routes would have air-tour aircraft Percent
34 Time Audible 11 to 20% of the day, an 8% increase from Alternative A at Whitmore Rapid Location Point due
35 to realignment of Blue Direct North. There would be no appreciable change at Parashant Wash Location Point.
36 Average Sound Level would be 25 to 28 dBA; within 8 dBA of Alternative A. Aircraft would be more than

1 2,500 meters from locations on the ground. Wildlife would be disturbed for relatively small portions of the day.
 2 Moderate adverse impacts would occur with short-term negligible to minor adverse change in impacts from
 3 Alternative A.

4
 5 **At the SFRA's northern boundary**, represented by **Andrus Canyon** Location Point, air-tour Average Sound
 6 Level would be 37 dBA, an increase of 15 dBA from Alternative A, and Percent Time Audible 50% of the day, a
 7 28% increase due to reconfiguration of Blue Direct North. Major adverse impacts would occur with short-term
 8 moderate to major adverse change in impact compared to Alternative A.

9
 10 Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire**
 11 **Camp, and Grid Location Point 32** would experience a 28 to 40% decrease in Percent Time Audible compared
 12 to Alternative A to less than 4% of the day. Aircraft Average Sound Level would also decrease by 6 to 24 dBA
 13 compared to Alternative A to 18 to 21 dBA. Due to Blue Direct movement north, Sanup/Shivwits area wildlife
 14 would be less disturbed, which may result in increased density of wildlife and populations in this area of the park
 15 and **Grand Canyon-Parashant National Monument**. Distances from aircraft to points on the ground would
 16 increase to more than 18,000 meters. Negligible to minor adverse impacts would occur, a short- and long-term
 17 moderate to major beneficial change in impacts compared to Alternative A.

18
 19 *West End* *Alternative E* *Wildlife*
 20 *Ten-Year Forecast Peak Season*

21 Near Blue-2 and Green-4, air-tour aircraft Percent Time Audible would be 62 to 84%, a 12 to 37% decrease from
 22 Alternative A. Average Sound Level at **Burnt Springs Canyon** Location Point would be 43 dBA, a 4 dBA
 23 decrease from Alternative A. **Bat Cave** Location Point would be nearly the same as Alternative A, and **Grid**
 24 **Location Point 33** would decrease to 37 dBA, a 6 dBA decrease compared to Alternative A. Major adverse
 25 impacts would occur under air-tour routes, but there would generally be minor to major beneficial change in
 26 impacts compared to Alternative A.

27
 28 **Whitmore Rapids and Parashant Wash** Location Points near Brown routes would have air-tour aircraft Percent
 29 Time Audible 14 to 21% of the day, a one to 8% increase from Alternative A at Whitmore Rapid Location Point
 30 due to realignment of Blue Direct North. There would be no appreciable change at Parashant Wash Location
 31 Point. Average Sound Level would be 21 to 28 dBA, no appreciable difference from Base Year Peak Season.
 32 Aircraft would be more than 2,500 meters from locations on the ground. Wildlife would be disturbed for
 33 relatively small portions of the day. Moderate adverse impacts would occur with short-term negligible to minor
 34 adverse change in impacts from Alternative A.

35
 36 **At the SFRA's northern boundary**, represented by **Andrus Canyon** Location Point, Percent Time Audible
 37 would increase to 57%, but Average Sound Level would stay about the same as Base Year, and there would be
 38 major adverse impacts with moderate to major adverse change in impacts compared to Alternative A.

39
 40 Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire**
 41 **Camp, and Grid Location Point 32** impacts would be very similar to Base Year Peak Season, negligible to
 42 minor adverse impacts with moderate to major beneficial change in impacts from Alternative A.

43
 44 *West End* *Alternative E* *Wildlife*
 45 *Base Year Off-Peak Season*

46 Impacts would increase slightly at Location Points **under Blue-2 and Green-4** (a 4 to 9% Percent Time Audible
 47 increase, but only a one dBA Average Sound Level increase) compared to Base Year Peak Season. Impacts
 48 would remain major adverse under air-tour routes, and there would be negligible to minor adverse change in
 49 impacts from Alternative A.

50
 51 Aircraft Average Sound Level and Distance at **Whitmore Rapids and Parashant Wash** Location Points would
 52 be similar to Base Year Peak Season. Percent Time Audible would increase to 14 and 24%, a 2 to 12% increase
 53 compared to Alternative A. Due to increase in Percent Time Audible, moderate adverse impacts would occur
 54 with negligible to minor adverse change in impacts from Alternative A.

1 Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire**
 2 **Camp, and Grid Location Point 32** impacts would be very similar to Base Year Peak Season, negligible to
 3 minor adverse impacts with moderate to major beneficial change from Alternative A.

4
 5 *West End*

Alternative E

Wildlife

6 *Ten-Year Forecast Off-Peak Season*

7 Percent Time Audible and Average Sound Level would generally decline a small amount Base Year to Ten-Year
 8 Forecast (except **Grid Location Point 33** which declines 29%), but impacts would continue major adverse under
 9 Green-4 and Blue-2 similar to those described Base Year Off-Peak Season with negligible to minor beneficial
 10 change in impacts compared to Alternative A.

11
 12 **Whitmore Rapids and Parashant Wash** Location Points near Brown routes would have air-tour aircraft Percent
 13 Time Audible 18 to 25% of the day, a 12% increase from Alternative A at Whitmore Rapid Location Point due
 14 to realignment of Blue Direct North. There would be no appreciable change at Parashant Wash Location Point.
 15 Average Sound Level would be 25 to 28 dBA; within 5 dBA of Alternative A. Aircraft would be more than
 16 2,500 meters from locations on the ground. Wildlife would be disturbed for relatively small portions of the day.
 17 Moderate adverse impacts would occur with short-term negligible to minor adverse change in impacts from
 18 Alternative A.

19
 20 Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire**
 21 **Camp, and Grid Location Point 32** impacts would be very similar to Base Year Peak Season with negligible to
 22 minor adverse impacts and moderate to major beneficial change in impacts compared to Alternative A.

23
 24 *West End*

Alternative E

Wildlife

25 *Base Year and Ten-Year Forecast Off-Peak Season*

26 **At the SFRA's northern boundary**, represented by **Andrus Canyon** Location Point, Percent Time Audible
 27 would be 55 to 65% Off-Peak Season, an increase of 5 to 8% compared to Peak Season, but Average Sound
 28 Level would be 38 to 39 dBA, a one to 2 dBA increase compared to Peak Season, and 21 to 22 dBA higher than
 29 Alternative A. This represents moderate to major adverse impacts with moderate to major adverse changes in
 30 impacts compared to Alternative A.

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1 **Table 4.129 Alternative E Average Sound Level West End**

Location Point Name	Alternative A		Alternative E																	
			Peak Season										Off Peak Season							
	Percent Percent Time Audible (%)		Average Sound Level (dBA)		Percent Percent Time Audible (%)				Average Sound Level (dBA)				Percent Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Burnt Springs Canyon	70	75	46	47	70	-1	62	-13	46	0	43	-3	76	6	67	-9	47	1	44	-3
Bat Cave	93	95	47	48	92	-1	84	-12	47	0	46	-2	96	3	88	-8	48	0	46	-2
Grid Location Point 33	87	90	42	43	80	-7	53	-37	42	0	37	-6	89	2	61	-29	43	1	38	-5
Whitmore Rapids	12	13	21	21	20	8	21	8	28	7	28	6	24	12	25	12	30	9	28	7
Grid Location Point 27	20	23	26	27	10	-11	11	-13	19	-7	19	-7	12	-8	12	-11	19	-7	20	-7
Grid Location Point 28	14	16	17	18	5	-9	3	-13	16	-1	17	-1	5	-9	3	-13	16	-1	17	-1
Grid Location Point 31	37	41	42	43	2	-35	2	-39	12	-30	12	-31	2	-35	2	-39	12	-30	13	-30
Mt. Dellenbaugh	29	32	41	42	1	-28	1	-31	18	-24	18	-25	1	-28	1	-31	18	-23	19	-23
Shivwits Fire Camp	35	39	38	38	1	-34	2	-38	18	-19	18	-19	1	-34	2	-38	19	-19	20	-19
Grid Location Point 32	44	49	27	28	4	-40	5	-43	21	-6	22	-6	4	-40	5	-43	21	-6	22	-6
Granite Peak	2	2	17	18	2	0	2	0	15	-2	16	-2	2	0	2	0	15	-2	16	-2
NPS Administration site	44	49	31	32	16	-28	2	-46	20	-12	21	-12	30	-14	2	-46	20	-11	21	-11
Parashant Wash	12	14	33	33	11	-1	14	1	25	8	24	-9	14	2	18	4	27	-6	25	-8
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	7	7	1	1
Pumpkin Springs	0	0	7	8	0	0	0	0	0	7	0	0	0	0	0	0	7	0	8	0
Castle Peak	27	30	18	48	45	18	30	20	22	4	23	-25	56	29	58	28	24	5	24	-24
Meriwhitca	0	1	7	8	0	0	1	0	7	0	7	0	2	1	1	0	8	1	8	1
Andrus Canyon	22	24	17	17	50	28	57	33	37	15	36	19	55	33	65	41	39	22	38	21

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

2

1 **Table 4.130 Alternative E Slant Distances West End**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
Burnt Springs Canyon	1,215	1,215	0	
Bat Cave	1,134	1,134	0	
Grid Location Point 33	1,105	1,105	0	
Whitmore Rapids	1,804	2,512	708	
Grid Location Point 27	3,388	11,852	8,464	
Grid Location Point 28	8,327	21,438	13,111	
Grid Location Point 31	502	11,367	10,865	
Mt. Dellenbaugh	824	17,901	17,077	
Shivwits Fire Camp	1,669	17,030	15,361	
Grid Location Point 32	2,016	18,618	16,602	
Granite Peak	5,264	16,588	11,324	
NPS Administration site	3,719	15,048	11,329	
Castle Peak	8,629	9,586	957	
Diamond Creek	27,108	10,814	-16,294	
Pumpkin Springs	12,630	22,337	9,707	
Meriwhitca	15,742	5,833	-9,909	
Andrus Canyon	1,393	1,954	561	

Δ indicates change in noise metric data from Alternative A

2
3
4 **Cumulative Impacts Alternative E Wildlife**

5
6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
7 *actions. In this context, Cumulative Impacts include impacts on Wildlife from sounds of*

- 8 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
9 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
10 *3) ground-based noise sources, plus*
11 *4) noise from air-tour-and-related aircraft under Alternative E*

12
13 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 (Alternative E).*

14
15 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
16 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
17 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
18 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
19 *SFRA see Appendix D, Figures 91 to 94).*

20
21 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
22 *Wildlife, but is mostly concentrated in the Developed Zone (2% of the park), although a small component exists*
23 *in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire management*
24 *activities, and mining activities outside the park. Noise from ground-based sources is discussed in Chapter 3,*
25 *Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time Audible*
26 *capable of masking some aircraft noise.*

27
28 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
29 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
30 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
31 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
32 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*

1 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 2 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 3 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 4 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
 5 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
 6 *Because they would be audible a very high percentage of the day, the combination of aircraft noise from all*
 7 *sources would generally be the overriding cumulative noise influence on Wildlife and habitat.*

8
 9 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 10 *(Alternative E compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 11 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 12 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 13 *(Alternative E in this case).*

14
 15 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 16 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
 17 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
 18 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 19 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 20 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 21 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 22 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

23
 24 *Comparing noise impacts from just Alternative E by itself (Appendix D Tables 16 (Peak Season) and 21 (Off-*
 25 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative E plus 1 plus 2) (Appendix D Tables 49 (Peak*
 26 *Season) and 53 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*
 27 *Cumulative Impacts and the impacts of Alternative E by itself. For the Entire Park Cumulative Impact results*
 28 *(Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 83% of the*
 29 *park, with Average Sound Level 25 to <35 dBA in 92 to 93% of the park, with 1% of the park below 25 dBA and 6*
 30 *to 7% at 35 dBA or more. For the Entire Park results for Alternative E by itself (Peak and Off-Peak Season Ten-*
 31 *Year Forecast), aircraft are audible 60% or more of the day in 3% of the park, with Average Sound Level 25 to*
 32 *<35 dBA in 6 to 9% of the park, with 74 to 81% of the park below 25 dBA and 5% at 35 dBA or more.*

33
 34 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 35 *including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour*
 36 *routes; (b) Cumulative Impacts increase the impacts of Alternative E, and (c) reducing air-tour-and-related*
 37 *impacts under the Alternatives reduces Cumulative Impacts.*

38
 39 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 40 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 41 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 42 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 43 *described for Alternative E would generally increase by one level as shown in the Cumulative Impacts discussion*
 44 *in the Conclusions section below.*

45
 46 **Conclusion** **Alternative E** **Wildlife**

47
 48 Overall Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced
 49 amount of area exposed to high Percent Time Audible and high Average Sound Level for long periods of the day.
 50 The majority of habitat would experience large reduction in aircraft Percent Time Audible; Ten-Year Forecast Peak
 51 and Off-Peak Seasons, half the SFRA habitat would have air-tour aircraft Average Sound Level less than 15 dBA.
 52 This would result in greatly reduced impacts on Wildlife and habitat with larger areas protected from air-tour aircraft
 53 sights and sounds. Wildlife habitat would be improved, and fewer disturbances to wildlife would occur compared to
 54 Alternative A.
 55
 56

*Conclusion Marble Canyon**Alternative E**Wildlife*

Alternative E would have negligible impacts on Marble Canyon wildlife; however, there would be short-term negligible to minor beneficial change in impacts compared to Alternative A due to decreased air-tours Percent Time Audible (under Alternative E Marble Canyon would be part of the expanded Bright Angel Flight-free Zone). Impacts would not be appreciably different Peak and Off-Peak Season or Base Year and Ten-Year Forecast.

*Conclusion East End**Alternative E**Wildlife*

In the majority of East End there would be moderate to major beneficial change in impacts from Alternative A on Wildlife and habitat due to Zuni Point and Dragon Corridor air-tour route seasonal use. Peak Season, when Zuni Point Corridor would be open for air-tour use, impacts to wildlife beneath and adjacent to active corridor routes would be short and long term moderate to major adverse (greater than 75% Percent Time Audible with aircraft Average Sound Level greater than 35 dBA), a minor beneficial change in impacts compared to Alternative A Base Year and Ten-Year Forecast. Off-Peak Season, when Zuni Point Corridor is closed to use, there would be negligible impact under the inactive flight corridor, a major beneficial change in impacts compared to Alternative A Base Year and Ten-Year Forecast. Also, beneficial changes in impacts compared to Alternative A would increase Ten-Year Forecast due to Alternative E's quiet-technology conversion requirements.

Peak Season, in areas under and near Dragon Corridor, when the corridor would be closed to air-tour use, there would be negligible to minor adverse impacts, a short-term major beneficial change in impacts compared to Alternative A Base Year and Ten-Year Forecast. Off-Peak Season, when Dragon Corridor would be open for air-tour use, areas under and near active corridor routes would experience moderate adverse impacts, a moderate to major beneficial change in impacts compared to Alternative A Base Year and Ten-Year Forecast. Also, beneficial changes in impacts compared to Alternative A would increase Ten-Year Forecast due to Alternative E's quiet-technology conversion requirements.

In areas away from air-tour routes, such as amid Bright Angel Flight-free Zone, impacts All Scenarios would generally be negligible with negligible change in impacts compared to Alternative A. Areas in Bright Angel Flight-free Zone near air-tour routes would have moderate adverse impacts with moderate to major beneficial change in impacts compared to Alternative A. Beneficial changes in impacts compared to Alternative A would increase Ten-Year Forecast due to Alternative E's quiet-technology conversion requirements.

*Conclusion Central**Alternative E**Wildlife*

Impacts due to Alternative E would generally be negligible with negligible change in impacts compared to Alternative A All Scenarios.

*Conclusion West End**Alternative E**Wildlife*

Under and near Green-4 and Blue-2 impacts would generally be major adverse, a minor to major beneficial change in impacts compared to Alternative A All Scenarios.

Areas along West End's northern SFRA boundary would experience increased aircraft noise and visual impacts as a result of Blue Direct North realignment, resulting in short- and long-term major adverse impacts with moderate to major adverse change in impacts on wildlife compared to Alternative A All Scenarios. However, at the same time, areas under current Blue Direct routes would experience major beneficial change in impacts compared to Alternative A due to the same route shift northward.

In areas near Brown routes, there would be moderate adverse impacts with negligible to minor adverse change in impacts compared to Alternative A.

In Sanup Flight-free Zone there would be negligible impacts with negligible change in impacts compared to Alternative A.

*Cumulative Impacts Summary**Alternative E**Wildlife*

As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,

1 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 2 *and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison with the*
 3 *other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts followed by Modified NPS*
 4 *Preferred Alternative and Alternative F (Alternative A ranks last).*

5
 6 **ALTERNATIVE F** **MODIFIED CURRENT CONDITIONS** **WILDLIFE**

7
 8 See Alternative A for species and habitat descriptions.

9
 10 Wildlife would experience noise from air-tour aircraft that would disturb individuals, affect behaviors, population
 11 numbers, and species distributions in nearly half the Study Area Base Year. Ten-Year Forecast there would be
 12 improvement in wildlife habitat and reduction of impacts on wildlife as aircraft noise is reduced through
 13 implementation of quiet-technology incentives and conversion. Ten-Year Forecast 34% of the park would have air-
 14 tour Percent Time Audible greater than 25% of the day, predominantly in East and West Ends under and near air-
 15 tour routes. Air-tour Average Sound Level would generally be low, less than 25 dBA, in about 70% of the SFRA.
 16 Greatest exposure to noise and visual impacts would occur in East and West Ends where aircraft Average Sound
 17 Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75%. Although there would be
 18 localized impacts to species in East and West Ends close to air-tour routes, large habitat areas would be relatively
 19 undisturbed by air-tours in Marble Canyon and the Central area.

20
 21 **Marble Canyon** **Alternative F** **Wildlife**

22
 23 Marble Canyon's predominant plateau habitat is old-desert scrub. Based on Appendix F contour data, Base Year
 24 Peak Season 87% of Marble Canyon old-desert scrub habitat would have aircraft Percent Time Audible 5% of the
 25 day or less and 79% would have Average Sound Level 15 dBA or less. In Marble Canyon along the river where
 26 background sounds can be loud, 94% of habitat would experience air-tour sounds less than 5% with 77% of habitat
 27 exposed to aircraft noise of 15 dBA or less.

28
 29 *Marble Canyon* *Alternative F* *Wildlife*
 30 *Base Year and Ten-Year Forecast Peak Season*

31 In Marble Canyon, as shown in Tables 4.131 and 4.132, impacts of air-tour aircraft noise would be similar to
 32 Alternative A Peak Season Base Year and Ten-Year Forecast. Directly under air-tour routes, air-tour aircraft
 33 Percent Time Audible would be 3%. As represented by Location Points **Cliff Dwellers Lodge, Grid Location**
 34 **Points 4 and 5, and Marble Canyon Dam Site**, the majority of Marble Canyon wildlife habitat would have air-
 35 tour Average Sound Level of 15 dBA or less. Aircraft would generally be more than 2,000 meters away from
 36 points on the ground. At **Grid Location Point 2**, aircraft would be about 860 meters from points on the ground.
 37 There would be little potential to disturb or displace wildlife in these locations. In some areas directly beneath
 38 routes, Average Sound Level would be higher such as at **North** and **South Canyon** Location Points, and areas
 39 where air-tour routes would be close to the canyon rim, potential for wildlife disturbance in desert-scrub habitat
 40 could increase. Negligible to minor adverse impacts would generally occur with negligible change from
 41 Alternative A.

42
 43 *Marble Canyon* *Alternative F* *Wildlife*
 44 *Base Year and Ten-Year Forecast Off-Peak Season*

45 Impacts would be reduced compared to Peak Season. As represented by **North** and **South Canyon** Location
 46 Points, with reduced operations Off-Peak Season, aircraft would rarely be audible, less than one percent of the
 47 day, there would be slight reductions in air-tour aircraft visibility, and Average Sound Level would be zero, a
 48 decrease of 21 and 24 dBA compared to Alternative A. Marble Canyon wildlife habitat would be improved to a
 49 small degree as air-tour aircraft noise would be very low. Although adverse impacts would occur, there would be
 50 long-term negligible to minor beneficial change in impacts compared to Alternative A.

1 **Table 4.131 Alternative F Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Cliff Dwellers Lodge	1	1	6	10	1	0	1	0	6	0	6	-3	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	15	0	16	-1	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	2	0	2	0	16	0	17	-3	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	3	0	3	0	14	0	15	-1	1	-2	1	-2	7	-8	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	2	0	2	0	8	0	8	-4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	3	0	2	-1	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	3	0	3	0	24	0	24	0	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	2	0	2	0	21	0	21	-2	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2 **Table 4.132 Alternative F Slant Distances Marble Canyon**

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	3,695	0
Grid Location Point 1	1,665	1,665	0
Grid Location Point 2	858	858	0
Grid Location Point 3	2,958	2,958	0
Grid Location Point 4	4,585	4,585	0
Grid Location Point 5	2,335	2,335	0
Marble Canyon Dam Site	3,845	3,846	1
North Canyon	999	999	0
South Canyon	816	822	7

Δ indicates change in noise metric data from Alternative A

1 **East End** **Alternative F** **Wildlife**

2
3 As shown in Appendix F, Base Year Peak Season, animals would be exposed to aircraft Percent Time Audible
4 greater than 25% of the day in the majority of piñon-juniper (83%), ponderosa pine (81%), cold-desert scrub (78%),
5 and old-conifer forest (98%) habitats. However, most habitats would be exposed to low Average Sound Level of 25
6 dBA or less similar to Alternative A. In 58% of river/riparian habitat, aircraft Percent Time Audible would be
7 greater than 25% of the day and Average Sound Level would be 25 dBA or less in 65% of the habitat. With quiet-
8 technology conversion, noise impacts would decrease Ten-Year Forecast.

9
10 *East End* *Alternative F* *Wildlife*
11 *Base Year Peak Season*

12 There would be little difference in impacts to wildlife compared to Alternative A under routes in **Zuni Point** and
13 **Dragon Corridors** and adjacent areas. Proximity of air-tour aircraft to locations on the ground would not differ
14 notably from Alternative A. As shown in Tables 4.133 and 4.134 air-tour aircraft Percent Time Audible would be
15 62 to nearly 100% of the day in areas beneath air-tour routes, with Average Sound Level 28 to 49 dBA at
16 representative Location Points. Given close proximity of flights to **The Basin** and **1.5 km southeast of Moran**
17 **Point** Location Points, and persistent air-tour noise in areas under routes, there would be potential to disrupt
18 normal behavior patterns such as breeding, feeding or sheltering. Moderate to major adverse impacts would
19 continue with negligible change from Alternative A.

20
21 **Beneath Bright Angel Flight-free Zone**, effects of air-tour aircraft would generally be similar to Alternative A.
22 **Grid Location Points 12 and 13** and **Phantom Ranch** Location Point, air-tour aircraft Percent Time Audible
23 would be one to 3% of the day, with aircraft Average Sound Level 12 to 13 dBA. However, **Cedar Ridge**
24 Location Point Percent Time Audible would be 81%, **Point Sublime** Location Point Percent Time Audible
25 would be 100%, and **Grid Location Point 11** Percent Time Audible would be 60%. Aircraft would be much
26 greater than 2,000 meters. Air-tour aircraft would rarely be audible at relatively low sound levels with negligible
27 to minor adverse impacts away from routes in the middle of Bright Angel Flight-free Zone, but audible most of
28 the time with moderate to major adverse impacts at locations near flight routes. Impacts would continue with
29 negligible change in impacts compared to Alternative A.

30
31 *East End* *Alternative F* *Wildlife*
32 *Ten-Year Forecast Peak Season*

33 Air-tour aircraft Percent Time Audible would be 41 to 53% in **Zuni Point Corridor**, a decrease of 21 to 28%
34 from Alternative A, and 47 to 98% in **Dragon Corridor**, a decrease of 2 to 27% from Alternative A. Air-tour
35 aircraft Average Sound Level would be 24 to 31 dBA in Zuni Point Corridor, declining 4 to 7 dBA from
36 Alternative A, and 37 to 46 dBA in Dragon Corridor, a decline of 3 to 5 dBA. Aircraft would be visible as in
37 Base Year. There could be modest improvement for wildlife breeding, nesting, and foraging due to decline in
38 aircraft Percent Time Audible. Although moderate to major adverse impacts would continue under and near
39 heavily used air-tour routes, there would generally be long-term minor to major beneficial change in impacts
40 compared to Alternative A.

41
42 *East End* *Alternative F* *Wildlife*
43 *Base Year Off-Peak Season*

44 Wildlife habitat beneath **Zuni Point Corridor** would experience a decrease in aircraft noise effects. Aircraft
45 Percent Time Audible would be 33 to 45% of day; a decrease of 26 to 33% from Alternative A. Average aircraft
46 noise levels would range 29 to 31 dBA at **Grid Location Point 14**, **Temple Butte**, and **Lipan Point** Location
47 Points, a decrease of 4 to 6 dBA from Alternative A. However, sound levels would increase to 38 dBA at **Grid**
48 **Location Point 15**, an increase of 10 dBA from Alternative A. Distance from areas on the ground would be
49 similar to Base Year Peak Season. Moderate to major adverse impacts would occur with minor to major
50 beneficial change in impacts from Alternative A, except Grid Location Point 15.

51
52 When Dragon Corridor shifts seven-miles west Off-Peak Season, in areas that were under routes in Peak Season
53 (**96 Mile Camp**, **Tower of Ra**, and **Hermit Basin** Location Points) would experience a decrease in Percent Time
54 Audible one to 60%, a 39 to 80% decrease from Alternative A. Air-tour aircraft Average Sound Level would also
55 decline to 13 to 23 dBA, a 19 to 31 dBA decrease from Alternative A. Aircraft would rarely be visible from
56 locations on the ground. Wildlife habitat would be temporarily improved with less interruption. However, at

1 **Eremita Mesa** Location Point, which would still be under active air-tour routes in the shifted Dragon Corridor,
 2 sound levels and Percent Time Audible would not change appreciably from Peak Season, or more than a
 3 negligible amount from Alternative A. Negligible to minor adverse impacts would occur, and overall in Dragon
 4 Corridor there would be moderate to major beneficial change in impacts compared to Alternative A.
 5

6 When Dragon Corridor shifts seven-miles west Off-Peak Season, at **Bass Camp** and **Rainbow Plateau** Location
 7 Points aircraft Percent Time Audible would be 24 to 37% of the day, an increase of 24 to 36% compared to
 8 Alternative A. Average Sound Level would increase to 13 to 33 dBA, an increase of 7 to 26 dBA. In contrast,
 9 these sites would experience very little air-tour noise Peak Season (Percent Time Audible less than one percent at
 10 Average Sound Level 7 dBA). Because the route shift would be abrupt, there may be a higher reaction level
 11 which could result in area avoidance and localized population level changes as animals abandon habitat. Short-
 12 term moderate to major adverse impacts would occur Off-Peak Season with moderate to major adverse change in
 13 impacts from Alternative A at sites under and near the shifted corridor location.
 14

15 *East End* *Alternative F* *Wildlife*
 16 *Ten-Year Forecast Off-Peak Season*

17 **Dragon Corridor** Percent Time Audible would further decline to less than one percent at **96 Mile Camp**
 18 Location Point and 6 to 32% at **Tower of Ra** and **Hermit Basin** Location Points respectively. Percent Time
 19 Audible would be reduced 68 to 92% compared to Alternative A. At **Point Sublime** Location Point, near air-tour
 20 routes, air-tour aircraft Percent Time Audible would be 24% Ten-Year Forecast, a 75% decrease from
 21 Alternative A, with air-tour aircraft Average Sound Level declining to 19 dBA, a decrease of 16 dBA from
 22 Alternative A. At **Eremita Mesa** Location Point, impacts would decline 12% Percent Time Audible, and 2 dBA
 23 Average Sound Level compared to Base Year Off-Peak Season. Although adverse impacts would continue, there
 24 would be moderate to major beneficial change in impacts compared to Alternative A.
 25

26 For **Zuni Point Corridor** Location Points, reductions of 16 to 23% Percent Time Audible and 3 to 6 dBA would
 27 occur Base Year to Ten-Year Forecast Off-Peak Season, with major beneficial changes (reductions of 43 to 55%
 28 Percent Time Audible) compared to Alternative A due to quiet-technology conversion requirements.
 29

30 Impacts due to Alternative F Off-Peak Season Dragon Corridor route shift would be reduced due to quiet-
 31 technology conversion requirements. At **Bass Camp** Location Point, aircraft Percent Time Audible would be
 32 20% of the day, a 17% reduction from Base Year, but a 20% increase from Alternative A. At **Rainbow Plateau**
 33 Location Point, aircraft Percent Time Audible would be 2% of the day, a 22% reduction from Base Year, and
 34 similar to Alternative A. Average Sound Level would be 10 to 29 dBA, a 3 to 4 dBA decrease from Base Year,
 35 but still a 4 to 22 dBA increase from Alternative A. Wildlife activities and behaviors would less frequently be
 36 interrupted by air-tour aircraft. Although negligible to moderate adverse impacts would occur, there would be
 37 negligible to moderate adverse changes in impacts compared to Alternative A.
 38

39 *East End* *Alternative F* *Wildlife*
 40 *Ten-Year Forecast Peak and Off-Peak Season*

41 Beneath Bright Angel Flight-free Zone, impacts and level of change at **Grid Location Points 12 and 13** and at
 42 **Phantom Ranch** Location Point would be negligible with negligible change from Alternative A. However, at
 43 **Cedar Ridge** Location Point and **Grid Location Point 11**, there would be a 47 to 78% reduction in Percent
 44 Time Audible to 5 to 10%, representing minor adverse impacts and moderate to major beneficial change in
 45 impacts compared to Alternative A.

1 **Table 4.133 Alternative F Average Sound Level East End**

Location Point Name	Alternative A				Alternative F																
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season								
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)				
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	
Little Colorado River/Nankoweap Area																					
Nankoweap River	7	8	34	35	7	0	5	-4	34	0	33	-2	0	-7	0	-8	20	-14	17	-18	
Nankoweap Mesa	87	90	43	43	87	0	68	-22	43	0	39	-4	53	-34	33	-57	29	-14	25	-18	
Dragon Corridor																					
96 Mile Camp	72	74	45	45	72	0	47	-27	45	0	41	-4	1	-70	0	-74	13	-31	10	-35	
Tower of Ra	97	98	44	45	97	0	90	-8	44	0	41	-4	17	-80	6	-92	15	-29	13	-32	
Eremita Mesa	100	100	49	49	100	0	98	-2	49	0	46	-3	95	-5	83	-17	49	0	47	-2	
Hermit Basin	99	100	42	42	99	0	89	-11	42	0	37	-5	60	-39	32	-68	23	-19	19	-23	
North Rim																					
Cape Royal	59	61	25	26	59	0	17	-44	25	0	19	-7	31	-28	7	-54	21	-5	16	-10	
Point Imperial	66	68	38	39	66	0	25	-43	38	0	37	-2	28	-38	2	-66	18	-20	14	-25	
Bright Angel Point	47	48	24	24	47	0	12	-36	24	0	18	-2	2	-45	2	-47	13	-11	11	-13	
The Basin	73	75	48	48	73	0	40	-35	48	0	45	-3	26	-47	16	-60	30	-18	26	-22	
Grid Location Point 16	80	84	33	34	84	4	42	-42	33	0	24	-10	37	-43	21	-63	15	-18	13	-21	
Zuni Point Corridor																					
Grid Location Point 14	70	74	34	34	70	0	53	-21	34	0	28	-7	43	-27	27	-47	30	-4	24	-10	
Grid Location Point 15	65	69	28	29	65	0	41	-28	28	0	24	-4	33	-33	17	-52	38	10	35	6	
Temple Butte	62	66	37	38	62	0	45	-22	37	0	31	-7	37	-26	23	-43	31	-6	27	-11	
Lipan Point	74	77	34	35	74	0	49	-28	34	0	27	-7	45	-29	22	-55	29	-5	24	-11	
South Rim																					
Tusayan Museum	64	67	35	36	64	0	33	-36	35	0	28	-8	36	-28	15	-52	29	-6	24	-12	
El Tovar	95	96	19	20	95	0	22	-74	19	0	13	-6	19	-76	8	-88	11	-8	8	-11	
Zuni Alpha	43	46	46	46	43	0	24	-33	46	0	41	-5	22	-21	11	-35	41	-5	38	-9	
Ten X Meadow	64	68	49	49	64	3	22	-36	49	0	45	-4	38	-26	18	-51	42	-7	39	-10	
1.5 km SE of Moran Point	64	68	41	41	65	1	43	-25	41	0	37	-4	38	-26	22	-46	36	-5	33	-8	
Bright Angel Flight Free Zone																					
Cedar Ridge	81	82	19	19	81	0	5	-78	19	0	13	-6	20	-61	5	-77	14	-5	12	-7	
Grid Location Point 11	55	56	18	18	60	5	10	-47	18	0	12	-7	16	-39	7	-49	11	-7	9	-9	
Grid Location Point 12	1	1	13	14	1	0	1	0	13	0	12	-2	1	0	1	0	12	-1	12	-2	
Grid Location Point 13	1	1	12	13	1	0	1	0	12	0	9	-4	1	0	1	0	9	-3	8	-4	
Phantom Ranch	3	4	12	12	3	0	1	-3	12	0	7	-5	1	-2	1	-3	7	-4	6	-6	
Toroweap /Shinumo Flight Free Zone																					
Grid Location Point 10	92	92	25	25	92	0	0	-92	25	0	19	-6	66	-26	16	-77	32	7	29	4	
Grid Location Point 18	60	60	16	17	60	0	14	-46	16	0	13	-4	57	-3	32	-28	39	23	35	19	
Point Sublime	100	100	35	35	100	0	94	-6	35	0	30	-6	89	-10	24	-75	19	-16	17	-18	
Bass Camp	0	0	7	7	0	0	0	0	7	0	2	-5	37	36	20	20	33	26	29	22	
Rainbow Plateau	0	0	6	7	0	0	0	0	7	1	5	-1	24	24	2	0	13	7	10	4	

Δ indicates change in noise metric data from Alternative A
 Forecast indicates a Ten-Year Forecast

1 **Table 4.134 Alternative F Slant Distances East End**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
Little Colorado River/Nankoweap Area				
Nankoweap River	1,449	1,448	0	
Nankoweap Mesa	973	970	-3	
Dragon Corridor				
96 Mile Camp	1,573	1,573	0	
Tower of Ra	1,147	854	-293	
Eremita Mesa	1,034	357	-677	
Hermit Basin	1,518	1,656	139	
North Rim				
Cape Royal	4,038	4,038	0	
Point Imperial	2,292	2,343	50	
Bright Angel Point	6,235	6,225	-10	
The Basin	477	489	13	
Grid Location Point 16	2,589	2,575	-14	
Zuni Point Corridor				
Grid Location Point 14	687	687	0	
Grid Location Point 15	1,637	1,636	-1	
Temple Butte	1,458	1,458	0	
Lipan Point	2,890	2,890	0	
South Rim				
Tusayan Museum	2,016	2,016	0	
El Tovar	5,854	5,857	3	
Zuni Alpha	573	573	0	
Ten X Meadow	540	540	0	
1.5 km SE of Moran Point	448	448	0	
Bright Angel Flight Free Zone				
Cedar Ridge	9,827	9,837	10	
Grid Location Point 11	8,061	8,028	-33	
Grid Location Point 12	9,014	9,014	0	
Grid Location Point 13	7,925	7,925	0	
Phantom Ranch	11,027	10,961	-66	
Toroweap/Shinumo Flight Free Zone				
Grid Location Point 10	2,931	2,900	-31	
Grid Location Point 18	8,449	1,341	-7,108	
Point Sublime	3,760	3,609	-151	
Bass Camp	13,358	2,667	-10,691	
Rainbow Plateau	14,878	3,294	-11,585	

Δ indicates change in noise metric data from Alternative A

2
3

1 **Central** **Alternative F** **Wildlife**

2
3 The Central area is composed of cold- and old-desert scrub, piñon-juniper, and river/riparian habitat. As shown in
4 Appendix F, overall Wildlife and habitat would be exposed to little aircraft noise. Base Year Peak Season, aircraft
5 Percent Time Audible would be 5% of the day or less in the majority of habitats: 97% of cold- and old-desert scrub,
6 86% of piñon-juniper, and 97% of river/riparian habitats. Average Sound Level would also be relatively low with
7 the majority of the area exposed to aircraft noise of 15 dBA or less.
8

9 *Central* *Alternative F* *Wildlife*

10 *Base Year and Ten-Year Forecast Peak Season*

11 Similar to Alternative A, wildlife throughout most of Central area would be little affected by air-tour aircraft
12 noise. As shown in Table 4.135 Percent Time Audible would generally be one percent or less, similar to
13 Alternative A. Wildlife would be exposed to air-tour Average Sound Level generally 8 dBA or less, similar to
14 Alternative A. As shown in Table 4.136, aircraft proximity would be mostly greater than 7,000 meters away
15 from points on the ground. Given low aircraft audibility, sound levels, and air-tour aircraft distant from locations
16 on the ground, there would be little potential to disturb wildlife behaviors or activities, or to affect population
17 levels or area use, although some individuals may be disturbed for short periods. Negligible impacts would
18 occur, with negligible change in impacts compared to Alternative A, and little change Base Year to Ten-Year
19 Forecast.
20

21 Outside the park in the SFRA near **South Supai Canyon** and **Havatagvitch Canyon** Location Points, aircraft
22 noise would be similar to Alternative A. Air-tour aircraft Percent Time Audible would be one to 7% at Average
23 Sound Level 7 to 25 dBA. There would be negligible to minor adverse impacts with negligible change in impacts
24 compared to Alternative A, and little change Base Year to Ten-Year Forecast.
25

26 *Central* *Alternative F* *Wildlife*

27 *Base Year Off-Peak Season*

28 Air-tour noise would be similar to Peak Season (generally negligible impacts with negligible change from
29 Alternative A), except **Fossil Canyon** Location Point where there would be a 16% increase in Percent Time
30 Audible compared to Base Year (a moderate adverse impact with moderate adverse change in impacts at that site
31 compared to Alternative A).
32

33 *Central* *Alternative F* *Wildlife*

34 *Ten-Year Forecast Off-Peak Season*

35 Most sites would be similar to Base Year Off-Peak Season (generally negligible impacts with negligible changes
36 in impacts from Alternative A). An exception would be **Prospect Canyon** Location Point, which would
37 experience a 5% increase in Percent Time Audible from Base Year, but still a 14% decrease compared to
38 Alternative A (a moderate adverse impact with moderate beneficial change in impacts from Alternative A).

1 **Table 4.135 Alternative F Average Sound Level Central**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Havatagvitch Canyon	1	1	7	8	1	0	1	0	7	0	7	0	1	0	1	0	7	0	7	-1
Supai Village	0	0	5	13	0	0	0	0	5	0	5	-8	0	0	0	0	5	-1	5	-8
Coyote Canyon	0	0	16	16	0	0	0	0	16	0	16	0	0	0	0	0	16	0	16	0
Mohawk Canyon	1	1	11	12	0	-1	0	-1	8	-3	10	-2	0	-1	0	-1	8	-3	9	-3
Mohawk Canyon	2	2	11	12	0	-2	0	-2	7	-5	8	-4	-2	0	-2	6	-5	7	-5	
Prospect Canyon	22	25	22	22	6	-16	13	-12	18	-4	21	-2	8	-17	11	-14	17	-5	20	-2
The Dome	1	1	16	16	1	0	1	0	13	-3	14	-2	1	0	1	0	12	-3	13	-3
Fossil Canyon	2	2	12	12	2	0	1	-1	12	0	10	-2	18	16	3	1	11	-1	10	-2
Grid Location Point 21	2	2	14	14	2	0	2	0	14	0	14	0	2	0	2	0	14	-1	14	0
Grid Location Point 22	18	21	12	13	1	-17	1	-19	10	-3	10	-3	1	-17	1	-19	8	-4	10	-3
Grid Location Point 25	11	12	9	10	2	-9	2	-10	7	-3	7	-2	2	-9	2	-10	6	-3	7	-3
Grid Location Point 9	1	1	5	5	1	0	1	0	5	0	3	-2	1	0	1	0	6	1	4	-2
South Supai Canyon	6	7	27	27	7	1	8	2	5	-2	26	-1	7	1	7	1	24	-3	26	-2

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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1 **Table 4.136 Alternative F Slant Distances Central**

Location Point Name	Alternative A		Alternative F	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
Havatagvitch Canyon	3,668	3,668	3,668	0
Supai Village	163	163	163	0
Coyote Canyon	7,651	7,651	7,651	0
Mohawk Canyon	3,009	3,009	3,009	0
Mohawk Canyon	6,304	6,304	6,304	0
Prospect Canyon	1,550	1,550	1,550	0
The Dome	13,109	13,109	13,109	0
Fossil Canyon	10,346	10,346	10,346	0
Grid Location Point 21	20,393	20,393	20,393	0
Grid Location Point 22	26,089	26,089	26,089	0
Grid Location Point 25	20,188	20,188	20,188	0
Grid Location Point 9	11,103	11,103	11,103	0
South Supai Canyon	1,480	1,480	1,480	0

Δ indicates change in noise metric data from Alternative A

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West End Alternative F Wildlife

Under Alternative F, a range of aircraft noise intensities and audibility would affect West End Wildlife and habitats. West End is a mixture of warm- and cold-desert scrub, piñon-juniper, and riparian habitat along the river. West End Wildlife and habitat would be exposed to varying levels of aircraft noise depending on proximity to routes. As shown in Appendix F, Base Year Peak Season, aircraft Percent Time Audible would be greater than 25% of the day in 61% of piñon-juniper habitat; 53% of warm-desert scrub; and 27% of the river/riparian habitat (due to masking by river sounds). However, in areas away from routes, a large amount of habitat would experience very infrequent aircraft noise. Average Sound Level would remain relatively low with the majority of the area exposed to sound levels 25 dBA or less.

West End Alternative F Wildlife
All Scenarios

Impacts to wildlife would generally not be appreciably different from Alternative A. As shown in Table 4.137, in areas under Green-4 and Blue-2 represented by Location Points **Bat Cave, Burnt Springs Canyon, and Grid Location Point 33**, air-tour aircraft Percent Time Audible would be 65 to 88% of the day, a 4% increase (at Burnt Springs Canyon) to a 12% decrease (at Grid Location Point 33) compared to Alternative A. Air-tour aircraft Average Sound Level would be 40 to 47 dBA, similar to Alternative A. Aircraft would be approximately 1,000 to 1,215 meters from the ground similar to Alternative A (Table 4.138). There would be similar potential as Alternative A to disrupt normal behavior patterns such as breeding, feeding, or sheltering in areas under and close to routes. Major adverse impacts would continue with short-term negligible to minor beneficial change in impacts compared to Alternative A.

In areas **under Blue Direct routes**, represented by **Grid Location Points 27 and 32**, air-tour aircraft Percent Time Audible would be 27 to 51% of the day at Average Sound Level 31 to 38 dBA, and about 1,000 to 3,000 meters away from points on the ground. Wildlife activities and behaviors could be interrupted and, similar to East End, wildlife may avoid areas of high aircraft noise. Moderate to major adverse impacts to wildlife would continue in localized areas under and near Blue Direct routes with negligible to minor adverse change in impacts compared to Alternative A.

Near Brown routes, **Whitmore Rapids and Parashant Wash** Location Points would have Percent Time Audible 7 to 9% of the day and Average Sound Level 23 to 33 dBA, as much as a 10% decrease and 2% increase in Percent Time Audible, as a much as a 10 dBA decrease and a 15 dBA increase compared to Alternative A.

1 Aircraft would be 1,800 to 4,200 meters from points on the ground, an increase of zero to 1,338 meters from
2 Alternative A. Wildlife may be disturbed minimally by audible air-tour aircraft noise; however, normal activities
3 would be expected to recover after disturbance, without population level impacts. Minor adverse impacts would
4 continue with negligible to minor beneficial change in impacts from Alternative A.
5

6 Wildlife habitat located in **Sanup Flight-free Zone** and **south of the SFRA boundary** would be negligibly
7 affected by air-tour operations, as reflected in the data at **Pumpkin Springs, Diamond Creek, and Grid**
8 **Location Point 34** Location Points. Base Year Peak Season in this West End area, air-tour Average Sound Level
9 would be less than one to 9 dBA with air-tour Percent Time Audible less than one percent of the day. Wildlife
10 would experience very little disturbance from air-tour aircraft in this southern West End area similar to
11 Alternative A. There would be negligible impacts with negligible change in impacts from Alternative A in Sanup
12 Flight-free Zone.
13
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1 **Table 4.137 Alternative F Average Sound Level West End**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	75	4	69	-6	47	1	44	-3	73	2	66	-9	46	1	44	-3
Bat Cave	93	95	47	48	88	-5	83	-13	47	-1	46	-2	88	-5	81	-14	46	-1	45	-3
Grid Location Point 33	87	90	42	43	75	-12	65	-25	42	0	40	-3	77	-10	66	-24	43	1	40	-3
Whitmore Rapids	12	13	21	21	9	-3	16	2	33	12	37	15	5	-7	12	-1	32	11	36	14
Grid Location Point 27	20	23	26	27	28	8	35	12	36	10	38	11	7	7	31	8	36	10	37	10
Grid Location Point 28	14	16	17	18	41	28	52	36	26	9	28	10	39	25	47	31	25	8	28	10
Grid Location Point 31	37	41	42	43	19	-18	14	-27	17	-25	17	-16	21	-15	13	-28	17	-25	16	-26
Mt. Dellenbaugh	29	32	41	42	2	-27	1	-31	17	-25	18	-24	2	-27	1	-31	16	-25	17	-24
Shivwits Fire Camp	35	39	38	38	1	-34	2	-38	15	-23	16	-22	1	-34	2	-38	15	-23	16	-22
Grid Location Point 32	44	49	27	28	47	3	51	2	33	6	31	3	46	2	46	-2	34	7	31	3
Granite Peak	2	2	17	18	21	19	17	15	28	12	27	9	22	20	16	14	29	12	27	9
NPS Administration site	44	49	31	32	3	-41	2	-46	17	-4	18	-14	2	-42	2	-46	17	-14	18	-14
Castle Peak	27	30	18	48	1	-27	1	-30	12	-6	13	-35	1	-27	1	-30	12	-6	13	-35
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Parashant Wash	12	14	33	33	7	-5	7	-3	23	-10	26	-8	8	-4	9	-5	23	-10	25	-8
Pumpkin Springs	0	0	7	8	0	0	0	0	9	2	10	2	0	0	0	0	9	2	9	2
Meriwhitca	0	1	7	8	0	0	0	0	8	1	8	1	0	0	1	0	7	1	8	1
Andrus Canyon	22	24	17	17	2	-20	0	-23	10	-7	11	-6	0	-22	1	-23	9	-8	11	-6

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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1 **Table 4.138 Alternative F Slant Distances West End**

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,134	936	-198
Grid Location Point 33	1,105	1,123	18
Whitmore Rapids	1,804	1,804	0
Grid Location Point 27	3,388	1,223	-2,165
Grid Location Point 28	8,327	3,336	-4,991
Grid Location Point 31	502	10,407	9,905
Mt. Dellenbaugh	824	12,307	11,483
Shivwits Fire Camp	1,669	13,192	11,523
Grid Location Point 32	2,016	2,995	979
Granite Peak	5,264	5,257	-7
NPS Administration site	3,719	13,025	9,306
Castle Peak	8,629	13,637	5,008
Diamond Creek	27,108	23,339	-3,769
Parashant Wash	2,852	4,190	1,338
Pumpkin Springs	12,630	12,622	-8
Meriwhitca	15,742	13,733	-2,009
Andrus Canyon	1,393	817	-576

Δ indicates change in noise metric data from Alternative A

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4 **Cumulative Impacts Alternative F Wildlife**

5
6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
7 *actions. In this context, Cumulative Impacts include impacts on Wildlife from sounds of*

- 8 1) high-altitude aircraft at or above 18,000 feet MSL, plus
9 2) aircraft below 18,000 feet MSL and outside the SFRA, plus
10 3) ground-based noise sources, plus
11 4) noise from air-tour-and-related aircraft under Alternative F

12
13 *That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 (Alternative F).*

14
15 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
16 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
17 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
18 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
19 *SFRA see Appendix D, Figures 91 to 94).*

20
21 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
22 *Wildlife, but is mostly concentrated in the Developed Zone (2% of the park), although a small component exists*
23 *in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire management*
24 *activities, and mining activities outside the park. Noise from ground-based sources is discussed in Chapter 3,*
25 *Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time Audible*
26 *capable of masking some aircraft noise.*

27
28 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
29 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
30 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
31 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*

1 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 2 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 3 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon’s rare*
 4 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 5 *Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the*
 6 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
 7 *Because they would be audible a very high percentage of the day, the combination of aircraft from all sources*
 8 *would generally be the overriding cumulative influence on Wildlife and habitat.*
 9

10 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 11 *(Alternative F compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 12 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 13 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 14 *(Alternative F in this case).*
 15

16 *Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 17 *Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season),*
 18 *noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone,*
 19 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 20 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 21 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 22 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 23 *unpaved roads, the Colorado River, and mining activity areas north of the park.*
 24

25 *Comparing noise impacts from just Alternative F by itself (Appendix D Tables 26 (Peak Season) and 31 (Off-*
 26 *Peak Season) Ten-Year Forecast) versus All Aircraft (#4 Alternative F plus #1 Above and #2 Outside) (Appendix*
 27 *D Tables 57 (Peak Season) and 61 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the*
 28 *difference between Cumulative Impacts and the impacts of Alternative F by itself. For the Entire Park*
 29 *Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more*
 30 *of the day in 87 to 89% of the park, with Average Sound Level 25 to <35 dBA in 84 to 86% of the park, with 1%*
 31 *of the park below 25 dBA and 15 to 18% at 35 dBA or more. For the Entire Park results for Alternative F by*
 32 *itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to 10%*
 33 *of the park, with Average Sound Level 25 to <35 dBA in 14% of the park, with 68 to 70% of the park below 25 dBA*
 34 *and 10 to 13% at 35 dBA or more.*
 35

36 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 37 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
 38 *routes; (b) Cumulative Impacts increase the impacts of Alternative F, and (c) reducing air-tour-and-related*
 39 *impacts under the Alternatives reduces Cumulative Impacts.*
 40

41 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 42 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 43 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 44 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 45 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts discussion*
 46 *in the Conclusions section below.*
 47

48 **Conclusion**

49 **Alternative F**

50 **Wildlife**

51 Overall, Alternative F will generally result in beneficial change in impacts compared with Alternative A due to
 52 reduced area exposed to high Percent Time Audible and high Average Sound Level for long periods of the day.
 53 Alternative F would result in wildlife habitat improvement and reduction of impacts on wildlife as aircraft noise is
 54 reduced due to quiet-technology incentives and conversion. Ten-Year Forecast 34% of the park would have air-tour
 55 aircraft Percent Time Audible 25% or more of the day predominantly in East and West Ends under and near air-tour
 56 routes. Air-tour Average Sound Level would generally be less than 25 dBA in about 70% of the SFRA. Greatest
 exposure to noise and visual impacts would occur under East and West End heavily-used air-tour routes where

1 aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75% of the
 2 day. However, there would also be large areas of habitat relatively undisturbed by air-tours in Marble Canyon and
 3 the Central area.

4
 5 *Conclusion* *Alternative F* *Wildlife*
 6 *Marble Canyon*

7 Alternative F would generally result in negligible to minor adverse impacts on wildlife and habitats with negligible
 8 change in impacts Peak Season, and negligible to minor beneficial change in impacts from Alternative A Off-Peak
 9 Season Base Year and Ten-Year Forecast.

10
 11 *Conclusion* *Alternative F* *Wildlife*
 12 *East End*

13 Base Year Peak Season, there would be moderate to major adverse impacts under and near heavily used air-tour
 14 routes in Zuni Point and Dragon Corridors, with negligible changes from Alternative A. Base Year Off-Peak Season,
 15 Zuni Point Corridor would be similar to Peak Season, but with the seasonal shift in Dragon Corridor, in Off-Peak
 16 Season the moderate to major adverse impacts would move seven-miles west, with mixed results between moderate
 17 adverse and moderate beneficial changes in impacts compared to Alternative A, depending on location. Ten-Year
 18 Forecast aircraft Percent Time Audible would be reduced due to quiet-technology incentives and conversion still
 19 resulting in moderate to major adverse impacts under the routes but minor to major beneficial changes in impacts
 20 compared to Alternative A. Peak Season, and mixed results due to the Dragon Corridor shift in Off-Peak Season.

21
 22 In areas away from air-tour routes such as amid Bright Angel Flight-free Zone, there would generally be negligible
 23 to minor adverse impacts with negligible changes in impacts compared to Alternative A. Base Year Peak and Off-
 24 Peak Season, with up to major beneficial changes in impacts Ten-Year Forecast Peak and Off-Peak Season.

25
 26 *Conclusion* *Alternative F* *Wildlife*
 27 *Central*

28 Alternative F would generally result in negligible to minor adverse impacts with negligible change in impacts to
 29 Wildlife and habitat compared to Alternative A in the Central area Peak Season, and negligible impacts with
 30 negligible change in impacts compared to Alternative A Off-Peak Season Base Year and Ten-Year Forecast.

31
 32 *Conclusion* *Alternative F* *Wildlife*
 33 *West End*

34 In All Scenarios Alternative F would generally result in short-term moderate to major adverse impacts under Blue-2
 35 and Green-4, with minor adverse to minor beneficial change in impacts compared to Alternative A. In All Scenarios
 36 in areas under Blue Direct routes, there would be moderate to major adverse impacts with negligible to minor
 37 adverse changes in impacts compared to Alternative A. Near Whitmore Rapids and Parashant Wash there would be
 38 minor to moderate adverse impacts with negligible change in impacts compared to Alternative A. In All Scenarios,
 39 in areas under Sanup Flight-free Zone, there would be negligible impacts with negligible change in impacts from
 40 Alternative A.

41
 42 *Cumulative Impacts Summary* *Alternative F* *Wildlife*

43
 44 ***As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase***
 45 ***impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts in***
 46 ***all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,***
 47 ***Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,***
 48 ***and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In comparison with the***
 49 ***other Alternatives, Alternative F ranks third in lowest overall Cumulative Impacts behind Alternative E and the***
 50 ***Modified NPS Preferred Alternative (Alternative A ranks last).***

51
 52 **MODIFIED NPS PREFERRED ALTERNATIVE** **WILDLIFE**

53
 54 See Alternative A for species and habitat descriptions.
 55

1 Overall the **Modified** NPS Preferred Alternative would result in a beneficial change in impacts from Alternative A to
 2 wildlife and habitat. Base Year, percent of the park in which air-tour aircraft Percent Time Audible would be greater
 3 than **or equal to** 25% of the day would **decrease** slightly Peak Season from 45% in Alternative A to **43%**, **and** would
 4 decline to **26%** Off-Peak Season. Ten-Year Forecast, percent of the park greater than **or equal to** 25% Percent Time
 5 Audible would decline to **27%** Peak Season and **15%** Off-Peak Season. Amount of the park in which air-tour aircraft
 6 Average Sound Level would **be greater than or equal to** 35 dBA Ten-Year Forecast Peak Season would be **9%**
 7 compared to 23% in Alternative A. Although aircraft noise would continue to cause wildlife disturbance and affect
 8 wildlife habitat, Ten-Year Forecast there would be reduced aircraft Percent Time Audible and Average Sound Level
 9 due in large part to the requirement for quiet-technology aircraft conversion.

10 **Marble Canyon**

11 **Modified NPS Preferred Alternative**

12 **Wildlife**

13 Marble Canyon wildlife habitat conditions would be quiet, similar to Alternative A Peak and Off-Peak Seasons.
 14 Based on Appendix F contour data, air-tour aircraft in **96 to 100%** of Marble Canyon old-desert scrub and river
 15 habitats would have air-tour aircraft Percent Time Audible 5% or less of the day with air-tour Average Sound Level
 16 less than 15 dBA.

17 *Marble Canyon*

18 *Modified NPS Preferred Alternative*

19 *Wildlife*

20 **All Scenarios**

21 **Impacts at representative Location Points around Marble Canyon would generally be minor to moderate**
 22 **beneficial compared to Alternative A as shown in Table 4.139 and 4.140. Air-tour aircraft Percent Time**
 23 **Audible would be 1% or less, a reduction from Alternative A, and aircraft Average Sound Level would be zero**
 24 **to 13 dBA, a decrease of one to 24 dBA compared to Alternative A. With elimination of all Marble Canyon air-**
 25 **tour routes, aircraft would be much farther away and not visible from locations on the ground, ranging from**
 26 **approximately 18,273 meters at Marble Canyon Dam Site Location Point to 75,891 meters at Grid Location**
 27 **Point 1. Improvement over Alternative A would occur at all Location Points close to rim and river. Wildlife is**
 28 **unlikely to be disturbed from normal daily activities, and if disturbed, would be expected to resume normal**
 29 **behaviors and return to pre-disturbance conditions shortly after an aircraft event. There would generally be**
 30 **long-term minor to major beneficial change in impacts compared with Alternative A.**

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1 **Table 4.139 Modified NPS Preferred Alternative Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	1	-5	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9	1	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	1	-7	0	-12	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-3	0	-3	2	--22	1	-24	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-3	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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4 **Table 4.140 Modified NPS Preferred Alternative Slant Distances Marble Canyon**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	56,620	52,925
Grid Location Point 1	1,665	73,891	74,226
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	59,548	50,590
Grid Location Point 4	4,585	71,678	67,093
Grid Location Point 5	2,335	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669

Δ indicates change in noise metric data from Alternative A

5
6

1 **East End** *Modified NPS Preferred Alternative* **Wildlife**
 2
 3 Beneficial impacts to East End *wildlife* and habitat are clearly seen in modeled results due to *closure of Zuni Point*
 4 *Corridor* short-loop tours *and long-loop tours* during *Off-Peak* Season.

5
 6 Base Year Peak Season East End noise conditions in wildlife habitats would *be reduced compared* to Alternative A.
 7 As shown in Appendix F, *wildlife* would be exposed to aircraft Percent Time Audible greater than 25% of the day in
 8 the majority of piñon-juniper (58%), ponderosa pine (53%), cold-desert scrub (53%), and old-conifer forest (43%)
 9 habitats. The majority of these habitats would be exposed to Average Sound Level of 25 dBA or less similar to
 10 Alternative A. In river/riparian habitat, aircraft Percent Time Audible would be greater than *or equal to* 25% of the
 11 day in 43% of the habitat, and Average Sound Level would be 25 dBA or less in 2% of the habitat.

12
 13 Ten-Year Forecast with implementation of quiet-technology incentives and conversion requirements, noise impacts
 14 would substantially decrease particularly in the area where aircraft Percent Time Audible *would be greater than*
 15 *25% of the day: piñon-juniper (60% Peak Season; 36% Off-Peak), ponderosa pine (42% Peak Season; 5% Off-*
 16 *Peak), cold-desert scrub (35% Peak Season; 29% Off-Peak), and old-conifer forest (37% Peak Season; 15% Off-*
 17 *Peak). These values are all much less than in Alternative A.*

18
 19 *East End* *Modified NPS Preferred Alternative* *Wildlife*
 20 *Base Year Peak Season*

21 As shown in Tables 4.141 and 4.142, areas where air-tour operations would have highest effect would **be under**
 22 **and adjacent to Dragon Corridor** represented by Location Points **96 Mile Camp, Tower of Ra, Eremita Mesa**
 23 **and Hermit Basin**. This results from high air-tour Percent Time Audible of 59 to 100%, a one to 12% decrease
 24 from Alternative A. Average Sound Level would be 20 to 42 dBA, a 2 to 22 dBA decrease from Alternative A.
 25 Air-tour aircraft would be farther away from points on the ground, about 1,500 to 6,400 meters. Although *minor*
 26 to major adverse impacts would occur under and near Dragon Corridor routes, there would be short-term
 27 negligible to minor beneficial change in impacts compared to Alternative A.

28
 29 When Zuni Point Corridor short-loop routes *and the long-loop routes* would be inactive, **under and near Zuni**
 30 **Point Corridor** at Location Points **Temple Butte, Upan Point, and Grid Location Points 14 and 15** aircraft
 31 Percent Time Audible would be **54 to 76%** of the day, a decrease of **8%** compared to Alternative A. Aircraft
 32 Average Sound Level would be 34 to 39 dBA, an increase of up to 11 dBA from Alternative A. Wildlife
 33 activities could be interrupted by aircraft noise portions of the day. Moderate to major adverse impacts would
 34 continue with negligible beneficial change from Alternative A.

35
 36 **In Bright Angel Flight-free Zone**, air-tour aircraft Percent Time Audible would increase by **1 to 10%** from
 37 Alternative A in areas near **Cape Royal, Bright Angel Point, The Basin** and **Cedar Ridge** Location Points. Air-
 38 tour aircraft Percent Time Audible would decrease **26%** in areas near **Grid Location Point 16, 19%** at **Point**
 39 **Imperial** Location Point, and **5%** at **Grid Location Point 11** compared to Alternative A. Average Sound Level
 40 would range 10 to 44 dBA, similar to Alternative A, except **Point Imperial Location Point** where sound levels
 41 would be reduced by 20 dBA from 38 to 18 dBA. Aircraft would generally be greater than 2,000 meters from
 42 locations on the ground, except The Basin Location Point which would be less than 900 meters. Moderate
 43 adverse impacts would continue near air-tour routes with negligible *to minor* adverse change in impacts
 44 compared to Alternative A at **Cape Royal, Bright Angel Point and The Basin** Location Points, and a moderate
 45 to major beneficial change in impacts compared to Alternative A at **Point Imperial and Grid Location Point 16**
 46 Location Points. Amid Bright Angel Flight-free Zone away from tour routes would remain quiet, as represented
 47 by **Grid Location Points 12 and 13** and **Phantom Ranch** Location Points, with negligible impacts and
 48 negligible change in impacts from Alternative A.

49
 50 *East End* *Modified NPS Preferred Alternative* *Wildlife*
 51 *Ten-Year Forecast Peak Season*

52 **Under and near Dragon Corridor** air-tour aircraft Percent Time Audible would decline to 41 to **98%**, a 10 to
 53 **43%** decrease from Alternative A, due to conversion to quiet-technology aircraft. Average aircraft noise levels
 54 would range **17 to 38 dBA**; a decrease of 7 to **25 dBA** from Alternative A. Aircraft *Distance* would be the same
 55 as Base Year. Although *minor* to major adverse impacts would continue, there would be *long-term* minor to
 56 *major* beneficial change in impacts compared to Alternative A.

1 **Under and near Zuni Point Corridor**, there would be reduction in air-tour aircraft noise primarily due to quiet-
 2 technology aircraft conversion. Aircraft Percent Time Audible would be **33 to 46%** of the day, a **28 to 33%**
 3 decrease compared to Alternative A. Average Sound Level would be **28 to 36** dBA. Wildlife would generally be
 4 disrupted less frequently during the day, which may improve feeding, breeding, and nesting. Although moderate
 5 to major adverse impacts would continue, there would generally be **long-term minor to moderate** beneficial
 6 change in impacts compared to Alternative A, although Average Sound Level would increase a negligible
 7 amount at **Grid Location Points 14 and 15**.

8
 9 Aircraft audibility would decline at **all North Rim Location Points in Bright Angel Flight-free Zone**. At
 10 Location Points **Cape Royal** and **Grid Location Point 11**, aircraft Percent Time Audible would be **23 to 28%** of
 11 the day, a decrease of **33%** from Alternative A (and a decrease of **27 to 40%** from Base Year). Average air-tour
 12 sounds would be only slightly lower than Alternative A, and range **14 to 21** dBA. **Point Imperial** Location Point
 13 Percent Time Audible would be 11%, a reduction of 56% from Alternative A, with Average Sound Level 16
 14 dBA, a 22 dBA reduction from Alternative A. Air-tour aircraft Percent Time Audible at **Cedar Ridge** Location
 15 Point would decline 83% compared to Base Year (76% lower than Alternative A), and at **Grid Location Point 11**
 16 it would decline **27%** from Base Year (**33%** from Alternative A). Declines would be due primarily to quiet-
 17 technology conversion. Wildlife would be much less frequently disturbed during daily activities compared to
 18 Base Year and Alternative A. Although moderate adverse impacts would continue, there would be short-term
 19 moderate to major beneficial change in impacts compared to Alternative A in areas near air-tour routes. The
 20 middle of the Bright Angel Flight-free Zone would remain quiet, represented by **Grid Location Points 12 and**
 21 **13**, with negligible impacts and negligible change in impacts from Alternative A and from Base Year Peak
 22 Season.

23
 24 North Rim wildlife habitat would improve at **Point Imperial, The Basin, and Grid Location Point 16** Location
 25 Points. Aircraft Percent Time Audible would be **11 to 39%** of the day, a **39 to 56%** decrease from Alternative A.
 26 Average Sound Level would range 16 to 40 dBA, **an 8 to 22** dBA decline. There would be much less interruption
 27 or disturbance of breeding, nesting, and foraging activities. Although moderate to major adverse impacts would
 28 continue, there would be **long-term moderate to major beneficial change** in impacts compared to Alternative A.

29
 30 *East End* *Modified NPS Preferred Alternative* *Wildlife*
 31 *Base Year Off-Peak Season*

32 **Dragon Corridor** air-tour aircraft Percent Time Audible would be **38 to 98%** of the day, a **2 to 32% increase**
 33 from Alternative A. Average Sound Level would be **17 to 38** dBA, a **6 to 25** dBA reduction. Wildlife would
 34 experience less frequent disturbance from aircraft compared to Alternative A. Although **minor** to major adverse
 35 impacts would continue, there would be short-term moderate to major beneficial change in impacts compared to
 36 Alternative A.

37
 38 Aircraft noise would **decrease** in **Zuni Point Corridor** as short-loop **and long-loop routes** would be **inactive**. At
 39 Location Points **Grid Location Point 14 and 15, Lipan Point, and Temple Butte**, aircraft Percent Time Audible
 40 would be **zero to 1%** of the day, a **61 to 74%** decrease compared to Alternative A. Average Sound Level would
 41 range **6 to 14** dBA **a decrease of 14 to 31 dBA compared** to Alternative A. **Negligible** impacts would continue
 42 with **short-term moderate to major beneficial** change in impacts from Alternative A.

43
 44 Aircraft Percent Time Audible in **Bright Angel Flight-free Zone** would **decrease to 1%** of the day near **Cape**
 45 **Royal** Location Point; a **58% decrease** from Alternative A with Average Sound Level of **11** dBA, **a reduction of**
 46 **14 dBA from** Alternative A. Air-tour aircraft **would be less visible** during this time of year as short-loop tour
 47 routes in Zuni Point Corridor would be **inactive**. **Although negligible to minor adverse impacts would occur**
 48 **there would be short-term minor to moderate beneficial change in impacts compared to Alternative A**.

49
 50 There would **be some** improvement in areas close to **Dragon Corridor**. At **Grid Location Point 11**, aircraft
 51 Percent Time Audible would be **27%**, **a 28%** decrease compared to Alternative A, and Average Sound Level **15**
 52 **dBA, a 3** dBA decrease from Alternative A. Wildlife activities and behaviors near Grid Location Point 11 would
 53 be rarely disrupted by aircraft. Some locations near Dragon Corridor would continue to receive noise impacts
 54 (e.g., **The Basin** Location Point would be at **37%** Percent Time Audible and **19** dBA; **Tower of Ra** Location
 55 Point would be at **80%** Percent Time Audible and **38** dBA; however, these would be reductions of **17 to 36%**
 56 Percent Time Audible and **6 to 29** dBA compared to Alternative A). Although moderate to major adverse impacts

1 would occur, there would generally be short-term moderate to major beneficial change in impacts compared to
 2 Alternative A.

3
 4 *East End*

Modified NPS Preferred Alternative

Wildlife

5 *Ten-Year Forecast Off-Peak Season*

6 **Percent Time Audible in areas near and under Dragon Corridor would have Aircraft Percent Time Audible of**
 7 **25 to 92%** of the day, a reduction of **8 to 61%** compared to Alternative A. Average Sound Level would range **15**
 8 **to 35 dBA**, a **10 to 27 dBA** decrease from Alternative A. Although **minor to major** adverse impacts would occur,
 9 there would be **long- and** short-term minor to major beneficial change in impacts compared to Alternative A.

10
 11 **There would be further reduction in aircraft noise in and near Zuni Point Corridor** would be **zero to 1%**; a
 12 decline of **65 to 77%** from Alternative A. Average aircraft noise levels would range **6 to 14 dBA**, **a 15 to 32 dBA**
 13 **reduction from** Alternative A. **Negligible** adverse impacts would **occur with long- and short-term moderate to**
 14 **major beneficial change** in impacts from Alternative A.

15
 16 Aircraft Percent Time Audible would decline along **Bright Angel Flight-free Zone** edges. Aircraft Percent Time
 17 Audible would be **1%** of the day near Zuni Point Corridor at **Cape Royal** Location Point, a decrease of **60%**
 18 from Alternative A. Near Dragon Corridor at **Grid Location Point 11**, Percent Time Audible would be **17%**, a
 19 **39%** reduction compared to Alternative A, with **a negligible change in Average Sound Level of 12 dBA** from
 20 Alternative A. **The Basin and Tower of Ra** Location Points would receive further reductions in noise from Base
 21 Year, with Percent Time Audible **7 to 67%** and Average Sound Level **20 to 35 dBA**, reductions of **31 to 68%**
 22 Percent Time Audible and **10 to 28 dBA** from Alternative A. Although moderate adverse impacts would occur
 23 near air-tour routes, there would be short-term minor to major beneficial change in impacts compared to
 24 Alternative A.

25
 26 *East End*

Modified NPS Preferred Alternative

Wildlife

27 *Base Year and Ten-Year Forecast Off-Peak Season*

28 Conditions in habitats along **North Rim** would improve at Location Points **Point Imperial, The Basin,** and
 29 **Grid Location Point 16** as Percent Time Audible would decrease **64 to 70%** compared to Base Year Peak
 30 Season, and **10 to 30%** compared to Ten-Year Forecast Peak Season. Reductions in Percent Time Audible
 31 compared to Alternative A would be **64 to 68%** Base Year, and **22 to 32%** Ten-Year Forecast Off-Peak Season.
 32 Although moderate to major adverse impacts would occur, there would be short-term **negligible to minor**
 33 beneficial change in impacts compared to Alternative A.
 34

1 **Table 4.141 Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Little Colorado River/Nankoweap Area																				
Nankoweap River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	11	-23	12	-23
Nankoweap Mesa	87	90	43	43	76	-11	48	-42	31	-12	29	-14	1	-42	2	-88	14	-29	15	-28
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	38	-32	25	-49	35	-10	33	-12
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	80	-17	67	-31	38	-6	35	-10
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	98	-2	92	-8	32	-17	29	-20
Hermit Basin	99	100	42	42	96	-4	57	-43	20	-22	17	-25	29	-20	39	-61	17	-25	15	-27
North Rim																				
Cape Royal	59	61	25	26	68	9	28	-33	27	2	21	-6	1	-58	1	-60	11	-14	12	-14
Point Imperial	66	68	38	39	47	-19	11	-56	18	-20	16	-2	1	-65	1	-67	7	-31	7	-32
Bright Angel Point	47	48	24	24	57	10	18	-30	24	0	16	-6	4	-43	5	-43	13	-11	12	-12
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	37	-36	7	-68	19	-29	20	-28
Grid Location Point 16	80	84	33	34	54	-26	39	-45	32	-1	24	-9	13	-67	20	-64	12	-21	12	-22
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	62	-8	46	-28	39	0	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	56	-9	37	-32	39	0	35	6	1	-64	1	-68	14	-14	14	-15
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32
Lipan Point	74	77	34	35	76	2	46	-31	34	0	28	-7	0	-74	0	-77	9	-25	8	-27
South Rim																				
Tusayan Museum	64	67	35	36	64	0	38	-9	35	0	29	-7	0	-64	0	-67	4	-31	4	-32
El Tovar	95	96	19	20	93	2	23	-73	20	0	14	-6	66	-29	13	-83	15	-4	13	-7
Zuni Alpha	43	46	46	46	41	-2	25	-21	48	2	45	-1	0	-43	0	-46	3	-43	3	-3
Ten X Meadow	64	68	49	49	60	-4	33	-35	52	3	50	1	19	-45	11	-57	18	-31	19	-30
1.5 km SE of Moran Point	64	68	41	41	62	-2	43	-25	38	-3	33	-8	2	-62	3	-65	6	-35	5	-36
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	89	9	6	-76	19	1	14	-5	56	-25	6	-76	15	-4	13	-6
Grid Location Point 11	55	56	18	18	50	-5	23	-33	20	2	14	-4	27	-28	17	-39	15	-3	12	-6
Grid Location Point 12	1	1	13	14	2	1	2	1	13	0	12	-1	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	12	0	9	-4	1	0	1	0	9	-3	9	-4
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	7	-5	1	-2	1	-3	7	-5	7	-5
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	73	-19	19	-73	26	1	23	-2
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	73	13	31	-29	17	1	15	-2
Point Sublime	100	100	35	35	100	0	95	-5	35	-1	29	-6	97	-3	83	-17	32	-3	27	-8
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	6	-1	3	-4
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	6	-1	0	0	0	0	7	1	7	0

Table 4.142 Modified Preferred Alternative Slant Distances East End

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	9,655	8,206
Nankoweap Mesa	973	6,096	5,123
Dragon Corridor			
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,579	431
Eremita Mesa	1,034	4,277	3,244
Hermit Basin	1,518	6,447	4,929
North Rim			
Cape Royal	4,038	4,026	-12
Point Imperial	2,292	2,754	462
Bright Angel Point	6,235	6,236	2
The Basin	477	874	397
Grid Location Point 16	2,589	2,591	2
Zuni Point Corridor			
Grid Location Point 14	687	1,412	726
Grid Location Point 15	1,637	2,345	708
Temple Butte	1,458	1,303	-155
Lipan Point	2,890	2,894	3
South Rim			
Tusayan Museum	2,016	2,018	3
El Tovar	5,854	10,914	5,060
Zuni Alpha	573	574	0
Ten X Meadow	540	391	-146
1.5 km SE of Moran Point	448	1,144	696
Bright Angel Flight Free Zone			
Cedar Ridge	9,827	12,261	2,434
Grid Location Point 11	8,031	8,035	-46
Grid Location Point 12	9,014	9,012	-2
Grid Location Point 13	7,925	7,852	-73
Phantom Ranch	11,027	11,313	286
Toroweap/Shimomo Flight Free Zone			
Grid Location Point 10	2,931	3,253	322
Grid Location Point 18	8,449	5,106	-3,342
Point Sublime	3,760	4,076	316
Bass Camp	13,358	13,352	-5
Rainbow Plateau	14,878	14,974	96

Δ indicates change in noise metric data from Alternative A

Central Modified NPS Preferred Alternative Wildlife
All Scenarios

Similar to Alternative A, Wildlife and habitat throughout most of the **Central area** would be little affected by air-tour aircraft noise. There would be little difference in sound metrics compared to Alternative A. As shown in Tables 4.143 and 4.144, air-tour aircraft Percent Time Audible would generally be less than 10% (with greatest exception being **15%** Percent Time Audible at **Prospect Canyon** Location Point), with Average Sound Level zero to **17** dBA (except **Prospect Canyon** Location Point at **18** dBA and **South Supai Canyon** Location Point at **29** dBA). Air-tour aircraft would generally be greater than 7,000 meters from locations on the ground (except **Prospect Canyon** and **South Supai Canyon** at 1,500 meters). Wildlife activities and behaviors such as foraging and roosting would generally be little affected by air-tour aircraft. Negligible to minor adverse impacts would continue with negligible change from Alternative A.

1 **Table 4.143** *Modified NPS Preferred Alternative* **Average Sound Level** **Central**

Location Point Name	Alternative A		<i>Modified NPS Preferred Alternative</i>																	
			Peak Season										Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Havatagvitch Canyon	1	1	7	8	1	0	1	0	7	0	7	0	1	0	1	0	7	0	7	-1
Supai Village	0	0	5	13	0	0	0	0	5	0	5	-8	0	0	0	0	4	-1	5	-8
Coyote Canyon	0	0	16	16	0	0	0	0	16	0	16	0	0	0	0	0	16	0	16	0
Mohawk Canyon	1	1	11	12	0	-1	0	-1	8	-3	8	-4	0	0	-1	8	-3	8	-4	
Mohawk Canyon	2	2	11	12	0	-2	0	-2	5	-6	5	-7	0	-2	0	-2	5	-6	5	-7
Prospect Canyon	22	25	22	22	14	-8	15	-10	18	-4	18	-4	2	-7	14	-11	18	-4	17	-15
The Dome	1	1	16	16	1	0	1	0	12	-4	12	-4	1	0	1	0	12	-4	12	-4
Fossil Canyon	2	2	12	12	1	-1	1	-1	13	1	10	-2	1	-1	1	-1	11	-1	10	-2
Grid Location Point 21	2	2	14	14	2	0	2	0	14	0	14	0	2	0	2	0	14	0	14	0
Grid Location Point 22	18	21	12	13	1	-17	1	-20	9	-3	9	-4	1	-17	1	-20	8	-4	8	-5
Grid Location Point 25	11	12	9	10	2	-9	2	-10	6	-3	7	-3	2	-9	2	-10	6	-3	6	-4
Grid Location Point 9	1	1	5	5	1	0	0	0	6	0	4	-1	1	0	0	-1	5	0	3	-3
South Supai Canyon	6	7	27	27	1	-5	2	-5	18	-9	29	2	1	-5	2	-5	18	-9	19	-8

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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1 **Table 4.144 Modified Preferred Alternative Slant Distances Central**

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Havatagvitch Canyon	3,668	5,007	1,338
Supai Village	163	1,319	1,156
Coyote Canyon	7,651	7,703	52
Mohawk Canyon	3,009	3,009	0
Mohawk Canyon	6,304	6,304	0
Prospect Canyon	1,550	1,550	0
The Dome	13,109	13,119	10
Fossil Canyon	10,346	12,405	2,060
Grid Location Point 21	20,393	20,401	8
Grid Location Point 22	26,089	26,095	6
Grid Location Point 25	20,188	20,216	28
Grid Location Point 9	11,103	19,140	8,038
South Supai Canyon	1,480	1,557	76

Δ indicates change in noise metric data from Alternative A

2
3
4 **West End Modified NPS Preferred Alternative Wildlife**

5
6 A range of aircraft noise intensities and audibility would affect Wildlife and habitats. West End is a mixture of
7 warm- and cold-desert shrub, piñon-juniper, and riparian habitat along the river. West End Wildlife and habitat
8 would be exposed to varying levels of aircraft noise depending on proximity to Blue-2, Green-4, and **the Z-shaped**
9 **Route (realigned Blue Direct)**. Base Year Peak Season, aircraft Percent Time Audible would be greater than **or**
10 **equal to** 25% of the day in **30%** of piñon-juniper habitat; **52%** of cold-desert scrub; **44%** of warm-desert scrub; and
11 **39%** of river/riparian habitat (due to masking by river sounds). However, in areas away from routes (Sanup Flight-
12 free Zone), there is also a large amount of habitat that would experience very infrequent aircraft noise, with Average
13 Sound Level relatively low (the majority of the area exposed to sound levels of 25 dBA or less).

14
15 *West End Modified NPS Preferred Alternative Wildlife*
16 *Base Year Peak and Off-Peak Season*

17 Wildlife habitat near Green-4 and Blue-2, represented by Location Points **Burnt Springs Canyon, Bat Cave,**
18 **and Grid Location Point 33**, would be exposed to air-tour aircraft impacts similar to those described in
19 Alternative A and shown in Tables 4.145 and 4.146. Air-tour aircraft Percent Time Audible would be **61** to 93%
20 of the day at Average Sound Level **42** to **45** dBA. Wildlife activities could be disrupted frequently which may
21 result in displacement from suitable habitats for nesting and foraging that could affect population levels. Short-
22 term major adverse impacts would continue with negligible change in impacts from Alternative A.

23
24 *West End Modified NPS Preferred Alternative Wildlife*
25 *Ten-Year Forecast Peak and Off-Peak Season*

26 Near Green-4 and Blue-2, air-tour aircraft Percent Time Audible would decrease to **54** to 88%, a 7 to 10%
27 decline from Alternative A. Average Sound Level would be similar to Alternative A. Although short-term major
28 adverse impacts would continue under air-tour routes, there would generally be a short-term minor beneficial
29 change in impacts compared to Alternative A.

30
31 *West End Modified NPS Preferred Alternative Wildlife*
32 *All Scenarios*

33 **Areas proximal to the Z-shaped Route (Blue Direct)** as represented by **Grid Location Points 27 and 32,**
34 would experience aircraft Percent Time Audible would be **4 to 10%** of the day, with Average Sound Level **19 to**
35 **22** dBA. Aircraft would be nearly 5,000 meters **to 18,000 meters** from locations on the ground. Wildlife
36 activities could be interrupted throughout the day by aircraft. Moderate adverse impacts would continue with
37 negligible change from Alternative A.

1 Near Brown routes, represented by **Parashant Wash** and **Whitmore Rapids** Location Points, aircraft Percent
2 Time Audible would be 11 to **20%** at Average Sound Level **24 to 29** dBA, similar to Alternative A. Aircraft
3 would be at least 1,800 to nearly 3,000 meters away. Wildlife would be disturbed for relatively small portions of
4 the day. Minor to moderate adverse impacts would occur with negligible change from Alternative A.
5
6 Base Year Peak Season Wildlife and habitat located **under Sanup Flight-free Zone** and **areas near the south**
7 **SFRA boundary** would be negligibly affected by air-tour operations. Air-tour aircraft would be rarely audible at
8 Average Sound Level of less than one to 7 dBA as reflected in Location Point data at **Diamond Creek,**
9 **Pumpkin Springs,** and **Grid Location Point 34**. Impacts of air-tour aircraft on wildlife in Sanup Flight-free
10 Zone and to the south would be negligible with negligible change in impacts from Alternative A.

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1 **Table 4.145 Modified NPS Preferred Alternative Average Sound Level West End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Burnt Springs Canyon	70	75	46	47	63	-7	58	-17	45	-1	43	-4	61	-9	54	-21	45	-1	42	-5
Bat Cave	93	95	47	48	93	0	88	-7	45	-2	43	-5	91	-2	85	-10	44	-3	43	-5
Grid Location Point 33	87	90	42	43	80	-7	55	-35	42	0	38	-5	81	-6	57	-33	42	0	38	-4
Whitmore Rapids	12	13	21	21	19	7	20	7	29	8	28	7	18	6	17	4	28	7	27	6
Grid Location Point 31	37	41	42	43	2	-35	2	-39	11	-31	12	-31	2	-35	2	-39	11	-31	11	-32
Mt. Dellenbaugh	29	32	41	42	1	-28	1	-31	17	-24	18	-24	-28	1	-31	17	-24	18	-24	
Shivwits Fire Camp	35	39	38	38	1	-34	2	-37	18	-20	19	-19	-35	2	-37	18	-20	19	-19	
Grid Location Point 28	14	16	17	18	5	-9	3	-13	15	-2	17	1	3	-11	3	-9	15	-2	17	-1
Grid Location Point 32	44	49	27	28	4	-40	5	-44	21	-6	22	-6	4	-40	5	-44	21	-6	22	-6
Granite Peak	2	2	17	18	2	0	2	0	15	-2	16	2	2	0	2	0	15	-2	16	--2
NPS Administration site	44	49	31	32	15	-29	2	-47	20	-11	20	-12	20	-24	2	-47	19	-12	20	--12
Castle Peak	27	30	18	48	43	16	48	18	22	4	33	-25	44	17	44	14	22	4	22	-26
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grid Location Point 27	20	23	26	27	9	-6	10	-3	19	0	19	-8	10	-20	9	-14	19	-7	19	-8
Grid Location Point 34	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0
Parashant Wash	12	14	33	33	11	-1	14	0	24	-9	24	-9	11	-1	12	-2	25	-8	24	-9
Pumpkin Springs	0	0	7	8	0	0	0	0	0	7	-1	0	0	0	0	0	7	0	7	-1
Meriwhitca	0	1	7	8	0	0	0	0	4	-3	4	-4	0	0	1	0	6	-1	7	0
Andrus Canyon	22	24	17	17	47	23	55	17	36	19	36	19	48	26	51	27	37	20	36	19

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2

1 **Table 4.146 Modified Preferred Alternative Slant Distances West End**

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,134	1,134	0
Grid Location Point 33	1,105	1,105	0
Whitmore Rapids	1,804	1,804	0
Grid Location Point 27	3,388	4,923	1,535
Grid Location Point 28	8,327	21,438	13,111
Grid Location Point 31	502	11,367	10,865
Mt. Dellenbaugh	824	17,901	17,077
Shivwits Fire Camp	1,669	17,030	15,361
Grid Location Point 32	2,016	18,618	6,602
Granite Peak	5,264	12,090	6,826
NPS Administration site	3,719	3,719	0
Castle Peak	8,629	8,629	0
Diamond Creek	27,108	33,411	6,303
Parashant Wash	2,852	2,852	0
Pumpkin Springs	12,630	19,695	7,065
Meriwhitca	15,742	15,742	0
Andrus Canyon	1,393	1,393	0

Δ indicates change in noise metric data from Alternative A

2
3
4 **Cumulative Impact****Modified NPS Preferred Alternative****Wildlife**

5
6 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
7 *actions. In this context, Cumulative Impacts include impacts on Wildlife from sounds of*

- 8 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
9 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
10 *3) ground-based noise sources, plus*
11 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

12
13 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
14 *(Modified NPS Preferred Alternative).*

15
16 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
17 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
18 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
19 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
20 *SFRA see Appendix D, Figures 91 to 94).*

21
22 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
23 *Wildlife, but is mostly concentrated in the Developed Zone (2% of the park), although a small component exists*
24 *in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire management*
25 *activities, and mining activities outside the park. Noise from ground-based sources is discussed in Chapter 3,*
26 *Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time Audible*
27 *capable of masking some aircraft noise.*

28
29 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
30 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
31 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
32 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*

1 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 2 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 3 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon’s rare*
 4 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 5 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
 6 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
 7 *noise some of the time.*

8
 9 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 10 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
 11 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
 12 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
 13 *Alternatives (Modified NPS Preferred Alternative in this case).*

14
 15 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
 16 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
 17 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
 18 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
 19 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
 20 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
 21 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
 22 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

23
 24 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
 25 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (A Modified NPS Preferred Alternative*
 26 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*
 27 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
 28 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
 29 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
 30 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
 31 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
 32 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
 33 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

34
 35 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 36 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
 37 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
 38 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

39
 40 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 41 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 42 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 43 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 44 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 45 *Cumulative Impacts discussion in the Conclusions section below.*

46
 47 **Conclusion** **Modified NPS Preferred Alternative** **Wildlife**

48
 49 Overall, the **Modified** NPS Preferred Alternative would result in beneficial change in impacts compared with
 50 Alternative A due to reduced area exposed to high Percent Time Audible and high Average Sound Level. Ten-Year
 51 Forecast the **Modified** NPS Preferred Alternative would result in improvement in wildlife habitat and reduction of
 52 impacts on wildlife as aircraft noise is reduced by implementation of quiet-technology incentives and conversion
 53 requirements. Ten-Year Forecast Peak Season, 27% of the park would have air-tour aircraft Percent Time Audible
 54 greater than *or equal to* 25% of the day. **Amount of the park in which air-tour aircraft Average Sound Level**
 55 **would be greater than or equal to 35 dBA Ten-Year Forecast Peak Season would be 9% compared to 23% in**
 56 **Alternative A.** Greatest exposure to noise and visual impacts would occur predominantly under and near heavily-

1 used air-tour routes East and West Ends where aircraft Average Sound Level would be 40 to 50 dBA, and Percent
 2 Time Audible would be greater than 75% of the day. However, there would also be large portions of habitat
 3 relatively undisturbed by air-tours in Marble Canyon and the Central area.

4
 5 **Conclusion** *Modified NPS Preferred Alternative* **Wildlife**

6
 7 *Conclusion* *Modified NPS Preferred Alternative* *Wildlife*
 8 *Marble Canyon*

9 All Scenarios, the NPS Preferred Alternative would generally result in negligible adverse impacts with *minor to*
 10 *moderate* beneficial changes in impacts to Marble Canyon wildlife compared to Alternative A.

11
 12 *Conclusion* *Modified NPS Preferred Alternative* *Wildlife*
 13 *East End*

14 East End there would be localized beneficial change in impacts to Wildlife and habitat due to *seasonal closures of*
 15 short-loop air-tour routes in Zuni Point *Corridor and the long-loop route*. Base Year Peak Season impacts to
 16 Wildlife and habitat beneath and adjacent to active Dragon *and Zuni Point Corridors* would be moderate to major
 17 adverse with negligible to minor beneficial change in impacts compared to Alternative A. Ten-Year Forecast with
 18 conversion to quiet-technology aircraft, there would still be *minor* to major adverse impacts under and near the
 19 *corridors*, but there would be minor to *major* beneficial change in impacts compared to Alternative A. Off-Peak
 20 Season, when *Zuni Point* Corridor would be closed to all air tours, there would be negligible adverse impacts Base
 21 Year *and* Ten-Year Forecast, with long-term minor to major beneficial change in impacts compared to Alternative A.

22
 23 *Base Year Peak Season beneath and adjacent to Dragon Corridor and North Rim routes*, moderate to major
 24 adverse impacts would occur to wildlife with a *short-term minor beneficial* change in impacts from Alternative A.
 25 *However*, Ten-Year Forecast Peak Season, although impacts would remain at moderate to major adverse levels they
 26 would decrease and there would be a moderate to major beneficial change in impacts at many points compared to
 27 Alternative A due to conversion to quiet-technology aircraft. Off-Peak Season *Base Year and Ten-Year Forecast*,
 28 there would be moderate to major beneficial change in impacts compared to *Alternative A* in areas *near and under*
 29 North Rim *due to the seasonal closure (November 15 – March 31)*.

30
 31 *Ten-Year Forecast there would generally be minor to moderate adverse impacts with short- and long-term minor*
 32 *to major beneficial change in impacts compared to Alternative A at locations beneath* Bright Angel Flight-free
 33 Zone near air-tour routes *and along North Rim in Peak and Off-Peak Seasons. East End areas removed from air-*
 34 *tour routes, such as amid Bright Angel Flight-free Zone, there would be negligible adverse impacts and*
 35 *negligible beneficial change from Alternative A.*

36
 37 *Conclusion* *Modified NPS Preferred Alternative* *Wildlife*
 38 *Central*

39 All Scenarios, there would generally be negligible to minor adverse impacts in the Central area with negligible
 40 change in impacts on Wildlife and habitat compared to Alternative A.

41
 42 *Conclusion* *Modified NPS Preferred Alternative* *Wildlife*
 43 *West End*

44 All Scenarios, in areas under and near Green-4 and Blue-2 routes, there would be short-term major adverse impacts
 45 with minor beneficial change in impacts compared to Alternative A. All Scenarios, in areas near Brown routes,
 46 wildlife would experience minor to moderate adverse impacts with negligible change in impacts compared to
 47 Alternative A. All Scenarios, under *the Z-shaped Route (realigned Blue Direct)*, wildlife would experience
 48 moderate adverse impacts with negligible *to minor beneficial* change in impacts compared to Alternative A. All
 49 Scenarios, Wildlife in Sanup Flight-free Zone and near the southern SFRA boundary would generally experience
 50 negligible impacts with negligible change in impacts compared to Alternative A.

51
 52 **Cumulative Impacts Summary** *Modified NPS Preferred Alternative* **Wildlife**

53
 54 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 55 *impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is, Ten-*
 56 *Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble*

1 ***Canyon, East End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and***
2 ***near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of Flight-free Zones. In***
3 ***comparison with the other Alternatives, Modified NPS Preferred Alternative ranks second behind Alternative E***
4 ***for the lowest overall Cumulative Impacts (Alternative A ranks last).***

6 SPECIAL-STATUS SPECIES

8 General Methodology

10 As described in Chapter 3, area of analysis for Special Status Species includes the park, but may also extend to the
11 SFRA and throughout the Study Area. To the extent habitat and species occurrences correlate, impacts to park
12 species and habitats are expected to be similar in the entire Study Area. Effects of aircraft noise and proximity to
13 Special Status Species and their habitats are analyzed in the context of natural variability and ecosystem integrity, as
14 well as effects on individuals and populations. Responses to impacts may sometimes be species-specific. This
15 analysis applies to Federal, state, and tribal listed species and, in the context of NPS lands, other Special Status
16 Species as discussed in Chapter 3. Impacts are assessed for each Alternative by species: American peregrine falcon,
17 ***bald eagle, golden eagle, Southwest willow flycatcher***, California condor, and Mexican spotted owl. Other Special
18 Status Species (see Appendix E) are not included here for reasons described in Chapter 1, Impact Topics Considered
19 and Dismissed from Detailed Analysis.

21 Analysis relies on noise modeling results at Location Points in the park and SFRA. Noise data by Location Point is
22 often presented as a range to provide understanding of level of effect for specific areas influenced by air-tour
23 operations. In addition, as presented in Appendix F, spatial analysis for Mexican spotted owls, California condors,
24 ***and southwestern willow flycatchers*** was conducted using noise contour data (Chapter 4, Methodology) to
25 determine percent of each Special Status Species use area within a range of sound metrics (Average Sound Level
26 and Percent Time Audible) for each geographic area (Marble Canyon, East End, Central, and West End). ***Also, see***
27 ***the beginning of Chapter 4, General Methodology for discussion of overall methodology for impact analysis for***
28 ***all impact topics.***

30 General Assumptions

32 In the thresholds below, and as described in Chapter 4, Wildlife, General Assumptions, all aspects of aircraft noise
33 intensity and duration including, but not limited to, audibility, aircraft Average Sound Level (sound energy metrics),
34 and timing are considered in the phrase *impacts due to the event*. Audibility is the ability of animals and humans
35 with normal hearing to hear a given sound. Audibility is affected by the animal's hearing ability, other simultaneous
36 interfering sounds or stimuli, sound frequency content and amplitude, and whether the sound contains information
37 the animal has learned to pay attention to or ignore. Sound energy metrics include Average Sound Level and Percent
38 Time Audible decibel levels.

40 Percent Time Audible relates to human hearing (audibility) used here as a surrogate for sounds heard by wildlife,
41 understanding different animals can hear sounds at different sound frequencies and levels, and some hear sounds at
42 frequencies humans cannot. Use of human audibility as a surrogate for impacts related to wildlife audibility is
43 reasonable for this impact analysis because the type of noise generated by aircraft mostly falls within the human
44 hearing range, and wildlife species of interest in this analysis can also hear quite well in the human hearing range
45 even though some can also hear in ranges humans cannot.

47 A measure of Distance between representative Special Status Species habitat Location Points and aircraft routes is
48 used as an indicator related to effects of aircraft in close proximity to sensitive wildlife species or habitats, including
49 aircraft visibility and presence to wildlife on the ground. While there is usually close correlation between distance
50 and sound intensity, this distance measure is included primarily to address effects other than aircraft noise. Distance
51 of aircraft to locations on the ground is also used as an indicator of potential for collisions with California condors,
52 peregrine falcons, ***and eagles***. In late 1999 and early 2000, a formal section 7 consultation (2-21-97-F-085) was
53 conducted by Grand Canyon National Park and the U.S. Fish and Wildlife Service Arizona Ecological Services
54 Office regarding new flight rules for commercial air-tours in the vicinity of the park. During this process potential
55 for collisions with aircraft was identified as an issue of concern. Bird strikes have occurred in Grand Canyon
56 National Park in the past; however, they were not considered significant enough to report to the FAA (61 FR

1 54044). As condors, falcons, *eagles*, and air-tour aircraft may occupy the same airspace, potential exists for
 2 collisions; therefore, this issue is addressed in analysis for these species.

3
 4 Although wildlife would tend to habituate (i.e., become accustomed to or tolerant of noise) to frequent audible
 5 aircraft with lower Average Sound Level (especially those not close to the ground), habituation in natural areas in a
 6 national park is an adverse impact (Barber, Turina, and Frstrup 2009/2010).

8 **Impact Intensity Threshold Descriptions**

Special Status Species

9
 10 Professional judgment and knowledge of Grand Canyon wildlife and habitat was applied in using intensity
 11 thresholds described below to make impact determinations for Special Status Species where data related to specific
 12 situations fell into more than one intensity threshold (negligible, minor, moderate, major). Not all conditions need to
 13 be met for an impact threshold level to apply. For example, where Percent Time Audible is at levels considered
 14 major in the thresholds (greater than 25% Percent Time Audible), but Average Sound Level and Distance are at
 15 levels considered negligible (less than or equal to 15 dBA and greater than or equal to 2,000 meters), then impact
 16 level would generally be considered moderate adverse, when reasonably consistent with other portions of thresholds
 17 for moderate levels (observable and measurable impacts, no risk of extirpation, changes outside natural variability,
 18 etc.), absent any over-riding information more relevant to impact determination indicating a different level.

19
 20 Similarly, where Percent Time Audible is at levels considered moderate in the thresholds (greater than 10% and less
 21 than or equal to 25% Percent Time Audible), but Average Sound Level and Distance are at levels considered
 22 negligible (less than or equal to 15 dBA and greater than or equal to 2,000 meters), then impact level would
 23 generally be considered minor adverse, when reasonably consistent with other portions of thresholds for minor
 24 levels (observable or measurable impacts, changes not outside natural variability and no effects at the population
 25 level, etc.), absent any over-riding information more relevant to impact determination indicating a different level.

27 **Threshold Levels**

Special Status Species

28
 29 *Negligible* Impacts due to the event have no observable effects to a Special Status Species or habitat

30 Impacts outside critical periods such as breeding season

31 Distance from points of interest to aircraft routes greater than 2000 meters

32 Aircraft noise rarely audible, i.e., aircraft audible less than 5% of the 12-hour day in this analysis

33 Aircraft noise intensity in a specific area is less than 15 dBA

34
 35 *Minor* Impacts due to the event have observable or measurable effects to individuals of a Special Status
 36 Species or localized habitats

37 Severity and timing of changes to parameter measurements not outside natural variability and have
 38 no effects on species at the population level, including distributions, behaviors, habitat, or
 39 ecosystem processes

40 Impacts outside critical periods such as breeding season

41 Distance from points of interest to aircraft routes greater than 1,000 meters and less than *or equal*
 42 *to* 2,000 meters

43 Aircraft noise audible for a small portion of applicable time periods, i.e., aircraft audible greater
 44 than *or equal to* 5% and less than 10% of the 12-hour day

45 Aircraft noise intensity in a specific area greater than *or equal to* 15 dBA and less than 25 dBA

1	<i>Moderate</i>	Impacts due to the event observable and measurable to individuals or a population of a Special
2		Status Species or its habitat
3		
4		No species is at risk of being extirpated
5		Severity and timing of changes to parameter measurements sometimes fall outside natural
6		variability, and changes within natural variability might be long term
7		
8		Measurable changes occur from natural variability (which could be from displacement) on
9		species' populations including numbers, structure, distributions, behaviors, genetic variability, or
10		other demographic factors
11		
12		Some impacts affect critical periods, key habitat, ecosystem processes, or activities necessary for
13		survival, but effects are temporary and populations expected to return to pre-disturbance
14		conditions, and remain indefinitely stable and viable
15		
16		Distance from points of interest to aircraft routes greater than 500 meters and less than <i>or equal to</i>
17		1,000 meters
18		
19		Aircraft noise audible for an intermediate portion of applicable time periods, i.e., aircraft audible
20		greater than <i>or equal to</i> 10% and less than 25% of the 12-hour day
21		
22		Aircraft noise intensity in a specific area greater than <i>or equal to</i> 25 dBA and less than 35 dBA
23		
24	<i>Major</i>	Impacts due to the event readily measurable to a population of a Special Status Species or its
25		habitat
26		
27		Severity and timing of changes to parameter measurements often outside natural variability by a
28		large amount or for long periods. Changes within natural variability might be long term or
29		permanent
30		
31		Population numbers, structure, distributions, behaviors, genetic variability, habitat, other
32		demographic factors, or reproduction could have large long-term changes from natural variability
33		and may not rebound to pre-disturbance conditions or remain stable and viable
34		
35		In severe adverse cases, species at risk of extirpation, key ecosystem processes could be disrupted,
36		or habitat for one or more species rendered not functional
37		
38		Substantial impacts could occur during critical time periods
39		
40		Distance from points of interest to aircraft routes less than <i>or equal to</i> 500 meters
41		
42		Aircraft noise audible for a large portion of applicable time periods, i.e., aircraft audible greater
43		than <i>or equal to</i> 25% of the 12-hour day
44		
45		Aircraft noise intensity in a specific area greater than <i>or equal to</i> 35 dBA
46		
47	Type of Impact	Special Status Species
48		
49	<i>Adverse</i>	Impacts adversely affect size, continuity, or integrity of Special Status Species or habitat outside
50		normal range of variability, move habitat areas away from desired conditions, or impede normal
51		breeding, foraging, or resting behavior or lead to a loss of nesting, foraging, or dispersal habitat.
52		Other examples are events that could result in direct mortality, temporal or spatial displacement of
53		wildlife from habitat, habitat fragmentation, or reduction of habitat quality
54		
55	<i>Beneficial</i>	Impacts positively affect size, continuity, or integrity of individual Special Status Species or
56		habitat, move habitat areas toward desired conditions, enhance normal breeding, foraging, or

resting behavior, or lead to an increase in nesting, foraging, or dispersal habitat. ***Beneficial effects are usually described in terms of changes in impacts compared to Alternative A***

Context

Regional Impacts affect a large part of the population or a widespread area of suitable habitat or a species' range within the park or SFRA

Localized Impacts confined to a small part of the population or to a small percentage of suitable habitat or a species' range within the park or SFRA

Park Management Zone Although impacts to Special Status Species and habitat do not differ greatly across Park Management Zones, the way those impacts are assessed may vary across Zones. For example, an aircraft Average Sound Level consistent with the moderate intensity level definition in the Wilderness Zone may be considered a minor intensity impact in the Developed Zone because management objectives may allow greater impacts in developed areas

Duration

Short Term Impacts to an individual, population, or habitat area last up to one year

Long Term Impacts to an individual, population, or habitat area last longer than one year

Timing

Impacts could occur year-round, but wildlife would typically be most sensitive to impacts during spring and summer months when breeding, incubation, and birthing/hatching occur. Certain species may exhibit high-sensitivity levels during rearing of young. Some species may also be more vulnerable during late fall or winter when heavy snowfall may limit food supplies or otherwise place them in a weakened state. In addition, species may be more sensitive to disturbance during the time they are most active (e.g., owls and bats most active feeding at night while passerine birds most active during daylight hours)

Peregrine Falcon

Special Status Species

Peregrine falcon territories are found along the river and canyons throughout the park and SFRA. Falcons use canyon walls for nesting and perching, but they are typically found in the park March 1 through October 31. In all Alternatives except Alternative F, there would be effects to the falcon both Peak and Off-Peak Season, although East End when route-use alternates seasonally, impacts may be only for a few months. In Alternative F, Off-Peak Season is represented by two months (December through January) when Dragon Corridor routes shift seven-miles west. **As falcons are not present in the park at this time, there would be no effect from this shift and, therefore, no analysis of Off-Peak Season under Alternative F.**

ALTERNATIVE A

NO ACTION

SPECIAL STATUS SPECIES

PEREGRINE FALCON

In Marble Canyon, Central areas, and West End's southern portion (Sanup Flight-free Zone), aircraft Average Sound Level would generally be less than 15 dBA with Percent Time Audible less than 5% of the day. In these areas, air-tour aircraft noise would be very infrequent and at low sound levels resulting in little disturbance to falcons. Greatest exposure to noise and visual impacts would occur under and near East and West End heavily-used air-tour routes where aircraft Average Sound Level would be 40 to 50 dBA with Percent Time Audible greater than 75%. Under this Alternative, falcon populations would stay stable but individual falcons could be displaced from suitable habitats and establishing additional nesting sites (eyries) in portions of East End and West End. There would generally be no appreciable change in impact to falcons Ten-Year Forecast compared to Base Year.

Marble Canyon

Alternative A

Special Status Species

Peregrine Falcon

All Scenarios

In **Marble Canyon**, falcons would experience mostly quiet conditions with little disruption from air-tour aircraft. Based on Location Point information in Table 4.147 and 4.148, falcons in Marble Canyon would be exposed to air-tour aircraft Percent Time Audible zero to 3% of the day with Average Sound Level zero to 24 dBA. Aircraft in this area would generally be more than 2,000 meters Distant from points on the ground. In few locations (e.g. **North** and **South Canyon** Location Points), aircraft would be between 800 and 1,000 meters from points on the ground. With limited air-tour noise Percent Time Audible at low Average Sound Level, and with air-tour aircraft Distant from locations on the ground, there would be little potential for disturbance to falcons. There would not be expected effect on population levels or area use, although some individuals may be disturbed for short-periods. Impacts to falcons would generally be short-term negligible to minor adverse. Impacts would increase a small amount Ten-Year Forecast, but would generally remain at the same impact intensity levels.

Table 4.147 Alternative A Average Sound Level Marble Canyon

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Cliff Dwellers Lodge	1	1	6	10
Grid Location Point 1	0	0	15	17
Grid Location Point 2	2	3	16	19
Grid Location Point 3	3	3	14	16
Grid Location Point 4	0	0	0	
Grid Location Point 5	2	2	8	12
Marble Canyon Dam Site	0	0	3	4
North Canyon	3	3	24	25
South Canyon	2	3	21	23

Table 4.148 Alternative A Slant Distances Marble Canyon

Location Point Name	Slant Distance (m)
Cliff Dwellers Lodge	3,695
Grid Location Point 1	1,665
Grid Location Point 2	858
Grid Location Point 3	2,958
Grid Location Point 4	4,565
Grid Location Point 5	3,385
Marble Canyon Dam Site	3,845
North Canyon	999
South Canyon	816

East End Alternative A Special Status Species

Peregrine Falcon

Base Year

In areas beneath and adjacent to **Zuni Point and Dragon Corridors** represented by Location Points **Hermit Basin, Tower of Ra, and Point Sublime**, air-tour Average Sound Level would range 28 to 45 dBA. In areas **along South and North Rims**, represented by Location Points **The Basin and 1.5 km SE of Moran Point**, air-tour Distance would be less than 500 meters. In areas with flights close to the rim, and with persistent air-tour noise under the Corridors, there would be potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering, and for collisions with aircraft along rims in areas where aircraft would be at lower altitudes. According to park Biologists, eyries occur at a reduced density in areas beneath current air-tour routes. This may indicate nearly continuous high-level noise during summer is restricting peregrine use of suitable habitats (NPS 2010c). As a result, short- and long-term moderate to major adverse impacts on falcons would continue in areas beneath air-tour routes.

1 East End, areas more distant from air-tour routes would experience lower levels of air-tour noise. In
 2 **Toroweap/Shinumo Flight-free Zone's eastern portion**, away from Dragon Corridor and amid Bright Angel
 3 Flight-free Zone, represented by Location Points **Phantom Ranch, Grid Location Points 12 and 13**, and **Bass**
 4 **Camp**, falcons would experience quiet conditions. Air-tour sounds would interrupt or disturb falcon behaviors
 5 less often with air-tour aircraft Percent Time Audible less than 5% of the day with Average Sound Level 7 to 13
 6 dBA. In these areas, air-tour aircraft would be very far from locations on the ground, approximately 8,000 to
 7 over 13,000 meters. Individuals may be disturbed from normal behaviors, but would be expected to return to
 8 within normal ranges after air-tour activity with no population-level changes. In these areas, short-term impacts
 9 on falcons would be negligible to minor adverse.

10 **East End Alternative A Special Status Species**

11 **Peregrine Falcon**

12 *Ten-Year Forecast*

13 Although aircraft operations and Average Sound Level would increase a small amount, impacts would not
 14 change appreciably Base Year to Ten-Year Forecast East End.

15 **Table 4.149 Alternative A Average Sound Level East End**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Fore cast	Base Year	Ten Year Fore cast
Dragon Corridor				
96 Mile Camp	72	74	45	45
Tower of Ra	97	98	44	45
Hermit Basin	99	100	42	42
North Rim				
Bright Angel Point	47	48	24	24
Point Imperial	66	68	38	39
The Basin	73	75	48	48
Grid Location Point 16	80	84	33	34
Zuni Point Corridor				
Grid Location Point 14	70	74	34	34
Grid Location Point 15	65	69	28	29
Temple Butte	62	66	37	38
South Rim				
Tusayan Museum	64	67	35	36
1.5 km SE of Moran Point	64	68	41	41
Bright Angel Flight Free Zone				
Cape Royal	59	61	25	26
Grid Location Point 11	53	56	18	18
Grid Location Point 12	1	1	13	14
Grid Location Point 13	1	1	12	13
Phantom Ranch	3	4	12	12
Toroweap /Shinumo Flight Free Zone				
Grid Location Point 10	92	92	25	25
Grid Location Point 18	60	60	16	17
Point Sublime	100	100	35	35
Bass Camp	0	0	7	7
Rainbow Plateau	0	0	6	7

18
19

1 **Table 4.150 Alternative A Slant Distances East End**

Location Point Name	Slant Distance (m)
Dragon Corridor	
96 Mile Camp	1,573
Tower of Ra	1,147
Hermit Basin	1,518
North Rim	
Point Imperial	2,292
Bright Angel Point	6,235
The Basin	477
Grid Location Point 16	2,589
Zuni Point Corridor	
Grid Location Point 14	687
Grid Location Point 15	1,637
Temple Butte	1,458
South Rim	
Tusayan Museum	2,016
1.5 km SE of Moran Point	448
Bright Angel Flight Free Zone	
Cape Royal	4,038
Grid Location Point 11	8,081
Grid Location Point 12	9,014
Grid Location Point 13	7,925
Phantom Ranch	11,027
Toroweap/Shinumo Flight Free Zone	
Grid Location Point 10	2,931
Grid Location Point 18	8,449
Point Sublime	3,760
Bass Camp	13,358
Rainbow Plateau	14,878

2
3
4 **Central Alternative A Special Status Species**
5 **Peregrine Falcon**
6 *Base Year*

7 In the **Central area**, falcons would be little affected by air-tour and general-aviation aircraft noise. This area
8 comprises **Toroweap/Shinumo Flight-free Zone**'s middle and western portions, as well as **Fossil Canyon and**
9 **Tuckup General Aviation Corridors**. Based on Location Point data in Tables 4.151 and 4.152, Percent Time
10 Audible would range less than one to 11%, and falcons would be exposed to low air-tour Average Sound Level
11 less than one to 13 dBA. Aircraft in the Central area would be greater than 7,000 meters Distant. With limited
12 presence of air-tour noise at low Average Sound Level, and air-tour aircraft distant from locations on the ground,
13 there would be little potential for falcon disturbance with no expected effect on population levels. Individuals
14 may be disturbed from normal behaviors, but would be expected to return to normal ranges after air-tour activity.
15 Impacts to falcons would be short-term negligible to minor adverse.

16
17 *Central Alternative A Special Status Species*
18 *Peregrine Falcon*
19 *Ten-Year Forecast*

20 Although aircraft operations and Average Sound Level would increase a small amount, impacts would not
21 change appreciably Base Year to Ten-Year Forecast.
22
23

1 **Table 4.151 Alternative A Noise Metrics Central**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
1 km W of Kanab Point	2	2	9	9
Grid Location Point 9	1	1	5	5
Grid Location Point 20	0	0	4	4
Grid Location Point 25	11	12	9	10
Havasu Point	0	0	0	0
Kanab Point	1	1	6	7
Mt. Sinyala	1	1	0	0
Stone Creek	0	0	0	0
Surprise Valley	1	1	0	0
Toroweap Overlook	0	0	13	14
Upper Deer Creek	1	1	1	1

2
3 **Table 4.15247 Alternative A Slant Distances Central**

Location Point Name	Slant Distance (m)
1 km W of Kanab Point	18,850
Grid Location Point 9	11,103
Grid Location Point 20	22,053
Grid Location Point 25	20,188
Havasu Point	10,450
Kanab Point	19,021
Mt. Sinyala	7,272
Stone Creek	21,882
Surprise Valley	25,500
Toroweap Overlook	9,425
Upper Deer Creek	23,663

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4
5
6 **West End Alternative A Special Status Species**
7 **Peregrine Falcon**
8 Base Year

9 West End, falcons would be affected by heavy helicopter traffic for river access near Grand Canyon West and, to
10 a lesser extent, the Whitmore area, and by direct fixed-wing flight routes between Las Vegas and Grand Canyon
11 Airport. However, a large West End portion would be mostly free from air-tour noise under Sanup Flight-free
12 Zone.

13
14 In areas under Green-4 and Blue-2, represented by Location Points **Bat Cave, Burnt Springs Canyon, and Grid**
15 **Location Point 33** and shown in Tables 4.153 and 4.154, air-tour aircraft Percent Time Audible would be 70 to
16 93% of the day with aircraft Average Sound Level 42 to 47 dBA. Aircraft would be approximately 1,100 to
17 1,215 meters from the ground. Under and close to these routes, there would be potential to disrupt normal
18 behavior patterns such as breeding, feeding, or sheltering. This level of aircraft noise may result in long-term
19 changes in population numbers and structure. As a result, short- and long-term moderate to major adverse
20 impacts on falcons would occur due to noise persistence at high sound levels in areas close to Green-4/Blue-2.

21
22 In areas **under Blue Direct routes** where falcon territories occur, represented by **Grid Location Points 27 and**
23 **32**, air-tour aircraft Percent Time Audible would be 20 to 44% of the day at Average Sound Level 26 to 27 dBA.
24 In these areas aircraft would be at 2,016 to 3,388 meters from points on the ground. Impacts to falcons in areas
25 under and near air-tour routes would be short-term moderate adverse.

Near and under Brown routes, represented by Whitmore Rapids and Parashant Wash Location Points, air-tour aircraft would be audible 12% of the day with Average Sound Level 21 to 33 dBA. Aircraft would be 1,800 to 2,852 meters Distant. Falcons may be disturbed minimally during the day by air-tour aircraft noise, but normal activities would recover after disturbance, and there would not be population-level impacts. Impact of air-tour aircraft on falcons would be short term minor to moderate adverse.

Peregrine falcon eyries and habitat in Sanup Flight-free Zone would be negligibly affected by air-tour operations. Air-tour Average Sound Level would be less than 15 dBA with air-tours Percent Time Audible less than 5% of the day, as reflected in data at Pumpkin Springs and Grid Location Point 34 Location Points. Impact of air-tour aircraft on falcons in Sanup Flight-free Zone would be short term negligible.

West End Alternative A Special Status Species
 Peregrine Falcon
 Ten-Year Forecast

Although aircraft operations and Average Sound Level would increase a small amount, impacts would not change appreciably Base Year to Ten-Year Forecast West End.

Table 4.153 Alternative A Average Sound Level West End

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Burnt Springs Canyon	70	75	46	47
Bat Cave	93	95	47	48
Grid Location Point 33	87	90	42	43
Whitmore Rapids	12	13	21	21
Grid Location Point 32	44	49	27	28
Diamond Creek	0	0	0	0
Grid Location Point 27	20	23	26	27
Grid Location Point 34	0	0	1	1
Parashant Wash	12	14	33	33
Pumpkin Springs	0	0	7	8

Table 4.154 Alternative A Slant Distances West End

Location Point Name	Slant Distance (m)
Burnt Springs Canyon	1,215
Bat Cave	1,134
Grid Location Point 33	1,105
Whitmore Rapids	1,804
Grid Location Point 32	2,016
Diamond Creek	27,108
Grid Location Point 27	3,388
Grid Location Point 34	28,206
Parashant Wash	2,852
Pumpkin Springs	12,630

Cumulative Impacts Alternative A Special Status Species
 Peregrine Falcon

Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of

- 1) high-altitude aircraft at or above 18,000 feet MSL, plus
- 2) aircraft below 18,000 feet MSL and outside the SFRA, plus
- 3) ground-based noise sources, plus

1 **4) noise from air-tour-and-related aircraft under Alternative A**

2
3 ***That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).***

4
5 ***Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All***
6 ***Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout***
7 ***the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or***
8 ***above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the***
9 ***SFRA see Appendix D, Figures 91 to 94).***

10
11 ***Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts***
12 ***Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small***
13 ***component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire***
14 ***management activities, and mining activities outside the park. Noise from ground-based sources is discussed in***
15 ***Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time***
16 ***Audible capable of masking some aircraft noise.***

17
18 ***Noise from ground-based sources is usually very localized. Even though there is some spread into some***
19 ***backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of***
20 ***spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated***
21 ***by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often***
22 ***the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of***
23 ***civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights***
24 ***and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare***
25 ***and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.***
26 ***Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the***
27 ***park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.***
28 ***Because they would be audible a very high percentage of the day, the combination of aircraft noise from all***
29 ***sources would generally be the overriding cumulative noise influence on Special Status Species and habitat.***

30
31 ***Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives***
32 ***(Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly***
33 ***affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables***
34 ***43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives***
35 ***(Alternative A in this case).***

36
37 ***Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in***
38 ***Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is***
39 ***detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year***
40 ***Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS;***
41 ***however, since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas***
42 ***(2% of the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in***
43 ***interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas***
44 ***north of the park.***

45
46 ***Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All***
47 ***Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the***
48 ***difference between Cumulative Impacts and impacts of Alternative A by itself. For the Entire Park Cumulative***
49 ***Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the park, with***
50 ***Average Sound Level 25 to <35 dBA in 85% of the park, with none of the park below 25 dBA, and 24% at 35 dBA***
51 ***or more. For the Entire Park results for Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or***
52 ***more of the day in 27% of the park, with Average Sound Level 25 to <35 dBA in 28% of the park, with 50% of the***
53 ***park below 25 dBA, and 22% at 35 dBA or more.***

54
55 ***These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,***
56 ***including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour***

1 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
 2 *impacts under the Alternatives reduces Cumulative Impacts.*

3
 4 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 5 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 6 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 7 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 8 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
 9 *in the Conclusions section below.*

10
 11 **Conclusion** **Alternative A** **Special Status Species**
 12 **Peregrine Falcon**

13
 14 Peregrine falcons occur along the river and canyons throughout the park and SFRA. In Marble Canyon, Central
 15 areas, and West End's southern portions (Sanup Flight-free Zone), Average Sound Level would generally be less
 16 than 15 dBA, and aircraft would be audible less than 5% of the day. There would be little disturbance to falcons or
 17 their habitat. Greatest exposure to aircraft noise and visual impacts would occur near heavily-used air-tour routes in
 18 East End and portions of West End where Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time
 19 Audible would be greater than 75%. Under Alternative A, falcon populations would stay stable, but in East End air-
 20 tour route areas and West End portions, falcon populations and behaviors could be disrupted with falcons displaced
 21 from suitable habitats and from establishing additional nesting sites. Although aircraft operations and Average
 22 Sound Level would increase a small amount over all areas, impacts would not change appreciably Base Year to Ten-
 23 Year Forecast.

24
 25 *Conclusion Marble Canyon* *Alternative A* *Special Status Species*
 26 *Peregrine Falcon*

27 Base Year and Ten-Year Forecast Alternative A would result in short-term negligible to minor adverse impacts on
 28 peregrine falcons in Marble Canyon. Impacts would increase a small amount Ten-Year Forecast, but would
 29 generally remain at the same impact intensity levels.

30
 31 *Conclusion East End* *Alternative A* *Special Status Species*
 32 *Peregrine Falcon*

33 Base Year there would be short- and long-term moderate to major adverse impacts to falcons, particularly in areas
 34 beneath and adjacent to air-tour routes. In areas away from air-tour routes including beneath Bright Angel Flight-
 35 free Zone impacts would be short term negligible to minor adverse. Impacts would increase a small amount Ten-
 36 Year Forecast, but would generally remain at the same impact intensity levels.

37
 38 *Conclusion Central* *Alternative A* *Special Status Species*
 39 *Peregrine Falcon*

40 Base Year and Ten-Year Forecast Alternative A would result in short-term negligible to minor adverse impacts on
 41 falcons in the Central area. Impacts would increase a small amount Ten-Year Forecast, but would generally remain
 42 at the same impact intensity level.

43
 44 *Conclusion West End* *Alternative A* *Special Status Species*
 45 *Peregrine Falcon*

46 Base Year, Alternative A would result in moderate to major adverse impacts to falcons beneath Green-4 and Blue-2.
 47 In areas under Blue Direct routes where falcon territories occur, aircraft would be farther away from points on the
 48 ground. Impacts to falcons in areas under and near air-tour routes would be short-term moderate adverse. Short- and
 49 long-term minor to moderate adverse impacts would result under and near Brown routes. Impacts under Sanup
 50 Flight-free Zone would be negligible. Impacts would increase a small amount Ten-Year Forecast, but would
 51 generally remain at the same impact intensity level as Base Year.

1 **Cumulative Impacts Summary** **Alternative A** **Special Status Species**
 2 **Peregrine Falcon**

3
 4 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 5 *the impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts*
 6 *in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 7 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 8 *and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
 9 *comparison with the other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts*
 10 *(Alternative E ranks first in lowest Cumulative Impacts).*

11
 12 **ALTERNATIVE E** **PEREGRINE FALCON** **SPECIAL STATUS SPECIES**
 13 **ALTERNATING SEASONAL USE**

14
 15 Overall Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced
 16 amount of area exposed to high Average Sound Level for long periods of the day. This would result in greatly
 17 reduced impacts on falcons with greater areas of the park mostly free from air-tour aircraft sights and sounds.

18
 19 **Marble Canyon** **Alternative E** **Special Status Species**
 20 **Peregrine Falcon**

21 *All Scenarios*

22 Under Alternative E, **Marble Canyon** would be in Bright Angel Flight-free Zone where air-tour aircraft Percent
 23 Time Audible would generally be less than 5% and Average Sound Level below 13 dBA, a 3 to 24 dBA decrease
 24 from Alternative A as shown in Tables 4.155 and 4.156. Aircraft would be barely audible and at very low levels.
 25 Air-tour aircraft would generally not be visible from points on the ground. Improvements over Alternative A
 26 would occur at all Location Points, and most at **North** and **South Canyon** Location Points. Although negligible
 27 to minor adverse impacts would continue, there would be short-term negligible to minor beneficial change in
 28 impacts to peregrine falcons compared with Alternative A.

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1 **Table 4.155 Alternative E Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	0	-6	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-2	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-8	7	-9	1	-2	1	-2	7	-8	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	0	-8	0	-12	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-2	0	-3	0	-24	0	-25	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-2	0	-21	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

2
3
4

Table 4.156 Alternative E Slant Distances Marble Canyon

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Cliff Dwellers Lodge	3,695	50,287	46,591	
Grid Location Point 1	1,665	65,834	64,169	
Grid Location Point 2	868	54,066	53,208	
Grid Location Point 3	2,958	44,163	41,205	
Grid Location Point 4	4,585	63,986	59,401	
Grid Location Point 5	2,355	43,729	41,394	
Marble Canyon Dam Site	3,845	17,396	13,551	
North Canyon	999	36,247	35,248	
South Canyon	816	26,091	25,275	

Δ indicates the change in noise metric data from Alternative A

5

1 **East End** **Alternative E** **Special Status Species**
 2 **Peregrine Falcon**

3
 4 In the majority of East End, falcons would experience a decrease in adverse effects from air-tour operations at some
 5 point during the year dependent on when air-tour routes would be in use.

6
 7 *East End* *Alternative E* *Special Status Species*
 8 *Peregrine Falcon*
 9 *Base Year Peak Season*

10 Areas where air-tour operations would have the highest level of effect would be under and adjacent to **Zuni**
 11 **Point Corridor** air-tour routes, represented by **Temple Butte, Grid Location Point 14, and Tusayan Museum**
 12 Location Points as shown in Table 4.157 and 4.158. This results from high Percent Time Audible of air-tour
 13 noise during the day of 75 to 84%, an 11 to 20% increase from Alternative A. Average Sound Level would be 38
 14 to 42 dBA, an increase of one to 7 dBA from Alternative A. Air-tour aircraft would be closer to points on the
 15 ground than in Alternative A at Temple Butte (450 meters closer) and Tusayan Museum (1,566 meters closer).
 16 Because routes become active rather abruptly when falcons have established residency, there may be a higher
 17 level of reaction, and some falcons could abandon area use resulting in localized population changes. Given air-
 18 tour aircraft Distance from the ground, there would also be potential for collision with aircraft. Under and near
 19 air-tour routes in Zuni Point Corridor, moderate to major adverse impacts would continue with short-term minor
 20 to moderate change in impacts compared to Alternative A due to increased aircraft Percent Time Audible.

21
 22 When Dragon Corridor routes would not be in use, aircraft would be audible under and near **Dragon Corridor**
 23 zero to 13% of the day, a decrease of 71 to 96% compared to Alternative A at **Hermit Basin, Tower of Ra, and**
 24 **96 Mile Camp** Location Points. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37
 25 dBA from Alternative A. As Dragon Corridor routes would be inactive at this time, aircraft would be far less
 26 visible than in Alternative A at locations on the ground. Due to substantial reduction in time and level of audible
 27 aircraft noise and reduced visual impact, falcons would experience near natural conditions with limited to no
 28 disruption in behaviors as a result of air-tour operations. When falcons are present July through mid-September,
 29 falcon behaviors would be less often interrupted due to air-tour aircraft. Although negligible to minor adverse
 30 impacts would continue, this would result in short-term major beneficial change in impact from Alternative A.

31
 32 In **Bright Angel Flight-free Zone**, where numerous falcon territories exist, there would be a decline in air-tour
 33 noise. When Zuni Point Corridor is in use, air-tour aircraft Percent Time Audible at **Grid Location Point 11**
 34 would decline from 55% in Alternative A to 6% under Alternative E, a decrease of 49%. Average Sound Level
 35 would be 9 dBA, a 9 dBA decrease from Alternative A. This would expand the East End area where peregrine
 36 falcons could roost and forage with substantially fewer disruptions in daily activities due to air-tour noise.
 37 Although negligible to minor adverse impacts would continue, there would be short-term moderate to major
 38 beneficial change in impacts compared to Alternative A in Bright Angel Flight-free Zone due to reduced Percent
 39 Time Audible. The middle of Bright Angel Flight-free Zone would remain quiet, as represented by **Grid**
 40 **Location Points 12 and 13**, which would experience negligible impacts and negligible change in impacts from
 41 Alternative A.

42
 43 *East End* *Alternative E* *Special Status Species*
 44 *Peregrine Falcon*
 45 *Ten-Year Forecast Peak Season*

46 Air-tour aircraft Percent Time Audible near **Zuni Point Corridor** Location Points would decline to 50 to 66%,
 47 an 8 to 18% decrease from Alternative A, due to quiet-technology aircraft conversion. Average aircraft noise
 48 levels would range 35 to 40 dBA; similar to Alternative A. Distance of aircraft would be the same as Base Year.
 49 Given the Percent Time Audible decrease, there may be less of a reaction from falcons to routes becoming
 50 abruptly active. Although moderate to major adverse impacts would occur under and near Zuni Point Corridor,
 51 there would be short-term minor beneficial change in impacts compared to Alternative A. Although there would
 52 be higher level of reduction in audibility Ten-Year Forecast, change that may occur to populations as a result of
 53 routes becoming active reduces level of expected benefit from decline in aircraft audibility.

54
 55 In areas under and near **Dragon Corridor** and **Bright Angel Flight-free Zone** Location Points, beneficial
 56 change in impacts would be similar to Base Year Peak Season.

1 *East End* *Alternative E* *Special Status Species*
 2 *Peregrine Falcon*
 3 *Base Year Off-Peak Season*

4 Routes in and near **Zuni Point Corridor** Location Points would be inactive, and air-tour aircraft Percent Time
 5 Audible would be one percent of the day or less, a 62 to 69% decrease from Alternative A. Average Sound Level
 6 would be 3 to 7 dBA, a 62 to 69 dBA reduction. Visual aircraft impacts would be mostly eliminated for this
 7 period. Peregrine falcons would experience very quiet conditions with little to no disturbance from air-tour
 8 aircraft. March through June, when falcons would be present Off-Peak Season, falcon nesting and rearing of
 9 chicks may improve in Zuni Point Corridor without interference from aircraft which may result in positive
 10 population-size changes. There would be negligible impacts under and near Zuni Point Corridor with short-term
 11 major beneficial change in impacts compared to Alternative A.
 12

13 When **Dragon Corridor** would be in use and falcons present (March through June), air-tour aircraft Percent
 14 Time Audible at **Tower of Ra** and **Hermit Basin** Location Points would be 61 to 71%, a decrease of 28 to 36%
 15 from Alternative A. Aircraft Average Sound Level would be 23 to 46 dBA, a decrease of 19 dBA from
 16 Alternative A at **Hermit Basin** Location Point, probably due to the Dragon Corridor dogleg. At **96 Mile Camp**
 17 Location Point along the river, Percent Time Audible would decline to 26% from 72% in Alternative A although
 18 Average Sound Level would be remain relatively high at 37 dBA. Air-tour aircraft would be more Distant than in
 19 Alternative A at locations on the ground. Although Percent Time Audible and Average Sound Level decline,
 20 falcons may avoid establishing territories and eyries under and near routes as more suitable areas would be
 21 available elsewhere without interference from aircraft sights and sounds. Although moderate to major adverse
 22 impacts on falcons would continue under Dragon Corridor air-tour routes, there would be short-term moderate to
 23 major beneficial change in impacts from Alternative A.
 24

25 When Dragon Corridor would be active, **Bright Angel Flight-free Zone** areas close to air-tour routes (**Grid**
 26 **Location Point 11**) would experience aircraft noise 23% of the day, a 32% decrease from Alternative A, and at
 27 12 dBA, a 6 dBA decline due to fewer aircraft operations and higher altitudes air-tour aircraft would be required
 28 to fly. Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative
 29 A could result in increased potential that peregrine falcons would establish territories and eyries March through
 30 June in this area. With less frequent falcon behavior interruption there may be increased localized population
 31 levels. This would represent minor to moderate adverse impact with moderate beneficial change in impacts to
 32 falcons compared to Alternative A. The midst of Bright Angel Flight-free Zone would remain quiet, as
 33 represented by **Grid Location Points 12 and 13**, with negligible change in impacts from Alternative A.
 34

35 *East End* *Alternative E* *Special Status Species*
 36 *Peregrine Falcon*
 37 *Ten-Year Forecast Off-Peak Season*

38 In areas under and near **Zuni Point Corridor**, beneficial change in impacts would be similar to Base Year Off-
 39 Peak Season.
 40

41 Aircraft Percent Time Audible in areas near and under **Dragon Corridor** would be 17 to 49%, a decline of 49 to
 42 67% from Alternative A. Average Sound Level would range 18 to 44 dBA, a one to 24 dBA decrease. Although
 43 air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A would result
 44 in increased potential peregrine falcons would establish territories and eyries March through June. With less
 45 frequent interruption in falcon behavior, there may be increase in localized population levels. This improvement
 46 would be substantial in areas where Percent Time Audible is greatly reduced such as near **96 Mile Camp**
 47 Location Point along the river. Although moderate adverse impacts would continue, this would be short-term
 48 moderate to major beneficial change in impacts from Alternative A.
 49

50 Beneficial changes in impacts in **Bright Angel Flight-free Zone** would generally be similar to Base Year Off-
 51 Peak Season, except Percent Time Audible would be reduced to 16% at **Grid Location Point 11** (a 7% decrease
 52 from Base Year, and a 41% decrease compared to Alternative A), due primarily to conversion to quiet-
 53 technology aircraft.

1 **Table 4.157 Alternative E Average Sound Level East End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Dragon Corridor																				
96 Mile Camp	72	74	45	45	0	-71	0	-74	8	-37	8	-37	26	-46	17	-57	37	-7	34	-11
Tower of Ra	97	98	44	45	1	-96	1	-97	8	-36	8	-37	6	-36	49	-49	46	2	44	-1
Hermit Basin	99	100	42	42	13	-87	16	-83	10	-32	10	-32	6	-28	32	-67	23	-19	18	-24
North Rim																				
Bright Angel Point	47	48	24	24	5	-42	1	-47	13	-11	11	-15	1	-46	1	-47	11	-13	11	-13
Point Imperial	66	68	38	39	31	-34	1	-67	11	-28	8	-31	1	-65	1	-67	6	-32	6	-32
The Basin	73	75	48	48	1	-72	1	-74	5	-42	3	-43	14	-59	1	-74	7	-41	6	-42
Grid Location Point 16	80	84	33	34	17	-63	23	-61	12	-21	13	-21	17	-63	27	-57	12	-21	13	-21
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	81	11	66	-8	39	5	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	34	-31	11	-58	18	-10	16	-13	1	-64	1	-68	14	-15	14	-14
Temple Butte	62	66	37	38	75	12	57	10	28	1	35	-2	1	-62	1	-66	6	-32	6	-32
South Rim																				
Tusayan Museum	64	67	35	36	84	20	58	-18	42	7	40	4	0	-63	0	-67	3	-33	2	-33
1.5 km SE of Moran Point	64	68	41	41	81	18	61	1	53	12	51	10	4	-60	6	-62	5	-36	4	-37
Bright Angel Flight Free Zone																				
Cape Royal	59	61	25	26	7	18	25	-36	26	1	20	-6	1	-57	1	-60	11	-15	11	-15
Grid Location Point 11	55	56	18	18	6	-49	1	-49	9	-9	9	-9	23	-32	16	-41	12	-6	11	-7
Grid Location Point 12	1	1	13	14	1	0	1	0	12	-1	12	-2	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	0	1	0	10	-2	9	-4	1	0	1	0	8	-4	8	-5
Phantom Ranch	3	4	12	12	1	2	1	-3	7	-5	6	-6	1	-2	1	-3	7	-5	6	-6
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	0	-92	0	-92	9	-16	10	-15	44	-48	0	-92	19	-6	14	-11
Grid Location Point 18	60	60	16	17	1	-59	1	-60	6	-10	6	-10	34	-26	5	-55	11	-5	9	-7
Point Sublime	100	100	35	35	46	-54	29	-71	16	-20	17	-18	89	-11	63	-37	29	-6	25	-11
Bass Camp	0	0	7	7	0	0	0	0	0	-7	1	-7	0	0	0	0	3	-4	1	-6
Rainbow Plateau	0	0	6	7	0	0	0	0	2	-4	3	-4	0	0	0	0	3	-3	4	-3

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

1 **Table 4.158 Alternative E Slant Distances East End**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
Dragon Corridor				
96 Mile Camp	1,573	1,724	151	
Tower of Ra	1,147	511	-637	
Hermit Basin	1,518	3,605	2,088	
North Rim				
Point Imperial	2,292	13,405	11,113	
Bright Angel Point	6,235	9,522	3,287	
The Basin	477	3,923	3,446	
Grid Location Point 16	2,589	12,983	10,394	
Zuni Point Corridor				
Grid Location Point 14	687	1,591	904	
Grid Location Point 15	1,637	5,133	3,496	
Temple Butte	1,458	1,038	-420	
South Rim				
Tusayan Museum	2,016	450	-1,566	
1.5 km SE of Moran Point	448	251	-197	
Bright Angel Flight Free Zone				
Cape Royal	4,038	6,132	2,094	
Grid Location Point 11	8,081	6,862	-1,219	
Grid Location Point 12	9,074	6,852	-2,222	
Grid Location Point 13	8,015	9,042	1,117	
Phantom Ranch	11,027	9,999	-1,028	
Toroweap /Shinumo Flight Free Zone				
Grid Location Point 10	2,931	2,931	0	
Grid Location Point 18	8,449	6,672	-1,777	
Point Sublime	3,760	3,760	0	
Bass Camp	13,358	13,358	0	
Rainbow Plateau	14,878	14,878	0	

Δ indicates change in noise metric data from Alternative A

2
3
4
5 **Central Alternative E Special Status Species**
6 **Peregrine Falcon**

7 *All Scenarios*

8 Similar to Alternative A, peregrine falcon territories throughout most of the Central area would be little affected
9 by aircraft noise. Peak Season, when Dragon Corridor would not be in use, there would generally be little
10 difference in sound metrics compared to Alternative A. As shown in Table 4.159 and 4.160 air-tour aircraft
11 Percent Time Audible would be less than 5% of the day, with aircraft Average Sound Level zero to 14 dBA. Air-
12 tour aircraft would be greater than 7,000 meters Distant. Falcon daily behaviors such as foraging and roosting
13 would be little affected by air-tour aircraft. Negligible impacts would occur with negligible change in impacts
14 from Alternative A.
15
16

1 **Table 4.159 Alternative E Average Sound Level Central**

Location Point Name	Alternative E																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	6	-2	7	-2	2	0	2	0	7	-2	7	-2
Grid Location Point 9	1	1	5	5	1	0	1	0	3	-2	3	-2	1	0	1	0	4	-1	3	-2
Grid Location Point 20	0	0	4	4	0	0	0	0	4	0	4	0	0	0	0	0	4	0	4	0
Grid Location Point 25	11	12	9	10	2	-9	2	-10	7	-3	7	-3	2	-9	2	-10	7	-3	7	-3
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	7	1	8	1	0	1	0	7	1	8	2	
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Toroweap Overlook	0	0	13	14	0	0	0	0	14	1	15	1	0	0	0	0	15	2	16	2
Upper Deer Creek	1	1	1	1	1	0	1	0	0	-1	0	-1	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
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Table 4.160 Alternative E Slant Distances Central

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
1 km W of Kanab Point	18,850	0	18,850	0
Grid Location Point 8	13,765	838	14,603	838
Grid Location Point 9	11,103	8,281	19,384	8,281
Havasu Point	10,450	0	10,450	0
Kanab Point	19,021	0	19,021	0
Mt. Sinyala	7,272	0	7,272	0
Stone Creek	21,882	2,593	24,475	2,593
Surprise Valley	25,500	716	26,216	716
Upper Deer Creek	23,683	366	24,049	366

Δ indicates change in noise metric data from Alternative A

1 *West End* *Alternative E* *Special Status Species*

2 *Peregrine Falcon*

3 *Base Year Peak Season*

4 Peregrine falcons using habitat near **Green-4** and **Blue-2** (represented by Location Points **Burnt Springs Canyon, Bat Cave** and **Grid Location Point 33**) would be exposed to air-tour aircraft impacts similar to those described in Alternative A. As shown in Tables 4.161 and 4.162, air-tour aircraft Percent Time Audible would be 70 to 92% of the day at Average Sound Level 42 to 47 dBA. Daily falcon activities could be disrupted frequently which may result in abandoning or avoiding use of otherwise suitable habitats for nesting and foraging that could affect population levels. Short-term major adverse impacts would continue under air-tour routes with negligible change in impacts from Alternative A.

11 As represented by **Grid Location Points 27 and 32**, aircraft Percent Time Audible would be 4 to 10% of the day, a reduction of 11 to 40% compared to Alternative A, and Distance would increase 8,000 to 16,000 meters. Average Sound Level would be 19 to 21 dBA, a 6 to 7 dBA decrease from Alternative A. Change in Blue Direct North's location would increase available West End habitat for nesting and foraging with little disruption from air-tour aircraft. Although minor adverse impacts would continue, there would be short- and long-term moderate beneficial change in impacts compared to Alternative A.

18 **Whitmore Rapids** and **Parashant Wash** Location Points **near Brown routes** would have air-tour aircraft Percent Time Audible 11 to 20% of the day, an 8% increase from Alternative A at Whitmore Rapid Location Point due to realignment of Blue Direct North. There would not be appreciable change at Parashant Wash Location Point. Average Sound Level would be 25 to 28 dBA, within 8 dBA of Alternative A. Aircraft would be very Distant from locations on the ground. Falcons would be disturbed for relatively small portions of the day and potential for collision with air-tour aircraft would be greatly reduced. Minor to moderate adverse impacts would continue with short-term negligible to minor adverse change in impacts from Alternative A.

27 *West End* *Alternative E* *Special Status Species*

28 *Peregrine Falcon*

29 *Ten-Year Forecast Peak Season*

30 Near **Green-4** and **Blue-2**, Percent Time Audible would decrease to 62 to 84%, a 12 to 37% decline from Alternative A. Average Sound Level at **Burnt Springs Canyon** Location Point would increase to 43 dBA, a 4 dBA decrease from Alternative A. **Bat Cave** Location Point would similar to Alternative A, and **Grid Location Point 33** would decrease to 37 dBA, a 6 dBA decrease compared to Alternative A. Major adverse impacts would continue with generally minor to major beneficial change in impacts compared to Alternative A.

36 Impacts at **Whitmore Rapids** and **Parashant Wash** Location Points would be similar to Base Year Peak Season.

39 *West End* *Alternative E* *Special Status Species*

40 *Peregrine Falcon*

41 *Base Year Off-Peak Season*

42 Impacts would increase slightly at points under **Green-4** and **Blue-2** (i.e., 4 to 9% increased Percent Time Audible but only a one dBA Average Sound Level increase) compared to Base Year Peak Season. Impacts would remain major adverse under Green-4 and Blue-2 with negligible change in impacts from Alternative A.

46 Aircraft Average Sound Level and Distance at **Whitmore Rapids** and **Parashant Wash** Location Points would be similar to Base Year Peak Season. Percent Time Audible increases to 14 and 24%, a 2% to 12% increase compared to Alternative A. Minor to moderate adverse impacts would continue with short-term negligible to moderate adverse change in impacts from Alternative A due to increase in Percent Time Audible.

51 *West End* *Alternative E* *Special Status Species*

52 *Peregrine Falcon*

53 *Ten-Year Forecast Off-Peak Season*

54 Near **Green-4** and **Blue-2** Percent Time Audible and Average Sound Level would generally decline a small amount from Base Year to Ten-Year Forecast (except **Grid Location Point 33** which declines by 28%), but impacts would continue major adverse similar to Base Year Off-Peak Season.

1 Impacts at **Whitmore Rapids** and **Parashant Wash** Location Points would be similar to Base Year Off-Peak
2 Season.

3
4 *West End* *Alternative E* *Special Status Species*
5 *Peregrine Falcon*

6 *Base Year and Ten-Year Forecast Off-Peak Season and Ten-Year Forecast Peak Season*

7 **Grid Location Points 27 and 32** impacts would be similar to Base Year Peak Season.

8
9 *West End* *Alternative E* *Special Status Species*
10 *Peregrine Falcon*

11 *All Scenarios*

12 Peregrine falcon territories and habitat located near **Sanup Flight-free Zone** would be negligibly affected by air-
13 tour operations. Air-tour aircraft Percent Time Audible would be zero percent of the day with Average Sound
14 Level of zero to 7 dBA as reflected in data at **Diamond Creek, Pumpkin Springs** and **Grid Location Point 34**
15 Location Points. Distance to aircraft from points on the ground would decrease by 10,000 to 16,000 meters.
16 Impact of air-tour aircraft on falcons in Sanup Flight-free Zone would be negligible with negligible change in
17 impacts from Alternative A.

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1 **Table 4.161 Alternative E Average Sound Level West End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	70	-1	62	-13	46	0	43	-4	76	6	67	-9	47	1	44	-3
Bat Cave	93	95	47	48	92	-1	84	-12	47	0	46	-2	96	3	88	-8	48	0	46	-2
Grid Location Point 33	87	90	42	43	80	-7	53	-37	42	0	37	-6	89	2	61	-29	43	1	38	-5
Whitmore Rapids	12	13	21	21	20	8	21	8	28	7	28	6	24	12	25	12	30	9	28	7
Grid Location Point 32	44	49	27	28	4	-40	5	-43	21	-6	22	-6	4	-40	5	-43	21	-6	22	-6
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	7	7	1	1
Grid Location Point 27	20	23	26	27	10	-11	11	-13	19	-7	19	-7	42	-8	12	-11	19	-7	20	-7
Grid Location Point 34	0	0	1	1	0	0	0	0	1	0	1	0	1	1	0	0	4	2	2	1
Parashant Wash	12	14	33	33	11	-1	14	1	25	-8	24	-7	14	2	18	4	27	-6	25	-8
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	0	0	0	0	0	7	0	8	0

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

2
3
4

Table 4.162 Alternative E Slant Distances West End

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Burnt Springs Canyon	1,215	0	1,215	0
Bat Cave	1,134	0	1,134	0
Grid Location Point 33	1,105	0	1,105	0
Whitmore Rapids	1,804	708	2,512	708
Grid Location Point 32	2,016	16,602	8,618	16,602
Diamond Creek	27,108	-16,294	10,814	-16,294
Grid Location Point 27	3,388	8,464	11,852	8,464
Grid Location Point 34	28,206	-16,474	11,732	-16,474
Parashant Wash	2,852	3,507	6,359	3,507
Pumpkin Springs	12,630	9,707	22,337	9,707

Δ indicates change in noise metric data from Alternative A

5

1 **Cumulative Impacts** **Alternative E** **Special Status Species**
 2 **Peregrine Falcon**

3
 4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 5 *actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Alternative E*

10
 11 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 (Alternative E).*

12
 13 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 14 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 15 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 16 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 17 *SFRA see Appendix D, Figures 91 to 94).*

18
 19 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 20 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 21 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 22 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 23 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 24 *Audible capable of masking some aircraft noise.*

25
 26 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 27 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 28 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 29 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 30 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 31 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 32 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 33 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 34 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
 35 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
 36 *Because they would be audible a very high percentage of the day, the combination of aircraft noise from all*
 37 *sources would generally be the overriding cumulative noise influence on Special Status Species and habitat.*

38
 39 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 40 *(Alternative E compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 41 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 42 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 43 *(Alternative E in this case).*

44
 45 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 46 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
 47 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
 48 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 49 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 50 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 51 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 52 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

53
 54 *Comparing noise impacts from just Alternative E by itself (Appendix D Tables 16 (Peak Season) and 21 (Off-*
 55 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative E plus 1 plus 2) (Appendix D Tables 49 (Peak*
 56 *Season) and 53 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*

1 **Cumulative Impacts and the impacts of Alternative E by itself. For the Entire Park Cumulative Impact results**
 2 **(Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 83% of the**
 3 **park, with Average Sound Level 25 to <35 dBA in 92 to 93% of the park, with 1% of the park below 25 dBA and 6**
 4 **to 7% at 35 dBA or more. For the Entire Park results for Alternative E by itself (Peak and Off-Peak Season Ten-**
 5 **Year Forecast), aircraft are audible 60% or more of the day in 3% of the park, with Average Sound Level 25 to**
 6 **<35 dBA in 6 to 9% of the park, with 74 to 81% of the park below 25 dBA and 5% at 35 dBA or more.**

7
 8 **These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,**
 9 **including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour**
 10 **routes; (b) Cumulative Impacts increase the impacts of Alternative E, and (c) reducing air-tour-and-related**
 11 **impacts under the Alternatives reduces Cumulative Impacts.**

12
 13 **Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis**
 14 **sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each**
 15 **Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of**
 16 **the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area**
 17 **described for Alternative E would generally increase by one level as shown in the Cumulative Impacts discussion**
 18 **in the Conclusions section below.**

19
 20 **Conclusion Alternative E Special Status Species**
 21 **Peregrine Falcon**

22
 23 Overall Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area
 24 exposed to high Average Sound Level long periods of the day. Ten-Year Forecast the majority of falcon habitat
 25 would experience a large reduction in aircraft Percent Time Audible and in Average Sound Level. This would result
 26 in greatly reduced impacts on falcons and their habitat with fewer disturbances from air-tour aircraft compared to
 27 Alternative A.

28
 29 **Conclusion Marble Canyon Alternative E Special Status Species**
 30 **Peregrine Falcon**

31 Alternative E would continue to have negligible to minor adverse impacts on falcons in Marble Canyon; however,
 32 there would be short-term negligible to minor beneficial change in impacts to falcons compared to Alternative A due
 33 to decreased time air-tours would be audible, because Marble Canyon would be in Bright Angel Flight-free Zone
 34 under Alternative E. Impacts would not appreciably differ Peak and Off-Peak Season or Base Year and Ten-Year
 35 Forecast.

36
 37 **Conclusion East End Alternative E Special Status Species**
 38 **Peregrine Falcon**

39 In the majority of East End there would be moderate to major beneficial change in impacts from Alternative A to
 40 falcons due to alternating seasonal use of Zuni Point and Dragon Corridors. Base Year Peak Season, when Zuni
 41 Point Corridor would be open for air-tour use, impacts to falcons beneath and adjacent to active routes would be
 42 short- and long-term moderate to major adverse (greater than 75% Percent Time Audible with aircraft Average
 43 Sound Level greater than 35 dBA), and minor to moderate adverse change in impacts compared to Alternative A
 44 under the active flight corridor. Ten-Year Forecast, with conversion to quiet-technology aircraft, there would be
 45 moderate to major adverse impacts with short-term minor beneficial change in impacts compared to Alternative A
 46 under the active flight corridor. Off-Peak Season, when Zuni Point Corridor is closed to use, there would be
 47 negligible impact under the inactive flight corridor, a major beneficial change in impacts compared to Alternative A
 48 Base Year and Ten-Year Forecast. However, Ten-Year Forecast, beneficial changes in impacts compared to
 49 Alternative A would increase due to Alternative E's quiet-technology conversion requirements.

50
 51 In areas under and near Dragon Corridor, Base Year Peak Season when the corridor would be closed to air-tour use,
 52 there would be negligible to minor adverse impacts, a short-term major beneficial change in impacts compared to
 53 Alternative A. Base Year Off-Peak Season, when Dragon Corridor would be open for air-tour use, areas under and
 54 near the active corridor would experience moderate to major adverse impacts, a moderate to major beneficial change
 55 in impacts compared to Alternative A. Ten-Year Forecast Peak and Off-Peak Season would be similar to Base Year

1 Peak and Off Peak Season respectively although beneficial changes in impacts compared to Alternative A would
2 increase due to Alternative E's quiet-technology conversion requirements.
3

4 In areas away from air-tour routes, such as beneath Bright Angel Flight-free Zone, impacts Base Year Peak and Off-
5 Peak Season would generally be negligible to moderate adverse with short-term moderate to major beneficial change
6 in impacts compared to Alternative A. Ten-Year Forecast Peak Season impacts would generally be negligible to
7 minor with moderate to major beneficial change in impacts compared to Alternative A. Off Peak Season impacts
8 would generally be minor to moderate with moderate beneficial change in impacts compared to Alternative A.
9 However, beneficial changes in impacts compared to Alternative A would increase Peak and Off-Peak Season due to
10 Alternative E's quiet-technology conversion requirements.
11

12 *Conclusion Central Alternative E Special Status Species*
13 *Peregrine Falcon*

14 Impacts due to Alternative E All Scenarios would generally be negligible with negligible change in impacts
15 compared to Alternative A to falcons in the Central area.
16

17 *Conclusion West End Alternative E Special Status Species*
18 *Peregrine Falcon*

19 Base Year Peak and Off Peak Season under and near Green-4 and Blue-2, impacts would be major adverse with
20 negligible change in impacts to peregrine falcons and their habitat compared to Alternative A. Peak Season Ten-
21 Year Forecast major adverse impacts would continue with short-term minor to major beneficial change in impacts
22 compared to Alternative A as a result of reduction in air-tour Percent Time Audible due to quiet-technology
23 conversion. Off Peak Ten-Year Forecast impacts would be major adverse with negligible change in impacts
24 compared to Alternative A.
25

26 Areas along West End's northern SFRA boundary would experience increased aircraft noise and visual impacts due
27 to Blue Direct North's realignment. Impact would be minor adverse with short- and long-term moderate beneficial
28 change in impacts on falcons compared to Alternative A.
29

30 Brown route impacts All Scenarios would generally range from minor to moderate adverse with negligible to
31 moderate adverse change in impacts compared to Alternative A.
32

33 In Sanup Flight-free Zone there would be negligible impacts with negligible change in impacts compared to
34 Alternative A.
35

36 *Cumulative Impacts Summary Alternative E Special Status Species*
37 *Peregrine Falcon*

38
39 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
40 *the impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts*
41 *in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
42 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
43 *and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
44 *comparison with the other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts followed*
45 *by Modified NPS Preferred Alternative and Alternative F (Alternative A ranks last).
46*

47 **ALTERNATIVE F MODIFIED CURRENT CONDITIONS SPECIAL STATUS SPECIES**
48 **PEREGRINE FALCON**
49

50 In Alternative F, Off-Peak Season is December through January, when Dragon Corridor routes shift seven-miles
51 west. As falcons are not present in the park at this time, there would be no effect on falcons as a result of this shift
52 and, therefore, **no analysis of Off-Peak Season is presented under Alternative F.**
53
54

Marble Canyon Alternative F Special Status Species

Peregrine Falcon

Base Year and Ten-Year Forecast Peak Season

Marble Canyon impacts of air-tour aircraft noise would generally be the same as Alternative A Base Year Peak Season. As shown in Tables 4.163 and 4.164, air-tour aircraft Percent Time Audible would be 3% of the day or less, at Average Sound Level of 3 to 24 dBA. Air-tour aircraft at a few Location Points (**North and South Canyons and Grid Location Point Location 2**) would be relatively near to locations on the ground at 822 to 999 meters away, similar to Alternative A. Falcon behaviors such as nesting and foraging would be rarely interrupted from normal conditions. There would be negligible to minor adverse impacts with negligible change in impacts to falcons compared to Alternative A. Ten-Year Forecast Peak Season impacts would be similar to Base Year Peak Season.

Marble Canyon Alternative F Special Status Species

Peregrine Falcon

Base Year and Ten-Year Forecast Off-Peak Season

Off-Peak Season is December and January when Dragon Corridor routes shift seven-miles west. As falcons are not present in the park at this time, there would be no effect as a result of this shift and, therefore, no analysis of Off-Peak Season is presented under Alternative F.

Table 4.163 Alternative F Average Sound Level Marble Canyon

Location Point Name	Alternative A				Alternative F Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast	Base Year	Δ	Ten Year Forecast	Δ	Base Year	Δ	Ten Year Forecast	Δ
	Cliff Dwellers Lodge	1	1	6	10	1	0	1	0	6	0	6
Grid Location Point 1	0	0	15	17	0	0	0	0	15	0	16	-1
Grid Location Point 2	2	3	16	19	2	0	2	0	16	0	17	-3
Grid Location Point 3	3	3	14	16	3	0	3	0	14	0	15	-1
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	2	0	2	0	8	0	8	-4
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	3	0	2	-1
North Canyon	3	3	24	25	3	0	3	0	24	0	24	-1
South Canyon	2	3	21	23	2	0	2	0	21	0	21	-2

Δ indicates change in noise metric data from Alternative A

Table 4.164 Alternative F Slant Distances Marble Canyon

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	3,695	0
Grid Location Point 1	1,665	1,665	0
Grid Location Point 2	858	858	0
Grid Location Point 3	2,958	2,958	0
Grid Location Point 4	4,585	4,585	0
Grid Location Point 5	2,335	2,335	0
Marble Canyon Dam Site	3,845	3,846	1
North Canyon	999	999	0
South Canyon	816	822	7

Δ indicates change in noise metric data from Alternative A

1 **East End** **Alternative F** **Special Status Species**

2 **Peregrine Falcon**

3 *Base Year Peak Season*

4 There would be little difference in impacts to falcons compared to Alternative A under **Zuni Point** and **Dragon**
 5 **Corridors** and adjacent areas. As shown in Tables 4.165 and 4.166, Distance from air-tour aircraft to locations
 6 on the ground does not differ notably from Alternative A. Air-tour aircraft Percent Time Audible would be 62 to
 7 nearly 100% of the day in areas beneath air-tour routes, and would have Average Sound Level 28 to 49 dBA at
 8 representative Location Points. In areas with flights close to the rim and in areas under routes with persistent air-
 9 tour noise, there would be potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering
 10 and for collisions with aircraft along rims where aircraft would be at lower altitudes. As noted under Alternative
 11 A, nearly continuous audibility would result in reduced eyrie densities beneath air-tour routes displacing
 12 peregrine use of suitable habitats (NPS 2010c). Moderate to major adverse impacts would continue under and
 13 near air-tour routes with negligible change in impacts from Alternative A.

14
 15 In **Bright Angel Flight-free Zone**, where numerous falcon territories exist, there would be decline in air-tour
 16 noise. Base Year Peak Season, when Zuni Point Corridor is in use, air-tour aircraft Percent Time Audible would
 17 be 60% of the day at **Grid Location Point 11**, a 5% increase from Alternative A. **Cape Royal, Bright Angel**
 18 **Point** and **The Basin** Location Points would be the same as Alternative A. Average Sound Level would be 12 to
 19 19 dBA at points away from tour routes, and 24 to 48 dBA at points close to tour routes, the same as Alternative
 20 A. In areas along South and North Rims, represented by Location Points **The Basin** and **1.5 km SE of Moran**
 21 **Point**, Distance of air-tours from the ground would be less than 500 meters. In areas under and near routes
 22 persistent air-tour noise would have potential to disrupt normal behavior patterns such as breeding, feeding, or
 23 sheltering and for collisions with aircraft especially along the rims where aircraft would be at lower altitudes.
 24 Moderate to major adverse impacts would continue near air-tour routes, and minor to moderate adverse impacts
 25 away from routes, with negligible change in impacts from Alternative A.

26
 27 *East End*

Alternative F

Special Status Species

28 *Peregrine Falcon*

29 *Ten-Year Forecast Peak Season*

30 Air-tour aircraft Percent Time Audible would be 41 to 53% of the day in **Zuni Point Corridor**, a decrease of 21
 31 to 28% from Alternative A, and 47 to 94% of the day in **Dragon Corridor**, a decrease of 6 to 27% compared to
 32 Alternative A due to quiet-technology conversion. Average Sound Level would decrease to 24 to 46 dBA similar
 33 to Alternative A. Distance of air-tour aircraft from points on the ground would range 687 to 2,890 meters.
 34 Although falcon activities and behaviors could be interrupted frequently, there would be localized areas of
 35 improvement. Although moderate to major adverse impacts would continue under air-tour routes, there would be
 36 short-term moderate to major beneficial change in impacts compared to Alternative A due to reduction in Percent
 37 Time Audible.

38
 39 Air-tour Percent Time Audible would range one to 10% in **Bright Angel Flight-free Zone** away from routes
 40 (**Grid Location Points 11, 12, and 13** and **Phantom Ranch** Location Point), a decrease of zero to 47% from
 41 Alternative A, and 12 to 40% at points near tour routes (**Cape Royal, Bright Angel Point, The Basin** Location
 42 Points), a decrease of 35 to 44% compared to Alternative A. Average Sound Level would be 7 to 12 dBA at
 43 points away from routes, and 18 to 45 dBA at points near routes, with all points decreasing 7 dBA or less from
 44 Alternative A. Distance from locations on the ground would be as described Base Year. Although minor to
 45 moderate adverse impacts would continue, there would be short-term negligible to major beneficial changes in
 46 impacts compared to Alternative A Ten-Year Forecast due to quiet-technology incentives and conversion
 47 requirements.

48
 49 *East End*

Alternative F

Special Status Species

50 *Peregrine Falcon*

51 *Base Year and Ten-Year Forecast Off-Peak Season*

52 In Alternative F, Off-Peak Season is December and January when Dragon Corridor routes shift seven-miles west.
 53 As falcons are not present in the park at this time, there would be no effect as a result of this shift and, therefore,
 54 no analysis of Off-Peak Season is presented under Alternative F.

1 **Table 4.165 Alternative F Average Sound Level East End**

Location Point Name	Alternative A				Alternative F																
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season								
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)				
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	
Dragon Corridor																					
96 Mile Camp	72	74	45	45	72	0	47	-27	45	0	41	-4	1	-70	0	-74	13	-31	10	-35	
Tower of Ra	97	98	44	45	97	0	90	-8	44	0	41	-4	17	-80	6	-92	15	-29	13	-32	
Hermit Basin	99	100	42	42	99	0	89	-11	42	0	37	-5	60	-39	32	-68	23	-19	19	-23	
North Rim																					
Bright Angel Point	47	48	24	24	47	0	12	-36	24	0	18	-6	2	-45	2	-47	13	-11	11	-13	
Point Imperial	66	68	38	39	66	0	25	-43	38	0	37	-2	28	-38	2	-66	18	-20	14	-25	
The Basin	73	75	48	48	73	0	40	-35	48	0	45	26	-47	16	-60	30	-18	26	-22		
Grid Location Point 16	80	84	33	34	84	4	42	-42	33	0	24	-10	37	-43	21	-63	15	-18	13	-21	
Zuni Point Corridor																					
Grid Location Point 14	70	74	34	34	70	0	53	-21	34	0	28	-7	43	-27	27	-47	30	-4	24	-10	
Grid Location Point 15	65	69	28	29	65	0	41	-28	28	0	24	-4	33	-33	17	-52	38	10	35	6	
Temple Butte	62	66	37	38	62	0	45	-22	37	0	31	-7	37	-26	23	-43	31	-6	27	-11	
South Rim																					
Tusayan Museum	64	67	35	36	64	0	32	-36	35	0	28	-8	36	-28	15	-52	29	-6	24	-12	
1.5 km SE of Moran Point	64	68	41	41	65	1	43	-25	41	0	37	-4	38	-26	22	-46	36	-5	33	-8	
Bright Angel Flight Free Zone																					
Cape Royal	59	61	25	26	59	0	17	-44	25	0	19	-7	31	-28	7	-54	21	-5	16	-10	
Grid Location Point 11	55	56	18	18	60	5	10	-47	18	0	12	-7	16	-39	7	-49	11	-7	9	-9	
Grid Location Point 12	1	1	13	14	1	0	0	0	13	0	12	-2	1	0	1	0	12	-1	12	-2	
Grid Location Point 13	1	1	2	13	1	0	0	0	12	0	9	-4	1	0	1	0	9	-3	8	-4	
Phantom Ranch	3	4	12	12	3	0	1	-3	12	0	7	-5	1	-2	1	-3	7	-4	6	-6	
Toroweap /Shinumo Flight Free Zone																					
Grid Location Point 10	92	92	25	25	92	0	0	-92	25	0	19	-6	66	-26	16	-77	32	7	29	4	
Grid Location Point 18	60	60	16	17	60	0	14	-46	16	0	13	-4	57	-3	32	-28	39	23	35	19	
Point Sublime	100	100	35	35	100	0	94	-6	35	0	30	-6	89	-10	24	-75	19	-16	17	-18	
Bass Camp	0	0	7	7	0	0	0	0	7	0	2	-5	37	36	20	20	33	26	29	22	
Rainbow Plateau	0	0	6	7	0	0	0	0	7	1	5	-1	24	24	2	2	13	7	10	4	

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3

1 **Table 4.166 Alternative F Slant Distances East End**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
Dragon Corridor				
96 Mile Camp	1,573	1,573	0	
Tower of Ra	1,147	854	-293	
Hermit Basin	1,518	1,656	139	
North Rim				
Point Imperial	2,292	2,343	50	
Bright Angel Point	6,235	6,225	-10	
The Basin	477	489	13	
Grid Location Point 16	2,589	2,575	-14	
Zuni Point Corridor				
Grid Location Point 14	687	687	0	
Grid Location Point 15	1,637	1,636	-1	
Temple Butte	1,458	1,458	0	
South Rim				
Tusayan Museum	2,016	2,016	0	
1.5 km SE of Moran Point	448	448	0	
Bright Angel Flight Free Zone				
Cape Royal	4,038	4,038	0	
Grid Location Point 11	8,081	8,028	-53	
Grid Location Point 12	9,014	9,014	0	
Grid Location Point 13	7,925	7,925	0	
Phantom Ranch	11,027	10,961	-66	
Toroweap /Shinumo Flight Free Zone				
Grid Location Point 10	2,931	2,900	-31	
Grid Location Point 18	8,449	1,641	-7,108	
Point Sublime	3,760	3,609	-151	
Bass Camp	13,258	2,667	-10,691	
Rainbow Plateau	14,878	3,294	-11,585	

Δ indicates change in noise metric data from Alternative A

2
3
4
5 **Central Alternative F Special Status Species**
6 **Peregrine Falcon**
7 *All Scenarios*

8 Similar to Alternative A, falcons throughout most of the Central area would be little affected by air-tour and
9 general-aviation aircraft noise. As shown in Table 4.167, aircraft Percent Time Audible would generally range
10 less than 2%, with little change from Alternative A, except a 9% decrease at **Grid Location Point 25**. Falcons
11 would be exposed to air-tour Average Sound Level from 4 to 17 dBA, generally similar to Alternative A.
12 Distance of aircraft would generally be greater than 7,000 meters away from points on the ground as shown in
13 Table 4.168. Given low aircraft Percent Time Audible and Average Sound Level and with air-tour aircraft
14 Distant from locations on the ground, there would be little potential for falcon disturbance. Negligible impacts
15 would occur with short-term negligible to minor beneficial change in impacts compared to Alternative A.

16
17 *Central Alternative F Special Status Species*
18 *Peregrine Falcon*
19 *Base Year and Ten-Year Forecast Off-Peak Season*

20 In Alternative F, Off-Peak Season is December and January when Dragon Corridor routes shift seven-miles west.
21 As falcons are not present in the park at this time, there would be no effect as a result of this shift and, therefore,
22 no analysis of Off-Peak Season is presented under Alternative F.

Table 4.167 Alternative F Average Sound Level Central

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	8	-1	8	-1	2	0	2	0	7	-2	8	-1
Grid Location Point 9	1	1	5	5	1	0	1	0	5	0	3	-2	1	0	1	0	6	1	4	-2
Grid Location Point 20	0	0	4	4	0	0	0	0	4	0	4	0	0	0	0	0	4	0	4	0
Grid Location Point 25	11	12	9	10	2	-9	2	-10	7	-3	7	-2	2	-9	2	-10	6	-3	7	-3
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	2	1	1	0	8	2	7	1	3	2	3	2	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Toroweap Overlook	0	0	13	14	0	0	0	0	17	4	20	6	0	0	0	0	16	3	19	6
Upper Deer Creek	1	1	1	1	1	0	1	0	1	0	0	0	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

1
 2
 3

Table 4.16848 Alternative F Slant Distances Central

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
1 km W of Kanab Point	18,850	0	18,850	0
Grid Location Point 9	11,103	0	11,103	0
Grid Location Point 20	22,053	0	22,053	0
Grid Location Point 25	20,188	0	20,188	0
Havasu Point	10,450	0	10,450	0
Kanab Point	19,021	0	19,021	0
Mt. Sinyala	7,272	0	7,272	0
Stone Creek	21,882	-7,627	14,255	-7,627
Surprise Valley	25,500	-6,385	19,115	-6,385
Toroweap Overlook	9,625	0	9,625	0
Upper Deer Creek	23,683	-2,752	20,930	-2,752

Δ indicates change in noise metric data from Alternative A

4

1 **West End** **Alternative F** **Special Status Species**

2 **Peregrine Falcon**

3 *Base Year Peak Season*

4 Impacts to falcons would not be appreciably different from Alternative A. Aircraft noise would be more
5 persistent under **Green-4 and Blue-2**, represented by Location Points **Bat Cave, Burnt Springs Canyon, and**
6 **Grid Location Point 33**. As shown in Table 4.169, air-tour aircraft Percent Time Audible would be 75 to 88%
7 of the day, a 4% increase (at Burnt Springs Canyon) to 12% decrease (at Grid Location Point 33) from
8 Alternative A. Aircraft Average Sound Level would be 42 to 47 dBA, similar to Alternative A. Aircraft would be
9 approximately 1,000 meters from the ground similar to Alternative A (Table 4.170). There would be similar
10 potential to Alternative A to disrupt normal behavior patterns such as breeding, feeding, or sheltering in areas
11 under and close to these routes. Moderate to major adverse impacts would continue under Green-4 and Blue-2
12 with short-term negligible to moderate beneficial change in impacts compared to Alternative A.
13

14 In areas under Blue Direct routes where falcon territories occur, represented by **Grid Location Points 27 and**
15 **32**, air-tour aircraft Percent Time Audible would be 28 to 47% at Average Sound Level 33 to 36 dBA, a
16 negligible to minor change in impacts compared to Alternative A. In these areas aircraft would be 1,233 to 2,995
17 meters away from points on the ground. Falcon daily activities could be interrupted and, similar to East End,
18 falcon nesting may be inhibited in suitable habitat under routes. Moderate to major adverse impacts to falcons
19 would continue in localized areas under and near air-tour routes with negligible to minor change in impacts
20 compared to Alternative A.
21

22 Near Brown routes at Location Points **Whitmore Rapids** and **Parashant Wash** Percent Time Audible would be
23 7 to 9% of the day and Average Sound Level 23 to 33 dBA, both negligible changes in impacts from Alternative
24 A. Aircraft would be 1,800 to 4,200 meters from points on the ground, an increase in Distance of zero to 1,338
25 meters from Alternative A. Falcons may be disturbed to a minimal level during the day by audible air-tour
26 aircraft noise; however, normal activities would recover after disturbance and there would not be population-
27 level impacts. Negligible to minor adverse impacts would continue with negligible change in impacts from
28 Alternative A.
29

30 Peregrine falcon eyries and habitat located in and south of **Sanup Flight-free Zone** would be negligibly affected
31 by air-tour operations as reflected in data at Location Points **Pumpkin Springs, Diamond Creek, and Grid**
32 **Location Point 34**. In this area, air-tour Average Sound Level would be less than one to 9 dBA with air-tour
33 Percent Time Audible less than one percent of the day. With these negligible impacts, falcons would experience
34 very little if any disturbance from air-tour aircraft similar to Alternative A. There would be negligible change in
35 impacts from Alternative A in Sanup Flight-free Zone.
36

37 *West End*

Alternative F

Special Status Species

38 *Peregrine Falcon*

39 *Ten-Year Forecast Peak Season*

40 At points described near **Green-4 and Blue-2**, air-tour aircraft Percent Time Audible would range 65 to 83% of
41 the day, a 6 to 25% decline compared to Alternative A. Average Sound Level would be similar to Alternative A.
42 Major adverse impacts would occur with minor to moderate beneficial change in impacts compared to
43 Alternative A.
44

45 Near Blue Direct at **Grid Location Points 27 and 32**, Percent Time Audible would be 35 to 51% of the day, an
46 increase of 2 to 12% compared to Alternative A, a minor increase from Base Year Peak Season. Average Sound
47 Level and aircraft Distance would not be appreciably different from Base Year Peak Season. Major adverse
48 impacts would occur with short-term negligible to minor adverse change in impacts compared to Alternative A.
49

50 Impacts near Brown routes, at Location Points **Whitmore Rapids** and **Parashant Wash** would be similar to
51 Base Year Peak Season. At Location Points **Pumpkin Springs, Diamond Creek, and Grid Location Point 34**,
52 impacts would be similar to Base Year Peak Season near Sanup Flight-free Zone.
53
54

- | | | | |
|---|---|----------------------|-------------------------------|
| 1 | <i>West End</i> | <i>Alternative F</i> | <i>Special Status Species</i> |
| 2 | <i>Peregrine Falcon</i> | | |
| 3 | <i>Base Year and Ten-Year Forecast Off-Peak Season</i> | | |
| 4 | In Alternative F, Off-Peak Season is December and January when Dragon Corridor routes shift seven-miles west. | | |
| 5 | As falcons are not present in the park at this time, there would be no effect as a result of this shift and, therefore, | | |
| 6 | no analysis of Off-Peak Season is presented under Alternative F. | | |

DRAFT
Not Finalized
FOIA Discretionary Release

1 **Table 4.169 Alternative F Average Sound Level West End**
 2

Location Point Name	Alternative A		Alternative F																	
			Peak Season										Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Burnt Springs Canyon	70	75	46	47	75	4	69	-6	47	1	44	-3	73	2	66	-9	46	1	44	-3
Bat Cave	93	95	47	48	88	-5	83	-13	47	-1	46	-2	88	-5	81	-14	46	-1	45	-3
Grid Location Point 33	87	90	42	43	75	-12	65	-25	42	0	40	-3	77	-10	66	-24	43	1	40	-3
Whitmore Rapids	12	13	21	21	9	-3	16	2	33	12	37	15	5	-7	12	-1	32	11	36	14
Grid Location Point 32	44	49	27	28	47	3	51	2	33	6	31	3	4	2	46	-2	34	7	31	3
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grid Location Point 27	20	23	26	27	28	8	35	12	36	10	38	10	27	7	31	8	36	10	37	10
Grid Location Point 34	0	0	1	1	0	0	0	0	2	1	2	1	0	0	0	0	2	0	2	1
Parashant Wash	12	14	33	33	7	-5	11	-3	23	-10	2	-8	8	-4	9	-5	23	-10	25	-8
Pumpkin Springs	0	0	7	8	0	0	0	0	9	2	10	2	0	0	0	0	9	2	9	2

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

3
 4
 5 **Table 4.170 Alternative F Slant Distances West End**

Location Point Name	Alternative A		Alternative F	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
Burnt Springs Canyon	2,215		1,215	0
Bat Cave	1,124		926	-198
Grid Location Point 33	1,105		1,123	18
Whitmore Rapids	1,804		1,804	0
Grid Location Point 32	2,016		2,995	979
Diamond Creek	27,108		23,339	-3,769
Grid Location Point 27	3,388		1,223	-2,165
Grid Location Point 34	28,206		23,335	-4,871
Parashant Wash	2,852		4,190	1,338
Pumpkin Springs	12,630		12,622	-8

Δ indicates change in noise metric data from Alternative

6
 7

1 **Cumulative Impacts** **Alternative F** **Special Status Species**
 2 **Peregrine Falcon**
 3

4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 5 *actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Alternative F*

10
 11 *That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 (Alternative F).*
 12

13 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 14 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 15 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 16 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 17 *SFRA see Appendix D, Figures 91 to 94).*
 18

19 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 20 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 21 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 22 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 23 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 24 *Audible capable of masking some aircraft noise.*
 25

26 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 27 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 28 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 29 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 30 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 31 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 32 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 33 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 34 *Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the*
 35 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
 36 *Because they would be audible a very high percentage of the day, the combination of aircraft from all sources*
 37 *would generally be the overriding cumulative influence on Wildlife and habitat.*
 38

39 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 40 *(Alternative F compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 41 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 42 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 43 *(Alternative F in this case).*
 44

45 *Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 46 *Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season),*
 47 *noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone,*
 48 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 49 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 50 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 51 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 52 *unpaved roads, the Colorado River, and mining activity areas north of the park.*
 53

54 *Comparing noise impacts from just Alternative F by itself (Appendix D Tables 26 (Peak Season) and 31 (Off-*
 55 *Peak Season) Ten-Year Forecast) versus All Aircraft (#4 Alternative F plus #1 Above and #2 Outside) (Appendix*
 56 *D Tables 57 (Peak Season) and 61 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the*

1 *difference between Cumulative Impacts and the impacts of Alternative F by itself. For the Entire Park*
 2 *Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more*
 3 *of the day in 87 to 89% of the park, with Average Sound Level 25 to <35 dBA in 84 to 86% of the park, with 1%*
 4 *of the park below 25 dBA and 15 to 18% at 35 dBA or more. For the Entire Park results for Alternative F by*
 5 *itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to 10% of*
 6 *the park, with Average Sound Level 25 to <35 dBA in 14% of the park, with 68 to 70% of the park below 25 dBA*
 7 *and 10 to 13% at 35 dBA or more.*

8
 9 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 10 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
 11 *routes; (b) Cumulative Impacts increase the impacts of Alternative F, and (c) reducing air-tour-and-related*
 12 *impacts under the Alternatives reduces Cumulative Impacts.*

13
 14 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 15 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 16 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 17 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 18 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts discussion*
 19 *in the Conclusions section below.*

20
 21 **Conclusion** **Alternative F** **Special Status Species**
 22 **Peregrine Falcon**

23
 24 Because Alternative F's Off-Peak Season is December to January when peregrine falcons would not be present, no
 25 analysis for peregrine falcons is presented Off-Peak Season Alternative F.
 26

27 Overall, Alternative F will result in beneficial change in impacts to peregrine falcons compared with Alternative A
 28 due to reduced area exposed to high Average Sound Level long periods of the day. Ten-Year Forecast Alternative F
 29 would result in an improvement in peregrine falcon habitat and a reduction of impacts on peregrine falcons as
 30 aircraft noise is reduced by quiet-technology incentives and conversion requirements. Greatest exposure to noise and
 31 visual impacts would occur under heavily-used air-tour routes in East and West Ends where Average Sound Level
 32 would generally be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75% of the day. There
 33 would also be large portions of habitat relatively undisturbed by air-tours in Marble Canyon and Central area.
 34

35 *Conclusion Marble Canyon* *Alternative F* *Special Status Species*
 36 *Peregrine Falcon*

37 Alternative F would result in aircraft sights and sounds that would result in negligible to minor adverse impacts with
 38 negligible change in impacts from Alternative A in Marble Canyon Base Year and Ten-Year Forecast.
 39

40 *Conclusion East End* *Alternative F* *Special Status Species*
 41 *Peregrine Falcon*

42 Base Year Peak Season, in areas under and adjacent to East End air-tour routes, there would generally be moderate
 43 to major adverse impacts with negligible change in impacts to falcons from Alternative A. Ten-Year Forecast, there
 44 would be reduction in aircraft Percent Time Audible due to quiet-technology incentives and conversion
 45 requirements resulting in short-term moderate to major beneficial changes in impacts compared to Alternative A.
 46 Base Year Peak Season, amid Bright Angel Flight-free Zone there would be moderate to major adverse impacts near
 47 air-tour routes, and minor to moderate adverse impacts away from routes, with negligible change in impacts
 48 compared to Alternative A. Ten-Year Forecast Peak Season minor to moderate adverse impacts would occur with
 49 short-term negligible to major beneficial changes in impacts due to quiet-technology incentives and conversion
 50 requirements compared to Alternative A.
 51

52 *Conclusion Central* *Alternative F* *Special Status Species*
 53 *Peregrine Falcon*

54 Alternative F would result in negligible impacts with negligible to minor beneficial change in impacts on falcons at
 55 most Central area Location Points Base Year and Ten-Year Forecast compared to Alternative A.
 56

1 *Conclusion West End* *Alternative F* *Special Status Species*
 2 *Peregrine Falcon*
 3 Base Year Peak Season moderate to major adverse impacts would occur under Green-4 and Blue-2, and there would
 4 be short-term negligible to moderate beneficial change in impacts compared to Alternative A. Moderate to major
 5 adverse impacts would occur in localized areas under and near Blue Direct air-tour routes with negligible to minor
 6 adverse change in impacts compared to Alternative A. Near Brown routes, negligible to minor adverse impacts
 7 would occur with negligible change in impacts compared to Alternative A. In Sanup Flight-free Zone there would be
 8 negligible impacts with negligible change in impacts compared to Alternative A.
 9

10 Ten-Year Forecast Peak Season major adverse impacts would occur under Green-4 and Blue-2 with short-term
 11 minor to moderate beneficial change in impacts compared to Alternative A. Major adverse impacts to falcons would
 12 occur in localized areas under and near Blue Direct routes with negligible to minor adverse change in impacts
 13 compared to Alternative A. Impacts from Brown routes and Sanup Flight-free Zone would be similar to Base Year
 14 Peak Season.
 15

16 **Cumulative Impacts Summary** *Alternative F* *Special Status Species*
 17 **Peregrine Falcon**
 18

19 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 20 *impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts in*
 21 *all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 22 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 23 *and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
 24 *comparison with the other Alternatives, Alternative F ranks third in lowest overall Cumulative Impacts behind*
 25 *Alternative E and the Modified NPS Preferred Alternative (Alternative A ranks last).*
 26

27 **MODIFIED NPS PREFERRED ALTERNATIVE** **SPECIAL STATUS SPECIES**
 28 **PEREGRINE FALCON**
 29

30 Overall the **Modified NPS Preferred Alternative** would result in a beneficial change compared to Alternative A in
 31 peregrine falcon habitat condition with substantially fewer disturbances to falcons, especially Ten-Year Forecast.
 32 Although adverse impacts would occur with disturbances to falcon behaviors and daily activities near air-tour
 33 routes, Ten-Year Forecast there would be substantial improvement in natural conditions particularly Off-Peak
 34 Season.
 35

36 **Marble Canyon** *Modified NPS Preferred Alternative* **Special Status Species**
 37 **Peregrine Falcon**
 38

39 Peak and Off-Peak Season Marble Canyon would *be quiet compared to Alternative A. Air-tour aircraft* would be
 40 more distant than in Alternative A.
 41

42 *Marble Canyon* *Modified NPS Preferred Alternative* *Special Status Species*
 43 *Peregrine Falcon*
 44

All Scenarios

45 *Impacts at representative Location Points around Marble Canyon would generally be minor to moderate*
 46 *beneficial compared to Alternative A as shown in Table 4.171 and 4.172. Air-tour aircraft Percent Time*
 47 *Audible would be 1% or less, lower than Alternative A, and aircraft Average Sound Level would be zero to 13*
 48 *dBa, a decrease of one to 24 dBA compared to Alternative A. Aircraft would be much farther away and not*
 49 *visible from locations on the ground, ranging from 18,273 meters at Marble Canyon Dam Site Location Point*
 50 *to 75,891 meters at Grid Location Point 1. Improvement over Alternative A would occur at all Location Points*
 51 *close to the rim and river, and most at North and South Canyon Location Points. Peregrine falcons would not*
 52 *be disturbed from normal daily activities by aircraft. Closure of all Marble Canyon routes would result in an*
 53 *increased Distance between air traffic and peregrine falcon roosting/foraging areas. There would generally be*
 54 *long-term minor to major beneficial change in impacts compared with Alternative A.*

1 **Table 4.171** *Modified NPS Preferred Alternative* **Average Sound Level** **Marble Canyon**

Location Point Name	Alternative A		Modified Preferred Alternative																	
			Peak Season										Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)			Average Sound Level (dBA)				
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	1	-5	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9	0	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	1	-7	0	-7	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-3	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-3	0	-3	2	--22	0	-24	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-3	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4 **Table 4.172** *Modified NPS Preferred Alternative* **Slant Distances** **Marble Canyon**

Location Point Name	Alternative A	Modified Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	50,620	52,925
Grid Location Point 1	1,665	75,891	74,226
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	53,548	50,590
Grid Location Point 4	4,585	71,678	67,093
Grid Location Point 5	2,355	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669

Δ indicates change in noise metric data from Alternative A

	East End	Modified NPS Preferred Alternative	Special Status Species
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	Peregrine Falcon		
--	-------------------------	--	--

	<i>Base Year Peak Season</i>		
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As shown in Table 4.173 and 4.174, areas where air-tour operations would have highest level of effect would be under and adjacent to **Dragon Corridor**, represented by Location Points **96 Mile Camp, Tower of Ra, and Hermit Basin**. This results from high Percent Time Audible of air-tour noise during the day from 59 to 96%, a one to 12% decrease from Alternative A. Average Sound Level would be 20 to 42 dBA, a 2 to 22 dBA decrease from Alternative A. Air-tour aircraft would be farther away from points on the ground, about 1,500 to 6,400 meters. Given the *distance* of air-tour aircraft from the ground, there would be little potential for collision with falcons. Although *minor* to major adverse impacts would continue under and near Dragon Corridor air-tour routes, there would be short-term negligible to minor beneficial change in impacts compared to Alternative A.

There would be little reduction in air-tour aircraft noise under and near Zuni Point Corridor (Location Points Temple Butte and Grid Location Points 14 and 15). Aircraft Percent Time Audible would be 54 to 62% of the day, an 8% decrease compared to Alternative A. Average Sound Level would be 39 dBA, a 6 to 11 dBA increase from Alternative A. Moderate to major adverse impacts would continue under Zuni Point Corridor, with negligible to minor change in impacts compared to Alternative A.

In **Bright Angel Flight-free Zone**, air-tour aircraft Percent Time Audible would be 57 to 89% of the day, an increase of 4 to 10% from Alternative A in areas near **Cape Royal, Bright Angel Point, The Basin** and **Cedar Ridge** Location Points. Air-tour aircraft Percent Time Audible would decrease 26% in areas near **Grid Location Point 16** (to 54%), 19% at **Point Imperial** Location Point (to 47%), and 5% at **Grid Location Point 11** (to 50%) compared to Alternative A. Average Sound Level would range 10 to 44 dBA, similar to Alternative A, except **Point Imperial** Location Point where sound levels would be reduced by 20 dBA to 18 dBA. Aircraft would generally be very distant from locations on the ground, greater than 2,000 meters except **The Basin** Location Point which would be less than 900 meters. Moderate to major adverse impacts would continue near air-tour routes with negligible to moderate adverse change in impacts compared to Alternative A at **Cape Royal, Bright Angel Point and The Basin**, and moderate to major beneficial change in impacts compared to Alternative A at **Point Imperial and Grid Location Point 16**. The middle of Bright Angel Flight-free Zone would remain quiet, as represented by **Grid Location Points 12 and 13** and **Phantom Ranch** Location Points with negligible impacts and negligible change from Alternative A.

	East End	Modified NPS Preferred Alternative	Special Status Species
--	-----------------	---	-------------------------------

	Peregrine Falcon		
--	-------------------------	--	--

	<i>Ten-Year Forecast Peak Season</i>		
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Air-tour aircraft Percent Time Audible in **Dragon Corridor** (Location Points **96 Mile Camp, Tower of Ra, and Hermit Basin**) would decline to 41 to 88%, a 10 to 43% decrease from Alternative A, due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would range 17 to 38 dBA, a decrease of 7 to 25 dBA from Alternative A. Distance of aircraft would be the same as Base Year. Although moderate to major adverse impacts would continue under and near Dragon Corridor air-tour routes, there would be minor to major beneficial change in impacts compared to Alternative A.

There would be reduction in air-tour aircraft noise under and near **Zuni Point Corridor** (Location Points **Temple Butte and Grid Location Points 14 and 15**). Aircraft Percent Time Audible would be 33 to 46% of the day, a 28 to 33% decrease compared to Alternative A. Average Sound Level would be 35 dBA, similar to Alternative A. Although moderate to major adverse impacts would continue under Zuni Point Corridor, there would generally be moderate to major beneficial change in impacts compared to Alternative A.

Aircraft Percent Time Audible would decline at all **North Rim** Location Points in **Bright Angel Flight-free Zone**. At Location Points **Cape Royal** and **Grid Location Point 11**, aircraft Percent Time Audible would be 23 to 28% of the day, a decrease of 33% from Alternative A (and a decrease of 27 to 40% from Base Year). Air-tour Average Sound Level would be only slightly lower than Alternative A at 14 to 21 dBA. Air-tour aircraft Percent Time Audible at **Cedar Ridge** Location Point would decline 83% compared to Base Year (76% lower than Alternative A), and at **Grid Location Point 11** it would decline 27% from Base Year (33% from Alternative A). Declines would be due primarily to quiet-technology conversion. Falcons would be much less frequently disturbed during daily activities compared to Base Year and Alternative A. Although minor to moderate adverse

1 impacts would continue, there would be moderate to major beneficial change in impacts compared to Alternative
 2 A in areas near air-tour routes. The middle of Bright Angel Flight-free Zone would remain quiet, as represented
 3 by **Grid Location Points 12 and 13**, with negligible impacts and negligible change from Alternative A and Base
 4 Year Peak Season.

5
 6 **North Rim** falcon habitat would improve at Location Points **Point Imperial, Bright Angel Point, The Basin,**
 7 and **Grid Location Point 16**. Aircraft Percent Time Audible would be 11 to **39%** of the day; a 30 to **56%**
 8 decrease from Alternative A. Average Sound Level would range 16 to 40 dBA, a **6** to 22 dBA decline from
 9 Alternative A. There would be less interruption or disturbance to falcons breeding, nesting, and foraging.
 10 Although moderate adverse impacts would continue, there would be short-term minor to major beneficial change
 11 in impacts compared to Alternative A.

12
 13 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 14 *Peregrine Falcon*
 15 *Base Year Off-Peak Season*

16 Routes in **Dragon Corridor** (Location Points **96 Mile Camp, Tower of Ra, and Hermit Basin**) *may* experience
 17 *more air-tour use when Zuni Point Corridor routes are closed Off-Peak Season (November 15-March 31)*.
 18 Air-tour aircraft Percent Time Audible *would* be **38 to 80%**, a **17 to 32%** decrease from Alternative A. Average
 19 Sound Level would be **17 to 38** dBA, a **6 to 25** dBA reduction. *Aircraft* would be at the same Distance as Peak
 20 Season. Peregrine falcons would experience less frequent disturbance from aircraft compared to Alternative A.
 21 Although *minor to major* adverse impacts would occur under and near Dragon Corridor, there would be short-
 22 term moderate to major beneficial change in impacts compared to Alternative A.

23
 24 *When Zuni Point Corridor routes are closed, Location Points Temple Butte and Grid Location Points 14 and*
 25 *15 aircraft Percent Time Audible would be 1% of the day, a decrease of 61 to 69% compared to Alternative A.*
 26 *Aircraft Average Sound Level would be 6 to 14 dBA, a decrease of 14 to 31 dBA from Alternative A. As long-*
 27 *loop and short-loop routes would be inactive in Zuni Point Corridor at this time, aircraft would rarely be*
 28 *visible at locations on the ground. Off-Peak Season negligible to minor adverse impacts would occur under*
 29 *and near Zuni Point Corridor with moderate to major beneficial change in impacts from Alternative A.*

30
 31 Aircraft Percent Time Audible would *decrease to 1%* of the day near **Cape Royal** Location Point, a **58%**
 32 *decrease* from Alternative A with Average Sound Level **11 dBA** a **14% decrease from** Alternative A. Air-tour
 33 aircraft *would rarely be visible* during this time of year as short-loop tour routes in Zuni Point Corridor *and*
 34 *long-loop tour routes would be inactive. Negligible adverse* impacts would occur with *major beneficial* change
 35 compared to Alternative A. At **Grid Location Point 11**, aircraft Percent Time Audible would *be 27%, a 28%*
 36 *decrease* compared to Alternative A with Average Sound Level of **15 dBA**, a decrease of **3 dBA** from Alternative A.

37
 38 Points across North Rim and at some locations near Dragon Corridor would continue to receive noise impacts
 39 (e.g., **The Basin** Location Point Percent Time Audible would be **37% and 19 dBA**, and **Tower of Ra** Location
 40 Point Percent Time Audible would be at **80% and 38 dBA**; however, these would be reductions in Percent Time
 41 Audible of **17 to 36%, and 6 to 29 dBA** compared to Alternative A). Although moderate adverse impacts would
 42 continue, there would be moderate to major beneficial change in impacts compared to Alternative A.

43
 44 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 45 *Peregrine Falcon*
 46 *Ten-Year Forecast Off-Peak Season*

47 There would be aircraft noise reduction in and near **Dragon Corridor** (Location Points **96 Mile Camp, Tower**
 48 **of Ra, and Hermit Basin**). Aircraft Percent Time Audible would be **25 to 67%**, a reduction of **31 to 61%**
 49 compared to Alternative A. Average Sound Level would range **15 to 35** dBA, a **10 to 27** dBA decrease from
 50 Alternative A. Although minor to moderate adverse impacts would continue under and near Dragon Corridor
 51 there would be short-term *and long-term* minor to major beneficial change in impacts compared to Alternative A.

52
 53 Percent Time Audible near and under Zuni Point Corridor (Location Points **Temple Butte and Grid Location**
 54 **Points 14 and 15**) would be **1%, a decline of 65 to 73%** from Alternative A. Aircraft Average Sound Level
 55 would range **6 to 14 dBA, a decrease of 15 to 32 dBA from** Alternative A. *The* reduction in air-tour aircraft
 56 Percent Time Audible compared to Alternative A would result in increased potential for peregrine falcons to

1 establish territories and eyries. *Off-Peak Season negligible to minor* adverse impacts would *occur, but there*
2 would be *short- and long-term moderate to major* beneficial change in impacts from Alternative A.
3

4 Aircraft Percent Time Audible would decline along **Bright Angel Flight-free Zone** edges. Aircraft Percent Time
5 Audible would be *1%* of the day near Zuni Point Corridor at Location Point **Cape Royal**, a decrease of *60%*
6 from Alternative A, and *17%* of the day near Dragon Corridor at **Grid Location Point 11**, a *39%* reduction
7 compared to Alternative A, with reductions of *6 to 14* dBA in Average Sound Level from Alternative A. Percent
8 Time Audible at Location Points **Point Imperial** and **Grid Location Point 16** would be *1 to 20%*, a *64 to 67%*
9 decrease compared to Alternative A with Average Sound Level *7 to 12* dBA, a *22 to 32* dBA decrease from
10 Alternative A. **The Basin** and **Tower of Ra** Location Points would receive further noise reductions from Base
11 Year, with Percent Time Audible *7 to 67%* and Average Sound Level *20 to 35* dBA, *31 to 68% and 10 to 28*
12 dBA reductions from Alternative A. *Negligible to minor impacts* would *occur, and* there would be short-term
13 *and long-term* minor to major beneficial change in impacts compared to Alternative A.
14
15

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Not Finalized
FOIA Discretionary Release

1 **Table 4.173 Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)					
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	38	-32	25	-49	35	-10	33	-12
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	80	-17	67	-31	38	-6	35	-10
Hermit Basin	99	100	42	42	96	-4	57	-43	20	-22	17	-25	79	-20	39	-61	17	-25	15	-27
North Rim																				
Bright Angel Point	47	48	24	24	57	10	18	-30	24	0	18	-6	4	-43	5	-43	13	-11	12	-12
Point Imperial	66	68	38	39	47	-19	11	-56	18	-20	16	-22	1	-65	1	-67	7	-31	7	-32
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	37	-36	7	-68	19	-29	20	-28
Grid Location Point 16	80	84	33	34	54	-26	39	-45	32	-1	24	-9	13	-67	20	-64	12	-21	12	-22
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	62	-8	46	-28	39	6	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	56	-9	37	-32	39	11	35	6	1	-64	1	-68	14	-14	14	-15
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32
South Rim																				
Tusayan Museum	64	67	35	36	64	0	38	-29	35	0	29	-7	0	-64	0	-67	4	-31	4	-32
1.5 km SE of Moran Point	64	68	41	41	62	-2	42	-25	38	-3	33	-8	2	-62	3	-65	6	-35	5	-36
Bright Angel Flight Free Zone																				
Cape Royal	59	61	25	26	68	9	28	-33	27	2	21	-5	1	-58	1	-60	11	-14	12	-14
Cedar Ridge	81	82	19	19	89	0	6	-76	19	1	14	-5	56	-25	6	-76	15	-4	13	-6
Grid Location Point 11	55	56	18	18	50	-5	23	-33	20	2	14	-4	27	-28	17	-39	15	-3	12	-6
Grid Location Point 12	1	1	13	14	2	1	1	1	13	0	12	-1	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	12	0	9	-4	1	0	1	0	9	-3	9	-4
Phantom Ranch	3	4	12	12	2	1	1	-3	10	-2	7	-5	1	-2	1	-3	7	-5	7	-5
Toroweap/Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	73	-19	19	-73	26	1	23	-2
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	73	13	31	-29	17	1	15	-2
Point Sublime	100	100	35	35	100	0	95	-5	35	-1	29	-6	97	-3	83	-17	32	-3	27	-8
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	6	-1	3	-4
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	6	-1	0	0	0	0	7	1	7	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2

1 **Table 4.174 Modified NPS Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Dragon Corridor			
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,579	431
Hermit Basin	1,518	6,447	4,929
North Rim			
Point Imperial	2,292	2,754	462
Bright Angel Point	6,235	6,236	2
The Basin	477	874	397
Grid Location Point 16	2,589	2,591	2
Zuni Point Corridor			
Grid Location Point 14	687	1,412	726
Grid Location Point 15	1,637	2,345	708
Temple Butte	1,458	1,303	-155
South Rim			
Tusayan Museum	2,016	2,018	3
1.5 km SE of Moran Point	448	1,144	696
Bright Angel Flight Free Zone			
Cape Royal	4,038	4,026	
Cedar Ridge	9,827	12,261	2,434
Grid Location Point 11	8,081	8,035	-46
Grid Location Point 12	9,014	9,012	-2
Grid Location Point 13	7,925	7,852	-73
Phantom Ranch	11,027	11,313	286
Toroweap /Shinumo Flight Free Zone			
Grid Location Point 10	2,931	6,233	322
Grid Location Point 18	8,449	5,106	-3,342
Point Sublime	3,760	4,076	316
Bass Camp	13,088	13,352	-5
Rainbow Plateau	14,878	14,974	96

Δ indicates change in noise metric data from Alternative A

2
3
4
5 **Central Modified NPS Preferred Alternative Special Status Species**
6 **Peregrine Falcon**
7 *All Scenarios*

8 Similar to Alternative A, peregrine falcon territories would be little affected by aircraft noise. As shown in Table
9 4.175, Base Year and Ten-Year Forecast Peak Season when **all tour routes are open**, there would be **some**
10 difference in sound metrics compared to Alternative A. Air-tour aircraft Percent Time Audible would generally
11 **be less than 2%** of the day, with aircraft Average Sound Level **zero to 14** dBA. Air-tour aircraft would generally
12 be greater than 7,000 meters from locations on the ground as shown in Table 4.176. Off-Peak Season impacts
13 would be similar to Peak Season. Falcon daily behaviors such as foraging and roosting would be little affected by
14 air-tour aircraft. Negligible to minor adverse impacts would continue with negligible **to minor** change from
15 Alternative A.
16

1 **Table 4.175 Modified NPS Preferred Alternative Average Sound Level Central**

Location Point Name	Modified NPS Preferred Alternative																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	9	0	7	-2	2	0	2	0	7	-1	7	-2
Grid Location Point 9	1	1	5	5	1	0	0	-1	6	1	4	-1	1	0	0	-1	5	0	3	-3
Grid Location Point 20	0	0	4	4	0	0	0	0	4	0	4	0	0	0	0	0	4	0	4	0
Grid Location Point 25	11	12	9	10	2	-9	2	-10	6	-3	7	-3	2	-9	2	-10	6	-3	6	-4
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	10	4	8	1	1	0	1	0	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Toroweap Overlook	0	0	13	14	0	0	0	0	14	1	14	0	0	0	0	0	13	0	14	0
Upper Deer Creek	1	1	1	1	1	0	1	0	2	1	1	0	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.176 Modified NPS Preferred Alternative Slant Distances Central

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
1 km W of Kanab Point	8,250	18,857	8
Grid Location Point 9	1,103	19,140	8,038
Grid Location Point 20	22,053	22,095	42
Grid Location Point 25	20,188	20,216	28
Havasu Point	10,450	10,589	140
Kanab Point	19,021	19,029	8
Mt. Sinyala	7,272	7,302	30
Stone Creek	21,882	24,531	2,649
Surprise Valley	25,500	26,243	743
Toroweap Overlook	9,625	9,625	0
Upper Deer Creek	23,683	24,100	417

Δ indicates change in noise metric data from Alternative A

5
6

1 **West End** *Modified NPS Preferred Alternative* **Special Status Species**

2 **Peregrine Falcon**

3 *All Scenarios*

4 *Distance between the Z-shaped Route (realigned Blue Direct) and Grid Location Points 27 and 32 increases to*
 5 *4,923 and 18,618 meters respectively compared to Alternative A as shown in Table 4.177. Aircraft Percent*
 6 *Time Audible would range 4 to 10% of the day, a decrease of 6 to 44%, with Average Sound Level 19 to 22*
 7 *dBA, a minor reduction from Alternative A. Minor adverse impacts would continue with long-term negligible*
 8 *to major change in impacts from Alternative A.*

9
 10 **Near Brown routes**, represented by Location Points **Parashant Wash** and **Whitmore Rapids**, air-tour aircraft
 11 Percent Time Audible would be **11 to 20%** of the day at Average Sound Level **24 to 29** dBA, similar to
 12 Alternative A. Aircraft would be 1,800 to nearly 3,000 meters away from locations on the ground. Minor adverse
 13 impacts would continue with negligible change from Alternative A.

14
 15 Peregrine falcon and habitat located in **Sanup Flight-free Zone** and areas south would be negligibly affected by
 16 air-tour operations. Air-tour aircraft Percent Time Audible would be zero percent of the day with Average Sound
 17 Level of less than one to 7 dBA as reflected in data at Location Points **Diamond Creek, Pumpkin Springs** and
 18 **Grid Location Point 34**. Impact of air-tour aircraft on falcons in Sanup Flight-free Zone would be negligible
 19 with no change in impact from Alternative A.

20
 21 Peregrine falcons using habitat near **Green-4** and **Blue-2**, represented by Location Points **Burnt Springs**
 22 **Canyon, Bat Cave**, and **Grid Location Point 33**, would be exposed to *Percent Time Audible 54 to 93% a*
 23 *reduction of 2 to 33% with Average Sound Level of 38 to 45 dBA* similar to Alternative A. Falcon daily
 24 activities could be disrupted frequently, which may result in displacement from suitable habitats for nesting and
 25 foraging that could affect population levels. **Long-term** moderate to major adverse impacts would continue with
 26 negligible **to major** change in impacts from Alternative A.

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1 **Table 4.177 Modified NPS Preferred Alternative Average Sound Level West End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Burnt Springs Canyon	70	75	46	47	63	-7	58	-17	45	-1	43	-4	61	-9	54	-21	45	-1	42	-5
Bat Cave	93	95	47	48	93	0	88	-7	45	-2	43	-5	91	-2	85	-10	44	-3	43	-5
Grid Location Point 33	87	90	42	43	80	-7	55	-35	42	0	38	-5	81	-6	57	-33	42	0	38	-4
Whitmore Rapids	12	13	21	21	19	7	20	7	29	8	28	7	18	6	17	4	28	7	27	6
Grid Location Point 32	44	49	27	28	4	-40	5	-44	21	-6	22	-6	4	-40	5	-44	21	-6	22	-6
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grid Location Point 27	20	23	26	27	9	-6	10	-13	19	-7	19	-8	10	-20	9	-14	19	-7	19	-8
Grid Location Point 34	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0
Parashant Wash	12	14	33	33	11	-1	14	0	24	-9	24	-9	11	-1	12	-2	25	-8	24	-9
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	0	0	0	0	0	7	0	7	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
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6

Table 4.178 Modified NPS Preferred Alternative Slant Distances West End

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,374	1,374	0
Grid Location Point 33	1,105	1,105	0
Whitmore Rapids	1,804	1,804	0
Grid Location Point 32	2,016	18,618	16,602
Diamond Creek	27,108	33,411	6,303
Grid Location Point 27	3,388	4,923	1,535
Grid Location Point 34	28,206	29,373	1,167
Parashant Wash	2,852	2,852	0
Pumpkin Springs	12,630	19,695	7,065

1 **Cumulative Impact** *Modified NPS Preferred Alternative* **Special Status Species**
 2 **Peregrine Falcon**

3
 4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 5
 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

10
 11 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
 12 *(Modified NPS Preferred Alternative).*

13
 14 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 15 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 16 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 17 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 18 *SFRA see Appendix D, Figures 91 to 94).*

19
 20 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 21 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 22 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 23 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 24 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 25 *Audible capable of masking some aircraft noise.*

26
 27 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 28 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 29 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 30 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 31 *the lone human noise source in remote areas of the SFRA (why from air-tour routes—the only reminder of*
 32 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 33 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 34 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 35 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
 36 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
 37 *noise some of the time.*

38
 39 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 40 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
 41 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
 42 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
 43 *Alternatives (Modified NPS Preferred Alternative in this case).*

44
 45 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
 46 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
 47 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
 48 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
 49 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
 50 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
 51 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
 52 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

53
 54 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
 55 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
 56 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*

1 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
 2 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
 3 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
 4 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
 5 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
 6 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
 7 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

8
 9 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 10 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
 11 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
 12 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

13
 14 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 15 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 16 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 17 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 18 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 19 *Cumulative Impacts discussion in the Conclusions section below.*

20
 21 **Conclusion** *Modified NPS Preferred Alternative* **Special Status Species**
 22 **Peregrine Falcon**

23
 24 Overall, the *Modified* NPS Preferred Alternative would result in beneficial change in impacts to peregrine falcons
 25 compared with Alternative A due to reduced amount of area exposed to high Average Sound Level long periods of
 26 the day. Ten-Year Forecast the *Modified* NPS Preferred Alternative would result in improvement in peregrine
 27 habitat and reduction of impacts on peregrine falcons as aircraft noise is reduced by quiet-technology incentives and
 28 conversion requirements. Greatest impacts would occur under East and West End heavily-used air-tour routes where
 29 Average Sound Level would generally be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than
 30 75% of the day. However, there would also be large portions of habitat relatively undisturbed by air-tours in Marble
 31 Canyon and the Central area.

32
 33 *Conclusion Marble Canyon* *Modified NPS Preferred Alternative* *Special Status Species*
 34 *Peregrine Falcon*

35 All Scenarios for *Marble Canyon*, the *Modified* NPS Preferred Alternative would result in negligible impacts with
 36 *moderate* beneficial change in impacts to falcons compared to Alternative A.

37
 38 *Conclusion East End* *Modified NPS Preferred Alternative* *Special Status Species*
 39 *Peregrine Falcon*

40 East End, there would be seasonal decreases in impacts to falcons due to *seasonal closure of Zuni Point Corridor*
 41 *and the long-loop route (Dragon Corridor would remain open year-round).*

42
 43 Base Year Peak Season, impacts to falcons beneath and adjacent to Dragon Corridor routes would be *minor* to major
 44 adverse with negligible to minor beneficial impacts compared to Alternative A. Ten-Year Forecast Peak Season with
 45 conversion to quiet-technology aircraft, there would be *long-term* minor to major beneficial change in impacts
 46 compared to Alternative A.

47
 48 In Zuni Point Corridor, Base Year Peak Season there would be moderate to major adverse impacts with negligible
 49 change in impacts compared to Alternative A. Base Year Off-Peak Season, when Zuni Point Corridor *and long-loop*
 50 *routes would be inactive*, impacts would be *negligible to minor* adverse with *moderate to major beneficial* change
 51 in impacts compared to Alternative A. *Ten-Year Forecast Peak Season with conversion to quiet-technology*
 52 *aircraft, there would be long-term minor to major beneficial change in impacts compared to Alternative A.*

53
 54 Base Year Peak Season, moderate to major adverse impacts to falcons would continue under and near North Rim
 55 air-tour routes (*The Basin, Point Imperial, and Bright Angel Point* Location Points). There would be negligible
 56 adverse change in impacts compared to Alternative A at *some* Location Points. *However, Point Imperial* Location

1 Point would experience moderate to major beneficial change in impacts. Impacts at these location points Ten-Year
 2 Forecast Peak Season would be reduced to minor adverse. These represent moderate to major beneficial changes in
 3 impacts from Alternative A due to conversion to quiet-technology aircraft. Ten-Year Forecast Off-Peak Season there
 4 would be minor to moderate adverse impacts, **and** minor to major beneficial change in impacts compared to
 5 Alternative A beneath and adjacent to North Rim routes.

6
 7 Ten-Year Forecast Peak Season in **Bright Angel Flight-free Zone**, impacts would be **minor to moderate** with **minor**
 8 **to major** beneficial change from Alternative A.

9
 10 *Conclusion Central Modified NPS Preferred Alternative Special Status Species*
 11 *Peregrine Falcon*

12 Base Year and Ten-Year Forecast Peak and Off-Peak Season there would be negligible to minor adverse impacts
 13 with negligible **to minor** change in impacts compared to Alternative A on falcons.

14
 15 *Conclusion West End Modified NPS Preferred Alternative Special Status Species*
 16 *Peregrine Falcon*

17 Under Green-4 and Blue-2, there would be moderate to major adverse impacts with negligible beneficial change in
 18 impacts compared to Alternative A.

19
 20 In areas near **the Z-shaped Route (realigned Blue Direct)** there would be minor to moderate adverse impacts with
 21 negligible change in impact compared to Alternative A. In areas near Brown routes there would be minor adverse
 22 impacts with negligible change in impacts from Alternative A. In areas under and near **Sango Flight-free Zone** there
 23 would be negligible impacts with **no** change in impacts compared to Alternative A.

24
 25 *Cumulative Impacts Summary Modified NPS Preferred Alternative Special Status Species*
 26 *Peregrine Falcon*

27
 28 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 29 *the impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is,*
 30 *Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections*
 31 *(Marble Canyon, East End, Central, West End) of the park would tend to increase to major adverse Cumulative*
 32 *Impacts under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of*
 33 *the large Flight-free Zones. In comparison with the other Alternatives, Modified NPS Preferred Alternative ranks*
 34 *second behind Alternative E for the lowest overall Cumulative Impacts (Alternative A ranks last).*

35
 36 **BALD EAGLE** **SPECIAL STATUS SPECIES**

37
 38 *Bald eagles are uncommon winter residents along the Colorado River primarily from Glen Canyon Dam to*
 39 *Phantom Ranch (River Mile 89). Under Alternative A, a range of aircraft noise intensities and persistence would*
 40 *affect bald eagles in the southern portion of Marble Canyon and East End. These areas of the park and SFRA*
 41 *include the southern extension of the wintering bald eagle range. In addition, there are locations in East End*
 42 *that have historically supported some of the largest concentrations of wintering bald eagles in the southwest.*
 43 *Therefore the analysis focuses on these areas of the park and SFRA where impacts may be detectable. Location*
 44 *points of particular relevance to the analysis of impacts to bald eagles include but are not limited to Marble Dam,*
 45 *Nankoweap River, and Phantom Ranch.*

46
 47 **MODIFIED NPS PREFERRED ALTERNATIVE** **SPECIAL STATUS SPECIES**
 48 **BALD EAGLE**

49
 50 *Overall the Modified NPS Preferred Alternative would result in a beneficial change in impacts compared to*
 51 *Alternative A in bald eagle habitat and roost areas with substantially fewer disturbances to bald eagles. Distances*
 52 *between known bald eagle roost areas and air-tour routes would increase and range from 4,218 to 12,261 meters,*
 53 *a difference of 286 to 8,206 meters from Alternative A.*

1 **Marble Canyon** **Modified NPS Preferred Alternative** **Special Status Species**
2 **Bald Eagle**
3 **All Scenarios**
4 *Impacts at representative Location Points around Marble Canyon would generally be minor to moderate*
5 *beneficial compared to Alternative A as shown in Table 4.178a and 4.178b. Air-tour aircraft Percent Time*
6 *Audible would be 1% or less, lower than Alternative A, and aircraft Average Sound Level would be zero to 13*
7 *dBA, a decrease of one to 24 dBA compared to Alternative A. Aircraft would be much farther away and not*
8 *visible from locations on the ground, ranging from 18,273 meters at Marble Canyon Dam Site Location Point*
9 *to 75,891 meters at Grid Location Point 1. Improvement over Alternative A would occur at all Location Points*
10 *close to rim and river, and most at North and South Canyon Location Points. Bald eagles would not be*
11 *disturbed from normal daily activities by aircraft. Closure of all Marble Canyon routes would result in an*
12 *increased Distance between air traffic and bald eagle roosting/foraging areas. There would generally be long-*
13 *term minor to major beneficial change in impacts compared with Alternative A.*
14
15

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1 **Table 4.178a Modified NPS Preferred Alternative Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Modified Preferred Alternative															
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	1	-5	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9	1	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	1	-7	0	-7	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-3	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-3	0	-3	2	--22	0	-24	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-3	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

2
3 **Table 4.178b Modified NPS Preferred Alternative Slant Distances Marble Canyon**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	1,693	56,020	52,925
Grid Location Point 1	1,665	28,891	74,226
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	53,548	50,590
Grid Location Point 4	4,585	71,678	67,093
Grid Location Point 5	2,335	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669

Δ indicates change in noise metric data from Alternative A

4
5

East End Modified NPS Preferred Alternative Special Status Species

Bald Eagle

Under the proposed action, noise from air-tour traffic would continue at high, but reduced levels, and a seasonal closure of the long loop and Zuni Point Corridor November 15 – March 31 would reduce sound levels substantially in those areas. Analysis of three location points (Nankoweap River, Phantom Ranch, and Cedar Ridge) in proximity to known bald eagle roosting locations indicate a reduction in Percent Time Audible and Average Sound Levels.

East End Modified NPS Preferred Alternative Special Status Species

Bald Eagle

Base Year Peak Season

At Dragon Corridor Location Points 96 Mile Camp, Tower of Ra, and Hermit Basin air-tour Percent Time Audible would be 59 to 96% of the day, a one to 12% decrease from Alternative A. Average Sound Level would be 20 to 42 dBA, a 2 to 22 dBA decrease from Alternative A. Air-tour aircraft would be farther away from points on the ground compared to Alternative A by about 400 to almost 5,000 meters at those points. Moderate to major adverse impacts would continue under and near Dragon Corridor air-tour routes, generally with short-term negligible to minor beneficial change in impacts compared to Alternative A.

There would be little reduction in air-tour aircraft noise under and near Zuni Point Corridor (Location Points Temple Butte and Grid Location Points 14 and 15). Aircraft Percent Time Audible would be 54 to 62% of the day, an 8% decrease compared to Alternative A. Average Sound Level would be 39 dBA, a 6 to 11 dBA increase from Alternative A. Moderate to major adverse impacts would continue under Zuni Point Corridor, with negligible to minor change in impacts compared to Alternative A.

In Bright Angel Flight-free Zone air-tour aircraft Percent Time Audible would increase by 9% from Alternative A in areas near Cape Royal Location Point (Percent Time Audible 68%). Average Sound Level would range 10 to 20 dBA, similar to Alternative A. Aircraft would be greater than 4,000 meters from locations on the ground. Minor to moderate adverse impacts would continue with negligible change in impacts compared to Alternative A.

Along North Rim, in Bright Angel Flight-free Zone away from routes, areas would experience a decrease in air-tour aircraft noise. In areas represented by Location Points Point Imperial and Grid Location Point 16, aircraft Percent Time Audible would be 47% and 54% of the day, a 19 to 26% decrease compared to Alternative A. Average Sound Level would be 18 to 32 dBA a decrease of one to 20 dBA. Aircraft would be 2,500 to 6,200 meters from locations on the ground. Bald eagle daily activities would be occasionally interrupted by aircraft noise. Although minor to major adverse impacts would occur there would be short-term moderate beneficial change in impacts compared to Alternative A.

Little Colorado and Nankoweap area Percent Time Audible zero to 76% would be a decrease of 7 to 11% compared to Alternative A, and Average Sound Level 15 to 31 dBA a decrease of 12 to 19 dBA. Although minor to moderate impacts would occur, there would be moderate beneficial change compared to Alternative A.

East End Modified NPS Preferred Alternative Special Status Species

Bald Eagle

Ten-Year Forecast Peak Season

Under and adjacent to Dragon Corridor air-tour routes Percent Time Audible would decline to 41 to 88%, a 10 to 43% decrease from Alternative A due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would range 17 to 38 dBA, a decrease of 7 to 25 dBA. Aircraft Distance would be the same as Base Year. Although minor major adverse impacts would continue under and near Dragon Corridor there would be long-term minor to major beneficial change in impacts compared to Alternative A.

There would be greater reduction in air-tour aircraft noise compared to Base Year Peak Season near Zuni Point Corridor with aircraft Percent Time Audible 33 to 46% of the day, a 28 to 33% decrease from Alternative A. Average Sound Level would be 35 dBA, up to a 6 dBA increase compared to Alternative A. Aircraft noise would be farther away from location points on the ground which may improve bald eagle foraging and roosting behaviors. Moderate to major adverse impacts would continue under and near Zuni

1 *Point Corridor air-tour routes, with short-term minor adverse change and moderate to major beneficial*
 2 *change in impacts compared to Alternative A.*

3
 4 *In Bright Angel Flight-free Zone represented by Location Points Cape Royal and Grid Location Point 11*
 5 *aircraft Percent Time Audible would be 23 to 28% of the day, a decrease of 33% compared to Alternative A.*
 6 *Air-tour Average Sound Level would be similar to Alternative A and range 14 to 21 dBA. Bald eagles would*
 7 *be infrequently disturbed during daily activities due to air tours at a Distance between 8,000 to 12,000 meters*
 8 *away. Although minor to moderate adverse impacts would occur there would be long-term minor to moderate*
 9 *beneficial change in impacts compared to Alternative A. The middle of Bright Angel Flight-free Zone would*
 10 *remain quiet, as represented by Grid Location Points 12 and 13, with negligible impacts and negligible change*
 11 *in impacts from Alternative A.*

12
 13 *North Rim areas in Bright Angel Flight-free Zone would improve at areas represented by Location Points*
 14 *Point Imperial and Grid Location Point 16. Aircraft Percent Time Audible would be 11 to 39% of the day; a*
 15 *45 to 56% decrease from Alternative A. Average Sound Level would range 16 to 24 dBA, a 9 to 22 dBA*
 16 *decline. There would be less interruption or disturbance to bald eagle foraging and roosting than Base Year*
 17 *Peak Season. Although moderate adverse impacts would occur there would be long-term minor to major*
 18 *beneficial change in impacts compared to Alternative A.*

19
 20 *The Little Colorado and Nankoweap area would improve at Location Points Nankoweap River and*
 21 *Nankoweap Mesa with Percent Time Audible zero to 48%, a decrease of 8 to 42% compared to Alternative A.*
 22 *Average Sound level would be 13 to 29 dBA, a decrease of 14 to 22 dBA compared to Alternative A. Although*
 23 *minor to moderate impacts would occur, there would be moderate to major beneficial change compared to*
 24 *Alternative A.*

25
 26 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 27 *Bald Eagle*
 28 *Base Year Off-Peak Season*

29 *Dragon Corridor air-tour aircraft Percent Time Audible would be 33 to 80% of the day, a 17 to 32% decrease*
 30 *from Alternative A. Average Sound Level would be 17 to 38 dBA, a 6 to 25 dBA reduction. Aircraft would be*
 31 *at the same Distance as Peak Season. Eagle foraging and roosting may improve in Dragon Corridor with less*
 32 *noise interference from aircraft. Although moderate to major impacts would continue there would be short-*
 33 *term moderate to major beneficial change in impacts compared to Alternative A.*

34
 35 *When Zuni Point Corridor and long-loop routes are closed, areas under and near Zuni Point Corridor*
 36 *(represented by Location Points Temple Butte and Grid Location Points 14 and 15) would experience aircraft*
 37 *Percent Time Audible 1% of the day, a 61 to 69% decrease compared to Alternative A. Aircraft Average Sound*
 38 *Level would be 6 to 14 dBA, a decrease of 14 to 31 dBA from Alternative A. Aircraft would rarely be visible*
 39 *from locations on the ground. Bald eagle activities would rarely be interrupted from aircraft noise. Negligible*
 40 *impacts would occur with moderate to major beneficial change in impacts compared to Alternative A.*

41
 42 *In Bright Angel Flight-free Zone near air-tour routes, as represented by Cape Royal Location Point aircraft*
 43 *Percent Time would decrease to 1% of the day; a 58% decrease from Alternative A with Average Sound Level*
 44 *of 11 dBA, a 14 dBA decrease from Alternative A. Air-tour aircraft would be visible less frequently during this*
 45 *time of year as Zuni Point Corridor and long-loop routes would be closed. Negligible adverse impacts would*
 46 *occur with moderate to major beneficial impacts compared to Alternative A. At Grid Location Point 11,*
 47 *aircraft Percent Time Audible would be 27%; a 28% decrease compared to Alternative A. Average Sound*
 48 *Level would be 15 dBA, a decrease of 3 dBA from Alternative A. Although negligible to minor adverse impacts*
 49 *would occur there would be short-term minor to moderate beneficial change in impacts compared to*
 50 *Alternative A.*

51
 52 *The Little Colorado and Nankoweap area would improve at Location Points Nankoweap River and*
 53 *Nankoweap Mesa with Percent Time Audible 1% or less, a decrease of 7 to 42% compared to Alternative A.*
 54 *Average Sound level would be 11 to 14 dBA, a decrease of 23 to 29 dBA compared to Alternative A. Although*
 55 *negligible impacts would occur, there would be moderate to major beneficial change compared to Alternative A.*
 56

1 **East End** **Modified NPS Preferred Alternative** **Special Status Species**

2 **Bald Eagle**

3 **Ten-Year Forecast Off-Peak Season**

4 *There would be further reduction in aircraft noise under and near Dragon Corridor due to conversion to*
5 *quiet-technology aircraft. Aircraft Percent Time Audible would be 25 to 67% of the day; a reduction of 31 to*
6 *61% compared to Alternative A. Average Sound Level would range 15 to 35 dBA, a 10 to 27 dBA decrease.*
7 *Although minor to major adverse impacts would continue under and near Dragon Corridor there would be*
8 *long-term moderate to major beneficial change in impacts compared to Alternative A.*

9
10 *In areas near and under Zuni Point Corridor aircraft Percent Time Audible would be 1%; a decline of 65 to*
11 *73% from Alternative A. Aircraft Average Sound Level would range 6 to 14 dBA, a 15 to 32 dBA decrease*
12 *from Alternative A. Although negligible adverse impacts would occur there would be short- and long-term*
13 *moderate to major beneficial change in impacts from Alternative A.*

14
15 *Along edges of Bright Angel Flight-free Zone, aircraft Percent Time Audible would be 1% of the day near*
16 *Zuni Point Corridor at Cape Royal Location Point, a decrease of 60%, and Percent Time Audible 17% of the*
17 *day near Dragon Corridor at Grid Location Point 11, a 39% reduction compared to Alternative A, and*
18 *Average Sound Level of 12 dBA decreasing by 6 to 14 dBA. Although negligible adverse impacts would occur*
19 *there would be short- and long-term minor to major beneficial change in impacts compared to Alternative A.*

20
21 *The Little Colorado and Nankoweap area would improve at Location Points Nankoweap River and*
22 *Nankoweap Mesa with Percent Time Audible 2% or less, a decrease of 8 to 88% compared to Alternative A.*
23 *Average Sound level would be 12 to 15 dBA, a decrease of 23 to 28 dBA compared to Alternative A. Although*
24 *negligible adverse impacts would occur, there would be long-term moderate to major beneficial change*
25 *compared to Alternative A.*
26

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1 **Table 4.178c Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
					Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	38	-32	25	-49	35	-10	33	-12
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	80	-17	67	-31	38	-6	35	-10
Hermit Basin	99	100	42	42	96	-4	57	-43	20	-22	17	-25	79	-20	39	-61	17	-25	15	-27
North Rim																				
Bright Angel Point	47	48	24	24	57	10	18	-30	24	0	18	-6	4	-43	5	-43	13	-11	12	-12
Point Imperial	66	68	38	39	47	-19	11	-56	18	-20	16	-2	1	-65	1	-67	7	-31	7	-32
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	37	-36	7	-68	19	-29	20	-28
Grid Location Point 16	80	84	33	34	54	-26	39	-45	32	-1	24	-9	13	-67	20	-64	12	-21	12	-22
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	62	-8	46	-28	39	6	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	56	-9	37	-32	39	5	35	6	1	-64	1	-68	14	-14	14	-15
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32
Little Colorado/ Nankoweap Area																				
Nankoweap at River	7	8	34	35	0	-7	0	-8	5	-19	13	-22	0	-7	0	-8	11	-23	12	-23
Nankoweap Mesa	87	90	43	43	76	-11	48	-42	31	-12	29	-14	1	-86	2	-88	14	-29	15	-28
South Rim																				
Tusayan Museum	64	67	35	36	64	0	38	-29	35	0	29	-7	0	-64	0	-67	4	-31	4	-32
1.5 km SE of Moran Point	64	68	41	41	62	-2	43	-25	38	-3	33	-8	2	-62	3	-65	6	-35	5	-36
Bright Angel Flight Free Zone																				
Cape Royal	59	61	25	26	68	9	28	-33	27	2	21	-5	1	-58	1	-60	11	-14	12	-14
Cedar Ridge	81	82	19	19	89	6	6	-76	19	1	14	-5	56	-25	6	-76	15	-4	13	-6
Grid Location Point 11	55	56	18	18	50	-5	23	-33	20	2	14	-4	27	-28	17	-39	15	-3	12	-6
Grid Location Point 12	1	1	13	14	2	1	2	1	13	0	12	-1	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	12	0	9	-4	1	0	1	0	9	-3	9	-4
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	7	-5	1	-2	1	-3	7	-5	7	-5
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	73	-19	19	-73	26	1	23	-2
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	73	13	31	-29	17	1	15	-2
Point Sublime	100	100	35	35	100	0	95	-5	35	-1	29	-6	97	-3	83	-17	32	-3	27	-8
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	6	-1	3	-4
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	6	-1	0	0	0	0	7	1	7	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

1 **Table 4.178d Modified NPS Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Dragon Corridor			
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,579	431
Hermit Basin	1,518	6,447	4,929
North Rim			
Point Imperial	2,292	2,754	462
Bright Angel Point	6,235	6,236	2
The Basin	477	874	397
Grid Location Point 16	2,589	2,591	2
Zuni Point Corridor			
Grid Location Point 14	687	1,412	726
Grid Location Point 15	1,637	2,345	708
Temple Butte	1,458	1,303	-155
Little Colorado/ Nankoweap Area			
<i>Nankoweap at River</i>	1,449	9,655	8,206
<i>Nankoweap Mesa</i>	973	6,096	5,123
South Rim			
Tusayan Museum	2,016	2,018	
1.5 km SE of Moran Point	448	1,144	696
Bright Angel Flight Free Zone			
Cape Royal	4,038	4,026	-12
Cedar Ridge	9,827	12,261	2,434
Grid Location Point 11	8,081	8,035	-46
Grid Location Point 12	9,014	9,012	-2
Grid Location Point 13	7,925	7,852	-73
Phantom Ranch	11,087	11,313	286
Toroweap /Shinumo Flight Free Zone			
Grid Location Point 10	1,931	3,253	322
Grid Location Point 18	8,449	5,106	-3,342
Point Sublime	3,760	4,076	316
Bass Camp	13,358	13,352	-5
Rainbow Plateau	14,878	14,974	96

2
3
4 **Cumulative Impact** *Modified NPS Preferred Alternative* **Special Status Species**
5 **Bald Eagle**

6
7 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
8 *actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 9 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
10 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
11 *3) ground-based noise sources, plus*
12 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

13
14 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
15 *(Modified NPS Preferred Alternative).*

16
17 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
18 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
19 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
20 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
21 *SFRA see Appendix D, Figures 91 to 94).*

1 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
2 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
3 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
4 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
5 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
6 *Audible capable of masking some aircraft noise.*

7
8 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
9 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
10 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
11 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
12 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
13 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
14 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
15 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
16 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
17 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
18 *noise some of the time.*

19
20 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
21 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
22 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
23 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
24 *Alternatives (Modified NPS Preferred Alternative in this case).*

25
26 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
27 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
28 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
29 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
30 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
31 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
32 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
33 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

34
35 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
36 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
37 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*
38 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
39 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
40 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
41 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
42 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
43 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
44 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

45
46 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
47 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
48 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
49 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

50
51 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
52 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
53 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
54 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
55 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
56 *Cumulative Impacts discussion in the Conclusions section below.*

1 **Conclusion** **Modified NPS Preferred Alternative** **Special Status Species**
 2 **Bald Eagle**

3
 4 *The Modified NPS Preferred Alternative, with the seasonal closure of Zuni Point Corridor and long loop*
 5 *November through March would greatly reduce impacts to wintering bald eagles compared to Alternative A.*
 6 *During these months there may be increased air tours in Dragon Corridor and therefore minor to major adverse*
 7 *impacts would continue under and near this corridor. At locations along the river, particularly at Nankoweap,*
 8 *there would be minor to major benefits on eagles due to a reduction in air-tour sounds and a decrease in*
 9 *proximity. The increase in Distance between air-tour routes and known bald eagle roosting locations would result*
 10 *in moderate to major beneficial impacts compared to Alternative A.*

11
 12 *As winter residents, bald eagles are present in the park for a limited time and can move to avoid disturbances as*
 13 *they are not committed to reproductive activities. While GCNP is still concerned for the bald eagle, proposed*
 14 *changes in the Modified NPS Preferred Alternative will provide beneficial changes for eagles. In general, the*
 15 *following changes will benefit eagles in GCNP*

- 16 • *moving routes away from historic bald eagle winter roost areas*
- 17 • *raising air-tour flight altitudes*
- 18 • *eliminating some air-tour routes*
- 19 • *reducing current annual allocation*
- 20 • *instituting a daily cap on air-tour flights*
- 21 • *quiet-technology incentives*
- 22 • *seasonal route closures*

23
 24 *Under the Bald and Golden Eagle Act, “take” is defined as “pursue, shoot, shoot at, poison, wound, kill, capture,*
 25 *trap, collect, destroy, molest or disturb.” When speaking of overflights, the most likely impact would be*
 26 *disturbance. “Disturb” is defined in regulations as “to agitate or bother a bald or golden eagle to a degree that*
 27 *causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle, 2) a decrease*
 28 *in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest*
 29 *abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”(72 FR 31132)*

30
 31 *After analyzing impacts of these changes to eagles, and combining that knowledge with the current population*
 32 *status and the Distance of roosting and foraging eagles from air-tour operations, GCNP has concluded an*
 33 *Incidental Take Permit for bald eagles is not necessary. GCNP will continue to coordinate with U.S. Fish and*
 34 *Wildlife Service.*

35
 36 **Conclusion Marble Canyon** **Modified NPS Preferred Alternative** **Special Status Species**
 37 **Bald Eagle**

38 *Elimination of air tours in Marble Canyon would greatly improve impacts to bald eagle habitat and roost areas.*
 39 *Potential for disturbance by or collisions with air-tour aircraft would be greatly reduced or eliminated as*
 40 *compared to current conditions. Closure of all Marble Canyon routes would result in increased Distance between*
 41 *air traffic and bald eagle roosting/foraging areas. There would generally be long-term minor to major beneficial*
 42 *change in impacts compared with Alternative A.*

43
 44 **Conclusion East End** **Modified NPS Preferred Alternative** **Special Status Species**
 45 **Bald Eagle**

46 *Forecast Off-Peak Season, with removal of air-tour traffic in Zuni Point Corridor and long-loop November 15 to*
 47 *March 31 along with increased flight altitude for air tours, would result in short-term moderate to major*
 48 *beneficial impacts on the bald eagle, especially as bald eagles roost and forage along the Colorado River early*
 49 *November to mid-March. Potential for disturbance by or collisions with air-tour aircraft would be greatly*
 50 *reduced or eliminated as compared to current conditions.*

51
 52 *Forecast Peak Season East End would continue with long-term minor to major adverse impacts under and near*
 53 *Dragon Corridor and Zuni Point Corridor air-tour routes, generally with short-term negligible to minor*
 54 *beneficial change in impacts compared to Alternative A.*

1 **Cumulative Impacts Summary Modified NPS Preferred Alternative Special Status Species**
 2 **Bald Eagle**

3
 4 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 5 *the impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is,*
 6 *Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections*
 7 *(Marble Canyon, East End, Central, West End) of the park would tend to increase to major adverse Cumulative*
 8 *Impacts under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of*
 9 *the large Flight-free Zones. In comparison with the other Alternatives, Modified NPS Preferred Alternative ranks*
 10 *second behind Alternative E for the lowest overall Cumulative Impacts (Alternative A ranks last).*

11
 12 **GOLDEN EAGLE SPECIAL STATUS SPECIES**

13
 14 *Nesting golden eagles are very rare in Grand Canyon (Ward 2009), but recent data is lacking. Golden eagles are*
 15 *year-round residents within the park, but with numerous remote side canyons, estimating numbers of breeding*
 16 *pairs is very difficult. According to Brown's annotated checklist of Birds of the Grand Canyon Region, golden*
 17 *eagles are "uncommon permanent residents throughout the [Grand Canyon] region. Scattered nesting occurs in*
 18 *areas with suitable cliffs" (Brown 1984).*

19
 20 **GOLDEN EAGLE SPECIAL STATUS SPECIES**

21
 22 *Overall the Modified NPS Preferred Alternative would result in a beneficial change compared to Alternative A in*
 23 *golden eagle habitat condition with substantially fewer disturbances to eagles, especially Ten-Year Forecast.*
 24 *Although adverse impacts would occur with disturbances to golden eagle behaviors and daily activities near air-*
 25 *tour routes, Ten-Year Forecast there would be substantial improvement in natural conditions particularly Off-*
 26 *Peak Season.*

27
 28 **MODIFIED NPS PREFERRED ALTERNATIVE SPECIAL STATUS SPECIES**

29
 30 **Marble Canyon Modified NPS Preferred Alternative Special Status Species**
 31 **Golden Eagle**
 32 **All Scenarios**

33 *Impacts at representative Location Points around Marble Canyon would generally be minor to moderate*
 34 *beneficial compared to Alternative A as shown in Table 4.178e and 4.178f. Air-tour aircraft Percent Time*
 35 *Audible would be 1% or less, lower than Alternative A, and aircraft Average Sound Level would be zero to 13*
 36 *dBa, a decrease of one to 24 dBA compared to Alternative A. Aircraft would be much farther away and not*
 37 *visible from locations on the ground, ranging from 18,273 meters at Marble Canyon Dam Site Location Point*
 38 *to 75,891 meters at Grid Location Point 1. Improvement over Alternative A would occur at all Location Points*
 39 *close to rim and river, and most at North and South Canyon Location Points. Eagles would not be disturbed*
 40 *from normal daily activities by aircraft. Closure of all Marble Canyon routes would result in increased*
 41 *Distance between air traffic and eagle roosting/foraging areas. There would generally be long-term minor to*
 42 *major beneficial change in impacts compared with Alternative A.*

1 **Table 4.178e Modified NPS Preferred Alternative Average Sound Level Marble Canyon**

Location Point Name	Modified NPS Preferred Alternative																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	1	-5	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9	0	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	1	-7	0	-7	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-3	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-3	0	-3	2	--22	0	-24	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-3	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4 **Table 4.178f Modified NPS Preferred Alternative Slant Distances Marble Canyon**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	36,620	52,925
Grid Location Point 1	1,665	75,891	74,226
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	53,548	50,590
Grid Location Point 4	4,585	71,678	67,093
Grid Location Point 5	2,355	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669

Δ indicates change in noise metric data from Alternative A

5
 6

East End Modified NPS Preferred Alternative Special Status Species

Golden Eagle

Base Year Peak Season

As shown in Tables 4.178g and 4.178h, areas where air-tour operations would have highest level of effect would be under and adjacent to Dragon Corridor, represented by Location Points 96 Mile Camp, Tower of Ra, and Hermit Basin. This results from high Percent Time Audible of air-tour noise during the day from 59 to 96%, a one to 12% decrease from Alternative A. Average Sound Level would be 20 to 42 dBA, a 2 to 22 dBA decrease from Alternative A. Air-tour aircraft would be farther away from points on the ground, about 1,500 to 6,400 meters. Given the Distance of air-tour aircraft from the ground, there would be little potential for collision with eagles. Although minor to major adverse impacts would continue under and near Dragon Corridor air-tour routes, there would be short-term negligible to minor beneficial change in impacts compared to Alternative A.

There would be little reduction in air-tour aircraft noise under and near Zuni Point Corridor (Location Points Temple Butte and Grid Location Points 14 and 15) Peak Season. Aircraft Percent Time Audible would be 54 to 62% of the day, an 8% decrease compared to Alternative A. Average Sound Level would be 39 dBA, a 6 to 11 dBA increase from Alternative A. Moderate to major adverse impacts would continue under Zuni Point Corridor, with negligible to minor change in impacts compared to Alternative A

In Bright Angel Flight-free Zone when Dragon Corridor and Zuni Point Corridor are both in use, air-tour aircraft Percent Time Audible would be 57 to 89% of the day, an increase of 4 to 10% from Alternative A in areas near Cape Royal, Bright Angel Point, The Basin, and Cedar Ridge Location Points. Air-tour aircraft Percent Time Audible would decrease 26% in areas near Grid Location Point 16 (to 54%), 19% at Point Imperial Location Point (to 47%), and 5% at Grid Location Point 11 (to 50%) compared to Alternative A. Average Sound Level would range 10 to 44 dBA, similar to Alternative A, except Point Imperial Location Point where sound levels would be reduced by 20 dBA to 18 dBA. Aircraft would generally be very distant from locations on the ground, greater than 2,000 meters except The Basin Location Point which would be less than 900 meters. Minor to major adverse impacts would continue near air-tour routes with minor adverse change in impacts compared to Alternative A at Cape Royal, Bright Angel Point, and The Basin, and moderate to major beneficial change in impacts compared to Alternative A at Point Imperial and Grid Location Point 16. The middle of Bright Angel Flight-free Zone would remain quiet, as represented by Grid Location Points 12 and 13 and Phantom Ranch Location Points with negligible impacts and negligible change from Alternative A.

East End Modified NPS Preferred Alternative Special Status Species

Golden Eagle

Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible in Dragon Corridor (Location Points 96 Mile Camp, Tower of Ra, and Hermit Basin) would decline to 41 to 88%, a 10 to 43% decrease from Alternative A, due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would range 17 to 38 dBA, a decrease of 7 to 25 dBA from Alternative A. Distance of aircraft would be the same as Base Year. Although minor to major adverse impacts would continue under and near Dragon Corridor air-tour routes, there would be long-term minor to major beneficial change in impacts compared to Alternative A.

There would be little reduction in air-tour aircraft noise under and near Zuni Point Corridor (Location Points Temple Butte and Grid Location Points 14 and 15) with Aircraft Percent Time Audible 33 to 46% of the day, a 28 to 33% decrease compared to Alternative A. Average Sound Level would be 35 dBA, similar to Alternative A. Moderate to major adverse impacts would continue under and near Zuni Point Corridor air-tour routes, with short-term minor adverse change to moderate to major beneficial change in impacts compared to Alternative A.

Aircraft Percent Time Audible would decline at all North Rim Location Points in Bright Angel Flight-free Zone. At Location Points Cape Royal and Grid Location Point 11, aircraft Percent Time Audible would be 23 to 28% of the day, a decrease of 33% from Alternative A (and a decrease of 27 to 40% from Base Year). Air-tour Average Sound Level would be only slightly lower than Alternative A at 14 to 21 dBA. Air-tour aircraft Percent Time Audible at Cedar Ridge Location Point would decline 83% compared to Base Year (76% lower

1 *than Alternative A), and at Grid Location Point 11 it would decline 27% from Base Year (33% from*
 2 *Alternative A). Declines would be due to quiet-technology conversion. Eagles would be less frequently*
 3 *disturbed by aircraft noise during daily activities compared to Base Year and Alternative A. Although minor to*
 4 *moderate adverse impacts would continue, there would be long-term moderate to major beneficial change in*
 5 *impacts compared to Alternative A in areas near air-tour routes. The middle of Bright Angel Flight-free Zone*
 6 *would remain quiet, as represented by Grid Location Points 12 and 13, with negligible impacts and negligible*
 7 *change from Alternative A and Base Year Peak Season.*

8
 9 *North Rim golden eagle habitat would improve at Location Points Point Imperial, Bright Angel Point, The*
 10 *Basin, and Grid Location Point 16. Aircraft Percent Time Audible would be 11 to 39% of the day; a 30 to 56%*
 11 *decrease from Alternative A. Average Sound Level would range 16 to 40 dBA, a 6 to 22 dBA decline from*
 12 *Alternative A. There would be less interruption or disturbance to golden eagles breeding, nesting, and*
 13 *foraging. Although moderate adverse impacts would continue, there would be long-term minor to major*
 14 *beneficial change in impacts compared to Alternative A.*

15
 16 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 17 *Golden Eagle*

18 *Base Year Off-Peak Season*

19 *At location points under and near Dragon Corridor (Location Points 96 Mile Camp, Tower of Ra, and Hermit*
 20 *Basin) air-tour aircraft Percent Time Audible would be 38 to 80%, a 17 to 20% decrease from Alternative A.*
 21 *Average Sound Level would be 17 to 38 dBA, a 6 to 25 dBA reduction. Golden eagles would experience less*
 22 *disturbance from aircraft compared to Peak Season and Alternative A. Although minor to major adverse*
 23 *impacts would continue there would be short-term moderate to major beneficial change in impacts compared*
 24 *to Alternative A.*

25
 26 *When Zuni Point Corridor and the long loop are closed, location points Temple Butte and Grid Location*
 27 *Points 14 and 15 would have aircraft Percent Time Audible 1% of the day, a decrease of 61 to 69% compared*
 28 *to Alternative A. Aircraft Average Sound Level would be 6 to 14 dBA, a decrease of 14 to 31 dBA from*
 29 *Alternative A. As short-loop and long-loop routes would be inactive at this time, aircraft would rarely be*
 30 *visible compared to Alternative A from locations on the ground. Air-tour operations would have reduced*
 31 *impacts compared to Alternative A, and golden eagle activities would not be interrupted for large portions of*
 32 *the day from aircraft noise. Although negligible adverse impacts would occur at points under and near Zuni*
 33 *Point Corridor, there would be short-term moderate to major beneficial change in impacts compared to*
 34 *Alternative A.*

35
 36 *In Bright Angel Flight-Free Zone aircraft Percent Time Audible would decrease to 1% of the day at Cape*
 37 *Royal, Grid Location Points 12 and 13, and Phantom Ranch, a decrease of 2 to 58%. Negligible adverse*
 38 *impacts would occur with moderate to major beneficial impacts compared to Alternative A. Near Grid*
 39 *Location Point 11 Percent Time Audible would be 27%, a 28% decrease from Alternative A. Average Sound*
 40 *Level 7 to 15 dBA would be a 7 to 14 dBA decrease. Air-tour aircraft would be less frequently visible during*
 41 *this time of year with Zuni Point Corridor and long-loop routes closed. Although negligible to moderate*
 42 *adverse impacts would occur there would be short-term minor to moderate beneficial change in impacts*
 43 *compared to Alternative A.*

44
 45 *There would be improvements from Alternative A in areas across North Rim (e.g., The Basin Location Point*
 46 *Percent Time Audible would be 37% and 19 dBA, and Point Imperial Location Point Percent Time Audible*
 47 *would be at 1% and 7 dBA; these would be reductions in Percent Time Audible of 36 to 65%, and 29 to 31*
 48 *dBA compared to Alternative A) during this period. Although negligible to moderate adverse impacts would*
 49 *continue, there would be short-term moderate to major beneficial change in impacts compared to Alternative A.*

50
 51 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 52 *Golden Eagle*

53 *Ten-Year Forecast Off-Peak Season*

54 *There would be further aircraft noise reduction in and near Dragon Corridor (Location Points 96 Mile Camp,*
 55 *Tower of Ra, and Hermit Basin). Aircraft Percent Time Audible would be 39 to 67%, a reduction of 31 to 61%*
 56 *compared to Alternative A. Average Sound Level would range 15 to 35 dBA, a 10 to 27 dBA decrease from*

1 *Alternative A. Although minor to major adverse impacts would continue under and near Dragon Corridor*
2 *there would be short- and long-term minor to major beneficial change in impacts compared to Alternative A.*
3

4 *Percent Time Audible near and under Zuni Point Corridor (Location Points Temple Butte and Grid Location*
5 *Points 14 and 15) would be 1%, a decline of 65 to 73% from Alternative A. Aircraft Average Sound Level*
6 *would range 6 to 14 dBA, a decrease of 15 to 32dBA from Alternative A. Reduction in air-tour aircraft*
7 *Percent Time Audible compared to Alternative A would result in increased potential for golden eagles to*
8 *establish territories and nests. Although negligible adverse impacts would occur Off-Peak Season, there would*
9 *be short- and long-term moderate to major beneficial change in impacts from Alternative A.*

10
11 *Aircraft Percent Time Audible would decline along Bright Angel Flight-free Zone edges. Aircraft Percent*
12 *Time Audible would be 1% of the day near Zuni Point Corridor at Location Point Cape Royal, a decrease of*
13 *60% from Alternative A, but very similar to Base Year. Near Dragon Corridor at Grid Location Point 11, 17 %*
14 *a day is a 39% reduction compared to Alternative A, with reductions of 6 to 14 dBA in Average Sound Level*
15 *from Alternative A. Percent Time Audible at Point Imperial location point would be 1% of the day, a decrease*
16 *of 67%, and Average Sound Level would be 7 dBA, a 32 dBA reduction. Grid Location Point 16 would be*
17 *20%, a 64% decrease compared to Alternative A with Average Sound Level 12 dBA, a 22 dBA decrease from*
18 *Alternative A. The Basin and Tower of Ra Location Points would receive further noise reductions from Base*
19 *Year, with Percent Time Audible 7 to 67%, a reduction of 31 to 68% and Average Sound Level 20 to 35 dBA, a*
20 *10 to 28 dBA reduction from Alternative A. Although minor to moderate adverse impacts would continue,*
21 *there would be short- and long-term minor to major beneficial change in impacts compared to Alternative A.*
22

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1 **Table 4.178g Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)		Average Sound Level (dBA)					
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	38	-32	25	-49	35	-10	33	-12
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	80	-17	67	-31	38	-6	35	-10
Hermit Basin	99	100	42	42	96	-4	57	-43	20	-22	17	-25	79	-20	39	-61	17	-25	15	-27
North Rim																				
Bright Angel Point	47	48	24	24	57	10	18	-30	24	0	18	-6	4	-43	5	-43	13	-11	12	-12
Point Imperial	66	68	38	39	47	-19	11	-56	18	-20	16	-22	1	-65	1	-67	7	-31	7	-32
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	37	-36	7	-68	19	-29	20	-28
Grid Location Point 16	80	84	33	34	54	-26	39	-45	32	-1	24	-9	13	-67	20	-64	12	-21	12	-22
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	62	-8	46	-28	39	6	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	56	-9	37	-32	39	11	35	6	1	-64	1	-68	14	-14	14	-15
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32
South Rim																				
Tusayan Museum	64	67	35	36	64	0	38	-29	35	0	29	-7	0	-64	0	-67	4	-31	4	-32
1.5 km SE of Moran Point	64	68	41	41	62	-2	42	-25	38	-3	33	-8	2	-62	3	-65	6	-35	5	-36
Bright Angel Flight Free Zone																				
Cape Royal	59	61	25	26	68	9	28	-33	27	2	21	-5	1	-58	1	-60	11	-14	12	-14
Grid Location Point 11	55	56	18	18	50	3	23	-33	20	2	14	-4	27	-28	17	-39	15	-3	12	-6
Grid Location Point 12	1	1	13	14	2	1	1	1	13	0	12	-1	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	12	0	9	-4	1	0	1	0	9	-3	9	-4
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	7	-5	1	-2	1	-3	7	-5	7	-5
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	73	-19	19	-73	26	1	23	-2
Grid Location Point 18	60	60	16	17	61	31	47	-13	19	3	17	0	73	13	31	-29	17	1	15	-2
Point Sublime	100	100	35	35	100	0	95	-5	35	-1	29	-6	97	-3	83	-17	32	-3	27	-8
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	6	-1	3	-4
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	6	-1	0	0	0	0	7	1	7	0

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

2

1 **Table 4.178h Modified NPS Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Dragon Corridor			
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,579	431
Hermit Basin	1,518	6,447	4,929
North Rim			
Point Imperial	2,292	2,754	462
Bright Angel Point	6,235	6,236	2
The Basin	477	874	397
Grid Location Point 16	2,589	2,591	2
Zuni Point Corridor			
Grid Location Point 14	687	1,412	726
Grid Location Point 15	1,637	2,345	708
Temple Butte	1,458	1,303	-155
South Rim			
Tusayan Museum	2,016	2,018	3
1.5 km SE of Moran Point	448	1,144	696
Bright Angel Flight Free Zone			
Cape Royal	4,038	4,026	
Grid Location Point 11	8,081	8,035	-46
Grid Location Point 12	9,014	9,012	-2
Grid Location Point 13	7,925	7,852	-73
Phantom Ranch	11,027	11,313	286
Toroweap /Shinumo Flight Free Zone			
Grid Location Point 10	2,931	3,253	322
Grid Location Point 18	8,449	5,106	-3,342
Point Sublime	3,760	4,076	316
Bass Camp	13,358	13,352	-5
Rainbow Plateau	14,875	14,974	96

2
3
4 *Central Modified NPS Preferred Alternative Special Status Species*
5 *Golden Eagle*
6 *All Scenarios*

7 *Similar to Alternative A, golden eagles would be little affected by aircraft noise. As shown in Table 4.178i,*
8 *Base Year and Ten-Year Forecast Peak Season when all tour routes are open, there would be some difference*
9 *in sound metrics compared to Alternative A. Air-tour aircraft Percent Time Audible would generally be less*
10 *than 2% of the day, with aircraft Average Sound Level zero to 14 dBA. Air-tour aircraft would generally be*
11 *greater than 7,000 meters from locations on the ground as shown in Table 4.178j. Off-Peak Season impacts*
12 *would be similar to Peak Season. Eagle daily behaviors such as foraging and roosting would be little affected*
13 *by air-tour aircraft. Negligible to minor adverse impacts would continue with negligible to minor change from*
14 *Alternative A.*
15

1 **Table 4.178i Modified NPS Preferred Alternative Average Sound Level Central**

Location Point Name	Modified NPS Preferred Alternative																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	9	0	7	-2	2	0	2	0	7	-1	7	-2
Grid Location Point 9	1	1	5	5	1	0	0	-1	6	1	4	-1	1	0	0	-1	5	0	3	-3
Grid Location Point 20	0	0	4	4	0	0	0	0	4	0	4	0	0	0	0	0	4	0	4	0
Grid Location Point 25	11	12	9	10	2	-9	2	-10	6	-3	7	-3	2	-9	2	-10	6	-3	6	-4
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	10	4	8	1	1	1	0	0	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Toroweap Overlook	0	0	13	14	0	0	0	0	14	1	14	0	0	0	0	0	13	0	14	0
Upper Deer Creek	1	1	1	1	1	0	1	0	2	1	1	-1	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3
4

Table 4.178j Modified NPS Preferred Alternative Slant Distances Central

Location Point Name	Alternative A		Modified NPS Preferred Alternative	
	Slant Distance (m)			
	Slant Distance (m)		Base Year	Δ
1 km W of Kanab Point	18,850	18,850	18,857	8
Grid Location Point 9	11,102	11,102	19,140	8,038
Grid Location Point 20	22,063	22,063	22,095	42
Grid Location Point 25	20,188	20,188	20,216	28
Havasu Point	10,450	10,450	10,589	140
Kanab Point	19,021	19,021	19,029	8
Mt. Sinyala	7,272	7,272	7,302	30
Stone Creek	21,882	21,882	24,531	2,649
Surprise Valley	25,500	25,500	26,243	743
Toroweap Overlook	9,625	9,625	9,625	0
Upper Deer Creek	23,683	23,683	24,100	417

1	<i>West End</i>	<i>Modified NPS Preferred Alternative</i>	<i>Special Status Species</i>
2	<i>Golden Eagle</i>		
3	<i>All Scenarios</i>		
4		<i>Distance between Z-shaped Route (realigned Blue Direct) and Grid Location Points 27 and 32 increases to</i>	
5		<i>4,923 and 18,618 meters respectively compared to Alternative A as shown in Table 4.178l. Aircraft Percent</i>	
6		<i>Time Audible would range 4 to 10% of the day, a decrease of 6 to 44%, with Average Sound Level 19 to 22</i>	
7		<i>dBA, a minor reduction from Alternative A. Minor adverse impacts would continue with long-term negligible</i>	
8		<i>to major change in impacts from Alternative A.</i>	
9			
10		<i>Near Brown routes, represented by Location Points Parashant Wash and Whitmore Rapids, air-tour aircraft</i>	
11		<i>Percent Time Audible would be 11 to 20% of the day at Average Sound Level 24 to 29 dBA, similar to</i>	
12		<i>Alternative A. Aircraft would be 1,800 to nearly 3,000 meters away from locations on the ground. Minor</i>	
13		<i>adverse impacts would continue with negligible change from Alternative A.</i>	
14			
15		<i>Golden eagles and habitat located in Sanup Flight-free Zone and areas south would be negligibly affected by</i>	
16		<i>air-tour operations. Air-tour aircraft Percent Time Audible would be zero percent of the day with Average</i>	
17		<i>Sound Level of less than one to 7 dBA as reflected in data at Location Points Diamond Creek, Pumpkin</i>	
18		<i>Springs, and Grid Location Point 34. Impact of air-tour aircraft on eagles in Sanup Flight-free Zone would</i>	
19		<i>be negligible with no change in impact from Alternative A.</i>	
20			
21		<i>Golden eagles using habitat near Green-4 and Blue-2, represented by Location Points Burnt Springs Canyon,</i>	
22		<i>Bat Cave, and Grid Location Point 33 would be exposed to Percent Time Audible 54 to 93% a reduction of 2</i>	
23		<i>to 33% with Average Sound Level of 38 to 45 dBA similar to Alternative A. Eagle daily activities could be</i>	
24		<i>disrupted frequently, which may result in displacement from suitable habitats for nesting and foraging that</i>	
25		<i>could affect population levels. Long-term moderate to major adverse impacts would continue with negligible</i>	
26		<i>to major change in impacts from Alternative A.</i>	

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1 **Table 4.178k Modified NPS Preferred Alternative Average Sound Level West End**

Location Point Name	Modified NPS Preferred Alternative																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Burnt Springs Canyon	70	75	46	47	63	-7	58	-17	45	-1	43	-4	61	-9	54	-21	45	-1	42	-5
Bat Cave	93	95	47	48	93	0	88	-7	45	-2	43	-5	91	-2	85	-10	44	-3	43	-5
Grid Location Point 33	87	90	42	43	80	-7	55	-35	42	0	38	-5	81	-6	57	-33	42	0	38	-4
Whitmore Rapids	12	13	21	21	19	7	20	7	29	8	28	7	18	6	17	4	28	7	27	6
Grid Location Point 32	44	49	27	28	4	-40	5	-44	21	-6	22	-6	4	-40	5	-44	21	-6	22	-6
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Grid Location Point 27	20	23	26	27	9	-6	10	-13	19	-7	19	-8	10	-20	9	-14	19	-7	19	-8
Grid Location Point 34	0	0	1	1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0
Parashant Wash	12	14	33	33	11	-1	14	0	24	-9	24	-2	11	-1	12	-2	25	-8	24	-9
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	0	0	0	0	0	7	0	7	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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Table 4.178l Modified NPS Preferred Alternative Slant Distances West End

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,134	1,134	0
Grid Location Point 33	1,105	1,105	0
Whitmore Rapids	1,804	1,804	0
Grid Location Point 32	2,016	18,618	16,602
Diamond Creek	27,108	33,411	6,303
Grid Location Point 27	3,388	4,923	1,535
Grid Location Point 34	28,206	29,373	1,167
Parashant Wash	2,852	2,852	0
Pumpkin Springs	12,630	19,695	7,065

1 **Cumulative Impact** *Modified NPS Preferred Alternative* **Special Status Species**
 2 **Golden Eagle**

3
 4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 5
 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

10
 11 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
 12 *(Modified NPS Preferred Alternative).*

13
 14 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 15 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 16 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 17 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 18 *SFRA see Appendix D, Figures 91 to 94).*

19
 20 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 21 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 22 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 23 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 24 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 25 *Audible capable of masking some aircraft noise.*

26
 27 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 28 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 29 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 30 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 31 *the lone human noise source in remote areas of the SFRA (why from air-tour routes—the only reminder of*
 32 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 33 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 34 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 35 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
 36 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
 37 *noise some of the time.*

38
 39 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 40 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
 41 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
 42 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
 43 *Alternatives (Modified NPS Preferred Alternative in this case).*

44
 45 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
 46 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
 47 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
 48 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
 49 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
 50 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
 51 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
 52 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

53
 54 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
 55 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
 56 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*

1 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
 2 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
 3 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
 4 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
 5 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
 6 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
 7 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

8
 9 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 10 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
 11 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
 12 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

13
 14 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 15 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 16 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 17 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 18 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 19 *Cumulative Impacts discussion in the Conclusions section below.*

20
 21 **Conclusion** **Modified NPS Preferred Alternative** **Special Status Species**
 22 **Golden Eagle**

23
 24 *Overall, the Modified NPS Preferred Alternative would result in beneficial change in impacts to golden eagles*
 25 *compared with Alternative A due to reduced amount of area exposed to high Average Sound Level long periods*
 26 *of the day. Ten-Year Forecast the Modified NPS Preferred Alternative would result in improvement in golden*
 27 *eagle habitat and reduction of impacts on golden eagles as aircraft noise is reduced by quiet-technology*
 28 *incentives and conversion requirements. Greatest impacts would occur under East and West End heavily-used*
 29 *air-tour routes where Average Sound Level would generally be 40 to 50 dBA, and aircraft Percent Time Audible*
 30 *would be greater than 75% of the day. However, there would also be large portions of habitat undisturbed by air-*
 31 *tours in Marble Canyon and the Central area.*

32
 33 *GCNP is concerned for the golden eagle, and believes proposed changes in the Modified NPS Preferred*
 34 *Alternative will provide beneficial change for golden eagles. In general, the following changes will benefit eagles*
 35 *in GCNP*

- 36 • *raising air-tour flight altitudes*
- 37 • *eliminating some air-tour routes*
- 38 • *reducing current annual allocation*
- 39 • *instituting a daily cap of air-tour flights*
- 40 • *quiet-technology incentives*
- 41 • *seasonal route closures*

42
 43 *Under the Bald and Golden Eagle Act, “take” is defined as “pursue, shoot, shoot at, poison, wound, kill, capture,*
 44 *trap, collect, destroy, molest or disturb.” When speaking of overflights, the most likely impact would be*
 45 *disturbance. “Disturb” is defined in regulations as “to agitate or bother a bald or golden eagle to a degree that*
 46 *causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle, 2) a decrease*
 47 *in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest*
 48 *abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior.”(72 FR 31132)*
 49

50 *After analyzing impacts of the proposed action to golden eagles, and combining that knowledge with current*
 51 *population status, GCNP has determined an Incidental Take Permit for eagles is not necessary. GCNP will*
 52 *continue to coordinate with U.S. Fish and Wildlife Service.*
 53

1 **Conclusion Marble Canyon Modified NPS Preferred Alternative Special Status Species**
 2 **Golden Eagle**

3 *Elimination of air tours in Marble Canyon would greatly improve impacts to golden eagle habitat and roost*
 4 *areas. Potential for disturbance by or collisions with air-tour aircraft would be greatly reduced or eliminated as*
 5 *compared to current conditions. Closure of all Marble Canyon routes would result in an increased distance*
 6 *between air traffic and eagle roosting/foraging areas. There would generally be long-term minor to major*
 7 *beneficial change in impacts compared with Alternative A.*

8
 9 **Conclusion East End Modified NPS Preferred Alternative Special Status Species**
 10 **Golden Eagle**

11 *East End, there would be seasonal decreases in impacts to golden eagles due to the seasonal closure of Zuni*
 12 *Point Corridor and long-loop route (Dragon Corridor would remain open year-round) Base Year Peak Season,*
 13 *impacts to eagles beneath and adjacent to Dragon Corridor routes would be minor to major adverse with*
 14 *negligible to minor beneficial impacts compared to Alternative A. Ten-Year Forecast Peak Season with*
 15 *conversion to quiet-technology aircraft, there would be long-term minor to major beneficial change in impacts*
 16 *compared to Alternative A.*

17
 18 *In Zuni Point Corridor, Base Year Peak Season there would be moderate to major adverse impacts with*
 19 *negligible change in impacts compared to Alternative A. Base Year Off-Peak Season, when Zuni Point Corridor*
 20 *and long-loop routes would be inactive, impacts would be negligible to minor adverse with moderate to major*
 21 *beneficial change in impacts compared to Alternative A. Ten-Year Forecast Peak Season with conversion to*
 22 *quiet-technology aircraft, there would be long-term minor to major beneficial change in impacts compared to*
 23 *Alternative A.*

24
 25 *Base Year Peak Season, minor to major adverse impacts to golden eagles would continue under and near North*
 26 *Rim air-tour routes (The Basin, Point Imperial, and Bright Angel Point Location Points). There would be*
 27 *negligible adverse change in impacts compared Alternative A at some Location Points. However, Point Imperial*
 28 *Location Point would experience moderate to major beneficial change in impacts. Impacts at these location*
 29 *points Ten-Year Forecast Peak Season would be reduced to minor adverse. These represent moderate to major*
 30 *beneficial changes in impacts from Alternative A due to conversion to quiet-technology aircraft. Ten-Year*
 31 *Forecast Off-Peak Season there would be minor to moderate adverse impacts, and minor to major beneficial*
 32 *change in impacts compared to Alternative A beneath and adjacent to North Rim routes.*

33
 34 *Ten-Year Forecast Peak Season in Bright Angel Flight-free Zone, impacts would be minor to moderate with*
 35 *minor to major beneficial change from Alternative A.*

36
 37 **Conclusion Central Modified NPS Preferred Alternative Special Status Species**
 38 **Golden Eagle**

39 *Base Year and Ten-Year Forecast Peak and Off-Peak Season there would be negligible to minor adverse impacts*
 40 *with negligible to minor change in impacts compared to Alternative A on golden eagles.*

41
 42 **Conclusion West End Modified NPS Preferred Alternative Special Status Species**
 43 **Golden Eagle**

44 *Under Green-4 and Blue-2, there would be long-term moderate to major adverse impacts with negligible to major*
 45 *beneficial change in impacts compared to Alternative A.*

46
 47 *In areas near the Z-shaped Route (realigned Blue Direct) there would be long-term minor to moderate adverse*
 48 *impacts with long-term negligible to major beneficial change in impacts compared to Alternative A. In areas near*
 49 *Brown routes there would be minor adverse impacts with negligible change in impacts from Alternative A. In*
 50 *areas under and near Sanup Flight-free Zone there would be negligible impacts with no change in impacts*
 51 *compared to Alternative A.*

1 **Cumulative Impacts Summary Modified NPS Preferred Alternative Special Status Species**
 2 **Golden Eagle**

3
 4 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 5 *the impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is,*
 6 *Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections*
 7 *(Marble Canyon, East End, Central, West End) of the park would tend to increase to major adverse Cumulative*
 8 *Impacts under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of*
 9 *the large Flight-free Zones. In comparison with the other Alternatives, Modified NPS Preferred Alternative ranks*
 10 *second behind Alternative E for the lowest overall Cumulative Impacts (Alternative A ranks last).*

11
 12 **CALIFORNIA CONDOR**

SPECIAL STATUS SPECIES

13
 14 In addition to data presented in tables in this section, also see Appendix F Tables 9 to 16 which contain a summary
 15 of California condor habitat exposed to various sound levels. See Chapter 3, Special Status Species for information
 16 on California condor at GCNP.

17
 18 **ALTERNATIVE A**

NO ACTION

SPECIAL STATUS SPECIES

19 **CALIFORNIA CONDOR**

20
 21 Under Alternative A, a range of aircraft noise intensities and audibility would affect California condors in Marble
 22 Canyon, East End, and Central areas. Condor use areas are located in these geographic areas and in areas of the
 23 Kaibab National Forest and Vermilion Cliffs National Monument. Current data on condor presence suggests the
 24 birds do not use West End and, therefore, would not be affected by air-tours in this area. Thus, **West End is not**
 25 **analyzed for California condor impacts.**

26
 27 Under Alternative A, condors would experience greatest exposure to air-tour noise in East End where aircraft
 28 Average Sound Level would be 40 to 50 dBA and Percent Time Audible would be greater than 75%. In Marble
 29 Canyon and Central areas there would be little effect on condors as aircraft Average Sound Level would generally
 30 be less than 15 dBA and Percent Time Audible would be less than 5%. As a result, the condor population would
 31 likely remain stable although East End condor distribution and densities may be suppressed due to high air-tour
 32 Percent Time Audible at moderately high sound levels. As these birds are large and easily visible and pilots are
 33 aware of their presence, likelihood of collision is low.

34
 35 Under Alternative A, aircraft noise effects on condors Base Year and Ten-Year Forecast would not be appreciably
 36 different.

37
 38 **Marble Canyon**
 39 **California Condor**

Alternative A

Special Status Species

40 *Base Year*

41 Based on contour data (Appendix F Tables 9-10), **Marble Canyon** would be quiet with air-tour aircraft Percent
 42 Time Audible in 86% of condor use areas zero to 5% of the day. In 3% of the area, directly under air-tour routes,
 43 air-tour aircraft Percent Time Audible would be 25% of the day or greater. The majority of condor use area in
 44 Marble Canyon (83%) would have Average Sound Level 15 dBA or less. Tables 4.179 and 4.180 for Location
 45 Points **Cliff Dwellers Lodge, Grid Location Points 4 and 5, and Marble Canyon Dam Site**, show aircraft
 46 would generally be more than 2,000 meters away from points on the ground. At **Grid Location Point 2** which is
 47 in a condor high-use area, aircraft would be about 800 meters from points on the ground. With limited
 48 persistence of air-tour noise at sound levels near or below background levels in the majority of the region, and
 49 with air-tour aircraft modestly distant from locations on the ground, there would be little potential to disturb or
 50 displace condors. In some areas directly beneath routes (e.g., **North** and **South Canyon** Location Points)
 51 Average Sound Level would be higher and air-tour routes closer to the canyon rim which could increase
 52 potential for condor behavior disturbance. As these birds are large and easily visible and pilots aware of their
 53 presence, collision likelihood is low. Impacts to condors would be short term negligible to minor adverse in the
 54 majority of the Marble Canyon area.

1 *Marble Canyon* *Alternative A* *Special Status Species*
 2 *California Condor*
 3 *Ten-Year Forecast*

4 Impacts would increase a small amount Ten-Year Forecast compared to Base Year, but would generally remain
 5 at the same impact intensity levels.

7 **Table 4.179** **Alternative A** **Average Sound Level** **Marble Canyon**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Cliff Dwellers Lodge	1	1	6	10
Grid Location Point 1	0	0	15	17
Grid Location Point 2	2	3	16	19
Grid Location Point 3	3	3	14	16
Grid Location Point 4	0	0	0	2
Grid Location Point 5	2	2	8	12
Marble Canyon Dam Site	0	0	3	4
North Canyon	3	3	24	25
South Canyon	2	3	21	23

8
 9 **Table 4.180** **Alternative A** **Slant Distances** **Marble Canyon**

Location Point Name	Slant Distance (m)
Cliff Dwellers Lodge	3,695
Grid Location Point 1	1,665
Grid Location Point 2	858
Grid Location Point 3	2,958
Grid Location Point 4	4,585
Grid Location Point 5	2,336
Marble Canyon Dam Site	3,624
North Canyon	999
South Canyon	816

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10
 11
 12 **East End** *Alternative A* *Special Status Species*
 13 **California Condor**

14
 15 East End condor use areas occur in the park and south in Kaibab National Forest. As shown in Appendix F, the
 16 majority of condor high-use areas would be surrounded by air-tour routes, and Base Year approximately 77% of the
 17 condor use area would be exposed to air-tour aircraft Percent Time Audible more than 25% of the day. In most of
 18 East End, aircraft Average Sound Level would be relatively low with 68% of condor use area exposed to sound
 19 levels 25 dBA or less and 42% of use areas to less than 15 dBA. In nearly 14% of East End, air-tour Average Sound
 20 Level would be above 35 dBA or greater.

21
 22 *East End* *Alternative A* *Special Status Species*
 23 *California Condor*
 24 *Base Year*

25 As shown in Table 4.181, **under and near Zuni Point and Dragon Corridors**, air-tour Percent Time Audible
 26 would be 62 to 100% of the day with Average Sound Level of 25 to 49 dBA. At **Eremita Mesa** Location Point
 27 for example, air-tour aircraft Average Sound Level would be 49 dBA. In areas along South Rim such as Location
 28 Point **1.5 km SE of Moran Point** and North Rim Location Points such as **The Basin**, Distance of air-tours from
 29 the ground would be less than 500 meters (Table 4.182). Given close proximity of flights to the rim and over
 30 condor high-use areas, there would be potential to disrupt normal behaviors such as breeding, feeding, or
 31 sheltering. Although aircraft may be closer to points on the ground near the rim, potential for collisions with

1 aircraft would be unlikely given bird size and pilot awareness. Impacts under and near tour routes would be short
2 term moderate to major adverse.
3

4 Areas away from air-tour routes would be exposed to less noise from air-tour aircraft. Areas northwest of Dragon
5 Corridor such as Location Points **Bass Camp** and **Rainbow Plateau** and amidst Bright Angel Flight-free Zone
6 such as **Phantom Ranch** Location Point and **Grid Location Points 12 and 13** would have aircraft Percent Time
7 Audible less than 3% of the day with Average Sound Level 6 to 13 dBA. In these locations air-tour aircraft
8 would be greater than 7,000 meters from points on the ground. Impacts in these areas would generally be
9 negligible with little disturbance of condor activities.

10
11 *East End*

Alternative A

Special Status Species

12 *California Condor*

13 *Ten-Year Forecast*

14 Impacts would increase a small amount Ten-Year Forecast compared to Base Year, but would generally remain
15 at the same impact intensity levels.
16

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1 **Table 4.181 Alternative A Average Sound Level East End**

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Dragon Corridor				
96 Mile Camp	72	74	45	45
Tower of Ra	97	98	44	45
Eremita Mesa	100	100	49	49
Hermit Basin	99	100	42	42
North Rim				
Cape Royal	59	61	25	26
Point Imperial	66	68	38	39
Bright Angel Point	47	48	24	24
The Basin	73	75	48	48
Grid Location Point 16	80	84	33	34
Zuni Point Corridor				
Grid Location Point 14	70	74	34	34
Grid Location Point 15	65	69	28	29
Temple Butte	62	66	37	38
Lipan Point	74	77	34	35
South Rim				
Tusayan Museum	64	67	35	36
El Tovar	95	96	19	20
Zuni Alpha	43	46	46	46
Ten X Meadow	64	68	49	49
1.5 km SE of Moran Point	64	68	41	41
Bright Angel Flight Free Zone				
Cedar Ridge	81	82	19	19
Grid Location Point 11	55	56	18	18
Grid Location Point 12	1	1	13	14
Grid Location Point 13	1	1	12	13
Phantom Ranch	3	4	12	12
Toroweap/Shinumo Flight Free Zone				
Grid Location Point 10	92	92	25	25
Grid Location Point 18	60	60	16	17
Point Sublime	100	100	35	35
Bass Camp	0	0	7	7
Rainbow Plateau	0	0	6	7

2

1 **Table 4.182 Alternative A Slant Distances East End**

Location Point Name	Slant Distance (m)
Dragon Corridor	
96 Mile Camp	1,573
Tower of Ra	1,147
Eremita Mesa	1,034
Hermit Basin	1,518
North Rim	
Cape Royal	4,038
Point Imperial	2,292
Bright Angel Point	6,235
The Basin	477
Grid Location Point 16	2,589
Zuni Point Corridor	
Grid Location Point 14	687
Grid Location Point 15	1,637
Temple Butte	1,458
Lipan Point	2,890
South Rim	
Tusayan Museum	2,016
El Tovar	5,854
Zuni Alpha	573
Ten X Meadow	540
1.5 km SE of Moran Point	448
Bright Angel Flight Free Zone	
Cedar Ridge	9,827
Grid Location Point 11	8,081
Grid Location Point 12	9,014
Grid Location Point 13	7,825
Phantom Ranch	11,927
Toroweap/Shinumo Flight Free Zone	
Grid Location Point 10	2,931
Grid Location Point 18	8,449
Point Sublime	1,760
Bass Camp	13,358
Rainbow Plateau	14,878

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Central Alternative A Special Status Species
California Condor
Base Year

In the **Central area** and north in **Kaibab National Forest**, condors would be little affected by air-tour and general-aviation aircraft noise. The majority of this area is comprised of **Toroweap/Shinumo Flight-free Zone's** middle and western portions. As shown in Table 4.183, air-tour aircraft Percent Time Audible would generally be 3% of the day or less with air-tour Average Sound Level 10 dBA and less. Aircraft would be greater than 7,000 meters from condor use areas. With limited air-tour noise Percent Time Audible and very low Average Sound Level, and with air-tour aircraft Distant from locations on the ground, there would be little potential for condor disturbance. There would be no expected effect on population levels or area use. Impacts to condors would be negligible.

1 *Central* *Alternative A* *Special Status Species*
 2 *California Condor*
 3 *Ten-Year Forecast*

4 Impacts would increase a small amount Ten-Year Forecast compared to Base Year, but would generally remain
 5 at the same impact intensity levels.
 6

7 **Table 4.183 Alternative A Noise Metrics and Slant Distances Central**

Location Point Name	Alternative A				Slant Distance (m)
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast	
Hancock Knolls	2	2	10	10	30,162
1 km W of Kanab Point	2	2	9	9	18,850
Grid Location Point 8	3	3	10	10	13,765
Grid Location Point 9	1	1	5	5	11,103
Havasu Point	0	0	0	0	10,450
Kanab Point	1	1	6	7	19,021
Mt. Sinyala	1	1	0	0	7,272
Stone Creek	0	0	0	0	21,882
Surprise Valley	1	1	0	0	25,500
Upper Deer Creek	1	1	1	1	23,683

8
 9 **West End** **Alternative A** **Special Status Species**
 10 **California Condor**

11
 12 Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air-
 13 tours in this area. Thus, West End is not analyzed for California condor impacts.
 14

15 **Cumulative Impacts** **Alternative A** **Special Status Species**
 16 **California Condor**

17
 18 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 19 *actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 20 1) high-altitude aircraft at or above 18,000 feet MSL, plus
- 21 2) aircraft below 18,000 feet MSL and outside the SFRA, plus
- 22 3) ground-based noise sources, plus
- 23 4) noise from air-tour-and-related aircraft under Alternative A

24
 25 *That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).*
 26

27 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 28 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 29 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 30 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 31 *SFRA see Appendix D, Figures 91 to 94).*
 32

33 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 34 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 35 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 36 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 37 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 38 *Audible capable of masking some aircraft noise.*

1 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
2 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
3 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
4 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
5 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
6 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
7 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
8 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
9 *Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the*
10 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
11 *Because they would be audible a very high percentage of the day, the combination of aircraft noise from all*
12 *sources would generally be the overriding cumulative noise influence on Special Status Species and habitat.*
13

14 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
15 *(Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
16 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
17 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
18 *(Alternative A in this case).*
19

20 *Fire management activities in the park and on Federally-managed lands in the Study Area are expected to*
21 *provide long-term minor to moderate beneficial impacts to California condors by creating snags for future roost*
22 *sites, and improving foraging habitat through creating openings in otherwise dense forest stands. In addition to*
23 *influences of aircraft noise and presence, condors are influenced by human activities that involve approaching,*
24 *feeding, or harassing. These actions would have localized short-term minor adverse impacts mostly limited to the*
25 *Developed Zone.*
26

27 *Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in*
28 *Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is*
29 *detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year*
30 *Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS;*
31 *however, since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas*
32 *(2% of the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in*
33 *interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas*
34 *north of the park.*
35

36 *Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All*
37 *Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the*
38 *difference between Cumulative Impacts and impacts of Alternative A by itself. For the Entire Park Cumulative*
39 *Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the park, with*
40 *Average Sound Level 25 to <35 dBA in 85% of the park, with none of the park below 25 dBA, and 24% at 35 dBA*
41 *or more. For the Entire Park results for Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or*
42 *more of the day in 27% of the park, with Average Sound Level 25 to <35 dBA in 28% of the park, with 50% of the*
43 *park below 25 dBA, and 22% at 35 dBA or more.*
44

45 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
46 *including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour*
47 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
48 *impacts under the Alternatives reduces Cumulative Impacts.*
49

50 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
51 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
52 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
53 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
54 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
55 *in the Conclusions section below.*
56

1 Conclusion	2 Alternative A	3 Special Status Species
<p>4 Under Alternative A, condors would experience greatest exposure to air-tour noise in East End. In Marble Canyon 5 and the Central area there would be negligible impact on condors as aircraft Percent Time Audible and Average 6 Sound Level would be low. As a result, the condor population would likely remain stable, although East End 7 distribution and densities may change in areas near air-tour routes due to high air-tour Percent Time Audible at 8 moderately high Average Sound Level.</p> <p>9</p> <p>10 East End is the area with greatest potential for impacts on condors and, Ten-Year Forecast Peak Season, 14% of East 11 End condor use areas would be in low noise areas with air-tour aircraft Percent Time Audible 10% or less of the 12 day; 8% of condor use areas would have air-tour Average Sound Level of 15 dBA or less. 78% of East End condor 13 use areas would have frequent aircraft noise disturbances with air-tour Percent Time Audible greater than 25% of 14 the day.</p>	<p>16 <i>Alternative A</i></p>	<p>16 <i>Special Status Species</i></p>
<p>17 California Condor</p> <p>18 Alternative A Base Year would result in short-term negligible to minor adverse impacts on California condors in 19 most Marble Canyon locations. Impacts would increase a small amount Ten-Year Forecast, but would generally 20 remain at the same impact intensity levels.</p>	<p>22 <i>Alternative A</i></p>	<p>22 <i>Special Status Species</i></p>
<p>23 California Condor</p> <p>24 There would be moderate to major adverse impacts to condors in areas beneath and adjacent to air-tour routes. In 25 areas away from air-tour routes including beneath Bright Angel Flight-free Zone, impacts would be negligible. 26 Impacts would increase a small amount Ten-Year Forecast, but would generally remain at the same impact intensity 27 levels as Base Year.</p>	<p>29 <i>Alternative A</i></p>	<p>29 <i>Special Status Species</i></p>
<p>30 California Condor</p> <p>31 Alternative A would result in negligible impacts on condors Base Year and Ten-Year Forecast.</p>	<p>33 <i>Alternative A</i></p>	<p>33 <i>Special Status Species</i></p>
<p>34 California Condor</p> <p>35 Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air- 36 tours in this area. Thus, West End is not analyzed for California condor impacts.</p>	<p>38 <i>Alternative A</i></p>	<p>38 <i>Special Status Species</i></p>
<p>39 Cumulative Impacts Summary</p> <p>40 California Condor</p> <p>41 <i>As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase</i> 42 <i>the impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts</i> 43 <i>in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections of the park (Marble Canyon,</i> 44 <i>East End, Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-</i> 45 <i>tour routes, and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones.</i> 46 <i>In comparison with the other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts</i> 47 <i>(Alternative E ranks first in lowest Cumulative Impacts).</i></p>	<p>49 ALTERNATIVE E</p>	<p>49 SPECIAL STATUS SPECIES</p>
<p>50</p> <p>51 Overall, Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area 52 exposed to high Average Sound Level for long periods of the day. Habitat in condor use areas would be improved 53 with less disturbance from aircraft operations.</p> <p>54</p> <p>55</p>	<p>50 ALTERNATING SEASONAL USE</p>	<p>50 SPECIAL STATUS SPECIES</p>

1 **Marble Canyon** **Alternative E** **Special Status Species**

2 **California Condor**

3 *All Scenarios*

4 Under Alternative E, **Marble Canyon** would be in Bright Angel Flight-free Zone. As shown in Tables 4.184 and
5 4.185, air-tour aircraft Percent Time Audible would generally be one percent or less of day and Average Sound
6 Level would range zero to 13 dBA, a decrease of 3 to 24 dBA compared to Alternative A. There would generally
7 be negligible impacts on condors in this area, with no potential for disturbance by or collisions with air-tour
8 aircraft, a long-term negligible to minor beneficial change in impacts compared to Alternative A.

9
10

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1 **Table 4.184 Alternative E Average Sound Level Marble Canyon**

Location Point Name	Alternative A		Alternative E																	
			Peak Season										Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	0	-6	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-2	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-8	7	-9	1	-2	1	-2	7	-8	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	0	-8	0	-12	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-2	0	-3	0	-24	0	-25	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-2	0	-21	0	-22	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

2
3
4
5

Table 4.185 Alternative E Slant Distances Marble Canyon

Location Point Name	Alternative A		Alternative E	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
Cliff Dwellers Lodge	3,695		50,287	46,591
Grid Location Point 1	1,665		65,834	64,169
Grid Location Point 2	858		54,066	53,208
Grid Location Point 3	2,958		44,163	41,205
Grid Location Point 4	4,585		63,986	59,401
Grid Location Point 5	2,335		43,729	41,394
Marble Canyon Dam Site	3,845		17,396	13,551
North Canyon	999		36,247	35,248
South Canyon	816		26,091	25,275

Δ indicates change in noise metric data from Alternative A

1 **East End** **Alternative E** **Special Status Species**
 2 **California Condor**

3
 4 In the majority of East End, condor use areas would see a decrease in effects from air-tour operations at some point
 5 during the year dependent on when air-tour routes are not in use.

6
 7 Base Year Peak and Off-Peak Season, 59 to 64% of condor use area (as opposed to 15% under Alternative A) would
 8 experience air-tour Percent Time Audible 10% of the day or less. Area exposed to frequent aircraft noise would be
 9 much reduced with 31 to 26% of condor use area (as opposed to 77% under Alternative A) experiencing aircraft
 10 noise greater than 25% of the day. 76 to 77% of condor use area Peak and Off-Peak Season, respectively (as
 11 opposed to 42% in Alternative A) would have Average Sound Level less than 15 dBA. These would represent
 12 moderate to major beneficial changes in impacts compared to Alternative A Base Year.

13
 14 Ten-Year Forecast Peak Off-Peak Season, areas with low noise would increase to 73 and 78% Peak and Off-Peak
 15 Seasons, respectively with aircraft Percent Time Audible 10% or less of the day (compared to 14% in Alternative
 16 A), and 78 and 80% with Average Sound Level 15 dBA or less (compared to 8% in Alternative A). Areas with high
 17 Average Sound Level would decrease to 18 and 12% with aircraft Percent Time Audible greater than 25% of the day
 18 (compared to 78% in Alternative A), and one and 3% with Average Sound Level greater than 35 dBA (compared to
 19 20% in Alternative A) Peak and Off-Peak Seasons, respectively. These would represent major beneficial changes in
 20 impacts compared to Alternative A Ten-Year Forecast.

21
 22 *East End* *Alternative E* *Special Status Species*
 23 *California Condor*
 24 *Base Year Peak Season*

25 When Zuni Point Corridor would be in use, condor use areas **under and near Zuni Point Corridor** would be
 26 exposed to higher air-tour noise levels more frequently during the day. As shown in Table 4.186, air-tour Percent
 27 Time Audible would be 75 to 88% of the day at Location Points **Grid Location Point 14, Lipan Point,**
 28 **Tusayan Museum, and Temple Butte**, an 11 to 20% increase compared to Alternative A. Average air-tour
 29 aircraft Average Sound Level would be greater than Alternative A by one to 7 dBA and 38 to 42 dBA. Similar to
 30 Alternative A, as shown in Table 4.187, air-tour aircraft would be greater than 1,000 meters from locations on
 31 the ground for most of the route except along South Rim when aircraft are departing or returning Grand Canyon
 32 Airport. In this area, air-tour aircraft would be approximately 950 meters from the ground such as Lipan Point
 33 Location Point, and 450 meters at Tusayan Museum Location Point. Because routes would become active rather
 34 abruptly, there may be a higher level of reaction as condors could abandon the area resulting in localized East
 35 End population changes. As the route opens in July it is unlikely to adversely affect breeding or nesting.
 36 Moderate to major adverse impacts to condors from air-tour aircraft would continue under and near Zuni Point
 37 Corridor with negligible to minor adverse change in impacts compared to Alternative A.

38
 39 In **Bright Angel Flight-free Zone** there would be a decline in air-tour noise. Base Year Peak Season, when Zuni
 40 Point Corridor would be in use, air-tour aircraft Percent Time Audible at **Grid Location Point 11** would decline
 41 from 55% in Alternative A to 6% under Alternative E, a decrease of 49%. Average Sound Level would be 9
 42 dBA, a 9 dBA decrease from Alternative A. This would expand East End area where condors could forage,
 43 breed, and nest with substantially fewer disruptions in daily activities due to air-tour noise. Negligible impacts
 44 would occur with short-term moderate to major beneficial change in impacts compared to Alternative A in Bright
 45 Angel Flight-free Zone in areas west of routes due to high reduction in air-tour aircraft Percent Time Audible.
 46 The middle of the Bright Angel Flight-free Zone would remain quiet, as represented by **Grid Location Points 12**
 47 **and 13**, with negligible impacts and negligible change in impacts from Alternative A.

48
 49 *East End* *Alternative E* *Special Status Species*
 50 *California Condor*
 51 *Ten-Year Forecast Peak Season*

52 Air-tour aircraft Percent Time Audible would decline in **Zuni Pont Corridor** area to 50 to 66% of the day, a
 53 decrease of 8 to 18% due to conversion to quiet-technology air-tour aircraft. Aircraft Average Sound Level
 54 would range 35 to 40 dBA, similar to Alternative A (within 4 dBA). Distance would be the same as Base Year.
 55 Given decrease in aircraft Percent Time Audible, there may be less of a reaction of condors to routes becoming
 56 active. Although moderate to major adverse impacts would continue under and near Zuni Point Corridor, there

1 would be short-term minor beneficial change in impacts compared to Alternative A. Although there would be
 2 greater reduction in Percent Time Audible Ten-Year Forecast, impacts that may occur to condors as a result of
 3 routes becoming abruptly active would reduce level of benefit from decline in aircraft audibility.
 4

5 In **Bright Angel Flight-free Zone**, beneficial changes in impacts would nearly be the same as Base Year Peak
 6 Season, except **Cedar Ridge** Location Point where there would be negligible impacts with major beneficial
 7 change in impacts from Alternative A.
 8

9 *East End* *Alternative E* *Special Status Species*
 10 *California Condor*
 11 *Base Year Off-Peak Season*

12 Routes in and near **Zuni Point Corridor** would be inactive, and air-tour aircraft Percent Time Audible 8% of the
 13 day or less, a 62 to 69% decrease from Alternative A. Average Sound Level would be 3 to 7 dBA, a 27 to 33
 14 dBA reduction from Alternative A. Air-tour aircraft visual impacts would be virtually eliminated for this period.
 15 Condors would experience very quiet conditions with little to no disturbance from air-tour aircraft. As condors
 16 breed in December and lay eggs late January through early April, there may be increased breeding, nesting, and
 17 rearing success. Negligible impacts would occur under and near Zuni Point Corridor with short-term major
 18 beneficial change in impacts compared to Alternative A.
 19

20 When **Dragon Corridor** would be in use, air-tour aircraft Percent Time Audible would be 61 to 71% of the day,
 21 a decrease of 28 to 36%. Aircraft Average Sound Level would be less than Alternative A 23 to 46 dBA, a
 22 decrease of 19 dBA at **Hermit Basin** Location Point, probably due to the Dragon Corridor dogleg. At **96 Mile**
 23 **Camp** along the river, aircraft Percent Time Audible would decline to 26% of the day from 72% in Alternative A
 24 although Average Sound Level would remain relatively high at 37 dBA. Air-tour aircraft would be more
 25 distant than in Alternative A at locations on the ground. Although Percent Time Audible and Average Sound
 26 Level would decline, condors would likely be disturbed by relatively high levels of air-tour sounds for long
 27 periods of the day. As they breed December through early April, there may be a decline in nesting and fledgling
 28 success. Although moderate to major adverse impacts on condors would continue, there would be a short-term
 29 minor beneficial change in impacts from Alternative A. Level of benefit would be reduced due to potential for
 30 disruption during critical breeding periods.
 31

32 Areas in **Bright Angel Flight-free Zone** close to active Dragon Corridor air-tour routes would experience
 33 aircraft Percent Time Audible 23% of the day, a 32% decrease from Alternative A at Average Sound Level 12
 34 dBA, a 6 dBA decline from Alternative A. Due to higher altitudes air-tour aircraft would be required to fly.
 35 Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A
 36 would result in improved conditions to forage, breed, and nest. This would represent minor to moderate adverse
 37 impacts with short-term moderate beneficial change in impacts compared to Alternative A to condors due to
 38 large reduction in Percent Time Audible. The middle of Bright Angel Flight-free Zone would remain quiet, as
 39 represented by **Grid Location Points 12 and 13**, with negligible impacts and negligible change in impacts from
 40 Alternative A.
 41

42 *East End* *Alternative E* *Special Status Species*
 43 *California Condor*
 44 *Ten-Year Forecast Off-Peak Season*

45 In areas under and near **Zuni Point Corridor**, beneficial change in impacts would be similar to Base Year Off-
 46 Peak Season.
 47

48 There would be further decline in Percent Time Audible and Average Sound Level due to conversion to quiet-
 49 technology aircraft. Percent Time Audible in areas near and under **Dragon Corridor** would be 17 to 49%, a
 50 decline of 49 to 67% from Alternative A. Aircraft Average Sound Level would range 18 to 44 dBA, a one to 24
 51 dBA decrease from Alternative A. Although air-tour noise would still be present, reduction in Average Sound
 52 Level compared to Alternative A would result in less disruption of daily activities and may increase potential for
 53 breeding and nesting compared to Base Year. These improvements would be substantial in areas where aircraft
 54 Percent Time Audible is greatly reduced such as near **96 Mile Camp** Location Point along the river. Although
 55 moderate adverse impacts would continue, this would be a short-term moderate to major beneficial change in
 56 impacts from Alternative A.

1 Beneficial changes in impacts in **Bright Angel Flight-free Zone** would generally be similar to Base Year Off-
2 Peak Season, except there would be a reduction to 16% Percent Time Audible at **Grid Location Point 11** (a 7%
3 decrease from Base Year, and a 41% decrease compared to Alternative A), due primarily to quiet-technology
4 aircraft conversion.

5
6 *East End* *Alternative E* *Special Status Species*

7 *California Condor*

8 *Base Year and Ten-Year Forecast Peak Season*

9 When **Dragon Corridor** routes would not be in use, aircraft Percent Time Audible would be zero to 13% of the
10 day, a decrease of 71 to 96% compared to Alternative A at Location Points **Hermit Basin, Tower of Ra, and 96**
11 **Mile Camp**. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from Alternative
12 A. As routes would be inactive at this time, aircraft would be far less visible than in Alternative A at locations on
13 the ground. Due to substantial reduction aircraft Average Sound Level, Percent Time Audible, and reduced
14 visual impact, condors would experience near natural conditions with limited to no disruption in behaviors as a
15 result of Peak Season air-tour operations. Although negligible to minor adverse impacts would occur, this would
16 be a short-term major beneficial change from Alternative A.

17

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1 **Table 4.186 Alternative E Average Sound Level East End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Little Colorado River/Nankoweap Area																				
Nankoweap River	7	8	34	35	0	-7	0	-8	12	-23	12	-23	0	-7	0	-8	11	-23	12	-23
Nankoweap Mesa	87	90	43	43	78	-9	45	-45	23	-20	19	-24	1	-86	2	-88	14	-29	15	-28
Dragon Corridor																				
96 Mile Camp	72	74	45	45	0	-71	0	-74	8	-37	8	-37	26	-46	17	-57	37	-7	34	-11
Tower of Ra	97	98	44	45	1	-96	1	-97	8	-36	8	-37	61	-36	49	-49	46	2	44	-1
Eremita Mesa	100	100	49	49	67	-33	49	-50	21	-29	22	-28	93	-7	78	-21	41	-9	38	-12
Hermit Basin	99	100	42	42	13	-87	16	-83	10	-32	10	-32	5	-28	32	-67	23	-19	18	-24
North Rim																				
Cape Royal	59	61	25	26	77	18	25	-36	26	1	20	-6	1	-57	1	-60	11	-15	11	-15
Point Imperial	66	68	38	39	31	-34	1	-67	11	-28	8	-3	1	-65	1	-67	6	-32	6	-32
Bright Angel Point	47	48	24	24	5	-42	1	-47	13	-11	1	-13	1	-46	1	-47	11	-13	11	-13
The Basin	73	75	48	48	1	-72	1	-74	5	-42	5	-43	14	-59	1	-74	7	-41	6	-42
Grid Location Point 16	80	84	33	34	17	-63	23	-61	12	-21	13	-21	17	-63	27	-57	12	-21	13	-21
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	81	11	66	-8	39	1	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	34	-31	11	-38	18	1	16	-13	1	-64	1	-68	14	-15	14	-14
Temple Butte	62	66	37	38	75	12	57	-10	38	1	35	-2	1	-62	1	-66	6	-32	6	-32
Lipan Point	74	77	34	35	88	14	62	-16	40	5	36	1	8	-66	12	-65	7	-27	5	-30
South Rim																				
Tusayan Museum	64	67	35	36	84	20	50	-18	42	7	40	4	0	-63	0	-67	3	-33	2	-33
El Tovar	95	96	19	20	8	-88	9	-86	7	-12	8	-12	34	-61	11	-85	11	-8	10	-10
Zuni Alpha	43	46	46	46	63	20	38	-8	52	6	50	4	0	-43	0	-46	2	-43	3	-43
Ten X Meadow	64	68	49	49	76	12	64	-15	48	-1	46	-4	21	-44	15	-54	18	-31	20	-30
1.5 km SE of Moran Point	64	68	41	41	81	18	61	-7	53	12	51	10	4	-60	6	-62	5	-36	4	-37
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	46	11	4	-78	14	-5	11	-8	25	-55	4	-78	12	-7	11	-8
Grid Location Point 11	55	56	18	18	6	-49	8	-49	9	-9	9	-9	23	-32	16	-41	12	-6	11	-7
Grid Location Point 12	1	1	13	14	1	0	1	0	12	-1	12	-2	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	0	1	0	10	-2	9	-4	1	0	1	0	8	-4	8	-5
Phantom Ranch	3	4	12	12	1	-2	1	-3	7	-5	6	-6	1	-2	1	-3	7	-5	6	-6
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	0	-92	0	-92	9	-16	10	-15	44	-48	0	-92	19	-6	14	-11
Grid Location Point 18	60	60	16	17	1	-59	1	-60	6	-10	6	-10	34	-26	5	-55	11	-5	9	-7
Point Sublime	100	100	35	35	46	-54	29	-71	16	-20	17	-18	89	-11	63	-37	29	-6	25	-11
Bass Camp	0	0	7	7	0	0	0	0	0	-7	1	-7	0	0	0	0	3	-4	1	-6
Rainbow Plateau	0	0	6	7	0	0	0	0	2	-4	3	-4	0	0	0	0	3	-3	4	-3

1 **Table 4.187 Alternative E Slant Distances East End**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
Little Colorado River/Nankoweap Area				
Nankoweap River	1,449	9,063	7,615	
Nankoweap Mesa	973	6,114	5,140	
Dragon Corridor				
96 Mile Camp	1,573	1,724	151	
Tower of Ra	1,147	511	-637	
Eremita Mesa	1,034	756	-277	
Hermit Basin	1,518	3,605	2,088	
North Rim				
Cape Royal	4,038	6,132	2,094	
Point Imperial	2,292	13,405	11,113	
Bright Angel Point	6,235	9,522	3,287	
The Basin	477	3,923	3,446	
Grid Location Point 16	2,589	12,983	10,394	
Zuni Point Corridor				
Grid Location Point 14	687	1,591	904	
Grid Location Point 15	1,637	5,133	3,496	
Temple Butte	1,458	1,038	-420	
Lipan Point	2,890	955	-1,935	
South Rim				
Tusayan Museum	2,016	450	-1,566	
El Tovar	5,854	9,426	3,572	
Zuni Alpha	233	307	-267	
Ten X Meadow	540	389	-151	
1.5 km SE of Moran Point	448	251	-198	
Bright Angel Flight Free Zone				
Cedar Ridge	9,827	12,925	3,098	
Grid Location Point 11	8,081	6,862	-1,219	
Grid Location Point 12	9,014	11,236	2,222	
Grid Location Point 13	7,925	9,042	1,117	
Phantom Ranch	11,027	9,999	-1,028	
Toroweap /Shinumo Flight Free Zone				
Grid Location Point 10	2,931	2,931	0	
Grid Location Point 18	8,449	6,672	-1,777	
Point Sublime	3,760	3,760	0	
Bass Camp	13,358	13,358	0	
Rainbow Plateau	14,878	14,878	0	

Δ indicates change in noise metric data from Alternative A

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Central California Condor All Scenarios

Alternative E

Special Status Species

Similar to Alternative A, condor use areas throughout most of the Central area would be little affected by aircraft noise. Base Year Peak Season, there would generally be little difference in sound metrics compared to Alternative A. Based on contour data in Appendix F and Table 4.188, approximately 99% of condor use area would experience air-tour aircraft Percent Time Audible zero to 5% of the day, with aircraft Average Sound

1 Level 15 dBA or less. As shown in Table 4.189, air-tour aircraft would be greater than 7,000 meters from
2 locations on the ground. Condor behaviors and activities such as foraging, roosting, nesting, and breeding would
3 be little affected by air-tour aircraft. Negligible to minor adverse impacts would occur with negligible change in
4 impacts from Alternative A.

5
6 **West End** **Alternative E** **Special Status Species**
7 **California Condor**
8 *All Scenarios*
9 Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by
10 air-tours in this area. Thus, West End is not analyzed for California condor impacts.

11
12

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1 **Table 4.188 Alternative E Average Sound Level Central**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Hancock Knolls	2	2	10	10	2	0	2	0	9	-1	9	-1	2	0	2	0	9	0	10	0
1 km W of Kanab Point	2	2	9	9	2	0	2	0	6	-2	7	-2	2	0	2	0	7	-2	7	-2
Grid Location Point 8	3	3	10	10	1	-2	1	-2	9	-1	10	0	2	-1	1	-2	10	1	11	1
Grid Location Point 9	1	1	5	5	1	0	1	0	3	-2	3	-2	1	0	1	0	4	-1	3	-2
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	7	1	8	1	0	1	0	7	1	8	2	
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	2	1	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	1	1	1	1	0	1	0	0	-1	0	-1	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3 **Table 4.189 Alternative E Slant Distances Central**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
1 km W of Kanab Point	18,850	0	18,850	0
Grid Location Point 8	13,763	0	14,603	838
Grid Location Point 9	11,103	0	19,384	8,281
Havasu Point	10,450	0	10,450	0
Kanab Point	19,021	0	19,021	0
Mt. Sinyala	7,272	0	7,272	0
Stone Creek	21,882	0	24,475	2,593
Surprise Valley	25,500	0	26,216	716
Upper Deer Creek	23,683	0	24,049	366

Δ indicates change in noise metric data from Alternative A

1 **Cumulative Impacts** **Alternative E** **Special Status Species**
 2 **California Condor**

3
 4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 5 *actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Alternative E*

10
 11 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 (Alternative E).*

12
 13 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 14 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 15 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 16 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 17 *SFRA see Appendix D, Figures 91 to 94).*

18
 19 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 20 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 21 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 22 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 23 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 24 *Audible capable of masking some aircraft noise.*

25
 26 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 27 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 28 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 29 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 30 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 31 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 32 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 33 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 34 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
 35 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
 36 *Because they would be audible a very high percentage of the day, the combination of aircraft noise from all*
 37 *sources would generally be the overriding cumulative noise influence on Special Status Species and habitat.*

38
 39 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 40 *(Alternative E compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 41 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 42 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 43 *(Alternative E in this case).*

44
 45 *Fire management activities in the park and on Federally-managed lands in the Study Area are expected to*
 46 *provide long-term minor to moderate beneficial impacts to California condors by creating snags for future roost*
 47 *sites, and improving foraging habitat through creating openings in otherwise dense forest stands. In addition to*
 48 *influences of aircraft noise and presence, condors are influenced by human activities that involve approaching,*
 49 *feeding, or harassing. These actions would have localized short-term minor adverse impacts mostly limited to the*
 50 *Developed Zone.*

51
 52 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 53 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
 54 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
 55 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 56 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*

1 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 2 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 3 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

4
 5 *Comparing noise impacts from just Alternative E by itself (Appendix D Tables 16 (Peak Season) and 21 (Off-*
 6 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative E plus 1 plus 2) (Appendix D Tables 49 (Peak*
 7 *Season) and 53 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*
 8 *Cumulative Impacts and the impacts of Alternative E by itself. For the Entire Park Cumulative Impact results*
 9 *(Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 83% of the*
 10 *park, with Average Sound Level 25 to <35 dBA in 92 to 93% of the park, with 1% of the park below 25 dBA and 6*
 11 *to 7% at 35 dBA or more. For the Entire Park results for Alternative E by itself (Peak and Off-Peak Season Ten-*
 12 *Year Forecast), aircraft are audible 60% or more of the day in 3% of the park, with Average Sound Level 25 to*
 13 *<35 dBA in 6 to 9% of the park, with 74 to 81% of the park below 25 dBA and 5% at 35 dBA or more.*

14
 15 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 16 *including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour*
 17 *routes; (b) Cumulative Impacts increase the impacts of Alternative E, and (c) reducing air-tour-and-related*
 18 *impacts under the Alternatives reduces Cumulative Impacts.*

19
 20 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 21 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 22 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 23 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 24 *described for Alternative E would generally increase by one level as shown in the Cumulative Impacts discussion*
 25 *in the Conclusions section below.*

26
 27 **Conclusion** **Alternative E** **Special Status Species**
 28 **California Condor**

29
 30 Overall, Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced
 31 amount of area exposed to high Average Sound Level long periods of the day. Ten-Year Forecast, the majority of
 32 condor use areas would experience a large reduction in air-tour aircraft Percent Time Audible and Average Sound
 33 Level. Habitat in condor use areas would be improved with less disturbance from aircraft operations.

34
 35 As shown in Appendix F, East End (the area with greatest potential for impacts on condors) Ten-Year Forecast Peak
 36 Season, low noise areas would increase to 73% of condor use areas with air-tour aircraft Percent Time Audible 10%
 37 or less of the day (compared to 14% in Alternative A), and 78% of condor use areas with air-tour Average Sound
 38 Level 15 dBA or less (compared to 8% in Alternative A). Condor use areas with frequent aircraft noise disturbances
 39 would be greatly reduced with 18% of areas with air-tours audible greater than 25% of the day (compared to 78% in
 40 Alternative A). These would represent minor to major beneficial changes in impacts Ten-Year Forecast Peak Season
 41 compared to Alternative A.

42
 43 *Conclusion Marble Canyon* *Alternative E* *Special Status Species*
 44 *California Condor*

45 All Scenarios, Alternative E would result in negligible impacts to condors with long-term negligible to minor
 46 beneficial change in impacts compared to Alternative A due to inclusion of Marble Canyon in the expanded Bright
 47 Angel Flight-free Zone.

48
 49 *Conclusion East End* *Alternative E* *Special Status Species*
 50 *California Condor*

51 In the majority of East End there would be minor to major beneficial change in impacts from Alternative A on
 52 condors due to alternating seasonal use of Zuni Point and Dragon Corridors. Base Year Peak Season, when Zuni
 53 Point Corridor would be open for air-tour use, there would be moderate to major adverse impacts to condors beneath
 54 and adjacent to routes with negligible to minor change in impacts from Alternative A. Ten-Year Forecast Peak
 55 Season with conversion to quiet-technology there would be less air-tour noise under the active flight corridor
 56 resulting in moderate to major adverse impacts with short-term minor beneficial change in impacts compared to

1 Alternative A. When Zuni Point Corridor routes are inactive Base Year and Ten-Year Forecast Off-Peak Season,
2 there would be negligible impact in areas under and near the inactive corridor and short-term major beneficial
3 change in impacts compared to Alternative A.

4
5 In areas away from air-tour routes including beneath Bright Angel Flight-free Zone impacts would be negligible to
6 minor adverse with negligible change in impacts from Alternative A.

7
8 In and near Dragon Corridor Base Year and Ten-Year Forecast Peak Season when the corridor is inactive, impacts
9 would be negligible to minor adverse with major beneficial change in impacts from Alternative A. Base Year Off-
10 Peak Season when Dragon Corridor routes would be open for use by air-tours, impacts would be moderate to major
11 adverse, a minor beneficial change in impacts compared to Alternative A. Ten-Year Forecast Off-Peak Season
12 impacts would be moderate adverse with moderate to major beneficial change in impact compared to Alternative A
13 due to conversion to quiet-technology aircraft.

14
15 *Conclusion Central Alternative E Special Status Species*
16 *California Condor*
17 Alternative E would generally result in negligible to minor adverse impacts, a negligible change in impacts
18 compared to Alternative A.

19
20 *Conclusion West End Alternative E Special Status Species*
21 *California Condor*
22 Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air-
23 tours in this area. Thus, West End is not analyzed for California condor impacts.

24
25 *Cumulative Impacts Summary Alternative E Special Status Species*
26 *California Condor*

27
28 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
29 *the impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts*
30 *in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
31 *Central, West End) of the park would tend to increase to major adverse Cumulative Impacts under and near air-*
32 *tour routes, and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones.*
33 *In comparison with the other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts*
34 *followed by Modified NPS Preferred Alternative and Alternative F (Alternative A ranks last).*

35
36 **ALTERNATIVE F MODIFIED CURRENT CONDITIONS SPECIAL STATUS SPECIES**
37 **CALIFORNIA CONDOR**

38
39 Alternative F would result in negligible changes in impacts to condor use areas Base Year compared with
40 Alternative A. Ten-Year Forecast. With quiet-technology incentives and conversion requirements, noise impacts
41 would decrease. Greatest exposure to noise and visual impacts would occur East End where Average Sound Level
42 would be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75%. In Marble Canyon and the
43 Central area, condors would be little impacted by air-tour operations as aircraft Average Sound Level would
44 generally be less than 15 dBA, and Percent Time Audible would be less than 5%. Because Alternative F includes
45 quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-
46 Year Forecast in all condor use areas.

47
48 **Marble Canyon Alternative F Special Status Species**
49 **California Condor**

50 *Base Year and Ten-Year Forecast Peak Season*

51 In **Marble Canyon**, impacts of air-tour aircraft noise in Alternative F would generally be similar to Alternative
52 A during Peak Season. Based on contour data in Appendix F, Marble Canyon would be quiet with air-tour
53 aircraft in 86% of the area audible 5% or less of the day. In 3% of the area, directly under air-tour routes, air-tour
54 aircraft Percent Time Audible would be greater than 25% of the day. The majority of condor use area in Marble
55 Canyon (83%) would have air-tour Average Sound Level of 15 dBA or less. As shown in Tables 4.190 and 4.191
56 at **Cliff Dwellers Lodge, Grid Location Points 4 and 5, and the Marble Canyon Dam Site Location Points,**

1 aircraft would generally be more than 2,000 meters away from points on the ground, Percent Time Audible
2 would be zero to 3% of the day, and Average Sound Level would be 2 to 8 dBA, similar to Alternative A. At
3 **Grid Location Point 2**, a condor high-use area, aircraft would be about 800 meters from points on the ground;
4 Percent Time Audible would be 2% of the day with Average Sound Level 16 to 17 dBA, similar to Alternative
5 A. There would be little potential to disturb or displace condors. In some areas directly beneath routes, Average
6 Sound Level would be higher such as at **North Canyon** Location Point, and where air-tour routes would be close
7 to the rim, potential for disturbance of condor behavior could increase. As these birds are large and easily visible,
8 and pilots aware of their presence, collision likelihood is low. Negligible to minor adverse impacts would
9 continue with negligible change in impacts from Alternative A.

10
11 *Marble Canyon*

Alternative F

Special Status Species

12 *California Condor*

13 *Base Year and Ten-Year Forecast Off-Peak Season*

14 Air-tour aircraft noise would generally be reduced compared to Peak Season. Especially at **North** and **South**
15 **Canyon** Location Points, with reduced operations Off-Peak Season, aircraft Percent Time Audible would be less
16 than one percent of the day; aircraft Average Sound Level would be reduced to zero, a decrease of 21 and 25
17 dBA compared to Alternative A. Negligible impacts would continue with long-term negligible to minor
18 beneficial change in impacts compared to Alternative A.
19

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1 **Table 4.190 Alternative F Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	1	0	1	0	6	0	6	-3	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	15	0	16	-1	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	2	0	2	0	16	0	17	-3	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	3	0	3	0	14	0	15	-1	1	-2	1	-2	7	-8	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	2	0	2	0	8	0	8	-4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	3	0	2	-1	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	3	0	3	0	24	0	24	0	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	2	0	2	0	21	0	21	-2	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4 **Table 4.191 Alternative F Slant Distances Marble Canyon**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ	
Cliff Dwellers Lodge	3,695	3,695	0	
Grid Location Point 1	1,665	1,665	0	
Grid Location Point 2	858	858	0	
Grid Location Point 3	2,958	2,958	0	
Grid Location Point 4	4,585	4,585	0	
Grid Location Point 5	2,335	2,335	0	
Marble Canyon Dam Site	3,845	3,846	1	
North Canyon	999	999	0	
South Canyon	816	822	7	

Δ indicates change in noise metric data from Alternative A

1 **East End** **Alternative F** **Special Status Species**
 2 **California Condor**

3
 4 As shown in Appendix F, 15 to 27% of condor use area Base Year Peak and Off-Peak Season, respectively, (as
 5 opposed to 15% under Alternative A) would experience air-tour Percent Time Audible 10% of the day or less. Area
 6 exposed to frequent aircraft noise would be much reduced as well with 77 to 48% of condor use area (as opposed to
 7 77% under Alternative A) experiencing aircraft noise greater than 25% of the day. 40 to 49% of condor use area (as
 8 opposed to 42% in Alternative A) would have air-tour Average Sound Level less than 15 dBA Peak and Off-Peak
 9 Seasons, respectively, with 14 and 8% greater than 35 dBA. These would represent negligible to moderate beneficial
 10 changes in impacts compared to Alternative A.

11
 12 Areas with low noise would increase to 44 and 64%, with aircraft Percent Time Audible 10% or less of the day Ten-
 13 Year Forecast Peak and Off-Peak Seasons, respectively (compared to 14% in Alternative A), and 54 and 61% with
 14 Average Sound Level of 15 dBA or less (compared to 8% in Alternative A). Areas with high Average Sound Level
 15 would decrease to 39 and 17% with aircraft Percent Time Audible greater than 25% of the day (compared to 78% in
 16 Alternative A), and only 9 and 4% with Average Sound Level greater than 35 dBA (compared to 20% in Alternative
 17 A) Peak and Off-Peak Seasons, respectively. Ten-Year Forecast these would represent major beneficial changes in
 18 impacts compared to Alternative A.

19
 20 *East End* *Alternative F* *Special Status Species*
 21 *California Condor*
 22 *Base Year Peak Season*

23 There would be little difference in impacts to condors compared to Alternative A under **Zuni Point and Dragon**
 24 **Corridors** and adjacent areas. Proximity of air-tour aircraft to locations on the ground would not differ notably
 25 from Alternative A. As shown in Tables 4.192 and 4.193 air-tour aircraft Percent Time Audible would be 62 to
 26 nearly 100% of the day in areas beneath air-tour routes, with Average Sound Level 28 to 49 dBA, similar to
 27 Alternative A. Given close proximity of flights to South and North Rim and high levels of air-tour audibility in
 28 areas under routes, there would be potential to disrupt normal behavior patterns such as breeding, feeding, or
 29 sheltering. Major adverse impacts would continue with negligible change in impacts from Alternative A.

30
 31 *East End* *Alternative F* *Special Status Species*
 32 *California Condor*
 33 *Ten-Year Forecast Peak Season*

34 Air-tour aircraft Percent Time Audible would be 41 to 53% in **Zuni Point Corridor**, a decrease of 21 to 28%
 35 from Alternative A, and 47 to 98% of the day in **Dragon Corridor**, a decrease of 2 to 27% compared to
 36 Alternative A. Aircraft Average Sound Level would be 24 to 31 dBA in Zuni Point Corridor, declining 4 to 7
 37 dBA from Alternative A, and 37 to 46 dBA in **Dragon Corridor**, a decrease of 3 to 5 dBA compared to
 38 Alternative A. Aircraft Distance would be as described Base Year. There may be improvement for condor
 39 breeding, nesting, and foraging due to decline in aircraft Percent Time Audible. Although moderate to major
 40 adverse impacts would continue, there would be long-term moderate beneficial change in impacts compared to
 41 Alternative A.

42
 43 *East End* *Alternative F* *Special Status Species*
 44 *California Condor*
 45 *Base Year Off-Peak Season*

46 Condor use areas beneath **Zuni Point Corridor** would experience a decrease in aircraft noise effects with
 47 Percent Time Audible 33 to 45% of the day, a decrease of 26 to 33%, compared to Alternative A. Aircraft
 48 Average Sound Level would range 29 to 38 dBA, within 10 dBA of Alternative A. Distance from areas on the
 49 ground would be as for Peak Season. Moderate to major adverse impacts would continue with generally
 50 moderate beneficial change in impacts from Alternative A.

51
 52 When **Dragon Corridor** shifts west Off-Peak Season, in areas under routes (**96 Mile Camp, Tower of Ra, and**
 53 **Hermit Basin** Location Points) Percent Time Audible would be one to 60%, a 39 to 80% decrease from
 54 Alternative A. Aircraft Average Sound Level would decline to 13 to 23 dBA, a 19 to 31 dBA decrease from
 55 Alternative A. Aircraft would be farther from locations on the ground in the northern part of Dragon Corridor.
 56 Condor use of this area would be temporarily improved with less interruption of activities and, as improvements

1 occur during breeding and initial nesting season, there may be improvement in breeding success. Although
 2 negligible to moderate adverse impacts would continue, there would be moderate to major beneficial change in
 3 impacts compared to Alternative A.

4
 5 **Dragon Corridor's** seven-mile Off-Peak Season shift would occur during condor breeding and initial nesting
 6 season. Aircraft Percent Time Audible would be 24 to 37% at **Bass Camp** and **Rainbow Plateau** Location
 7 Points, an increase of 24 to 36% compared to Alternative A. Aircraft Average Sound Level would be 13 to 33
 8 dBA, an increase of 7 to 26 dBA. Because the route shift would be abrupt, there may be a higher level of reaction
 9 which could result in decreased condor breeding and nesting success in this localized area. Short-term moderate
 10 adverse impacts would continue with minor to moderate adverse change in impacts from Alternative A.

11
 12 *East End* *Alternative F* *Special Status Species*
 13 *California Condor*
 14 *Ten-Year Forecast Off-Peak Season*

15 Aircraft Percent Time Audible in **Dragon Corridor** would further decline to less than one percent at **96 Mile**
 16 **Camp** Location Point, and 6 to 32% at **Tower of Ra** and **The Basin** Location Points respectively, a decrease of
 17 68 to 92% from Alternative A. Aircraft Average Sound Level at those points would decline to 10 to 19 dBA, a
 18 decrease of 23 to 35 dBA from Alternative A. Aircraft Distance would be similar to Base Year Off-Peak Season.
 19 **Point Sublime** Location Point near air-tour routes would have air-tour aircraft Percent Time Audible at 24%
 20 Ten-Year Forecast, a 75% decrease from Alternative A. Although negligible to moderate adverse impacts would
 21 continue, there would be moderate to major beneficial change in impacts compared to Alternative A.

22
 23 Impacts of **Dragon Corridor's** route shift would be reduced due to quiet-technology incentives and conversion
 24 requirements. At **Bass Camp** Location Point, aircraft Percent Time Audible would be 20% of the day, a 20%
 25 increase from Alternative A. At **Rainbow Plateau** Location Point, aircraft Percent Time Audible would be 2%
 26 of the day, similar to Alternative A. Average Sound Level would be 10 to 29 dBA, a 4 to 22 dBA increase.
 27 Condor use and behaviors would be less frequently interrupted by air-tour aircraft than Base Year. Negligible to
 28 moderate adverse impacts would continue with short-term negligible to moderate adverse change in impacts
 29 compared to Alternative A at these locations.

30
 31 *East End* *Alternative F* *Special Status Species*
 32 *California Condor*
 33 *All Scenarios*

34 Beneath **Bright Angel Flight-free Zone**, effects of air-tour aircraft would be similar to Alternative A. **Grid**
 35 **Location Points 12 and 13** would have air-tour aircraft Percent Time Audible one percent of the day, with
 36 aircraft Average Sound Level 8 to 13 dBA. Aircraft would be at Distances greater than 2,000 meters. Air-tour
 37 aircraft would be rarely audible at relatively low sound levels in Bright Angel Flight-free Zone. Negligible
 38 impacts would occur with negligible change in impacts compared to Alternative A.

1 **Table 4.192 Alternative F Average Sound Level East End**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Little Colorado River/Nankoweap Area																				
Nankoweap River	7	8	34	35	7	0	5	-4	34	0	33	-2	0	-7	0	-8	20	-14	17	-18
Nankoweap Mesa	87	90	43	43	87	0	68	-22	43	0	39	-4	53	-34	33	-57	29	-14	25	-18
Dragon Corridor																				
96 Mile Camp	72	74	45	45	72	0	47	-27	45	0	41	-4	1	-70	0	-74	13	-31	10	-35
Tower of Ra	97	98	44	45	97	0	90	-8	44	0	41	-4	17	-80	6	-92	15	-29	13	-32
Eremita Mesa	100	100	49	49	100	0	98	-2	49	0	46	-3	95	-5	83	-17	49	0	47	-2
Hermit Basin	99	100	42	42	99	0	89	-11	42	0	37	-5	60	-39	32	-68	23	-19	19	-23
North Rim																				
Cape Royal	59	61	25	26	59	0	17	-44	25	0	19	-7	21	-28	7	-54	21	-5	16	-10
Point Imperial	66	68	38	39	66	0	25	-43	38	0	37	-2	28	-38	2	-66	18	-20	14	-25
Bright Angel Point	47	48	24	24	47	0	12	-36	24	0	18	6	2	-45	2	-47	13	-11	11	-13
The Basin	73	75	48	48	73	0	40	-35	48	0	45	-3	26	-47	16	-60	30	-18	26	-22
Grid Location Point 16	80	84	33	34	84	4	42	-42	33	0	24	-10	37	-43	21	-63	15	-18	13	-21
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	70	0	53	-21	34	0	28	-7	43	-27	27	-47	30	-4	24	-10
Grid Location Point 15	65	69	28	29	65	0	41	-28	28	0	24	-4	33	-33	17	-52	38	10	35	6
Temple Butte	62	66	37	38	62	0	45	-22	37	0	31	-7	37	-26	23	-43	31	-6	27	-11
Lipan Point	74	77	34	35	74	0	49	-29	34	0	27	-7	45	-29	22	-55	29	-5	24	-11
South Rim																				
Tusayan Museum	64	67	35	36	64	0	32	-36	35	0	28	-8	36	-28	15	-52	29	-6	24	-12
El Tovar	95	96	19	20	95	0	12	-84	19	0	13	-6	19	-76	8	-88	11	-8	8	-11
Zuni Alpha	43	46	46	46	43	0	24	-23	46	0	41	-5	22	-21	11	-35	41	-5	38	-9
Ten X Meadow	64	68	49	49	64	0	32	-36	49	0	45	-4	38	-26	18	-51	42	-7	39	-10
1.5 km SE of Moran Point	64	68	41	41	65	1	43	-25	41	0	37	-4	38	-26	22	-46	36	-5	33	-8
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	81	0	5	-78	19	0	13	-6	20	-61	5	-77	14	-5	12	-7
Grid Location Point 11	55	56	18	18	55	0	10	-47	18	0	12	-7	16	-39	7	-49	11	-7	9	-9
Grid Location Point 12	1	1	13	14	1	0	1	0	13	0	12	-2	1	0	1	0	12	-1	12	-2
Grid Location Point 13	1	1	12	13	1	0	1	0	12	0	9	-4	1	0	1	0	9	-3	8	-4
Phantom Ranch	3	4	12	12	3	0	1	-3	12	0	7	-5	1	-2	1	-3	7	-4	6	-6
Toroweap/Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	92	0	0	-92	25	0	19	-6	66	-26	16	-77	32	7	29	4
Grid Location Point 18	60	60	16	17	60	0	14	-46	16	0	13	-4	57	-3	32	-28	39	23	35	19
Point Sublime	100	100	35	35	100	0	94	-6	35	0	30	-6	89	-10	24	-75	19	-16	17	-18
Bass Camp	0	0	7	7	0	0	0	0	7	0	2	-5	37	36	20	20	33	26	29	22
Rainbow Plateau	0	0	6	7	0	0	0	0	7	1	5	-1	24	24	2	2	13	7	10	4

1 **Table 4.193 Alternative F Slant Distances East End**

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	1,448	0
Nankoweap Mesa	973	970	-3
Dragon Corridor			
96 Mile Camp	1,573	1,573	0
Tower of Ra	1,147	854	-293
Eremita Mesa	1,034	357	-677
Hermit Basin	1,518	1,656	139
North Rim			
Cape Royal	4,038	4,038	0
Point Imperial	2,292	2,343	50
Bright Angel Point	6,235	6,225	-10
The Basin	477	489	13
Grid Location Point 16	2,589	2,575	-14
Zuni Point Corridor			
Grid Location Point 14	687	687	0
Grid Location Point 15	1,637	1,636	-1
Temple Butte	1,458	1,458	0
Lipan Point	2,890	2,890	0
South Rim			
Tusayan Museum	2,016	2,016	0
El Tovar	5,854	5,857	3
Zuni Alpha	573	573	0
Ten X Meadow	540	540	0
1.5 km SE of Moran Point	448	448	0
Bright Angel Flight Free Zone			
Cedar Ridge	9,827	9,857	10
Grid Location Point 11	8,081	8,028	-53
Grid Location Point 12	9,014	9,014	0
Grid Location Point 13	7,925	7,925	0
Phantom Ranch	11,027	10,961	-66
Toroweap/Shimomo Flight Free Zone			
Grid Location Point 10	2,931	2,900	-31
Grid Location Point 18	8,449	1,341	-7,108
Point Sublime	3,760	3,609	-151
Bass Camp	13,358	2,667	-10,691
Rainbow Plateau	14,878	3,294	-11,585

Δ indicates change in noise metric data from Alternative A

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Central Alternative F Special Status Species California Condor

Base Year and Ten-Year Forecast Peak Season

Similar to Alternative A, condors throughout most of the Central area would be little affected by air-tour and general-aviation aircraft noise. As in Table 4.194 and 4.195, Base Year Peak Season, Percent Time Audible would range from less than one to 4%, similar to Alternative A. Condors would be exposed to air-tour Average Sound Level ranging less than one to 11 dBA, similar to Alternative A. Aircraft proximity would be greater 7,000 meters away from points on the ground. Given low aircraft Percent Time Audible and Average Sound Level with air-tour aircraft distant from locations on the ground, there would be little potential to disturb condor behaviors or activities. There would generally be no expected effect on population levels or area use, although some individuals may be disturbed for short-periods. Condor behaviors would be expected to return to normal ranges after air-tour activity. Negligible impacts would occur with negligible change in impacts compared to Alternative A.

1 *Central* *Alternative F* *Special Status Species*
2 *California Condor*
3 *Base Year and Ten-Year Forecast Off-Peak Season*
4 Average Sound Level and impacts would be similar to Base Year Peak Season, except **Grid Location Point 8**
5 Base Year Off-Peak Season where Percent Time Audible would increase 21% compared to Base Year Peak
6 Season, and by 23% compared to Alternative A.

7
8 **West End** **Alternative F** **Special Status Species**
9 **California Condor**

10
11 Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air-
12 tours in this area. Thus, West End is not analyzed for California condor impacts.
13

DRAFT
Not Finalized
FOIA Discretionary Release

1 **Table 4.194 Alternative F Average Sound Level Central**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	8	-1	8	-1	2	0	2	0	7	-2	8	-1
Grid Location Point 8	3	3	10	10	4	1	1	-2	11	2	9	-1	25	23	3	0	10	0	10	0
Grid Location Point 9	1	1	5	5	1	0	1	0	5	0	3	-2	1	0	1	0	6	1	4	-2
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	2	1	1	0	8	2	7	1	3	2	3	2	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	1	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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4 **Table 4.195 Alternative F Slant Distances Central**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
1 km W of Kanab Point	18,850	0	18,850	0
Grid Location Point 8	13,765	0	13,765	0
Grid Location Point 9	11,103	0	11,103	0
Havasu Point	10,450	0	10,450	0
Kanab Point	19,021	0	19,021	0
Mt. Sinyala	7,272	0	7,272	0
Stone Creek	21,882	-7,627	14,255	-7,627
Surprise Valley	25,500	-6,385	19,115	-6,385
Upper Deer Creek	23,683	-2,752	20,930	-2,752

Δ indicates change in noise metric data from Alternative A

5

1 **Cumulative Impacts** Alternative F Special Status Species
2 **California Condor**

3
4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 5
6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
8 *3) ground-based noise sources, plus*
9 *4) noise from air-tour-and-related aircraft under Alternative F*

10
11 *That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 (Alternative F).*

12
13 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the SFRA see Appendix D, Figures 91 to 94).*

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19 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire management activities, and mining activities outside the park. Noise from ground-based sources is discussed in Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time Audible capable of masking some aircraft noise.*

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26 *Noise from ground-based sources is usually very localized. Even though there is some spread into some backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above. Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time. Because they would be audible a very high percentage of the day, the combination of aircraft from all sources would generally be the overriding cumulative influence on Wildlife and habitat.*

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39 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives (Alternative F compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives (Alternative F in this case).*

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45 *Fire management activities in the park and on Federally-managed lands in the Study Area are expected to provide long-term minor to moderate beneficial impacts to California condors by creating snags for future roost sites, and improving foraging habitat through creating openings in otherwise dense forest stands. In addition to influences of aircraft noise and presence, condors are influenced by human activities that involve approaching, feeding, or harassing. These actions would have localized short-term minor adverse impacts mostly limited to the Developed Zone.*

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52 *Cumulative Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since noise from ground-*

1 *based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into*
 2 *account in interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point*
 3 *results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

4
 5 *Comparing noise impacts from just Alternative F by itself (Appendix D Tables 26 (Peak Season) and 31 (Off-*
 6 *Peak Season) Ten-Year Forecast) versus All Aircraft (#4 Alternative F plus #1 Above and #2 Outside) (Appendix*
 7 *D Tables 57 (Peak Season) and 61 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the*
 8 *difference between Cumulative Impacts and the impacts of Alternative F by itself. For the Entire Park*
 9 *Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more*
 10 *of the day in 87 to 89% of the park, with Average Sound Level 25 to <35 dBA in 84 to 86% of the park, with 1%*
 11 *of the park below 25 dBA and 15 to 18% at 35 dBA or more. For the Entire Park results for Alternative F by*
 12 *itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to 10% of*
 13 *the park, with Average Sound Level 25 to <35 dBA in 14% of the park, with 68 to 70% of the park below 25 dBA*
 14 *and 10 to 13% at 35 dBA or more.*

15
 16 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 17 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
 18 *routes; (b) Cumulative Impacts increase the impacts of Alternative F, and (c) reducing air-tour-and-related*
 19 *impacts under the Alternatives reduces Cumulative Impacts.*

20
 21 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 22 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 23 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 24 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 25 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts discussion*
 26 *in the Conclusions section below.*

27
 28 **Conclusion** **Alternative F** **Special Status Species**
 29 **California Condor**

30
 31 Overall in condor use areas, Alternative F would result in negligible to minor change in impacts Base Year
 32 compared with Alternative A. Greatest exposure to noise and visual impacts would occur in East End. In Marble
 33 Canyon and the Central area, condors would be little impacted by air-tour operations. Because Alternative F
 34 includes quiet-technology incentives and conversion requirements, noise impacts would decrease Base Year to Ten-
 35 Year Forecast in all condor use areas with beneficial change in both area of Percent Time Audible and Average
 36 Sound Level.

37
 38 East End, the area with greatest potential for impacts on condors, Ten-Year Forecast Peak Season, low noise areas
 39 would increase, with 44% of condor use areas with air-tour aircraft Percent Time Audible 10% or less of the day
 40 (compared to 14% in Alternative A) and 54% of condor use areas with air-tour Average Sound Level 15 dBA or
 41 less (compared to 8% in Alternative A). Condor use areas with frequent aircraft noise disturbances would be greatly
 42 reduced with only 39% of areas with air-tours Percent Time Audible greater than 25% of the day (compared to 78%
 43 in Alternative A). These would represent major beneficial changes in impacts Ten-Year Forecast Peak Season
 44 compared to Alternative A.

45
 46 *Conclusion Marble Canyon* *Alternative F* *Special Status Species*
 47 *California Condor*

48 Base Year and Ten-Year Forecast Peak Season Alternative F would result in negligible to minor impacts to condors
 49 in Marble Canyon with negligible change in impacts compared to Alternative A. Base Year and Ten-Year Forecast
 50 Off-Peak Season Alternative F would result in negligible impacts to condors in Marble Canyon with negligible to
 51 minor beneficial change in impacts compared to Alternative A.

52
 53 *Conclusion East End* *Alternative F* *Special Status Species*
 54 *California Condor*

55 East End impacts would vary depending on proximity to air-tour routes in Zuni Point and Dragon Corridors and
 56 across North Rim, with generally moderate to major adverse impacts under and near tour routes with minor to major

1 change in impacts compared to Alternative A. In Bright Angel Flight-free Zone Base Year and Ten-Year Forecast
2 there would be negligible impacts with negligible change in impacts compared to Alternative A.

3
4 Base Year Peak Season, air-tour aircraft impacts on condors would not be appreciably different from Alternative A.
5 Ten-Year Forecast Peak Season, moderate to major adverse impacts would occur but there would be reduction in
6 aircraft Percent Time Audible and Average Sound Level due to quiet-technology conversions resulting in short-term
7 moderate beneficial change in impacts compared to Alternative A.

8
9 Base Year Off-Peak Season, there would be moderate to major beneficial change in impacts compared to Alternative
10 A on condors near Zuni Point and Dragon Corridors; however, this would be off-set somewhat by minor to moderate
11 adverse change in impacts compared to Alternative A due to Dragon Corridor's westward Off-Peak Season shift.

12
13 Ten-Year Forecast Off-Peak Season, these impacts would decline to negligible to moderate adverse due to reduction
14 in aircraft audibility due primarily to quiet-technology conversion resulting in overall moderate to major beneficial
15 changes in impacts compared to Alternative A.

16 *Conclusion Central Alternative F Special Status Species*
17 *California Condor*

18 Alternative F would result in negligible impacts with negligible change in impacts on condors compared to
19 Alternative A at most Location Points in the Central area Base Year and Ten-Year Forecast.

20
21 *Conclusion West End Alternative F Special Status Species*
22 *California Condor*

23 Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air-
24 tours in this area. Thus, West End is not analyzed for California condor impacts.

25
26
27 *Cumulative Impacts Summary Alternative F Special Status Species*
28 *California Condor*

29
30 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
31 *the impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts*
32 *in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
33 *Central, West End) (Marble Canyon, East End, Central West End) of the park would tend to increase to major*
34 *adverse Cumulative Impacts under and near air-tour routes, and minor to moderate adverse Cumulative Impacts*
35 *near the middle of the large Flight-free Zones. In comparison with the other Alternatives, Alternative F ranks*
36 *third in lowest overall Cumulative Impacts behind Alternative E and the Modified NPS Preferred Alternative*
37 *(Alternative A ranks last).*

38
39 **MODIFIED NPS PREFERRED ALTERNATIVE SPECIAL STATUS SPECIES**
40 **CALIFORNIA CONDOR**

41
42 Overall, the *Modified* NPS Preferred Alternative would result in beneficial change in impacts compared with
43 Alternative A due to reduced amount of condor use area exposed to high audibility for long periods of the day.
44 Condor use areas would experience fewer disturbances from aircraft operations.

45
46 **Marble Canyon Modified NPS Preferred Alternative Special Status Species**
47 **California Condor**

48 Condor use areas would be quiet similar to Alternative A Peak and Off-Peak Seasons. As shown in Appendix F,
49 based on contour data, air-tour aircraft in **96 to 100%** of Marble Canyon would have air-tour aircraft audible 5% or
50 less of the day with Average Sound Level 15 dBA or less.

51
52 *Marble Canyon Modified NPS Preferred Alternative Special Status Species*
53 *California Condor*

54 **All Scenarios**

55 *Impacts at representative Location Points around Marble Canyon would generally be minor to moderate*
56 *beneficial compared to Alternative A (Table 4.196 and 4.197). Aircraft Percent Time Audible would be 1% or*

1 *less, lower than Alternative A, and aircraft Average Sound Level would be zero to 13 dBA, a decrease of one*
2 *to 24 dBA compared to Alternative A. Aircraft would be much farther away and not visible from locations on*
3 *the ground, ranging from 18,273 meters at Marble Canyon Dam Site Location Point to 75,891 meters at Grid*
4 *Location Point 1. Improvement over Alternative A would occur at all Location Points close to rim and river,*
5 *and most at North and South Canyon Location Points. Condors would not be disturbed from normal daily*
6 *activities by aircraft. Closure of all Marble Canyon routes would result in an increased distance between air*
7 *traffic and condor roosting/foraging areas. There would generally be long-term minor to major beneficial*
8 *change in impacts compared with Alternative A.*
9
10

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1 **Table 4.196 Modified NPS Preferred Alternative Average Sound Level Marble Canyon**

Location Point Name	Alternative A		Modified NPS Preferred Alternative																	
			Peak Season										Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	1	-5	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9	-2	1	-2	7	-8	7	-8	
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	1	-7	0	-2	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-2	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-3	0	-3	2	--22	1	-24	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-3	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4 **Table 4.197 Modified NPS Preferred Alternative Slant Distances Marble Canyon**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	55,620	52,925
Grid Location Point 1	1,665	75,891	74,226
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	53,548	50,590
Grid Location Point 4	4,585	71,678	67,093
Grid Location Point 5	2,325	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669

Δ indicates change in noise metric data from Alternative A

5
 6

1 **East End** *Modified NPS Preferred Alternative* **Special Status Species**
 2 **California Condor**

3
 4 As shown in Appendix F Tables 15 and 16, Base Year Peak Season approximately **15%** of East End condor use area
 5 would experience air-tour sounds 10% of the day or less, **the same percentage as Alternative A**. Area exposed to
 6 frequent aircraft noise would be about the same as Alternative A with 78% of condor use area experiencing aircraft
 7 noise greater than 25% of the day (as opposed to 77% under Alternative A). Approximately **40%** of condor use area
 8 would have air-tour Average Sound Level of 15 dBA or less (as opposed to 42% in Alternative A). These would
 9 represent negligible changes in impacts compared to Alternative A.

10
 11 Ten-Year Forecast Peak Season levels would be reduced from Base Year, mainly due to quiet-aircraft technology
 12 conversion requirements, to **41%** of condor use area with aircraft Percent Time Audible 10% or less of the day
 13 (compared to 14% in Alternative A), and **53%** of condor use area with Average Sound Level of 15 dBA or less
 14 (compared to 8% in Alternative A). Condor use area with high Average Sound Level would be greatly reduced with
 15 only **43%** of areas with air-tours audible greater than 25% of the day (compared to 78% in Alternative A). These
 16 would represent major beneficial changes in impacts compared to Alternative A.

17
 18 Base Year and Ten-Year Forecast Off-Peak Season, condor use areas with low Average Sound Level would increase
 19 compared to Peak Season, with **53 to 74%** of areas experiencing 10% or less Percent Time Audible (compared to
 20 14% in Alternative A), and **71 to 75%** of areas with Average Sound Level of 15 dBA or less (compared to 8% in
 21 Alternative A), Base Year and Ten-Year Forecast, respectively. Use areas with high Average Sound Level would
 22 similarly decrease from Peak Season, with **37 to 16%** of areas with Percent Time Audible greater than 25%, and 7 to
 23 5% with greater than 35 dBA, Base Year and Ten-Year Forecast, respectively (compared to 78% greater than 25%,
 24 and 20% greater than 35 dBA in Alternative A). These would represent moderate to major beneficial changes in
 25 impacts Ten-Year Forecast compared to Alternative A.

26
 27 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 28 *California Condor*
 29 *Base Year Peak Season*

30 At **Dragon Corridor** Location Points **96 Mile Camp, Tower of Ra, Eremita Mesa** and **Hermit Basin** air-tour
 31 Percent Time Audible would be 59 to **100%** of the day, a one to 12% decrease from Alternative A. Average
 32 Sound Level would be 20 to 42 dBA, a 2 to 22 dBA decrease from Alternative A. Air-tour aircraft would be
 33 farther away from points on the ground compared to Alternative A by about 400 to almost 5,000 meters at those
 34 points. **Minor** to major adverse impacts would continue under and near active Dragon Corridor air-tour routes,
 35 generally with short-term minor beneficial change in impacts compared to Alternative A.

36
 37 Aircraft noise would **decrease slightly** in **Zuni Point Corridor** **when** both long- and short-loop air-tour routes
 38 would be active. At Location Points such as **Grid Location Point 14** and **Temple Butte**, aircraft Percent Time
 39 Audible would be **54 to 62%** of the day, an 8% decrease compared to Alternative A. Average Sound Level would
 40 **average** 35 dBA, a negligible change from Alternative A. With air-tour aircraft activity in Zuni Point Corridor,
 41 condors may avoid the area under routes as suitable areas would be available elsewhere without interference
 42 from aircraft sights and sounds. High levels of aircraft noise would occur during critical time periods when
 43 condors would be breeding and nesting. Moderate to major adverse impacts on condors would continue with
 44 negligible change in impacts from Alternative A.

45
 46 In **Bright Angel Flight-free Zone** air-tour aircraft Percent Time Audible would increase by **9%** from Alternative
 47 A in areas near **Cape Royal** Location Point (Percent Time Audible **68%**). Average Sound Level would range 10
 48 to **20** dBA, similar to Alternative A. Aircraft would be greater than **7,000** meters from locations on the ground.
 49 Moderate adverse impacts would continue with negligible to minor adverse change in impacts compared to
 50 Alternative A.

51
 52 Along North Rim, in **Bright Angel Flight-free Zone** away from routes, areas would experience a decrease in
 53 air-tour aircraft noise. In areas represented by Location Points **Point Imperial** and **Grid Location Point 16**,
 54 aircraft Percent Time Audible would be 47% and **54%** of the day, a **19 to 26%** decrease compared to Alternative
 55 A. Average Sound Level would be 18 to 32 dBA a decrease of one to 20 dBA. Aircraft would be **nearly 900**
 56 meters **from The Basin location point to 6,200 meters from Bright Angel location point**. Condor daily activities

1 would be occasionally interrupted by aircraft noise. Although moderate adverse impacts would occur there
 2 would be short-term moderate beneficial change in impacts compared to Alternative A.

3
 4 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 5 *California Condor*
 6 *Ten-Year Forecast Peak Season*

7 Under and adjacent to **Dragon Corridor** air-tour routes Percent Time Audible would decline to 41 to 98%, a 2 to
 8 **43%** decrease from Alternative A due to conversion to quiet-technology aircraft. Aircraft Average Sound Level
 9 would range **17** to 38 dBA, a decrease of 7 to **25** dBA. Aircraft Distance would be the same as Base Year.
 10 Although *minor* to major adverse impacts would continue under and near Dragon Corridor there would *be long-*
 11 term minor to major beneficial change in impacts compared to Alternative A.

12
 13 There would be a reduction in air-tour aircraft noise compared to Base Year Peak Season near **Zuni Point**
 14 **Corridor** with aircraft Percent Time Audible **33 to 46%** of the day, a **28 to 33%** decrease from Alternative A.
 15 Average Sound Level would be **28 to 36 dBA**, up to a **2 to 7 dBA decrease** compared to Alternative A. Aircraft
 16 noise would be present less frequently during the day which may improve feeding, breeding, and nesting.
 17 Moderate to major adverse impacts would continue under and near Zuni Point Corridor air-tour routes with
 18 mixed results, *long-term* minor to major beneficial change in impacts compared to Alternative A.

19
 20 In condor use areas in **Bright Angel Flight-free Zone** represented by Location Points **Cape Royal** and **Grid**
 21 **Location Point 11** aircraft Percent Time Audible would be **23 to 28%** of the day, a decrease of **33%** compared to
 22 Alternative A. Air-tour Average Sound Level would be similar to Alternative A and range **14 to 21** dBA.
 23 Condors would be infrequently disturbed during daily activities. Although minor to moderate adverse impacts
 24 would occur there would be *long-term* moderate beneficial change in impacts compared to Alternative A. The
 25 middle of Bright Angel Flight-free Zone would remain quiet, as represented by *Grid Location Points 12 and 13*,
 26 with negligible impacts and negligible change in impacts from Alternative A.

27
 28 North Rim condor use areas in **Bright Angel Flight-free Zone** would improve at areas represented by Location
 29 Points **Point Imperial** and **Grid Location Point 16**. Aircraft Percent Time Audible would be 11 to **39%** of the
 30 day; a **45 to 56%** decrease from Alternative A. Average Sound Level would range 16 to 24 dBA, a 9 to 22 dBA
 31 decline. There would be much less interruption of disturbance to condor breeding, nesting, and foraging than
 32 Base Year Peak Season. Although minor to moderate adverse impacts would occur there would be *long-term*
 33 minor to major beneficial change in impacts compared to Alternative A.

34
 35 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 36 *California Condor*
 37 *Base Year Off-Peak Season*

38 **Dragon Corridor** would experience a *reduction in* air-tour aircraft Percent Time Audible **38 to 98%** of the day,
 39 a 2 to 32% decrease from Alternative A. Average Sound Level would be 17 to 38 dBA, a 6 to 25 dBA reduction.
 40 *Aircraft in air-tour routes* would be at the same *Distance* as Peak Season. Condors would experience less
 41 frequent aircraft disturbance. Condor foraging and rearing of young may improve in Dragon Corridor with less
 42 *noise* interference from aircraft. Although *minor to major* adverse impacts would continue there would be short-
 43 term moderate to major beneficial change in impacts compared to Alternative A.

44
 45 When Zuni Point Corridor short-loop tour routes and all long-loop tour routes are closed, areas **under and near**
 46 **Zuni Point Corridor** (represented by Location Points **Temple Butte**, **Lipan Point**, and **Grid Location Points**
 47 **14 and 15**) would experience aircraft Percent Time Audible **zero to 1%** of the day, a **61 to 74%** decrease
 48 compared to Alternative A. Aircraft Average Sound Level would be **6 to 14** dBA, a **decrease 14 to 31** dBA from
 49 Alternative A. *During this time the nearest air tours to these locations on the ground would be in Dragon*
 50 **Corridor**. Condor activities *would not* be interrupted for large portions of the day from aircraft noise. *Negligible*
 51 adverse impacts would continue with *short-term moderate to major* beneficial change in impacts compared to
 52 Alternative A.

53
 54 In **Bright Angel Flight-free Zone** near air-tour routes, as represented by **Cape Royal** Location Point aircraft
 55 Percent Time would *decrease to 1%* of the day; a 58% *decrease* from Alternative A with Average Sound Level
 56 of **11 dBA a 14 dBA reduction from** Alternative A. Air-tour aircraft *would* be visible *less* frequently during this

1 time of year as Zuni Point Corridor **and long-loop tour routes** would be **closed**. **Negligible** impacts would occur
 2 with **moderate to major beneficial** change in impacts compared to Alternative A. At **Grid Location Point 11**,
 3 aircraft Percent Time Audible would be **27%**, a **28%** decrease compared to Alternative A. Average Sound Level
 4 would be **15** dBA, a decrease of **4** dBA from Alternative A. Although **minor** adverse impacts would occur there
 5 would be short-term minor to moderate beneficial change in impacts compared to Alternative A.

6
 7 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 8 *California Condor*
 9 *Ten-Year Forecast Off-Peak Season*

10 **In areas near and under Dragon Corridor there would be a decrease in noise due to** conversion to quiet-
 11 technology aircraft. Aircraft Percent Time Audible would be **25 to 92%** of the day; a reduction of **8 to 61%**
 12 compared to Alternative A. Average Sound Level would range **15 to 35** dBA, a **10 to 27** dBA decrease. Although
 13 **minor to major** adverse impacts would continue under and near Dragon Corridor there would be **long- and**
 14 **short-term minor to major** beneficial change in impacts compared to Alternative A.

15
 16 **There would be further reduction in aircraft noise under and near Zuni Point Corridor due to conversion to**
 17 **quiet-technology aircraft along with closure of short- and long-loop routes.** Aircraft Percent Time Audible
 18 would be **zero to 1%**, a decline of **65 to 77%** from Alternative A. Aircraft Average Sound Level would range 6 to
 19 14 dBA, a 15 to 32 dBA **reduction** from Alternative A. **Negligible** adverse impacts would occur with long- and
 20 short-term **moderate to major** beneficial change in impacts from Alternative A.

21
 22 Along edges of **Bright Angel Flight-free Zone**, aircraft Percent Time Audible would be **1%** of the day near
 23 Zuni Point Corridor at **Cape Royal** Location Point, a decrease of **60%**, and Percent Time Audible **17%** of the
 24 day near Dragon Corridor at **Grid Location Point 11**, a **39%** reduction compared to Alternative A. There would
 25 be negligible change in Average Sound Level of **12** dBA. Although minor to moderate adverse impacts would
 26 occur there would be **long- and** short-term minor to major beneficial change in impacts compared to Alternative A.
 27
 28

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1 **Table 4.198 Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A		Modified NPS Preferred Alternative																		
			Peak Season										Off Peak Season								
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)				
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	
Little Colorado River/Nankoweap Area																					
Nankoweap River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	11	-23	12	-23	
Nankoweap Mesa	87	90	43	43	76	-11	48	-42	31	-12	29	-14	1	-42	2	-88	14	-29	15	-28	
Dragon Corridor																					
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	38	-32	25	-49	35	-10	33	-12	
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	80	-17	67	-31	38	-6	35	-10	
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	98	-2	92	-8	32	-17	29	-20	
Hermit Basin	99	100	42	42	96	-4	57	-43	20	-22	17	-25	79	-20	39	-61	17	-25	15	-27	
North Rim																					
Cape Royal	59	61	25	26	68	9	28	-33	27	2	21	-5	1	-58	1	-60	11	-14	12	-14	
Point Imperial	66	68	38	39	47	-19	11	-56	18	-20	16	-22	-65	1	-67	7	-31	7	-32		
Bright Angel Point	47	48	24	24	57	10	18	-30	24	0	18	-5	-43	5	-43	13	-11	12	-12		
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-1	37	-36	7	-68	19	-29	20	-28	
Grid Location Point 16	80	84	33	34	54	-26	39	-45	32	-1	24	-9	13	-67	20	-64	12	-21	12	-22	
Zuni Point Corridor																					
Grid Location Point 14	70	74	34	34	62	-8	46	-28	39	6	37	1	1	-69	1	-73	7	-27	7	-27	
Grid Location Point 15	65	69	28	29	56	-9	37	-32	39	11	35	6	1	-64	1	-68	14	-14	14	-15	
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32	
Lipan Point	74	77	34	35	76	2	46	-34	34	1	28	-7	0	-74	0	-77	9	-25	8	-27	
South Rim																					
Tusayan Museum	64	67	35	36	64	0	38	-29	5	0	29	-7	0	-64	0	-67	4	-31	4	-32	
El Tovar	95	96	19	20	93	-2	23	-73	20	0	14	-6	66	-29	13	-83	15	-4	13	-7	
Zuni Alpha	43	46	46	46	41	-2	33	-21	48	2	45	-1	0	-43	0	-46	3	-43	3	-3	
Ten X Meadow	64	68	49	49	60	-4	33	-33	52	3	50	1	19	-45	11	-57	18	-31	19	-30	
1.5 km SE of Moran Point	64	68	41	41	62	2	43	-23	38	-3	33	-8	2	-62	3	-65	6	-35	5	-36	
Bright Angel Flight Free Zone																					
Cedar Ridge	81	82	19	19	89	9	16	-76	19	1	14	-5	56	-25	6	-76	15	-4	13	-6	
Grid Location Point 11	55	56	18	18	50	-5	33	-33	20	2	14	-4	27	-28	17	-39	15	-3	12	-6	
Grid Location Point 12	1	1	13	14	2	1	1	13	0	12	-1	1	0	1	0	11	-2	12	-2		
Grid Location Point 13	1	1	12	13	1	1	0	12	0	9	-4	1	0	1	0	9	-3	9	-4		
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	7	-5	1	-2	1	-3	7	-5	7	-5	
Toroweap /Shinumo Flight Free Zone																					
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	73	-19	19	-73	26	1	23	-2	
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	73	13	31	-29	17	1	15	-2	
Point Sublime	100	100	35	35	100	0	95	-5	35	-1	29	-6	97	-3	83	-17	32	-3	27	-8	
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	6	-1	3	-4	
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	6	-1	0	0	0	0	7	1	7	0	

1 **Table 4.199 Modified NPS Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	9,655	8,206
Nankoweap Mesa	973	6,096	5,123
Dragon Corridor			
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,579	431
Eremita Mesa	1,034	4,277	3,244
Hermit Basin	1,518	6,447	4,929
North Rim			
Cape Royal	4,038	4,026	-12
Point Imperial	2,292	2,754	462
Bright Angel Point	6,235	6,236	2
The Basin	477	874	397
Grid Location Point 16	2,589	2,591	2
Zuni Point Corridor			
Grid Location Point 14	687	1,412	726
Grid Location Point 15	1,637	2,345	708
Temple Butte	1,458	1,303	-155
Lipan Point	2,890	2,894	3
South Rim			
Tusayan Museum	2,016	2,018	3
El Tovar	5,854	10,914	5,060
Zuni Alpha	573	574	0
Ten X Meadow	540	394	-146
1.5 km SE of Moran Point	448	1,144	696
Bright Angel Flight Free Zone			
Cedar Ridge	9,827	12,261	2,434
Grid Location Point 11	808	8,035	-46
Grid Location Point 12	9,014	9,012	-2
Grid Location Point 13	7,925	7,852	-73
Phantom Ranch	11,027	11,313	286
Toroweap/Shimomo Flight Free Zone			
Grid Location Point 10	2,931	3,253	322
Grid Location Point 18	8,449	5,106	-3,342
Point Sublime	3,760	4,076	316
Bass Camp	13,358	13,352	-5
Rainbow Plateau	14,878	14,974	96

Δ indicates change in noise metric data from Alternative A

2
3
4 Central **Modified NPS Preferred Alternative** Special Status Species
5 California Condor
6 *All Scenarios*

7 Similar to Alternative A, condors throughout most of the Central area would be little affected by aircraft noise.
8 Base Year Peak Season there would be little difference in sound metrics **in Dragon Corridor** compared to
9 Alternative A. Air-tour aircraft Percent Time Audible would be 10% or less of the day as shown in Appendix F
10 and Table 4.200, in **88%** of condor use areas Base Year Peak Season, and **98%** Ten-Year Forecast Peak Season,
11 with aircraft Average Sound Level 15 dBA or less in 100% of the Central area Base Year and Ten-Year Forecast.
12 Similar Percent Time Audible and Average Sound Level would occur Base Year and Ten-Year Forecast Off-
13 Peak Season. As shown in Table 4.201, air-tour aircraft would be greater than 7,000 meters from locations on the
14 ground. Condor daily behaviors such as foraging and roosting would be little affected by air-tour aircraft.
15 Negligible to minor adverse impacts would occur with negligible change in impacts from Alternative A.

1 **Table 4.200** *Modified NPS Preferred Alternative* *Average Sound Level* *Central*

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	9	0	7	-2	2	0	2	0	7	-1	7	-2
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	10	0	10	7	1	-2	12	2	10	0
Grid Location Point 9	1	1	5	5	1	0	0	-1	6	1	4	-1	1	0	0	-1	5	0	3	-3
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	10	4	8	1	1	0	1	0	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	1	1	1	1	0	1	0	2	1	1	0	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
3

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Table 4.201 Modified NPS Preferred Alternative Slant Distances Central

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
The Dome	13,109	13,119	10
Tuweep	8,688	8,688	0
Tuweep	14,322	12,923	-1,399
Hancock Knolls	30,162	30,166	4
1 km W of Kanab Point	18,850	18,857	8
Grid Location Point 8	13,765	14,620	855
Grid Location Point 9	11,103	19,140	8,038
Grid Location Point 20	22,053	22,095	42
Grid Location Point 21	20,393	20,401	8
Grid Location Point 22	26,089	26,095	6
Grid Location Point 23	29,326	27,482	-1,844
Grid Location Point 24	21,073	21,073	0
Grid Location Point 25	20,188	20,216	28
Havasu Point	10,450	10,589	140
Kanab Point	19,021	19,029	8
Mt. Sinyala	7,272	7,302	30
Stone Creek	21,882	24,531	2,649
Surprise Valley	25,500	26,243	743
Toroweap Overlook	9,625	9,625	0
Upper Deer Creek	23,683	24,100	417

Δ indicates change in noise metric data from Alternative A

West End Modified NPS Preferred Alternative Special Status Species California Condor

Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air-tours in this area. Thus, West End is not analyzed for California condor impacts.

Cumulative Impacts Modified NPS Preferred Alternative Special Status Species California Condor

Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of

- 1) high-altitude aircraft at or above 18,000 feet MSL, plus
- 2) aircraft below 18,000 feet MSL and outside the SFRA, plus
- 3) ground-based noise sources, plus
- 4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative

That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4 (Modified NPS Preferred Alternative).

Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the SFRA see Appendix D, Figures 91 to 94).

1 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
2 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
3 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
4 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
5 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
6 *Audible capable of masking some aircraft noise.*

7
8 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
9 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
10 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
11 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
12 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
13 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
14 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
15 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
16 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
17 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
18 *noise some of the time.*

19
20 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
21 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
22 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
23 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
24 *Alternatives (Modified NPS Preferred Alternative in this case).*

25
26 *Fire management activities in the park and on Federally-managed lands in the Study Area are expected to*
27 *provide long-term minor to moderate beneficial impacts to California condors by creating snags for future roost*
28 *sites, and improving foraging habitat through creating openings in otherwise dense forest stands. In addition to*
29 *influences of aircraft noise and presence, condors are influenced by human activities that involve approaching,*
30 *feeding, or harassing. These actions would have localized short-term minor adverse impacts mostly limited to the*
31 *Developed Zone.*

32
33 *Cumulative Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and*
34 *summarized for Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and*
35 *Tables 67 and 69 (Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred*
36 *Alternative) is detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year*
37 *and Ten-Year Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for*
38 *the EIS; however, since noise from ground-based sources affects less than 10% of the park, mostly Developed*
39 *Zone areas (2% of the park), this is taken into account in interpreting Developed Zone Cumulative Impact*
40 *results, and in interpreting localized Location Point results near unpaved roads, the Colorado River, and mining*
41 *activity areas north of the park.*

42
43 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
44 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
45 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*
46 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
47 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
48 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
49 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
50 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
51 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
52 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

53
54 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
55 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*

1 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
 2 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*
 3

4 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 5 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 6 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 7 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 8 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 9 *Cumulative Impacts discussion in the Conclusions section below.*

10 **Conclusion** *Modified NPS Preferred Alternative* **Special Status Species**
 11 **California Condor**

12 Overall, the *Modified* NPS Preferred Alternative would result in beneficial change in impacts compared with
 13 Alternative A due to reduced area exposed to high Average Sound Level for long periods of the day. Habitat in
 14 condor use areas would be improved with fewer disturbances from aircraft operations.

15 In East End, the area with greatest potential for impacts on condors, Ten-Year Forecast Peak Season, low noise areas
 16 would increase with **41%** of condor use areas with air-tour aircraft Percent Time Audible 10% or less of the day
 17 (compared to 14% in Alternative A), and **53%** of condor use areas with air-tour Average Sound Level of 15 dBA or
 18 less (compared to 8% in Alternative A). Condor use areas with frequent aircraft noise disturbances would be greatly
 19 reduced with **43%** of areas with air-tours audible greater than 25% of the day (compared to 78% in Alternative A).
 20 These would represent major beneficial changes in impacts compared to Alternative A.
 21

22 *Conclusion Marble Canyon* *Modified NPS Preferred Alternative* *Special Status Species*
 23 *California Condor*

24 **Closure of Marble Canyon routes in the Modified** NPS Preferred Alternative would *have* negligible adverse
 25 impacts with *minor to moderate* beneficial change in impacts to condors compared to Alternative A.
 26

27 *Conclusion East End* *Modified NPS Preferred Alternative* *Special Status Species*
 28 *California Condor*

29 East End there would generally be beneficial change in impacts to condors Ten-Year Forecast due to *seasonal*
 30 **closure of** Zuni Point Corridor and long-loop routes, and conversion to quiet-technology aircraft.
 31

32 Base Year Peak Season impacts to condors beneath and adjacent to Dragon Corridor routes and along North Rim
 33 would be *long* term *minor* to major adverse with short-term minor beneficial change in impacts compared to
 34 Alternative A. Ten-Year Forecast Peak Season, with conversion to quiet-technology aircraft, there would be *long-*
 35 term minor to major beneficial change in impacts compared to Alternative A. Base Year Off-Peak Season, Dragon
 36 Corridor would *receive minor to major* adverse impacts with short-term moderate to major beneficial change in
 37 impacts compared to Alternative A. Ten-Year Forecast Off-Peak Season there would be *minor* to major adverse
 38 **impacts with long- and short-term minor** to major beneficial change in impacts compared to Alternative A.
 39

40 Zuni Point Corridor Base Year Peak Season when short-loop tour routes *and long-loop routes* would be active there
 41 would be moderate to major adverse impact with *negligible* beneficial change in impacts compared to Alternative A.
 42 Ten-Year Forecast Off-Peak Seasons impacts would **greatly reduce due to the seasonal closure of Zuni Point**
 43 **Corridor and Long-Loop**, with *negligible* adverse *with long-term and short-term moderate to* major beneficial
 44 change in impacts compared to Alternative A.
 45

46 Ten-Year Forecast there would generally be minor to moderate adverse impacts with short-term minor to major
 47 beneficial change in impacts compared to Alternative A at locations beneath Bright Angel Flight-free Zone near air-
 48 tour routes and along North Rim Peak and Off-Peak Seasons. In East End areas removed from air-tour routes, such
 49 as amid Bright Angel Flight-free Zone, there would be negligible adverse impacts and negligible beneficial change
 50 from Alternative A.
 51
 52
 53

1 *Conclusion Central* **Modified NPS Preferred Alternative** *Special Status Species*
 2 *California Condor*

3 In the Central area, All Scenarios, there would be negligible to minor adverse impacts with negligible change in
 4 impacts on condors compared to Alternative A.

6 *Conclusion West End* **Modified NPS Preferred Alternative** *Special Status Species*
 7 *California Condor*

8 Current data on condor presence suggests the birds do not use West End and, therefore, would not be affected by air-
 9 tours in this area. Thus, West End is not analyzed for California condor impacts.

11 **Cumulative Impacts Summary** **Modified NPS Preferred Alternative** **Special Status Species**
 12 **California Condor**

14 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 15 *the impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is,*
 16 *Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections*
 17 *(Marble Canyon, East End, Central, West End) (Marble Canyon, East End, Central, West End) of the park*
 18 *would tend to increase to major adverse Cumulative Impacts under and near air-tour routes, and minor to*
 19 *moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In comparison with the*
 20 *other Alternatives, Modified NPS Preferred Alternative ranks second behind Alternative E for the lowest overall*
 21 *Cumulative Impacts (Alternative A ranks last).*

23 **MEXICAN SPOTTED OWL** **SPECIAL STATUS SPECIES**

25 Based on Mexican spotted owl (MSO) activity surveys conducted in Grand Canyon related to air-tour operations
 26 where owls have been found using areas with elevated air-tour sound levels, these elevated sound levels would not
 27 be expected to prevent habitat occupancy or reproduction (NPS 2008d). MSO seem to prefer Grand Canyon's
 28 habitat of steep canyons below the rim. This suggests aircraft overflights would often be obscured from MSO, but
 29 high canyon walls may also amplify sound and repeat it through echoes. In Delaney et al. 1999, MSO showed an
 30 alert response when aircraft were an average 403 meters from the owls, and no response at Distances greater than
 31 660 meters. In areas along South and North Rims, Distance of air-tours from the ground would be less than 500
 32 meters. When owls are using upper reaches of presently occupied side canyons or are above the rim, there could be
 33 potential for disturbance from air-tour aircraft. Given the majority of air-tour-route operations occur during MSO
 34 breeding period (March 15 through August 30), and that helicopters are required to pass over the rims 300 feet
 35 above ground level, potential for eliciting flushing responses and increased metabolic costs exists (NPS 1999).
 36 Although noise metrics may be high in locations under air-tour routes, MSO surveys indicate air-tour noise is not
 37 likely affecting habitat occupancy or owl reproduction.

39 In addition to data presented in tables in this section, please also see Appendix F Tables 1 to 8 for a summary of
 40 MSO habitat exposed to various sound levels.

42 **ALTERNATIVE A** **NO ACTION** **SPECIAL STATUS SPECIES**
 43 **MEXICAN SPOTTED OWL**

45 Under Alternative A, a range of aircraft noise intensities would affect MSO in Marble Canyon, East End, and the
 46 Central area. MSO critical habitat and most Protected Activity Centers (PAC) occur in these areas, Kaibab National
 47 Forest, and Vermilion Cliffs National Monument.

49 Under Alternative A, as shown in Appendix D, MSO would experience greatest exposure to air-tour noise under and
 50 near East End heavily-used air-tour routes where aircraft Average Sound Level would generally be 40 to 50 dBA,
 51 and Percent Time Audible greater than 75%. In Marble Canyon and the Central area there would be little effect on
 52 MSO as Average Sound Level would generally be less than 15 dBA with aircraft Percent Time Audible less than 5%
 53 of the day. As a result, the MSO population would likely remain stable although their East End distribution and
 54 densities may be suppressed due to high air-tour Percent Time Audible at moderately high Average Sound Level.

56 Under Alternative A, aircraft noise effects would not be appreciably different Base Year and Ten-Year Forecast.

Marble Canyon **Alternative A** **Special Status Species**

Mexican Spotted Owl

Base Year and Ten-Year Forecast

There are no PAC in Marble Canyon. In Alternative A, fixed-wing air-tour routes occur on both sides of Marble Canyon. Based on contour data (Appendix F Tables 1 and 2), Marble Canyon would be quiet with air-tour aircraft audible in 68% of MSO habitat zero to 5% of the day. In 4% of the area, directly under air-tour routes, air-tour aircraft Percent Time Audible would be greater than 25% of the day. The majority of Marble Canyon MSO habitat (96%) would have air-tour Average Sound Level of 15 dBA or less. In Location Point data shown in Table 4.202 and 4.203, (**Cliff Dwellers Lodge, Grid Location Points 4 and 5, and Marble Canyon Dam Site**), aircraft would generally be more than 2,000 meters away from points on the ground with Percent Time Audible less than 3% of the day and Average Sound Level less than 25 dBA. At **Grid Location Point 2**, aircraft would be about 850 meters from points on the ground. In some areas directly beneath routes, Average Sound Level would be higher (**North and South Canyon** Location Points). Where air-tour routes would be close to the canyon rim there could be increased potential for MSO behavior disturbance. Short-term impacts to owls would be negligible to minor adverse in the majority of the Marble Canyon area. Under Alternative A, aircraft noise effects would not be appreciably different Base Year and Ten-Year Forecast.

Table 4.202 Alternative A Average Sound Level Marble Canyon

Location Point Name	Alternative A			
	Percent Time Audible(%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Cliff Dwellers Lodge	1	1	6	10
Grid Location Point 1	0	0	15	17
Grid Location Point 2	2	3	16	19
Grid Location Point 3	3	3	14	16
Grid Location Point 4	0	0	0	2
Grid Location Point 5	2	2	8	12
Marble Canyon Dam Site	0	0	3	4
North Canyon	3	3	24	25
South Canyon	2	3	21	23

Table 4.203 Alternative A Slant Distances Marble Canyon

Location Point Name	Slant Distance (m)
Cliff Dwellers Lodge	3,695
Grid Location Point 1	1,665
Grid Location Point 2	858
Grid Location Point 3	2,958
Grid Location Point 4	4,585
Grid Location Point 5	2,335
Marble Canyon Dam Site	3,845
North Canyon	999
South Canyon	816

East End **Alternative A** **Special Status Species**

Mexican Spotted Owl

The majority of East End critical habitat and 12 PACS would experience high Average Sound Level from air-tour aircraft for extended periods of the day. As shown in Appendix F, in 76% of East End critical habitat, air-tour aircraft Percent Time Audible would be more than 25% of the day. In 15% of East End, air-tour Average Sound Level would be above 35 dBA. Aircraft noise beneath air-tour routes and in adjacent areas would be nearly continuous at 62 to 100% of the day as shown in Tables 4.204 and 4.205.

Base Year and Ten-Year Forecast

East End areas removed from routes would be exposed to less air-tour aircraft noise. Areas northwest of Dragon Corridor such as Location Points **Bass Camp** and **Rainbow Plateau** and amid **Bright Angel Flight-free Zone** such as Location Points **Phantom Ranch** and **Grid Location Points 12 and 13** would have aircraft Percent Time Audible less than 3% of the day and Average Sound Levels 6 to 13 dBA. In these locations air-tour aircraft would be very distant from points on the ground (more than 7,000 meters). Impacts in these areas would be short-term negligible to minor adverse with little disturbance of MSO activities.

Critical habitat in Kaibab National Forest is not located under air-tour routes and would generally be affected only a negligible amount by air-tour aircraft use under Alternative A.

Table 4.204 Alternative A Average Sound Level East End

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Dragon Corridor				
96 Mile Camp	72	74	45	45
Tower of Ra	97	98	44	45
Eremita Mesa	100	100	49	49
Hermit Basin	99	100	42	42
North Rim				
Cape Royal	59	61	25	26
Point Imperial	66	68	38	39
Bright Angel Point	47	48	24	24
The Basin	73	75	48	48
Grid Location Point 16	80	84	33	34
Zuni Point Corridor				
Grid Location Point 14	70	74	34	34
Grid Location Point 15	65	69	28	29
Temple Butte	62	66	37	38
Lipan Point	74	77	34	35
South Rim				
Tusayan Museum	64	67	35	36
El Tovar	95	96	19	20
Zuni Alpha	43	46	46	46
Ten X Meadow	64	68	49	49
1.5 km SE of Moran Point	64	68	41	41
Bright Angel Flight Free Zone				
Cedar Ridge	81	82	19	19
Grid Location Point 11	55	56	18	18
Grid Location Point 12	1	1	13	14
Grid Location Point 13	1	1	12	13
Phantom Ranch	3	4	12	12
Toroweap /Shinumo Flight Free Zone				
Grid Location Point 10	92	92	25	25
Grid Location Point 18	60	60	16	17
Point Sublime	100	100	35	35
Bass Camp	0	0	7	7
Rainbow Plateau	0	0	6	7

13

1 **Table 4.205 Alternative A Slant Distances East End**

Location Point Name	Slant Distance (m)
Dragon Corridor	
96 Mile Camp	1,573
Tower of Ra	1,147
Eremita Mesa	1,034
Hermit Basin	1,518
North Rim	
Cape Royal	4,038
Point Imperial	2,292
Bright Angel Point	6,235
The Basin	477
Grid Location Point 16	2,589
Zuni Point Corridor	
Grid Location Point 14	687
Grid Location Point 15	1,637
Temple Butte	1,458
Lipan Point	2,890
South Rim	
Tusayan Museum	2,016
El Tovar	5,854
Zuni Alpha	573
Ten X Meadow	540
1.5 km SE of Moran Point	448
Bright Angel Flight Free Zone	
Cedar Ridge	9,827
Grid Location Point 11	8,081
Grid Location Point 12	9,014
Grid Location Point 13	7,925
Phantom Ranch	11,027
Toroweap/Shinumo Flight Free Zone	
Grid Location Point 10	2,981
Grid Location Point 18	8,449
Point Sublime	3,760
Bass Camp	13,358
Rainbow Plateau	14,878

DRAFT Not Finalized FOIA Discretionary Release

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Central Alternative A Special Status Species
 Mexican Spotted Owl
Base Year and Ten Year Forecast

In the **Central area** and north in **Kaibab National Forest**, Mexican spotted owl critical habitat and PAC would be affected by general-aviation aircraft using Fossil Canyon and Tuckup Corridors. The majority of this area is comprised of Toroweap/Shinumo Flight Free Zone’s middle and western portions. There are nine PAC in this area. As shown in Appendix F and Table 4.206, aircraft Percent Time Audible would be 5% of the day or less in 89% of Central area MSO habitat. Base Year 100%, and Ten-Year Forecast 91%, of Central area habitat would experience Average Sound Level 15 dBA or less. Aircraft would be greater than 7,000 meters from PAC. With limited Percent Time Audible of air-tour noise at very low Average Sound Level, and with air-tour aircraft Distant from locations on the ground, there would be little potential for disturbance to MSO and their critical habitat. Impacts to MSO and their critical habitat would be negligible.

1 **Table 4.206 Alternative A Noise Metrics and Slant Distances Central**

Location Point Name	Alternative A				
	Percent Time Audible (%)		Average Sound Level (dBA)		Slant Distance (m)
	Base Year	Forecast	Base Year	Forecast	
Hancock Knolls	2	2	10	10	30,162 6
1 km W of Kanab Point	2	2	9	9	18,850 7
Grid Location Point 8	3	3	10	10	13,765 8
Grid Location Point 9	1	1	5	5	11,103 9
Havasu Point	0	0	0	0	10,450 10
Kanab Point	1	1	6	7	19,021 11
Mt. Sinyala	1	1	0	0	7,272 12
Stone Creek	0	0	0	0	21,882 13
Surprise Valley	1	1	0	0	25,500 14
Upper Deer Creek	1	1	1	1	23,683 15

Forecast indicates Ten-Year Forecast

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West End Alternative A Special Status Species Mexican Spotted Owl

Base Year and Ten-Year Forecast

West End PAC would be affected by air-tour operations on Blue Direct routes. Air-tour aircraft Average Sound Level would range 17 to 28 dBA, and Percent Time Audible 14 to 49% of the day. As shown in Appendix F and Tables 4.207 and 4.208, air-tour aircraft would be greater than 2,000 meters from locations on the ground. Noise from air-tour operations may interrupt daily behavior, but it is unlikely noise would affect occupancy or reproduction in area PAC. Under Alternative A, there would be moderate adverse impacts to MSO in areas near West End Blue Direct routes. In areas away from routes, impacts would be negligible to minor adverse.

Table 4.207 Alternative A Average Sound Level West End

Location Point Name	Alternative A			
	Percent Time Audible (%)		Average Sound Level (dBA)	
	Base Year	Ten Year Forecast	Base Year	Ten Year Forecast
Grid Location Point 28	14	16	17	18
Grid Location Point 32	44	49	27	28

31 **Table 4.208 Alternative A Slant Distances West End**

Location Point Name	Slant Distance (m)
Grid Location Point 28	8,327
Grid Location Point 32	2,016

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Cumulative Impacts Alternative A Special Status Species Mexican Spotted Owl

Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of

- 1) high-altitude aircraft at or above 18,000 feet MSL, plus
- 2) aircraft below 18,000 feet MSL and outside the SFRA, plus
- 3) ground-based noise sources, plus
- 4) noise from air-tour-and-related aircraft under Alternative A

That is, Cumulative Impacts for Alternative A are the sum of 1 plus 2 plus 3 plus 4 (Alternative A).

1 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
2 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
3 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
4 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
5 *SFRA see Appendix D, Figures 91 to 94).*

6
7 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
8 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
9 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
10 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
11 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
12 *Audible capable of masking some aircraft noise.*

13
14 *Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could*
15 *create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican*
16 *spotted owl habitat that would have long-term moderate adverse impact.*

17
18 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
19 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
20 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
21 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
22 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
23 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
24 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
25 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
26 *Aircraft (1 plus 2 plus 4 Alternative A) contribute by far the most prevalent non-natural noise over most of the*
27 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
28 *Because they would be audible a very high percentage of the day, the combination of aircraft noise from all*
29 *sources would generally be the overriding cumulative noise influence on Special Status Species and habitat.*

30
31 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
32 *(Alternative A compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
33 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
34 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
35 *(Alternative A in this case).*

36
37 *Impacts of Alternative A are described in detail in previous sections, and summarized for Ten-Year Forecast in*
38 *Conclusions below. In Appendix D, Tables 43 and 45, noise produced by aircraft (1 plus 2 plus 4 Alternative A) is*
39 *detailed for Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year*
40 *Forecast. Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS;*
41 *however, since noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas*
42 *(2% of the park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in*
43 *interpreting localized Location Point results near unpaved roads, the Colorado River, and mining activity areas*
44 *north of the park.*

45
46 *Comparing noise impacts from just Alternative A by itself (Appendix D, Table 11, Ten-Year Forecast) versus All*
47 *Aircraft (4 Alternative A plus 1 plus 2) (Appendix D, Table 45, Ten-Year Forecast) gives a good indication of the*
48 *difference between Cumulative Impacts and impacts of Alternative A by itself. For the Entire Park Cumulative*
49 *Impact results (Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 92% of the park, with*
50 *Average Sound Level 25 to <35 dBA in 85% of the park, with none of the park below 25 dBA, and 24% at 35 dBA*
51 *or more. For the Entire Park results for Alternative A by itself (Ten-Year Forecast), aircraft are audible 60% or*
52 *more of the day in 27% of the park, with Average Sound Level 25 to <35 dBA in 28% of the park, with 50% of the*
53 *park below 25 dBA, and 22% at 35 dBA or more.*

54
55 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
56 *including Flight-free Zones, whereas noise from Alternative A is more concentrated under and near air-tour*

1 *routes; (b) Cumulative Impacts increase the impacts of Alternative A, and (c) reducing air-tour-and-related*
 2 *impacts under the Alternatives reduces Cumulative Impacts.*

3
 4 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 5 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 6 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 7 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 8 *described for Alternative A would generally increase by one level as shown in the Cumulative Impacts discussion*
 9 *in the Conclusions section below.*

10
 11 **Conclusion** **Alternative A** **Special Status Species**
 12 **Mexican Spotted Owl**

13
 14 In Marble Canyon and the Central area, Average Sound Level would be less than 15 dBA in 96 to 100% of MSO
 15 habitat Base Year, and 15 to 91% Ten-Year Forecast. Aircraft would be audible less than 5% of the day in 68 to
 16 89% of MSO habitat Base Year and Ten-Year Forecast. In these areas, when air-tour aircraft would be audible it
 17 would be infrequent and at low sound levels resulting in little MSO disturbance.

18
 19 Greatest exposure to noise and visual impacts would occur in East End (76% of MSO habitat with Percent Time
 20 Audible greater than 25% of the day) and portions of West End (most Location Point near air-tour routes would
 21 experience aircraft Percent Time Audible greater than 40% of the day). In these areas, MSO populations and
 22 behaviors could sometimes be disrupted, and MSO may be displaced from suitable habitats.

23
 24 *Conclusion Marble Canyon* *Alternative A* *Special Status Species*
 25 *Mexican Spotted Owl*

26 Base Year and Ten-Year Forecast, Alternative A would result in short-term negligible to minor adverse impacts on
 27 MSO and their critical habitat in Marble Canyon. Under Alternative A, aircraft noise effects would not be
 28 appreciably different Base Year and Ten-Year Forecast.

29
 30 *Conclusion East End* *Alternative A* *Special Status Species*
 31 *Mexican Spotted Owl*

32 Base Year and Ten-Year Forecast, there would be short-term impacts to MSO and their critical habitat that would
 33 range to moderate adverse particularly in areas beneath and adjacent to air-tour routes. In areas away from air-tour
 34 routes, including beneath Bright Angel Flight-free Zone, impacts would be short term negligible to minor adverse.

35
 36 *Conclusion Central* *Alternative A* *Special Status Species*
 37 *Mexican Spotted Owl*

38 Base Year and Ten-Year Forecast with limited Percent Time Audible of air-tour noise at very low Average Sound
 39 Level, and with air-tour aircraft distant from locations on the ground, there would be little potential for disturbance
 40 to MSO and their critical habitat. Impacts to MSO and their critical habitat would be negligible.

41
 42 **Conclusion West End** **Alternative A** **Special Status Species**
 43 **Mexican Spotted Owl**

44 Base Year and Ten-Year Forecast, Alternative A would result in moderate adverse impacts to MSO and their critical
 45 habitat near Blue Direct routes. In areas away from routes, impacts would be negligible to minor adverse.

46
 47 **Cumulative Impacts Summary** **Alternative A** **Special Status Species**
 48 **Mexican Spotted Owl**

49
 50 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 51 *the impact levels for each area described above for Alternative A by one level. That is, Ten-Year Forecast impacts*
 52 *in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 53 *Central, West End) (would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 54 *and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
 55 *comparison with the other Alternatives, Alternative A ranks last in lowest overall Cumulative Impacts*
 56 *(Alternative E ranks first in lowest Cumulative Impacts).*

1 **ALTERNATIVE E** **ALTERNATING SEASONAL USE** **SPECIAL STATUS SPECIES**
 2 **MEXICAN SPOTTED OWL**

3
 4 Overall, Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area
 5 exposed to high Average Sound Level for long periods of the day. Critical habitat would be improved with fewer
 6 disturbances to Mexican spotted owls from aircraft operations.

7
 8 **Marble Canyon** **Alternative E** **Special Status Species**
 9 **Mexican Spotted Owl**

10 *All Scenarios*

11 Under Alternative E, Marble Canyon would be included in **Bright Angel Flight-free Zone**. As shown in
 12 Appendix F and Tables 4.209 and 4.210, air-tour aircraft Percent Time Audible would be less than 5% of the day
 13 in 99% of Marble Canyon MSO habitat with Average Sound Level 15 dBA or less in 100% of Marble Canyon
 14 MSO habitat, with a decrease of 3 to 25 dBA and Percent Time Audible up to 3% compared to Alternative A.
 15 There would be negligible impact to MSO with a negligible to minor long-term beneficial change in impacts
 16 compared to Alternative A.

17

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1 **Table 4.20949 Alternative E Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Alternative E															
					Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	0	-6	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-2	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-8	7	-9	1	-2	1	-2	7	-8	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	0	-8	0	-12	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-2	0	-3	0	-24	0	-25	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-2	0	-21	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4 **Table 4.210 Alternative E Slant Distances Marble Canyon**

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	50,287	46,591
Grid Location Point 1	1,665	65,834	64,169
Grid Location Point 2	858	54,066	53,208
Grid Location Point 3	2,958	44,163	41,205
Grid Location Point 4	4,585	63,986	59,401
Grid Location Point 5	2,335	43,729	41,394
Marble Canyon Dam Site	3,845	17,396	13,551
North Canyon	999	36,247	35,248
South Canyon	816	26,091	25,275

Δ indicates change in noise metric data from Alternative A

5

1 **East End** **Alternative E** **Special Status Species**
 2 **Mexican Spotted Owl**
 3

4 In the majority of East End, Mexican spotted owl habitats would see a decrease in effects from air-tour operations at
 5 some point during the year dependent on when air-tour routes would be in use near specific habitat areas.
 6

7 Base Year Peak and Off-Peak Season respectively, 60 and 65% of MSO East End habitat would experience air-tour
 8 sounds 5% of the day or less (14% under Alternative A) as shown in Appendix F. Area exposed to frequent aircraft
 9 noise would be much reduced with 29 to 21% of MSO habitat (76% under Alternative A) experiencing aircraft noise
 10 greater than 25% of the day. 82 to 86% of East End MSO habitat would have air-tour Average Sound Level 15 dBA
 11 or less (44% in Alternative A), major beneficial changes in impacts compared to Alternative A.
 12

13 Ten-Year Forecast Peak and Off-Peak Season, low-noise area would increase to 73 to 80% of MSO East End habitat
 14 Percent Time Audible 5% or less of the day, and 85 to 89% Average Sound Level less than 15 dBA, with a
 15 corresponding drop in high-noise area to 16 to 9% with aircraft Percent Time Audible greater than 25% of the day.
 16 This would represent a major beneficial change in impacts compared to Alternative A.
 17

18 *East End* *Alternative E* *Special Status Species*
 19 *Mexican Spotted Owl*
 20 *Base Year Peak Season*

21 When **Zuni Point Corridor** would be in use, MSO and 18 PAC would be exposed to high levels of air-tour
 22 noise frequently during the day. As shown in Table 4.211, air-tours Percent Time Audible would be 75 to 88% of
 23 the day at Location Points represented by **Grid Location Point 14, Lipan Point, Tusayan Museum, and**
 24 **Temple Butte**, an 11 to 20% increase compared to Alternative A. Average air-tour aircraft Average Sound Level
 25 would be greater than Alternative A by one to 7 dBA, and 38 to 42 dBA. As shown in Table 4.212 aircraft
 26 Distance would be similar to Alternative A, at greater than 1,000 meters from locations on the ground for most of
 27 the route, except along South Rim when aircraft are departing or approaching Grand Canyon Airport. In this
 28 area, air-tour aircraft would be approximately 950 meters from locations on the ground such as Lipan Point
 29 Location Point, and 450 meters at Tusayan Museum Location Point. Because routes would become active rather
 30 abruptly, there may be a higher level of reaction, and MSO could abandon area use which would result in
 31 localized East End population changes. As routes open in July it is unlikely to adversely affect MSO breeding or
 32 nesting. Impacts to MSO from air-tour aircraft would represent a moderate adverse impact with negligible to
 33 minor adverse change in impacts compared to Alternative A.
 34

35 *East End* *Alternative E* *Special Status Species*
 36 *Mexican Spotted Owl*
 37 *Ten-Year Forecast Peak Season*

38 Air-tour aircraft Percent Time Audible would decline at **Zuni Point Corridor** Location Points due to quiet-
 39 technology aircraft conversion to 50 to 66% of the day, a decrease of 8 to 18% from Alternative A. Aircraft
 40 Average Sound Level would range 35 to 40 dBA similar to Alternative A. Aircraft Distance would be the same
 41 Base Year. Given decrease in aircraft Percent Time Audible, there may be less of a MSO reaction to routes
 42 becoming active. Although moderate adverse impacts would occur under and near Zuni Point Corridor air-tour
 43 routes, there would be short-term minor beneficial change in impacts compared to Alternative A. Although there
 44 would be higher reduction in Percent Time Audible Ten-Year Forecast due to quiet-technology conversion,
 45 individuals may be displaced due to routes becoming active abruptly, which would reduce benefit level due to
 46 decline in aircraft Percent Time Audible.
 47

48 *East End* *Alternative E* *Special Status Species*
 49 *Mexican Spotted Owl*
 50 *Base Year and Ten-Year Forecast Off-Peak Season*

51 Routes in and near **Zuni Point Corridor** would be inactive and air-tour aircraft Percent Time Audible would be
 52 12% of the day or less, a 62 to 73% decrease from Alternative A. Average Sound Level would be 2 to 7 dBA, a
 53 27 to 33 dBA reduction. Visual aircraft impacts would be negligible for this period. MSO would experience quiet
 54 conditions with little disturbance from air-tour aircraft. As MSO nest March and April during this Off-Peak
 55 Season, there may be an increase in breeding, nesting, and rearing success. Negligible to minor adverse impacts

1 would occur under and near Zuni Point Corridor air-tour routes Off-Peak Season with short-term moderate to
2 major beneficial change in impacts compared to Alternative A.

3
4 Off-Peak Season when Dragon Corridor air-tour routes would be active, areas in **Bright Angel Flight-free Zone**
5 close to air-tour routes represented by **Grid Location Point 11** would experience aircraft noise 16 to 23% of the
6 day, a 32 to 41% decrease from Alternative A at 11 to 12 dBA, a 6 to 7 dBA decline due to the higher altitudes
7 air-tour aircraft would be required to fly. Although air-tour noise would still be present, reduction in Average
8 Sound Level compared to Alternative A would result in improved conditions to forage, breed, and nest. This
9 would represent short-term minor to moderate adverse impacts with minor to moderate beneficial change in
10 impacts compared to Alternative A due to reduction in Percent Time Audible. The middle of Bright Angel
11 Flight-free Zone would remain quiet, as represented by **Grid Location Points 12 and 13**, with negligible
12 impacts and negligible change in impacts from Alternative A.

13
14 *East End* *Alternative E* *Special Status Species*
15 *Mexican Spotted Owl*
16 *Base Year and Ten-Year Forecast Peak Season*

17 When **Dragon Corridor** routes would not be in use, aircraft Percent Time Audible would be one to 16% of the
18 day, a decrease of 71 to 97% compared to Alternative A at **Hermit Basin, Tower of Ra, and 96 Mile Camp**
19 Location Points. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from
20 Alternative A. As routes would be inactive at this time, aircraft would be further away from locations on the
21 ground than in Alternative A. Due to substantial reduction in time and level of audible aircraft noise and reduced
22 visual impact, MSO and four PACs would experience near natural conditions with limited disruption resulting
23 from air-tour operations. Negligible to minor adverse impacts would occur, a short-term moderate to major
24 beneficial change from Alternative A.

25
26 In **Bright Angel Flight-free Zone**, where there are ten PAC, there would be a decline in air-tour noise when
27 Zuni Point Corridor is in use. Air-tour aircraft Percent Time Audible would decline from 55% in Alternative A to
28 6 to 8% under Alternative E, a decrease of 49% at **Grid Location Point 11**. Average Sound Level would be 9
29 dBA, a 9 dBA decrease. This would expand East End area where MSO could forage, breed, and nest with few
30 disruptions in daily activities. Negligible impacts would occur with short-term moderate beneficial change in
31 impacts in Bright Angel Flight-free Zone in areas away from active air-tour routes due to high reduction in air-
32 tour aircraft Percent Time Audible. The middle of Bright Angel Flight-free Zone would remain quiet, as
33 represented by **Grid Location Points 12 and 13**, with negligible impacts and negligible change in impacts from
34 Alternative A.

35
36 *East End* *Alternative E* *Special Status Species*
37 *Mexican Spotted Owl*
38 *Base Year Off-Peak Season*

39 When **Dragon Corridor** would be in use, air-tour aircraft Percent Time Audible under and adjacent to routes
40 would be 26 to 71% of the day, a decrease of 28 to 46% from Alternative A. Aircraft Average Sound Level
41 would be less than Alternative A, 23 to 46 dBA, a decrease of up to 19 dBA at **Hermit Basin, Tower of Ra, and**
42 **96 Mile Camp** Location Points. Air-tour aircraft would be more Distant from locations on the ground than in
43 Alternative A. Although Percent Time Audible and Average Sound Level decline, MSO would likely be
44 disturbed by air-tour sounds long periods of the day. As MSO nest March and April, there may be a decline in
45 nesting and fledgling success in this area. Although moderate to major adverse impacts on MSO would continue,
46 representing a short-term minor to moderate beneficial change in impacts compared to Alternative A, level of
47 benefit would be reduced due to potential for disruption during critical breeding periods.

48
49 *East End* *Alternative E* *Special Status Species*
50 *Mexican Spotted Owl*
51 *Ten-Year Forecast Off-Peak Season*

52 There would be reduction in Percent Time Audible and Average Sound Level due to conversion to quiet-
53 technology aircraft. Percent Time Audible in areas near and under **Dragon Corridor** Location Points would be
54 17 to 49%, a decline of 49 to 67% from Alternative A. Aircraft Average Sound Level would range 18 to 44 dBA,
55 a one to 24 dBA decrease. Although air-tour noise would still be present, reduction in Average Sound Level
56 compared to Alternative A would result in less disruption of daily activities and may increase potential for

1 breeding and nesting success compared to Base Year. These improvements would be substantial in areas where
2 Percent Time Audible is greatly reduced such as near **96 Mile Camp** Location Point along the river. Although
3 moderate adverse impacts would occur, this would be a short-term moderate to major beneficial change in
4 impacts from Alternative A.
5
6

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1 **Table 4.211 Alternative E Average Sound Level East End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Little Colorado River/Nankoweap Area																				
Nankoweap River	7	8	34	35	0	-7	0	-8	12	-23	12	-23	0	-7	0	-8	11	-23	12	-23
Nankoweap Mesa	87	90	43	43	78	-9	45	-45	23	-20	19	-24	1	-86	2	-88	14	-29	15	-28
Dragon Corridor																				
96 Mile Camp	72	74	45	45	0	-71	0	-74	8	-37	8	-37	26	-46	17	-57	37	-7	34	-11
Tower of Ra	97	98	44	45	1	-96	1	-97	8	-36	8	-37	61	-36	49	-49	46	2	44	-1
Eremita Mesa	100	100	49	49	67	-33	49	-50	21	-29	22	-28	93	-7	78	-21	41	-9	38	-12
Hermit Basin	99	100	42	42	13	-87	16	-83	10	-32	10	-32	5	-28	32	-67	23	-19	18	-24
North Rim																				
Cape Royal	59	61	25	26	77	18	25	-36	26	1	20	-6	1	-57	1	-60	11	-15	11	-15
Point Imperial	66	68	38	39	31	-34	1	-67	11	-28	8	-3	1	-65	1	-67	6	-32	6	-32
Bright Angel Point	47	48	24	24	5	-42	1	-47	13	-11	1	-13	1	-46	1	-47	11	-13	11	-13
The Basin	73	75	48	48	1	-72	1	-74	5	-42	5	-43	14	-59	1	-74	7	-41	6	-42
Grid Location Point 16	80	84	33	34	17	-63	23	-61	12	-21	13	-21	17	-63	27	-57	12	-21	13	-21
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	81	11	66	-8	39	-1	35	1	1	-69	1	-73	7	-27	7	-27
Grid Location Point 15	65	69	28	29	34	-31	11	-38	18	-16	16	-13	1	-64	1	-68	14	-15	14	-14
Temple Butte	62	66	37	38	75	12	57	-10	38	1	35	-2	1	-62	1	-66	6	-32	6	-32
Lipan Point	74	77	34	35	88	14	62	-16	40	5	36	1	8	-66	12	-65	7	-27	5	-30
South Rim																				
Tusayan Museum	64	67	35	36	84	20	50	-18	42	7	40	4	0	-63	0	-67	3	-33	2	-33
El Tovar	95	96	19	20	8	-88	9	-86	7	-12	8	-12	34	-61	11	-85	11	-8	10	-10
Zuni Alpha	43	46	46	46	63	20	38	-8	52	6	50	4	0	-43	0	-46	2	-43	3	-43
Ten X Meadow	64	68	49	49	76	12	64	-15	48	-1	46	-4	21	-44	15	-54	18	-31	20	-30
1.5 km SE of Moran Point	64	68	41	41	81	18	61	-7	53	12	51	10	4	-60	6	-62	5	-36	4	-37
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	46	11	4	-78	14	-5	11	-8	25	-55	4	-78	12	-7	11	-8
Grid Location Point 11	55	56	18	18	6	-49	8	-49	9	-9	9	-9	23	-32	16	-41	12	-6	11	-7
Grid Location Point 12	1	1	13	14	1	0	1	0	12	-1	12	-2	1	0	1	0	11	-2	12	-2
Grid Location Point 13	1	1	12	13	1	0	1	0	10	-2	9	-4	1	0	1	0	8	-4	8	-5
Phantom Ranch	3	4	12	12	1	-2	1	-3	7	-5	6	-6	1	-2	1	-3	7	-5	6	-6
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	0	-92	0	-92	9	-16	10	-15	44	-48	0	-92	19	-6	14	-11
Grid Location Point 18	60	60	16	17	1	-59	1	-60	6	-10	6	-10	34	-26	5	-55	11	-5	9	-7
Point Sublime	100	100	35	35	46	-54	29	-71	16	-20	17	-18	89	-11	63	-37	29	-6	25	-11
Bass Camp	0	0	7	7	0	0	0	0	0	-7	1	-7	0	0	0	0	3	-4	1	-6
Rainbow Plateau	0	0	6	7	0	0	0	0	2	-4	3	-4	0	0	0	0	3	-3	4	-3

1 **Table 4.212 Alternative E Slant Distances East End**

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)	Slant Distance (m)		
		Base Year	Δ	
Little Colorado River/Nankoweap Area				
Nankoweap River	1,449	9,063	7,615	
Nankoweap Mesa	973	6,114	5,140	
Dragon Corridor				
96 Mile Camp	1,573	1,724	151	
Tower of Ra	1,147	511	-637	
Eremita Mesa	1,034	756	-277	
Hermit Basin	1,518	3,605	2,088	
North Rim				
Cape Royal	4,038	6,132	2,094	
Point Imperial	2,292	13,405	11,113	
Bright Angel Point	6,235	9,522	3,287	
The Basin	477	3,923	3,446	
Grid Location Point 16	2,589	12,983	10,394	
Zuni Point Corridor				
Grid Location Point 14	687	1,591	904	
Grid Location Point 15	1,637	5,133	3,496	
Temple Butte	1,458	1,038	-420	
Lipan Point	2,890	955	-1,935	
South Rim				
Tusayan Museum	2,016	450	-1,566	
El Tovar	5,854	9,426	3,572	
Zuni Alpha	778	307	-267	
Ten X Meadow	540	389	-151	
1.5 km SE of Moran Point	448	251	-198	
Bright Angel Flight Free Zone				
Cedar Ridge	9,827	12,925	3,098	
Grid Location Point 11	8,081	6,862	-1,219	
Grid Location Point 12	9,014	11,236	2,222	
Grid Location Point 13	7,925	9,042	1,117	
Phantom Ranch	11,027	9,999	-1,028	
Toroweap /Shinumo Flight Free Zone				
Grid Location Point 10	2,931	2,931	0	
Grid Location Point 18	8,449	6,672	-1,777	
Point Sublime	3,760	3,760	0	
Bass Camp	13,358	13,358	0	
Rainbow Plateau	14,878	14,878	0	

Δ indicates change in noise metric data from Alternative A

2
3
4
5
6

Central Mexican Spotted Owl All Scenarios

Alternative E

Special Status Species

7 13 Mexican spotted owl PAC and critical habitat throughout most of the Central area would be little affected by
8 aircraft noise. Base Year Peak Season, there would be little difference in sound metrics compared to Alternative
9 A. Based on contour data as shown in Appendix F and Tables 4.213 and 4.214, in approximately 99% of MSO
10 critical habitat Percent Time Audible would be 5% or less of the day (compared to 89% in Alternative A), with

1 aircraft Average Sound Level less than 15 dBA in 100% of MSO habitat (same as Alternative A). Air-tour
2 aircraft would be greater than 7,000 meters from locations on the ground. MSO behaviors and activities such as
3 foraging, roosting, nesting, and breeding would be little affected by air-tour aircraft. Negligible impacts would
4 occur with negligible change in impacts from Alternative A.
5

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1 **Table 4.21350 Alternative E Average Sound Level Central**

Location Point Name	Alternative E																			
	Alternative A				Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Hancock Knolls	2	2	10	10	2	0	2	0	9	-1	9	-1	2	0	2	0	9	0	10	0
1 km W of Kanab Point	2	2	9	9	2	0	2	0	6	-2	7	-2	2	0	2	0	7	-2	7	-2
Grid Location Point 8	3	3	10	10	1	-2	1	-2	9	-1	10	0	2	-1	1	-2	10	1	11	1
Grid Location Point 9	1	1	5	5	1	0	1	0	3	-2	3	-2	1	0	1	0	4	-1	3	-2
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	7	1	8	1	0	1	0	7	1	8	2	
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	2	1	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	1	1	1	1	0	1	0	0	-1	0	-1	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4

Table 4.214 Alternative E Slant Distances Central

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
1 km W of Kanab Point	18,850	18,850	0
Grid Location Point 8	13,765	14,603	838
Grid Location Point 9	11,103	19,384	8,281
Havasu Point	10,450	10,450	0
Kanab Point	19,021	19,021	0
Mt. Sinyala	7,272	7,272	0
Stone Creek	21,882	24,475	2,593
Surprise Valley	25,500	26,216	716
Upper Deer Creek	23,683	24,049	366

Δ indicates change in noise metric data from Alternative A

1	West End	Alternative E	Special Status Species
2	Mexican Spotted Owl		
3	<i>All Scenarios</i>		
4	MSO PAC would experience a decrease in air-tour aircraft effects due to Blue Direct North realignment and Blue Direct South elimination. In West End PAC locations, air-tour aircraft Average Sound Level would be 16 to 22 dBA which is only slightly less than Alternative A. However, air-tour Percent Time Audible would be less than 4 to 5% of the day, a 9 to 40% decrease compared to Alternative A. Aircraft would not be within 15,000 meters of a PAC. Although minor adverse impacts would generally occur there would be short-term minor to moderate beneficial change in impacts compared to Alternative A.		
10			

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1 **Table 4.215 Alternative E Average Sound Level West End**

Location Point Name	Alternative A				Alternative E															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Grid Location Point 28	14	16	17	18	5	-9	3	-13	16	-1	17	-1	5	-9	3	-13	16	-1	17	-1
Grid Location Point 32	44	49	27	28	4	-40	5	-43	21	-6	22	-6	4	-40	5	-43	21	-6	22	-6

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4

Table 4.216 Alternative E Slant Distances West End

Location Point Name	Alternative A		Alternative E	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Grid Location Point 28	8,327		21,438	13,111
Grid Location Point 32	2,016		18,618	16,602

Δ indicates change in noise metric data from Alternative A

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1 **Cumulative Impacts** **Alternative E** **Special Status Species**
 2 **Mexican Spotted Owl**
 3

4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 5 *actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Alternative E*

10
 11 *That is, Cumulative Impacts for Alternative E are the sum of 1 plus 2 plus 3 plus 4 (Alternative E).*
 12

13 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 14 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 15 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 16 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 17 *SFRA see Appendix D, Figures 91 to 94).*
 18

19 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 20 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 21 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 22 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 23 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 24 *Audible capable of masking some aircraft noise.*
 25

26 *Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could*
 27 *create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican*
 28 *spotted owl habitat that would have long-term moderate adverse impact.*
 29

30 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 31 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 32 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 33 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 34 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 35 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 36 *and/or contrails), high altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 37 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 38 *Aircraft (1 plus 2 plus 4 Alternative E) contribute by far the most prevalent non-natural noise over most of the*
 39 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
 40 *Because they would be audible a very high percentage of the day, the combination of aircraft noise from all*
 41 *sources would generally be the overriding cumulative noise influence on Special Status Species and habitat.*
 42

43 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 44 *(Alternative E compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 45 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 46 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 47 *(Alternative E in this case).*
 48

49 *Impacts of Alternative E are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 50 *Conclusions below. In Appendix D, Tables 47 and 49 (Peak Season) and Tables 51 and 53 (Off-Peak Season),*
 51 *noise produced by aircraft (1 plus 2 plus 4 Alternative E) is detailed for Developed Zone, Non-Wilderness Zone,*
 52 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 53 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 54 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 55 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 56 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

1 *Comparing noise impacts from just Alternative E by itself (Appendix D Tables 16 (Peak Season) and 21 (Off-*
 2 *Peak Season) Ten-Year Forecast) versus All Aircraft (4 Alternative E plus 1 plus 2) (Appendix D Tables 49 (Peak*
 3 *Season) and 53 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the difference between*
 4 *Cumulative Impacts and the impacts of Alternative E by itself. For the Entire Park Cumulative Impact results*
 5 *(Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more of the day in 83% of the*
 6 *park, with Average Sound Level 25 to <35 dBA in 92 to 93% of the park, with 1% of the park below 25 dBA and 6*
 7 *to 7% at 35 dBA or more. For the Entire Park results for Alternative E by itself (Peak and Off-Peak Season Ten-*
 8 *Year Forecast), aircraft are audible 60% or more of the day in 3% of the park, with Average Sound Level 25 to*
 9 *<35 dBA in 6 to 9% of the park, with 74 to 81% of the park below 25 dBA and 5% at 35 dBA or more.*

10
 11 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 12 *including Flight-free Zones, whereas noise from Alternative E is more concentrated under and near air-tour*
 13 *routes; (b) Cumulative Impacts increase the impacts of Alternative E, and (c) reducing air-tour-and-related*
 14 *impacts under the Alternatives reduces Cumulative Impacts.*

15
 16 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 17 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 18 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 19 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 20 *described for Alternative E would generally increase by one level as shown in the Cumulative Impacts discussion*
 21 *in the Conclusions section below.*

22
 23 **Conclusion** **Alternative E** **Special Status Species**
 24 **Mexican Spotted Owl**

25
 26 Overall Alternative E would result in beneficial change in impacts compared with Alternative A on MSO and their
 27 habitat due to reduced area exposed to high Average Sound Level for long periods of the day. Ten-Year Forecast the
 28 majority of MSO habitat would experience a large reduction in aircraft Percent Time Audible and in Average Sound
 29 Level. This would result in greatly reduced impacts on MSO and their habitat with greater areas with fewer
 30 disturbances compared to Alternative A.

31
 32 East End (the area with greatest potential for impacts on MSO) Ten-Year Forecast Peak Season, areas of low noise
 33 would increase, with 73% of MSO habitat areas with air-tour aircraft Percent Time Audible 5% or less of the day
 34 (compared to 14% in Alternative A), and 85% of MSO habitat areas with air-tour Average Sound Level of 15 dBA
 35 or less (compared to 3% in Alternative A). MSO habitat areas with frequent aircraft noise disturbances would be
 36 greatly reduced with only 16% of areas with air-tours Percent Time Audible greater than 25% of the day (compared
 37 to 76% in Alternative A). These would represent major beneficial changes in impacts compared to Alternative A
 38 Ten-Year Forecast Peak Season.

39
 40 *Conclusion Marble Canyon* *Alternative E* *Special Status Species*
 41 *Mexican Spotted Owl*

42 Base Year Peak Season, Alternative E would result in negligible impacts with long-term negligible to minor
 43 beneficial changes in impacts compared to Alternative A because Marble Canyon would be included in Bright
 44 Angel Flight-free Zone. Impacts would be essentially the same All Scenarios.

45
 46 *Conclusion East End* *Alternative E* *Special Status Species*
 47 *Mexican Spotted Owl*

48 There would be beneficial change in impacts on MSO from Alternative E due to seasonal rotational use of air-tour
 49 routes. When air-tour routes are active, there would be negligible to moderate adverse impacts to MSO beneath and
 50 adjacent to routes with negligible to major beneficial changes in impacts from Alternative A Base Year Peak
 51 Season. Ten-Year Forecast, with conversion to quiet-aircraft technology, there would be less air-tour noise resulting
 52 in moderate adverse impacts with up to major beneficial changes in impacts compared to Alternative A. Ten Year
 53 Forecast Off-Peak Season when Dragon Corridor is in use, there would be moderate adverse impacts with moderate
 54 to major beneficial change in impacts compared to Alternative A. Base Year and Ten-Year Forecast Peak Season
 55 when routes are inactive, there would be negligible to minor adverse impacts with moderate to major beneficial
 56 change in impacts in areas near and under routes compared to Alternative A. In areas away from air-tour routes

1 including beneath Bright Angel Flight-free Zone there would be negligible to moderate adverse impacts with
 2 negligible to moderate beneficial change in impacts compared to Alternative A. The middle of Bright Angel Flight-
 3 free Zone would remain quiet with negligible impacts and negligible change in impacts from Alternative A. These
 4 effects would occur Base Year and Ten-Year Forecast.

5
 6 *Conclusion Central* *Alternative E* *Special Status Species*
 7 *Mexican Spotted Owl*

8 MSO behaviors and activities such as foraging, roosting, nesting, and breeding would be little affected by air-tour
 9 aircraft. Alternative E would result in negligible impacts with negligible change in impacts on MSO Base Year and
 10 Ten-Year Forecast Peak and Off-Peak Season.

11
 12 *Conclusion West End* *Alternative E* *Special Status Species*
 13 *Mexican Spotted Owl*

14 There would be minor adverse impacts with minor to moderate beneficial change in impacts resulting from
 15 decreased audibility due to repositioning Blue Direct North and eliminating Blue Direct South route.

16
 17 *Cumulative Impacts Summary* *Alternative E* *Special Status Species*
 18 *Mexican Spotted Owl*

19
 20 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 21 *the impact levels for each area described above for Alternative E by one level. That is, Ten-Year Forecast impacts*
 22 *in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
 23 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
 24 *and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
 25 *comparison with the other Alternatives, Alternative E ranks first in lowest overall Cumulative Impacts followed*
 26 *by Modified NPS Preferred Alternative and Alternative F (Alternative A ranks last).*

27
 28 **ALTERNATIVE F** **MODIFIED CURRENT CONDITIONS** **SPECIAL STATUS SPECIES**
 29 **MEXICAN SPOTTED OWL**

30
 31 Overall in MSO critical habitat, Alternative F Base Year would generally result in negligible changes in impacts
 32 compared with Alternative A. Greatest exposure to noise and visual impacts would occur East End where aircraft
 33 Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75% of the time. In
 34 Marble Canyon and the Central area, MSO would be little impacted by air-tour operations as aircraft Average Sound
 35 Level would generally be less than 15 dBA with Percent Time Audible less than 5% of the time. Because
 36 Alternative F includes quiet-technology incentives and conversion requirements, noise impacts would decrease from
 37 Base Year to Ten-Year Forecast in all MSO critical habitat.

38
 39 **Marble Canyon** **Alternative F** **Special Status Species**
 40 **Mexican Spotted Owl**
 41 *Base Year Peak Season*

42 Air-tour aircraft noise impacts would be similar to Alternative A. Based on Appendix F contour data, Marble
 43 Canyon would be quiet in 67% of MSO habitat with Percent Time Audible 5% or less of the day (compared to
 44 68% in Alternative A). In 4% of Marble Canyon MSO habitat, directly under air-tour routes, air-tour aircraft
 45 Percent Time Audible would be 25% of the day or greater (same as Alternative A). 96% of MSO critical habitat
 46 in Marble Canyon would have air-tour Average Sound Level of 15 dBA or less. As shown in Tables 4.217 and
 47 4.218, at Location Points **Cliff Dwellers Lodge, Grid Location Points 4 and 5, and Marble Canyon Dam Site,**
 48 aircraft would generally be more than 2,000 meters away from points on the ground. At **Grid Location Point**
 49 **Location 2** aircraft would be about 800 meters from points on the ground. There would be little potential to
 50 disturb or displace MSO. In some areas directly beneath routes, Average Sound Level would be higher at **North**
 51 **and South Canyon** Location Points, and air-tour routes would be close to the canyon rim which could increase
 52 potential for MSO behavior disturbance. Negligible to minor adverse impacts would occur with negligible
 53 change in impacts from Alternative A.

1 *Marble Canyon* *Alternative F* *Special Status Species*
 2 *Mexican Spotted Owl*
 3 *Ten-Year Forecast Peak Season*

4 Impacts and level of change would be similar to Base Year Peak Season as shown in Appendix F, except much
 5 more MSO habitat would be in the low audibility category, 85% at 5% or less Percent Time Audible compared to
 6 67% Base Year.

7
 8 *Marble Canyon* *Alternative F* *Special Status Species*
 9 *Mexican Spotted Owl*
 10 *Base Year Ten-Year Forecast Off-Peak Season*

11 Conditions would be similar to Peak Season, except Marble Canyon's southern part. As represented by **North**
 12 **and South Canyon** Locations Points, with reduced Off-Peak Season operations, aircraft Percent Time Audible
 13 would rarely be audible, less than one percent of the day, and Average Sound Level would be reduced to zero, a
 14 decrease of 21 to 25 dBA compared to Alternative A. Marble Canyon MSO critical habitat would be improved to
 15 a small degree with a further increase in area with aircraft Percent Time Audible at 5% or less of the day to 99 to
 16 100%. Negligible impacts would occur with long-term minor to moderate beneficial change in impacts compared
 17 to Alternative A.

18

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1 **TABLE 4.217 Alternative F Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Cliff Dwellers Lodge	1	1	6	10	1	0	1	0	6	0	6	-3	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	15	0	16	-1	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	2	0	2	0	16	0	17	-3	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	3	0	3	0	14	0	15	-1	1	-2	1	-2	7	-8	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	2	0	2	0	8	0	8	-4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	3	0	2	-1	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	3	0	3	0	24	0	24	0	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	2	0	2	0	21	0	21	-2	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

2
 3
 4 **Table 4.21851 Alternative F Slant Distances Marble Canyon**

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Cliff Dwellers Lodge	3,695	3,695	3,695	0
Grid Location Point 1	1,665	1,665	1,665	0
Grid Location Point 2	858	858	858	0
Grid Location Point 3	2,958	2,958	2,958	0
Grid Location Point 4	4,585	4,585	4,585	0
Grid Location Point 5	2,335	2,335	2,335	0
Marble Canyon Dam Site	3,845	3,846	3,846	1
North Canyon	999	999	999	0
South Canyon	816	822	822	7

Δ indicates change in noise metric data from Alternative A

1 East End	Alternative F	Special Status Species
2 Mexican Spotted Owl		
3 Base Year and Ten-Year Forecast Peak Season, as shown in Appendix F, approximately 76% of MSO critical		
4 habitat would have air-tour aircraft Percent Time Audible over 25% of the day, same as Alternative A. Ten-Year		
5 Forecast with quiet-technology incentives and conversion requirements, area exposed to high aircraft audibility		
6 would be reduced to 41% (a reduction of 35% from Alternative A). Area with low audibility would be the reverse,		
7 with 14% of MSO habitat Percent Time Audible at 5% or less Base Year (same as Alternative A) changing to 37%		
8 Ten-Year Forecast (an increase of 23% from Alternative A). Aircraft Average Sound Level less than 15 dBA would		
9 occur in 44% of the area Base Year similar to Alternative A. Ten-Year Forecast, 59% of MSO habitat would		
10 experience Average Sound Level 15 dBA or less, a substantial increase in area with low levels of aircraft noise		
11 compared to 3% under Alternative A.		
12		
13 Base Year and Ten-Year Forecast Off-Peak Season (December and January) effects of aircraft would be less than		
14 Peak Season and Alternative A. Ten-Year Forecast Off-Peak Season, only 13% of MSO critical habitat would		
15 experience Percent Time Audible greater than 25% of the day. Base Year nearly 55% of MSO critical habitat would		
16 be exposed to air-tour Average Sound Level less than 15 dBA, but Ten-Year Forecast area would increase to 66%		
17 compared to 3% under Alternative A. Alternative F would result in large areas of MSO critical habitat exposed to		
18 much lower air-tour aircraft noise impacts which would improve MSO ability to breed, nest, and forage.		
19		
20 <i>East End</i>	<i>Alternative F</i>	<i>Special Status Species</i>
21 <i>Mexican Spotted Owl</i>		
22 <i>Base Year Peak Season</i>		
23 There would be little difference in impacts to MSO compared to Alternative A under Zuni Point and Dragon		
24 Corridors and adjacent areas. As shown in Table 4.219, air-tour aircraft Percent Time Audible would be 62% to		
25 nearly 100% of the day in areas beneath the Corridors with Average Sound Level 28 to 45 dBA at representative		
26 Location Points. As shown in Table 4.220, Distance to locations on the ground does not differ notably from		
27 Alternative A. With close proximity of flights to the rim and persistent air-tour noise in areas under routes, there		
28 would be potential to disrupt normal behavior such as breeding, feeding, or sheltering. Moderate adverse impacts		
29 would continue with negligible change in impacts from Alternative A.		
30		
31 <i>East End</i>	<i>Alternative F</i>	<i>Special Status Species</i>
32 <i>Mexican Spotted Owl</i>		
33 <i>Ten-Year Forecast Peak Season</i>		
34 In Zuni Point and Dragon Corridors air-tour aircraft Percent Time Audible would be 41 to 90%, a decrease of		
35 8 to 28% from Alternative A. Aircraft Average Sound Level would be 24 to 41 dBA, declining 4 to 7 dBA from		
36 Alternative A. Aircraft would at Distances shown in Table 4.220. There would be improvement in conditions for		
37 MSO breeding, nesting, and foraging due to decline in aircraft Percent Time Audible. Moderate adverse impacts		
38 would continue with long-term minor to moderate beneficial change in impacts compared to Alternative A.		
39		
40 <i>East End</i>	<i>Alternative F</i>	<i>Special Status Species</i>
41 <i>Mexican Spotted Owl</i>		
42 <i>Base Year Off-Peak Season</i>		
43 Critical MSO habitat beneath Zuni Point Corridor would experience a decrease in aircraft noise effects.		
44 Aircraft Percent Time Audible would be 36 to 45% of day, a decrease of 26 to 29% from Alternative A. Average		
45 Sound Level would range 29 to 31 dBA, a 4 to 6 dBA decrease from Alternative A. Distance from areas on the		
46 ground would be as described Peak Season. Moderate adverse impacts would occur with minor to moderate		
47 beneficial change in impacts from Alternative A.		
48		
49 In areas under Dragon Corridor represented by Location Points 96 Mile Camp, Tower of Ra, and Hermit		
50 Basin , air-tour Percent Time Audible would be one to 60%, a 39 to 80% decrease from Alternative A. Aircraft		
51 Average Sound Level would also decline to 13 to 23 dBA, a 19 to 31 dBA decrease from Alternative A. Aircraft		
52 would be much further away from locations on the ground due to Dragon Corridor's seasonal shift. Critical		
53 habitat would be temporarily improved with less interruption of activities and, as improvements occur during		
54 breeding and initial nesting season, there may be improvement in breeding success. Negligible to moderate		
55 adverse impacts would continue with moderate to major beneficial change in impacts compared to Alternative A.		

1 **Dragon Corridor's** seven-mile shift under Alternative F would occur during MSO breeding and initial nesting
 2 season. At **Bass Camp** and **Rainbow Plateau** Location Point, aircraft Percent Time Audible would be 24 to 37%
 3 of the day; an increase of 24 to 36% compared to Alternative A. Aircraft Average Sound Level would increase to
 4 13 to 33 dBA, an increase of 7 to 26 dBA. Because the route shift would be abrupt, there may be a higher level
 5 of reaction which could result in decreased MSO breeding and nesting success in this localized area. Moderate
 6 adverse short-term impacts would occur with moderate adverse change in impacts compared to Alternative A at
 7 habitat areas under and near shifted Dragon Corridor.

8
 9 *East End* *Alternative F* *Special Status Species*
 10 *Mexican Spotted Owl*
 11 *Ten-Year Forecast Off-Peak Season*

12 Under **Dragon Corridor**, Percent Time Audible would decline to less than one percent at **96 Mile Camp**
 13 Location Point, and 6 to 32% at **Tower of Ra** and **Hermit Basin** Location Points respectively, a decrease of 68
 14 to 92% from Alternative A. **Point Sublime** Location Point, near air-tour routes, would have air-tour aircraft
 15 Percent Time Audible 24%, a 75% decrease from Alternative A. Aircraft Average Sound Level would decline to
 16 10 to 19 dBA, a decrease of 23 to 35 dBA from Alternative A. Aircraft would be at similar Distances as Base
 17 Year Off-Peak Season. Minor to moderate adverse impacts would continue with moderate to major beneficial
 18 change in impacts compared to Alternative A.

19
 20 In **Dragon Corridor**, route-shift impacts would be reduced somewhat by quiet-technology incentives and
 21 conversion requirements. At **Bass Camp** Location Point, aircraft Percent Time Audible would be 20% of the
 22 day, a 20% increase from Alternative A. At **Rainbow Plateau** Location Point, aircraft Percent Time Audible
 23 would be 2% of the day, a 2% increase from Alternative A. Average Sound Level would be 10 to 29 dBA, a 4 to
 24 22 dBA increase from Alternative A. MSO critical habitat and behaviors could be infrequently interrupted by air-
 25 tour aircraft. Negligible to minor adverse impacts would continue with minor to moderate adverse change in
 26 impacts compared to Alternative A.

27
 28 *East End* *Alternative F* *Special Status Species*
 29 *Mexican Spotted Owl*
 30 *All Scenarios*

31 Beneath **Bright Angel Flight-free Zone**, effects of air-tour aircraft would be similar to Alternative A. **Grid**
 32 **Location Points 12 and 13** would have air-tour aircraft Percent Time Audible one percent of the day, with
 33 Average Sound Level 8 to 13 dBA. Aircraft would be at Distances greater than 2,000 meters. Air-tour aircraft
 34 would be rarely audible at relatively low sound levels. Negligible to minor adverse impacts would occur with
 35 negligible change in impacts compared to Alternative A.
 36

1 **Table 4.219 Alternative F Average Sound Level East End**

Location Point Name	Alternative A				Alternative F															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Little Colorado River/Nankoweap Area																				
Nankoweap River	7	8	34	35	7	0	5	-4	34	0	33	-2	0	-7	0	-8	20	-14	17	-18
Nankoweap Mesa	87	90	43	43	87	0	68	-22	43	0	39	-4	53	-34	33	-57	29	-14	25	-18
Dragon Corridor																				
96 Mile Camp	72	74	45	45	72	0	47	-27	45	0	41	-4	1	-70	0	-74	13	-31	10	-35
Tower of Ra	97	98	44	45	97	0	90	-8	44	0	41	-4	17	-80	6	-92	15	-29	13	-32
Eremita Mesa	100	100	49	49	100	0	98	-2	49	0	46	-3	95	-5	83	-17	49	0	47	-2
Hermit Basin	99	100	42	42	99	0	89	-11	42	0	37	-5	6	-39	32	-68	23	-19	19	-23
North Rim																				
Cape Royal	59	61	25	26	59	0	17	-44	25	0	19	-7	31	-28	7	-54	21	-5	16	-10
Point Imperial	66	68	38	39	66	0	25	-43	38	0	37	-3	28	-38	2	-66	18	-20	14	-25
Bright Angel Point	47	48	24	24	47	0	12	-36	24	0	18	-6	2	-45	2	-47	13	-11	11	-13
The Basin	73	75	48	48	73	0	40	-35	48	0	44	-3	26	-47	16	-60	30	-18	26	-22
Grid Location Point 16	80	84	33	34	84	4	42	-42	33	0	24	-10	37	-43	21	-63	15	-18	13	-21
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	70	0	53	-21	34	0	28	-7	43	-27	27	-47	30	-4	24	-10
Grid Location Point 15	65	69	28	29	65	0	41	-28	28	0	24	-4	33	-33	17	-52	38	10	35	6
Temple Butte	62	66	37	38	62	0	45	-23	37	0	31	-7	37	-26	23	-43	31	-6	27	-11
Lipan Point	74	77	34	35	74	0	49	-28	34	0	27	-7	45	-29	22	-55	29	-5	24	-11
South Rim																				
Tusayan Museum	64	67	35	36	64	0	32	-36	35	0	28	-8	36	-28	15	-52	29	-6	24	-12
El Tovar	95	96	19	20	95	0	12	-84	19	0	13	-6	19	-76	8	-88	11	-8	8	-11
Zuni Alpha	43	46	46	46	43	0	24	-3	46	0	41	-5	22	-21	11	-35	41	-5	38	-9
Ten X Meadow	64	68	49	49	64	3	32	-36	49	0	45	-4	38	-26	18	-51	42	-7	39	-10
1.5 km SE of Moran Point	64	68	41	41	64	1	43	-25	41	0	37	-4	38	-26	22	-46	36	-5	33	-8
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	81	0	5	-78	19	0	13	-6	20	-61	5	-77	14	-5	12	-7
Grid Location Point 11	55	56	18	18	60	5	10	-47	18	0	12	-7	16	-39	7	-49	11	-7	9	-9
Grid Location Point 12	1	1	13	14	1	0	1	0	13	0	12	-2	1	0	1	0	12	-1	12	-2
Grid Location Point 13	1	1	12	13	1	0	1	0	12	0	9	-4	1	0	1	0	9	-3	8	-4
Phantom Ranch	3	4	12	12	3	0	1	-3	12	0	7	-5	1	-2	1	-3	7	-4	6	-6
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	92	0	0	-92	25	0	19	-6	66	-26	16	-77	32	7	29	4
Grid Location Point 18	60	60	16	17	60	0	14	-46	16	0	13	-4	57	-3	32	-28	39	23	35	19
Point Sublime	100	100	35	35	100	0	94	-6	35	0	30	-6	89	-10	24	-75	19	-16	17	-18
Bass Camp	0	0	7	7	0	0	0	0	7	0	2	-5	37	36	20	20	33	26	29	22
Rainbow Plateau	0	0	6	7	0	0	0	0	7	1	5	-1	24	24	2	2	13	7	10	4

1 **Table 4.22052 Alternative F Slant Distances East End**

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	1,448	0
Nankoweap Mesa	973	970	-3
Dragon Corridor			
96 Mile Camp	1,573	1,573	0
Tower of Ra	1,147	854	-293
Eremita Mesa	1,034	357	-677
Hermit Basin	1,518	1,656	139
North Rim			
Cape Royal	4,038	4,038	0
Point Imperial	2,292	2,343	50
Bright Angel Point	6,235	6,225	-10
The Basin	477	489	13
Grid Location Point 16	2,589	2,575	-14
Zuni Point Corridor			
Grid Location Point 14	687	687	0
Grid Location Point 15	1,637	1,636	-1
Temple Butte	1,458	1,458	0
Lipan Point	2,890	2,890	0
South Rim			
Tusayan Museum	2,016	2,016	0
El Tovar	5,854	5,857	3
Zuni Alpha	573	573	0
Ten X Meadow	540	540	0
1.5 km SE of Moran Point	448	448	0
Bright Angel Flight Free Zone			
Cedar Ridge	9,827	9,857	10
Grid Location Point 11	8,081	8,028	-53
Grid Location Point 12	9,014	9,014	0
Grid Location Point 13	7,925	7,925	0
Phantom Ranch	11,027	10,961	-66
Toroweap/Shimmo Flight Free Zone			
Grid Location Point 10	2,931	2,900	-31
Grid Location Point 18	8,449	1,341	-7,108
Point Sublime	3,760	3,609	-151
Bass Camp	13,358	2,667	-10,691
Rainbow Plateau	14,878	3,294	-11,585

Δ indicates change in noise metric data from Alternative A

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Central Mexican Spotted Owl
All Scenarios

Alternative F

Special Status Species

Base Year Peak Season MSO throughout most of the Central area would be little affected by air-tour and general-aviation aircraft noise. As shown in Tables 4.221 and 4.222, Percent Time Audible would range less than one to 4%, similar to Alternative A. MSO would be exposed to air-tour Average Sound Level less than one to 11 dBA similar to Alternative A. Aircraft would be greater 7,000 meters away from points on the ground. As shown in Appendix F, 86 to 97% of MSO habitat would experience aircraft Percent Time Audible 5% or less of the day. 98 to 100% of MSO habitat would experience aircraft Average Sound Level of 15 dBA or less. Given low aircraft Percent Time Audible and Average Sound Level and with air-tour aircraft distant from locations on the ground, there would be little potential to disturb MSO behaviors or activities with no expected effect on population levels or area use. MSO behaviors would be expected to return to normal ranges after air-tour activity. Negligible impacts would occur with short-term negligible to minor beneficial change in impacts compared to Alternative A.

1 **Table 4.22153 Alternative F Average Sound Level Central**

Location Point Name	Alternative A		Alternative F																	
			Peak Season								Off Peak Season									
	Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	8	-1	8	-1	2	0	2	0	7	-2	8	-1
Grid Location Point 8	3	3	10	10	4	1	1	-2	11	2	9	-1	25	23	3	0	10	0	10	0
Grid Location Point 9	1	1	5	5	1	0	1	0	5	0	3	-2	1	0	1	0	6	1	4	-2
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	2	1	1	0	8	2	7	1	3	2	3	2	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	1	1	1	1	0	1	0	1	0	1	0	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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Table 4.222 Alternative F Slant Distances Central

Location Point Name	Alternative A	Alternative F	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
1 km W of Kanab Point	18,850	18,850	0
Grid Location Point 8	13,765	13,765	0
Grid Location Point 9	11,103	11,103	0
Havasu Point	10,450	10,450	0
Kanab Point	19,021	19,021	0
Mt. Sinyala	7,272	7,272	0
Stone Creek	21,882	14,255	-7,627
Surprise Valley	25,500	19,115	-6,385
Upper Deer Creek	23,683	20,930	-2,752

Δ indicates change in noise metric data from Alternative A

5

1 **West End** **Alternative F** **Special Status Species**

2 **Mexican Spotted Owl**

3 *All Scenarios*

4 West End PAC would be affected by air-tour operations on Blue Direct routes. As shown in Table 4.223, air-tour
5 aircraft Average Sound Level over PAC would be 25 to 34 dBA, a negligible increase from Alternative A. Air-
6 tour aircraft Percent Time Audible would be 39 to 52% of the day, an up to 36% increase, increasing a small
7 additional amount Ten-Year Forecast. Off-Peak Season would generally be similar to Peak Season. Air-tour
8 aircraft would generally be greater than 2,000 meters from locations on the ground as shown in Table 4.224.
9 Noise from air-tour operations may interrupt daily behavior, but is unlikely to affect occupancy or reproduction
10 in area PAC. This would result in moderate adverse impact with negligible to moderate adverse changes in
11 impacts compared to Alternative A.

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1 **Table 4.223 Alternative F Average Sound Level West End**

Location Point Name	Alternative A				Alternative F															
	Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Time Audible (%)		Average Sound Level (dBA)		Time Audible (%)		Average Sound Level (dBA)		Time Audible (%)		Average Sound Level (dBA)		Time Audible (%)		Average Sound Level (dBA)					
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
Grid Location Point 28	14	16	17	18	41	28	52	36	26	9	28	10	39	25	47	31	25	8	28	10
Grid Location Point 32	44	49	27	28	47	3	51	2	33	6	31	3	46	2	46	-2	34	7	31	3

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

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3
4

Table 4.224 Alternative F Slant Distances West End

Location Point Name	Alternative A		Alternative F	
	Slant Distance (m)		Slant Distance (m)	
	Base Year	Δ	Base Year	Δ
Grid Location Point 28	8,327		3,336	-4,991
Grid Location Point 32	2,016		2,995	979

Δ indicates change in noise metric data from Alternative A

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1 **Cumulative Impacts** **Alternative F** **Special Status Species**
 2 **Mexican Spotted Owl**
 3

4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 5 *actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

- 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Alternative F*

10
 11 *That is, Cumulative Impacts for Alternative F are the sum of 1 plus 2 plus 3 plus 4 (Alternative F).*
 12

13 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 14 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 15 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 16 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 17 *SFRA see Appendix D, Figures 91 to 94).*
 18

19 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
 20 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
 21 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
 22 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
 23 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
 24 *Audible capable of masking some aircraft noise.*
 25

26 *Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could*
 27 *create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican*
 28 *spotted owl habitat that would have long-term moderate adverse impact.*
 29

30 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 31 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 32 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 33 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 34 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 35 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 36 *and/or contrails), high altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 37 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 38 *Aircraft (1 plus 2 plus 4 Alternative F) contribute by far the most prevalent non-natural noise over most of the*
 39 *park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft noise some of the time.*
 40 *Because they would be audible a very high percentage of the day, the combination of aircraft from all sources*
 41 *would generally be the overriding cumulative influence on Wildlife and habitat.*
 42

43 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 44 *(Alternative F compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are generally not directly*
 45 *affected by the Alternatives, so their noise impact is considered Common to All Alternatives (Appendix D, Tables*
 46 *43 to 70); however, their noise impact generally increases impacts of noise produced under Alternatives*
 47 *(Alternative F in this case).*
 48

49 *Impacts of Alternative F are described in detail in previous sections, and summarized for Ten-Year Forecast in*
 50 *Conclusions below. In Appendix D, Tables 55 and 57 (Peak Season) and Tables 59 and 61 (Off-Peak Season),*
 51 *noise produced by aircraft (1 plus 2 plus 4 Alternative F) is detailed for Developed Zone, Non-Wilderness Zone,*
 52 *Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast. Noise from ground-based sources (3) was*
 53 *not able to be included in noise modeling for the EIS; however, since noise from ground-based sources affects*
 54 *less than 10% of the park, mostly Developed Zone areas (2% of the park), this is taken into account in*
 55 *interpreting Developed Zone Cumulative Impact results, and in interpreting localized Location Point results near*
 56 *unpaved roads, the Colorado River, and mining activity areas north of the park.*

1 *Comparing noise impacts from just Alternative F by itself (Appendix D Tables 26 (Peak Season) and 31 (Off-*
 2 *Peak Season) Ten-Year Forecast) versus All Aircraft (#4 Alternative F plus #1 Above and #2 Outside) (Appendix*
 3 *D Tables 57 (Peak Season) and 61 (Off-Peak Season) Ten-Year Forecast) gives a good indication of the*
 4 *difference between Cumulative Impacts and the impacts of Alternative F by itself. For the Entire Park*
 5 *Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All Aircraft are audible 60% or more*
 6 *of the day in 87 to 89% of the park, with Average Sound Level 25 to <35 dBA in 84 to 86% of the park, with 1%*
 7 *of the park below 25 dBA and 15 to 18% at 35 dBA or more. For the Entire Park results for Alternative F by*
 8 *itself (Peak and Off-Peak Season Ten-Year Forecast), aircraft are audible 60% or more of the day in 4 to 10%*
 9 *of the park, with Average Sound Level 25 to <35 dBA in 14% of the park, with 68 to 70% of the park below 25 dBA*
 10 *and 10 to 13% at 35 dBA or more.*

11
 12 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 13 *including Flight-free Zones, whereas noise from Alternative F is more concentrated under and near air-tour*
 14 *routes; (b) Cumulative Impacts increase the impacts of Alternative F, and (c) reducing air-tour-and-related*
 15 *impacts under the Alternatives reduces Cumulative Impacts.*

16
 17 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 18 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 19 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 20 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 21 *described for Alternative F would generally increase by one level as shown in the Cumulative Impacts discussion*
 22 *in the Conclusions section below.*

23
 24 **Conclusion** **Alternative F** **Special Status Species**
 25 **Mexican Spotted Owl**

26
 27 Overall, in MSO critical habitat, Alternative F Base Year Peak Season would result in negligible changes in impacts
 28 compared with Alternative A. Greatest exposure to noise and visual impacts would occur East End. In Marble
 29 Canyon and the Central area, MSO would be little impacted by air-tour operations. Because Alternative F includes
 30 quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-
 31 Year Forecast in all MSO critical habitat.

32
 33 East End (the area with greatest potential for MSO impacts, Ten-Year Forecast Peak Season, areas with low noise
 34 would increase, with 37% of MSO habitat with air-tour aircraft Percent Time Audible 5% or less of the day (14% in
 35 Alternative A), and 59% of MSO habitat areas with air-tour Average Sound Level 15 dBA or less (3% in Alternative
 36 A). MSO habitat areas with frequent aircraft noise disturbances would be reduced with 41% of areas with air-tours
 37 Percent Time Audible greater than 25% of the day (76% in Alternative A). Ten-Year Forecast Peak Season, these
 38 would represent minor to moderate beneficial changes in impacts compared to Alternative A.

39
 40 *Conclusion Marble Canyon* *Alternative F* *Special Status Species*
 41 *Mexican Spotted Owl*

42 Alternative F would result in negligible to minor adverse impacts with negligible change in impacts to MSO in
 43 Marble Canyon Base Year and Ten-Year Forecast Peak Season. Base Year and Ten-Year Forecast Off-Peak Season
 44 there would be negligible impacts with minor to moderate beneficial changes in impacts compared to Alternative A.

45
 46 *Conclusion East End* *Alternative F* *Special Status Species*
 47 *Mexican Spotted Owl*

48 East End impacts would vary depending on proximity to air-tour routes in Zuni Point and Dragon Corridors and
 49 across North Rim with generally moderate adverse impacts under and near tour routes, and negligible to minor
 50 adverse impacts away from routes in Bright Angel Flight-free Zone Base Year and Ten-Year Forecast.

51
 52 Base Year Peak Season air-tour aircraft impacts on MSO would not be appreciably different from Alternative A,
 53 ranging to moderate adverse beneath and adjacent to air-tour routes with negligible impacts compared to Alternative
 54 A, and negligible to minor adverse away from routes with negligible impacts compared to Alternative A. Ten-Year
 55 Forecast Peak Season, there would be reduction in aircraft audibility due to quiet-technology conversion resulting in

1 short-term minor to moderate beneficial changes in impacts compared to Alternative A, but with impact levels
2 generally similar to Base Year.

3
4 Base Year Off-Peak Season there would generally be negligible to moderate adverse impacts with minor to major
5 beneficial change in impacts compared to Alternative A on MSO near Zuni Point and Dragon Corridors. This would
6 be off-set somewhat by the westward shift in area where moderate adverse impacts with moderate adverse change in
7 impacts compared to Alternative A to MSO would occur under air-tour routes due to Dragon Corridor's Off-Peak
8 Season shift. Ten-Year Forecast, these impacts would decline due to reduction in aircraft Percent Time Audible and
9 Average Sound Level from conversion to quiet-technology aircraft and resulting in minor to moderate adverse
10 impact with moderate to major beneficial changes in impact compared to Alternative A. Impacts due to the
11 westward shift in area would decline Ten-Year Forecast resulting in negligible to minor adverse impacts with minor
12 to moderate adverse change in impacts compared to Alternative A.

13
14 *Conclusion Central Alternative F Special Status Species*
15 *Mexican Spotted Owl*

16 All Scenarios Alternative F would generally result in negligible impacts and negligible to minor beneficial change in
17 impacts compared to Alternative A on MSO at most Central area Location Points.

18
19 *Conclusion West End Alternative F Special Status Species*
20 *Mexican Spotted Owl*

21 Air-tour operations would have long-term moderate adverse impacts under Blue Direct routes with negligible to
22 moderate adverse change in impacts compared to Alternative A on MSO.

23
24 *Cumulative Impacts Summary Alternative F Special Status Species*
25 *Mexican Spotted Owl*

26
27 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
28 *the impact levels for each area described above for Alternative F by one level. That is, Ten-Year Forecast impacts*
29 *in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections (Marble Canyon, East End,*
30 *Central, West End) would tend to increase to major adverse Cumulative Impacts under and near air-tour routes,*
31 *and minor to moderate adverse Cumulative Impacts near the middle of the large Flight-free Zones. In*
32 *comparison with the other Alternatives, Alternative F ranks third in lowest overall Cumulative Impacts behind*
33 *Alternative E and the Modified NPS Preferred Alternative (Alternative A ranks last).*

34
35 **MODIFIED NPS PREFERRED ALTERNATIVE SPECIAL STATUS SPECIES**
36 **MEXICAN SPOTTED OWL**

37
38 Overall, the *Modified* NPS Preferred Alternative would result in beneficial change in impacts compared with
39 Alternative A due to reduced MSO critical habitat exposed to high audibility long periods of the day. Critical habitat
40 would be improved with fewer disturbances from aircraft operations.

41
42 **Marble Canyon Modified NPS Preferred Alternative Special Status Species**
43 **Mexican Spotted Owl**

44
45 Peak and Off-Peak Season Marble Canyon critical habitat would be quiet compared to Alternative A. Base Year *and*
46 *Forecast* Appendix F contour data shows 95 to 100% of Marble Canyon would have air-tour aircraft Percent Time
47 Audible less than 5% of the day (14% in Alternative A) with air-tour Average Sound Level less than 15 dBA in
48 100% of Marble Canyon. In most areas, as shown in Table 4.225, aircraft would be much farther away from
49 locations on the ground, ranging approximately 18,000 to 75,891 meters.

50
51 *Marble Canyon Modified NPS Preferred Alternative Special Status Species*
52 *Mexican Spotted Owl*

53 **All Scenarios**

54 *Impacts at representative Location Points around Marble Canyon would generally be minor to moderate*
55 *beneficial compared to Alternative A as shown in Table 4.226. Air-tour aircraft Percent Time Audible would*
56 *be 1% or less, lower than Alternative A, and aircraft Average Sound Level would be zero to 13 dBA, a*

1 *decrease of one to 24 dBA compared to Alternative A. Aircraft would be much farther away and not visible*
2 *from locations on the ground, ranging from 18,273 meters at Marble Canyon Dam Site Location Point to*
3 *75,891 meters at Grid Location Point 1. Improvement over Alternative A would occur at all Location Points*
4 *close to rim and river, and most at North and South Canyon Location Points. MSO would not be disturbed*
5 *from normal daily activities by aircraft. Closure of all Marble Canyon routes would result in an increased*
6 *distance between air traffic and MSO roosting/foraging areas. There would generally be long-term minor to*
7 *major beneficial change in impacts compared with Alternative A.*

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1 **Table 4.225 Modified NPS Preferred Alternative Average Sound Level Marble Canyon**

Location Point Name	Alternative A		Modified NPS Preferred Alternative																	
			Peak Season										Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	1	-5	0	-10	0	-1	0	-1	0	-6	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6	1	-2	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9	-2	1	-2	7	-8	7	-8	
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	1	-7	0	-2	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-2	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-3	0	-3	2	--22	1	-24	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	0	-2	0	-3	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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Table 4.226 Modified NPS Preferred Alternative Slant Distances Marble Canyon

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	55,620	52,925
Grid Location Point 1	1,665	75,891	74,226
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	53,548	50,590
Grid Location Point 4	4,585	71,678	67,093
Grid Location Point 5	2,325	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669

Δ indicates change in noise metric data from Alternative A

5
6

1 **East End** *Modified NPS Preferred Alternative* **Special Status Species**
 2 **Mexican Spotted Owl**

3
 4 As shown in Appendix F Base Year Peak Season, approximately 12% of MSO habitat would experience air-tour
 5 Percent Time Audible 5% of the day or less (14% under Alternative A). Area exposed to frequent aircraft noise Base
 6 Year Peak Season would be about the same as Alternative A with 78% of MSO habitat experiencing aircraft Percent
 7 Time Audible greater than 25% of the day (76% under Alternative A). Approximately 45% of MSO habitat area
 8 would have air-tour Average Sound Level of 15 dBA or less Base Year Peak Season (44% in Alternative A). Base
 9 Year, these would represent negligible changes in impacts compared to Alternative A.

10
 11 Ten-Year Forecast Peak Season levels would be reduced from Base Year mainly due to quiet-technology aircraft
 12 conversion requirements, to 34% of MSO habitat with aircraft Percent Time Audible 5% or less of the day (14% in
 13 Alternative A), and 57% of MSO habitat with air-tour Average Sound Level of 15 dBA or less (3% in Alternative
 14 A). MSO habitat areas with high Average Sound Level would be reduced with 43% of area with air-tours Percent
 15 Time Audible greater than 25% of the day (76% in Alternative A). Ten-Year Forecast Peak Season these would
 16 represent moderate beneficial changes in impacts compared to Alternative A.

17
 18 As shown in Appendix F Base Year and Ten-Year Forecast Off-Peak Season, respectively, MSO habitat with low
 19 Average Sound Level would increase compared to Peak Season, with 52 to 74% of areas experiencing 5% or less
 20 Percent Time Audible (14% in Alternative A), and 81 to 83% of areas with Average Sound Level of 15 dBA or less
 21 (44% Base Year and 3% Ten-Year Forecast in Alternative A). Habitat areas with high Average Sound Level would
 22 similarly decrease from Peak Season, with 14 to 34% of areas with greater than 25% Percent Time Audible, and 4 to
 23 2% with greater than 35 dBA, Base Year and Ten-Year Forecast, respectively (76% greater than 25% Percent Time
 24 Audible, and 15 to 22% greater than 35 dBA in Alternative A). These would represent moderate beneficial changes
 25 in impacts compared to Alternative A Ten-Year Forecast.

26
 27 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 28 *Mexican Spotted Owl*
 29 *Base Year Peak Season*

30 Areas where air-tour operations would have highest level of effect would be under and adjacent to **Dragon**
 31 **Corridor**, represented by Location Points **96 Mile Camp, Tower of Ra, Eremita Mesa, and Hermit Basin**. As
 32 shown in Table 4.227 and 4.228, this results from air-tour Percent Time Audible 59 to 100% of the day, a one to
 33 12% decrease from Alternative A. Air-tour Average Sound Level would be 20 to 42 dBA, a 2 to 22 dBA
 34 decrease from Alternative A. Air-tour aircraft would be farther away from points on the ground compared to
 35 Alternative A by about 1,300 to 6,400 meters. *Minor* to major adverse impacts would continue under and near
 36 Dragon Corridor short-loop air-tour routes Peak Season with short-term minor beneficial change in impacts
 37 compared to Alternative A.

38
 39 Areas under and near **Zuni Point Corridor** (represented by Location Points **Temple Butte, Grid Location**
 40 **Points 14 and 15, and Lipan Point**) would experience aircraft Percent Time Audible 54 to 76% of the day, an
 41 8% decrease compared to Alternative A. Aircraft Average Sound Level would be 34 to 39 dBA, an increase of
 42 up to 11 dBA from Alternative A. MSO activities could be interrupted by aircraft noise for substantial portions
 43 of the day *and although there may be a higher level of reaction in Peak Season when Zuni Point Corridor*
 44 *opens, MSO would not be expected to abandon area use or experience localized population changes..*
 45 Moderate to major adverse impacts would continue with *negligible* beneficial change in impacts compared to
 46 Alternative A.

47
 48 In **Bright Angel Flight-free Zone**, air-tour aircraft Percent Time Audible would increase by 9% from
 49 Alternative A in areas near **Cape Royal** Location Point (to 68% Percent Time Audible). Average Sound Level
 50 would range 18 to 27 dBA, similar to Alternative A. Aircraft would be greater than 7,000 meters from locations
 51 on the ground. Moderate adverse impacts would continue with negligible to minor adverse change in impacts
 52 compared to Alternative A.

53
 54 **Areas along North Rim, in Bright Angel Flight-free Zone** away from routes, would experience a decrease in
 55 air-tour aircraft noise at Location Points **Point Imperial** and **Grid Location Point 16**, aircraft Percent Time
 56 Audible would be 47 and 54% of the day, a 19 to 26% decrease compared to Alternative A. Average Sound

Level would be **16 to 24** dBA, a decrease of one to 20 dBA. Aircraft would be at a **Distance** of 2,500 to 6,200 meters from locations on the ground. MSO daily activities would be less frequently interrupted by aircraft noise. **Although moderate adverse impacts would occur there would be short-term moderate beneficial change in impacts compared to Alternative A.**

East End *Modified NPS Preferred Alternative* *Special Status Species*
Mexican Spotted Owl
Ten-Year Forecast Peak Season

Under and adjacent to **Dragon Corridor** Percent Time Audible would decline to 41 to **98%**, a **2 to 43%** decrease from Alternative A, due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would range **17 to 38** dBA, a decrease of 7 to **25** dBA. Aircraft **Distance** would be the same as Base Year. **High levels of aircraft noise would occur during critical time periods when MSO would be breeding and nesting which may result in localized population changes. Minor to major** adverse impacts would continue under and near Dragon Corridor with **long-term and** short-term minor to moderate beneficial change in impacts compared to Alternative A.

There would be a reduction in air-tour aircraft noise in **Zuni Point Corridor** with aircraft Percent Time Audible **33 to 46%** of the day, a **28 to 33%** decrease compared to Alternative A. Average Sound Level would be **28 to 36** dBA, up to a **2 to 7** dBA increase compared to Alternative A. Aircraft noise would be less frequent during the day which may improve feeding, breeding, and nesting. Moderate adverse impacts would continue under and near Zuni Point Corridor with **long-term minor to major** beneficial change in impacts compared to Alternative A.

In **Bright Angel Flight-free Zone** at Location Points **Cape Royal** and **Grid Location Point 11** aircraft Percent Time Audible would be **23 to 28%** of the day, a decrease of **33%** compared to Alternative A. Air-tour Average Sound Level would be similar to Alternative A and range **14 to 21** dBA. MSO would be less frequently disturbed during daily activities. Minor to moderate adverse impacts would occur with **long-term** moderate beneficial change in impacts compared to Alternative A. The middle of Bright Angel Flight-free Zone would remain quiet, as represented by **Grid Location Points 12 and 13**, with negligible impacts and negligible change in impacts from Alternative A.

North Rim MSO critical habitat would improve at Location Points **Point Imperial, The Basin, and Grid Location Point 16**. Aircraft Percent Time Audible would be **11 to 39%** of the day, a 39 to **56%** decrease from Alternative A. Average Sound Level would range 16 to 40 dBA, an 8 to 22 dBA decline. There would be less interruption or disturbance to MSO breeding, nesting, and foraging. Minor to moderate adverse impacts would occur with **long-term minor to major** beneficial change in impacts compared to Alternative A.

East End *Modified NPS Preferred Alternative* *Special Status Species*
Mexican Spotted Owl
Base Year Off-Peak Season

Dragon Corridor would experience a **reduction in** air-tour aircraft Percent Time Audible **38 to 98%** of the day, a **2 to 32%** decrease from Alternative A. Average Sound Level would be **17 to 38** dBA, a **7 to 25** dBA reduction. Aircraft would be at the same distance as Peak Season. MSO would experience less frequent aircraft noise disturbance. **Minor to major** adverse impacts would continue with short-term moderate **to major** beneficial change in impacts compared to Alternative A.

Aircraft noise would **greatly decrease** in **Zuni Point Corridor** as both long- and short-loop air-tour routes would **be closed**. At Location Points **Grid Location Point 14 and 15, Lipan Point, and Temple Butte**, aircraft Percent Time Audible would be zero to 1% of the day; a **61 to 74%** decrease compared to Alternative A. Average Sound Level would range 6 to 14 dBA, a **decrease of 14 to 31%** from Alternative A. **MSO foraging, breeding, and nesting with less interference from aircraft which may result in positive changes in population size. Negligible** adverse impacts on MSO would continue with **short-term moderate to major beneficial** change in impacts from Alternative A.

In **Bright Angel Flight-free Zone**, aircraft Percent Time Audible would **decrease to 1%** of the day near Location Point **Cape Royal**, a **58%** decrease from Alternative A with Average Sound Level of **11** dBA, a **14 dBA reduction** from Alternative A. **Although negligible impacts would occur, there would be short-term minor to moderate beneficial change in impacts compared to Alternative A.**

1 In **Bright Angel Flight-free Zone** edges close to Dragon Corridor, at **Grid Location Point 11**, aircraft Percent
 2 Time Audible would be **27%**, a **28%** decrease compared to Alternative A. Average Sound Level would be **15**
 3 **dBA**, a decrease of **3dBA** from Alternative A. Negligible to minor adverse impacts would continue with short-
 4 term minor to moderate beneficial change in impacts compared to Alternative A.

5
 6 *East End* *Modified NPS Preferred Alternative* *Special Status Species*
 7 *Mexican Spotted Owl*
 8 *Ten-Year Forecast Off-Peak Season*

9 Under and near **Dragon Corridor**, there would be reduction in aircraft noise due to conversion to quiet-
 10 technology aircraft. Aircraft Percent Time Audible would be **25 to 92%** of the day, a reduction of **8 to 61%**
 11 compared to Alternative A. Average Sound Level would range **15 to 35 dBA**, a **10 to 27 dBA** decrease. **Minor to**
 12 **major** adverse impacts would continue under and near Dragon Corridor with long-term and short-term minor to
 13 major beneficial change in impacts compared to Alternative A.

14
 15 Percent Time Audible in areas near and under **Zuni Point Corridor** would be **zero to 1%**, a decline of **65 to 77%**
 16 from Alternative A. Aircraft Average Sound Level would range **6 to 14 dBA**, a **15 to 32 dBA reduction** from
 17 Alternative A. Reduction in air-tour aircraft Percent Time Audible compared to Alternative A would result in
 18 increased potential that MSO would continue to occupy the area and that breeding and nesting could occur.
 19 Negligible adverse impacts would occur with **long- and** short-term moderate **to major** beneficial change in
 20 impacts from Alternative A.

21
 22 Aircraft Percent Time Audible would decline along **Bright Angel Flight-free Zone** edges. Aircraft Percent Time
 23 Audible would be **1%** of the day near Zuni Point Corridor at **Cape Royal** Location Point, a decrease of **60%**, and
 24 near Dragon Corridor at **Grid Location Point 11** Percent Time Audible would be **17%** of the day, a **39%**
 25 reduction compared to Alternative A. There would be negligible change in Average Sound Level **of 12 dBA**.
 26 **Although minor to moderate adverse impacts would occur there would be long- and short-term minor to major**
 27 **beneficial change in impacts compared to Alternative A.**

28
 29 Critical habitat conditions **along North Rim** would improve at Location Points **Point Imperial, The Basin,** and
 30 **Grid Location Point 16** with Percent Time Audible **to 20%**, a decrease of **64 to 68%** from Alternative A, and
 31 Average Sound Level of **7 to 20 dBA**, a decrease of **22 to 32 dBA** from Alternative A. Minor to moderate
 32 adverse impacts would occur with short-term moderate beneficial change in impacts compared to Alternative A.
 33
 34

1 **Table 4.227 Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative																
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season								
					Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)				
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	
Little Colorado River/Nankoweap Area																					
Nankoweap River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	11	-23	12	-23	
Nankoweap Mesa	87	90	43	43	76	-11	48	-42	31	-12	29	-14	1	-42	2	-88	14	-29	15	-28	
Dragon Corridor																					
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	38	-32	25	-49	35	-10	33	-12	
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	80	-17	67	-31	38	-6	35	-10	
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	98	-2	92	-8	32	-17	29	-20	
Hermit Basin	99	100	42	42	96	-4	57	-43	20	-22	17	-25	79	-20	39	-61	17	-25	15	-27	
North Rim																					
Cape Royal	59	61	25	26	68	9	28	-33	27	2	21	-5	1	-58	1	-60	11	-14	12	-14	
Point Imperial	66	68	38	39	47	-19	11	-56	18	-20	16	-22	-65	1	-67	7	-31	7	-32		
Bright Angel Point	47	48	24	24	57	10	18	-30	24	0	18	-5	-43	5	-43	13	-11	12	-12		
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-1	37	-36	7	-68	19	-29	20	-28	
Grid Location Point 16	80	84	33	34	54	-26	39	-45	32	-1	24	-9	13	-67	20	-64	12	-21	12	-22	
Zuni Point Corridor																					
Grid Location Point 14	70	74	34	34	62	-8	46	-28	39	6	33	1	1	-69	1	-73	7	-27	7	-27	
Grid Location Point 15	65	69	28	29	56	-9	37	-32	39	11	33	6	1	-64	1	-68	14	-14	14	-15	
Temple Butte	62	66	37	38	54	-8	33	-33	37	0	36	-2	1	-61	1	-65	6	-31	6	-32	
Lipan Point	74	77	34	35	76	2	46	-34	34	1	28	-7	0	-74	0	-77	9	-25	8	-27	
South Rim																					
Tusayan Museum	64	67	35	36	64	0	38	-29	5	0	29	-7	0	-64	0	-67	4	-31	4	-32	
El Tovar	95	96	19	20	93	-2	23	-73	20	0	14	-6	66	-29	13	-83	15	-4	13	-7	
Zuni Alpha	43	46	46	46	41	-2	33	-21	48	2	45	-1	0	-43	0	-46	3	-43	3	-3	
Ten X Meadow	64	68	49	49	60	-4	33	-33	52	3	50	1	19	-45	11	-57	18	-31	19	-30	
1.5 km SE of Moran Point	64	68	41	41	62	2	43	-23	38	-3	33	-8	2	-62	3	-65	6	-35	5	-36	
Bright Angel Flight Free Zone																					
Cedar Ridge	81	82	19	19	89	9	16	-76	19	1	14	-5	56	-25	6	-76	15	-4	13	-6	
Grid Location Point 11	55	56	18	18	50	-5	33	-33	20	2	14	-4	27	-28	17	-39	15	-3	12	-6	
Grid Location Point 12	1	1	13	14	2	1	1	13	0	12	-1	1	0	1	0	11	-2	12	-2		
Grid Location Point 13	1	1	12	13	1	1	0	12	0	9	-4	1	0	1	0	9	-3	9	-4		
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	7	-5	1	-2	1	-3	7	-5	7	-5	
Toroweap /Shinumo Flight Free Zone																					
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	73	-19	19	-73	26	1	23	-2	
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	73	13	31	-29	17	1	15	-2	
Point Sublime	100	100	35	35	100	0	95	-5	35	-1	29	-6	97	-3	83	-17	32	-3	27	-8	
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	6	-1	3	-4	
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	6	-1	0	0	0	0	7	1	7	0	

1 **Table 4.228 Modified NPS Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	9,655	8,206
Nankoweap Mesa	973	6,096	5,123
Dragon Corridor			
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,579	431
Eremita Mesa	1,034	4,277	3,244
Hermit Basin	1,518	6,447	4,929
North Rim			
Cape Royal	4,038	4,026	-12
Point Imperial	2,292	2,754	462
Bright Angel Point	6,235	6,236	2
The Basin	477	874	397
Grid Location Point 16	2,589	2,591	2
Zuni Point Corridor			
Grid Location Point 14	687	1,412	726
Grid Location Point 15	1,637	2,345	708
Temple Butte	1,458	1,303	-155
Lipan Point	2,890	2,894	3
South Rim			
Tusayan Museum	2,016	2,018	3
El Tovar	5,854	10,914	5,060
Zuni Alpha	573	574	0
Ten X Meadow	540	394	-146
1.5 km SE of Moran Point	448	1,144	696
Bright Angel Flight Free Zone			
Cedar Ridge	9,827	12,261	2,434
Grid Location Point 11	8,081	8,035	-46
Grid Location Point 12	9,014	9,012	-2
Grid Location Point 13	7,925	7,852	-73
Phantom Ranch	11,027	11,313	286
Toroweap/Shinumo Flight Free Zone			
Grid Location Point 10	2,931	3,253	322
Grid Location Point 18	3,449	5,106	-3,342
Point Sublime	3,760	4,076	316
Bass Camp	13,358	13,352	-5
Rainbow Plateau	14,878	14,974	96

Δ indicates change in noise metric data from Alternative A

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Central Modified NPS Preferred Alternative Special Status Species
Mexican Spotted Owl
All Scenarios

As shown in Appendix F and Tables 4.229 and 4.230, MSO throughout most of the Central area would be little affected by aircraft noise. Base Year Peak Season when Dragon **and Zuni Point Corridor** short-loop tour routes **are open**, there would be little difference in sound metrics compared to Alternative A. Air-tour aircraft Percent Time Audible would be 5% or less of the day in 92% of MSO habitat in the Central area Base Year, and **98%** Ten-Year Forecast Peak Season, with aircraft Average Sound Level of 15 dBA or less in 100% of the area. Similar Percent Time Audible and Average Sound Level would occur Off-Peak Season. Air-tour aircraft would be greater than 7,000 meters from locations on the ground. MSO daily behaviors such as foraging and roosting would be little affected by air-tour aircraft. Negligible to minor adverse impacts would occur with negligible change in impacts from Alternative A.

1 **Table 4.229 Modified NPS Preferred Alternative Average Sound Level Central**

Location Point Name	Alternative A				Modified NPS Preferred Alternative															
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season								Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
1 km W of Kanab Point	2	2	9	9	2	0	2	0	9	0	7	-2	2	0	2	0	7	-1	7	-2
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	10	0	10	7	1	-2	12	2	10	0
Grid Location Point 9	1	1	5	5	1	0	0	-1	6	1	4	-1	1	0	0	-1	5	0	3	-3
Havasu Point	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanab Point	1	1	6	7	1	0	1	0	10	4	8	1	1	0	1	0	8	2	8	1
Mt. Sinyala	1	1	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0
Stone Creek	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	5
Surprise Valley	1	1	0	0	1	0	1	0	0	0	0	0	1	0	1	0	0	0	0	0
Upper Deer Creek	1	1	1	1	1	0	1	0	2	1	1	1	1	0	1	0	1	0	1	0

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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 Not Finalized
 FOIA Discretionary Release

1 **Table 4.230** *Modified NPS Preferred Alternative* **Slant Distances** **Central**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
The Dome	13,109	13,119	10
Tuweep	8,688	8,688	0
Tuweep	14,322	12,923	-1,399
Hancock Knolls	30,162	30,166	4
1 km W of Kanab Point	18,850	18,857	8
Grid Location Point 8	13,765	14,620	855
Grid Location Point 9	11,103	19,140	8,038
Grid Location Point 20	22,053	22,095	42
Grid Location Point 21	20,393	20,401	8
Grid Location Point 22	26,089	26,095	6
Grid Location Point 23	29,326	27,482	-1,844
Grid Location Point 24	21,073	21,073	0
Grid Location Point 25	20,188	20,216	28
Havasu Point	10,450	10,589	140
Kanab Point	19,021	19,029	8
Mt. Sinyala	7,272	7,302	30
Stone Creek	21,882	24,531	2,649
Surprise Valley	25,500	26,243	743
Toroweap Overlook	9,625	9,625	0
Upper Deer Creek	23,683	24,100	417

Δ indicates change in noise metric data from Alternative A

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West End *Modified NPS Preferred Alternative* **Special Status Species**
Mexican Spotted Owl
All Scenarios

West End *Protected Activity Centers* represented by *Grid Location Points 32 and 28* would be affected by *the Z-shaped Route (realigned Blue Direct)* air-tour operations. Impacts on MSO would be *less than* those for Alternative A. As shown in Table 4.231 and 4.232, air-tour aircraft Average Sound Level would range *15 to 22* dBA with Percent Time Audible *3 to 5%* of the day, *a reduction of 9 to 44% from Alternative A*. Air-tour aircraft would *range between 18,000 to 21,000* meters from locations on the ground. Noise from air-tour operations *at such a distance is not likely to* interrupt daily behavior *or* affect MSO PAC occupancy or reproduction. There would be *negligible to minor* adverse impacts with negligible to *major* beneficial change in impacts compared to Alternative A.

1 **Table 4.231** *Modified NPS Preferred Alternative* **Average Sound Level** **West End**

Location Point Name	Alternative A		<i>Modified NPS Preferred Alternative</i>																	
			Peak Season										Off Peak Season							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)				Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Grid Location Point 28	14	16	17	18	5	-9	3	-13	15	-2	17	-1	3	-11	3	-13	15	-2	17	-1
Grid Location Point 32	44	49	27	28	4	-40	5	-44	21	-6	22	-6	4	-40	5	-44	21	-6	22	-6

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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Table 4.232 *Modified NPS Preferred Alternative* **Slant Distances** **West End**

Location Point Name	Alternative A		<i>Modified NPS Preferred Alternative</i>	
			Slant Distance (m)	
	Slant Distance (m)		Base Year	Δ
Grid Location Point 28	8,327		21,438	13,111
Grid Location Point 32	2,016		18,618	16,602

Δ indicates change in noise metric data from Alternative A

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Not Finalized
FOIA Discretionary Release

1 **Cumulative Impacts** *Modified NPS Preferred Alternative* **Special Status Species**
2 **Mexican Spotted Owl**

3
4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future actions. In this context, Cumulative Impacts include impacts on Special Status Species from sounds of*

5 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*

6 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*

7 *3) ground-based noise sources, plus*

8 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

9
10
11 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
12 *(Modified NPS Preferred Alternative).*

13
14 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
15 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
16 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
17 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
18 *SFRA see Appendix D, Figures 91 to 94).*

19
20 *Noise from ground-based sources including vehicles, building noise, machinery, and electronics, also impacts*
21 *Special Status Species, but is mostly concentrated in the Developed Zone (2% of the park), although a small*
22 *component exists in other Zones from vehicles on remote unpaved roads, motorboats on the Colorado River, fire*
23 *management activities, and mining activities outside the park. Noise from ground-based sources is discussed in*
24 *Chapter 3, Soundscape, and varies greatly, sometimes with high Average Sound Levels and high Percent Time*
25 *Audible capable of masking some aircraft noise.*

26
27 *Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could*
28 *create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican*
29 *spotted owl habitat that would have long-term moderate adverse impact.*

30
31 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
32 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
33 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
34 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
35 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
36 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
37 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
38 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
39 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
40 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
41 *noise some of the time.*

42
43 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
44 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
45 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
46 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
47 *Alternatives (Modified NPS Preferred Alternative in this case).*

48
49 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
50 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
51 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
52 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
53 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
54 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
55 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
56 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

1 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
 2 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
 3 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*
 4 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
 5 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
 6 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
 7 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
 8 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
 9 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
 10 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

11
 12 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 13 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
 14 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
 15 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

16
 17 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 18 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 19 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 20 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 21 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 22 *Cumulative Impacts discussion in the Conclusions section below.*

23
 24 **Conclusion** *Modified NPS Preferred Alternative* **Special Status Species**
 25 **Mexican Spotted Owl**

26
 27 Overall, the *Modified* NPS Preferred Alternative would result in beneficial change in impacts compared with
 28 Alternative A due to reduced area exposed to high audibility for long periods of the day. MSO and their critical
 29 habitat would be improved with fewer disturbances from aircraft operations.

30
 31 The *Modified* NPS Preferred Alternative would result in beneficial change in impacts compared with Alternative A
 32 on MSO and their habitat due to reduced area exposed to high Average Sound Level for long periods of the day.
 33 Ten-Year Forecast the majority of MSO habitat would experience a large reduction in aircraft Percent Time Audible
 34 and Average Sound Level. This would result in greatly reduced impacts on MSO and their habitat with greater areas
 35 with fewer disturbances compared to Alternative A.

36
 37 **Conclusion Marble Canyon** *Modified NPS Preferred Alternative* **Special Status Species**
 38 **Mexican Spotted Owl**

39 *Closure of Marble Canyon routes in the Modified NPS Preferred Alternative would have negligible adverse*
 40 *impacts with minor to moderate beneficial change in impacts to MSO compared to Alternative A.*

41
 42 **Conclusion East End** *Modified NPS Preferred Alternative* **Special Status Species**
 43 **Mexican Spotted Owl**

44 There would be beneficial change in impacts to MSO due to *the seasonal closure of Zuni Point Corridor and long-*
 45 *loop route, and conversion to quiet-technology aircraft.* East End (the area with greatest potential for impacts on
 46 MSO) Ten-Year Forecast Peak Season, areas of low noise would increase with 34% of MSO habitat areas with air-
 47 tour aircraft Percent Time Audible 5% or less of the day (14% in Alternative A), and 57% of MSO habitat areas
 48 with air-tour Average Sound Level of 15 dBA or less (3% in Alternative A). MSO habitat areas with frequent
 49 aircraft noise disturbances would be greatly reduced with 43% of areas with air-tours Percent Time Audible greater
 50 than 25% of the day (76% in Alternative A). Ten-Year Forecast Peak and Off-Peak Season these would represent
 51 overall impact of minor to major beneficial changes in impacts compared to Alternative A.

52
 53 Base Year Peak Season, beneath and adjacent to Dragon Corridor short-loop tour routes, MSO and their habitat
 54 would experience *minor to major* adverse impacts *with* short-term minor beneficial change in impact compared to
 55 Alternative A. Ten-Year Forecast Peak Season, with conversion to quiet-technology aircraft, there would be *long-*
 56 *and* short-term minor to *major* beneficial change in impacts compared to Alternative A. Base Year Off-Peak

1 Season, there would be *minor to major* adverse impacts with short-term moderate *to major* beneficial impacts
 2 compared to Alternative A. Ten-Year Forecast Off-Peak Season there would be *moderate to major* adverse impacts
 3 with *long- and short-term minor to major* beneficial impacts compared to Alternative A.

4
 5 In Zuni Point Corridor Base Year Peak Season, there would be *minor to major* adverse impacts with *negligible*
 6 beneficial change in impacts compared to Alternative A. Ten-Year Forecast Peak Season impacts would be reduced
 7 with minor to moderate adverse impacts with minor to moderate beneficial change in impacts compared to
 8 Alternative A.

9
 10 Base Year Off-Peak Season, in areas under and near Zuni Point Corridor *inactive* short-loop air-tour routes, the
 11 *Modified* NPS Preferred Alternative would have moderate adverse impacts with negligible change in impact
 12 compared to Alternative A. Ten-Year Forecast Off-Peak Season, *when Zuni Point Corridor and the long-loop*
 13 *route is closed, would have negligible adverse impacts with long- and short-term moderate to major beneficial*
 14 *change* compared to Alternative A.

15
 16 Ten-Year Forecast there would generally be minor to moderate adverse impacts with short-term minor to *major*
 17 beneficial change in impacts at locations beneath Bright Angel Flight-free Zone and along North Rim near air-tour
 18 routes Peak and Off-Peak Seasons. In other East End areas removed from air-tour routes, such as amid Bright Angel
 19 Flight-free Zone, there would be negligible *adverse impacts and negligible beneficial* change from Alternative A.

20
 21 *Conclusion Central* *Modified NPS Preferred Alternative* *Special Status Species*
 22 *Mexican Spotted Owl*

23 In the Central area there would be negligible to minor adverse impacts with negligible change in impacts on MSO
 24 compared to Alternative A Base Year and Ten-Year Forecast Peak and Off-Peak Season.

25
 26 *Conclusion West End* *Modified NPS Preferred Alternative* *Special Status Species*
 27 *Mexican Spotted Owl*

28 West End, All Scenarios, there would be *there would be negligible to minor* adverse impacts with *negligible to*
 29 *major beneficial change in impacts compared to Alternative A.*

30
 31 *Cumulative Impacts Summary* *Modified NPS Preferred Alternative* *Special Status Species*
 32 *Mexican Spotted Owl*

33
 34 *As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase*
 35 *the impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is,*
 36 *Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections*
 37 *(Marble Canyon, East End, Central, West End) would tend to increase to major adverse Cumulative Impacts*
 38 *under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of the large*
 39 *Flight-free Zones. In comparison with the other Alternatives, Modified NPS Preferred Alternative ranks second*
 40 *behind Alternative E for the lowest overall Cumulative Impacts (Alternative A ranks last).*

41
 42 *SOUTHWESTERN WILLOW FLYCATCHER* *SPECIAL STATUS SPECIES*

43
 44 *MODIFIED NPS PREFERRED ALTERNATIVE* *SPECIAL STATUS SPECIES*
 45 *SOUTHWESTERN WILLOW FLYCATCHER*

46
 47 *Noise impact analysis from air tours specific to southwestern willow flycatchers (SWFL) has not been studied.*
 48 *Auditory feedback studies on other species suggest exposure to high noise levels (95-100 dB) can mask important*
 49 *feedback signals and lead to deficits in high-frequency sensitivity (Marler et al., 1973). Impacts on SWFL are*
 50 *focused on the park's river/riparian habitat which constitute the species' potential and suitable breeding areas.*
 51 *Air-tour routes largely avoid the riparian corridor or fly over at altitudes greater than 4,000 feet above ground*
 52 *level.*

1 *Marble Canyon* *Modified NPS Preferred Alternative* *Special Status Species*
2 *Southwestern Willow Flycatcher*
3 *All Scenarios*

4 *There are four documented SWFL nesting sites in Marble Canyon. Marble Canyon riparian habitat would*
5 *experience a decrease in audible air-tour noise compared to current conditions due to elimination of all*
6 *routes. In 100% of Marble Canyon, aircraft Percent Time Audible would be 5% or less of the day. Almost the*
7 *entire area would experience Average Sound Levels less than 7 dBA or less, except Grid Location Point 2 at*
8 *13dBA. Air-tour aircraft Percent Time Audible would be less than 5%, and Average Sound Level would be*
9 *below 13 dBA, a zero to 25 dBA decrease from current conditions. Aircraft would be barely audible and at*
10 *very low decibel levels. There would be no air-tour aircraft visible from most points on the ground.*
11 *Improvements over current conditions would occur at all Marble Canyon Location Points, most notably at*
12 *North and South Canyon Location Points. SWFL would rarely be disturbed by air-tour aircraft operations,*
13 *and removal of flight routes would result in a minor to moderate beneficial change compared Alternative A.*

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1 **Table 4.232a Modified NPS Preferred Alternative Average Sound Level Marble Canyon**

Location Point Name	Alternative A				Modified NPS Preferred Alternative							
	Percent Time Audible (%)		Average Sound Level (dBA)		Percent Time Audible (%)				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
Cliff Dwellers Lodge	1	1	6	10	0	-1	0	-1	1	-5	0	-10
Grid Location Point 1	0	0	15	17	0	0	0	0	3	-12	3	-13
Grid Location Point 2	2	3	16	19	1	-1	1	-2	13	-3	13	-6
Grid Location Point 3	3	3	14	16	1	-2	1	-2	7	-7	7	-9
Grid Location Point 4	0	0	0	2	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	0	-2	0	-2	0	-7	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	0	-3	0	0	2	--22	1	-24
South Canyon	2	3	21	23	0	-2	0	0	0	-20	0	-23

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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3
4

Table 4.232b Modified NPS Preferred Alternative Slant Distances Marble Canyon

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	5,693	56,620	52,925
Grid Location Point 1	1,665	2,891	74,226
Grid Location Point 2	858	62,484	61,626
Grid Location Point 3	2,958	53,548	50,590
Grid Location Point 4	4,585	71,678	67,093
Grid Location Point 5	2,335	49,469	47,134
Marble Canyon Dam Site	3,845	18,273	14,428
North Canyon	999	42,784	41,785
South Canyon	816	28,485	27,669

Δ indicates change in noise metric data from Alternative A

5
6
7

1 **East End** **Modified NPS Preferred Alternative** **Special Status Species**
 2 **Southwestern Willow Flycatcher**

3
 4 *There is one documented East End SWFL nesting site, and it falls within Zuni Point Corridor. However, SWFLs*
 5 *have not been detected at this location since 1994 (Sogge et. al. 1992, 1993, 1994, 1997, Laczek-Johnson et. al.*
 6 *2006, Palarino et al 2010). Suitable East End nesting habitat has not been documented. SWFL will use this area*
 7 *for foraging and migration as represented by Location Points 96 Mile Camp, Bass Camp, Grid Location Point 13,*
 8 *Phantom Ranch, Little Colorado River, and Nankoweap River. Air-tour aircraft would be farther away from*
 9 *points on the ground compared to current flight routes, and range from 2,400 to 13,300 meters.*

10
 11 *As shown in Appendix F Tables 23 and 24, Base Year Peak Season approximately 33% of East End river habitat*
 12 *would experience air-tour sounds 10% of the day or less, compared to 28% in Alternative A. River habitat*
 13 *exposed to frequent aircraft noise greater than or equal to 25% of the day would be 43% (opposed to 58% under*
 14 *Alternative A). Approximately 68% of river habitat would have air-tour Average Sound Level 15 dBA or less*
 15 *(opposed to 33% in Alternative A). These would represent minor beneficial change in impacts compared to*
 16 *Alternative A.*

17
 18 *Ten-Year Forecast Peak Season levels would be reduced from Base Year, mainly due to quiet-aircraft technology*
 19 *conversion requirements, to 56% of river habitat with aircraft Percent Time Audible 10% or less of the day*
 20 *(compared to 28% in Alternative A), and 72% of river habitat with Average Sound Level of 15 dBA or less*
 21 *(compared to 2% in Alternative A). River habitat with high Average Sound Level would be greatly reduced with*
 22 *only 17% with air-tours audible greater than or equal to 25% of the day (compared to 60% in Alternative A).*
 23 *These would represent moderate to major beneficial changes in impacts compared to Alternative A.*

24
 25 **East End** **Modified NPS Preferred Alternative** **Special Status Species**
 26 **Southwestern Willow Flycatcher**

27 **Ten-Year Forecast and Base Year Peak Season**

28 *All East End Location Points along the river, except 96 Mile Camp, and analyzed for impacts to SWFL, range*
 29 *from zero to 7% Base Year and zero to 3% Ten-Year Forecast, a zero to 34% decrease from Alternative A.*
 30 *Average Sound Level would range from 8 to 26 dBA and 3 to 26 dBA Base Year and Ten-Year Forecast*
 31 *respectively. This is a decrease of zero to 22 dBA from Alternative A. Negligible to minor adverse impacts*
 32 *would occur throughout most of East End with long-term negligible to moderate beneficial change in impacts.*

33
 34 *96 Mile Camp is under Dragon Corridor and would have a Percent Time Audible of 59 to 41% Base Year and*
 35 *Ten-Year Forecast respectively, a decrease of 12 to 33% compared to Alternative A. Average Sound Level*
 36 *would be 39 to 37 dBA Base Year and Ten-Year Forecast respectively, a decrease of 6 to 8 dBA from*
 37 *Alternative A. Moderate to major adverse impacts would continue under Dragon Corridor with long-term*
 38 *negligible to moderate beneficial change.*

39
 40 **East End** **Modified NPS Preferred Alternative** **Special Status Species**
 41 **Southwestern Willow Flycatcher**

42 **Ten-Year Forecast and Base Year Off-Peak Season**

43 *SWFLs are only found at GCNP May through August. As the Off-Peak Season for air tours is November 15*
 44 *through March 31, Off-Peak Season is not included in the analysis of impacts on SWFL.*

1 **Table 4.232c Modified NPS Preferred Alternative Average Sound Level East End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative							
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season				Average Sound Level (dBA)			
	Base Year	Fore cast	Base Year	Fore cast	Base Year	Δ	Fore cast	Δ	Base Year	Δ	Fore cast	Δ
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8
Nankoweap at River	7	8	34	35	0	-7	0	-8	15	-19	13	-22
Grid Location Point 13	1	1	12	13	1	1	1	0	12	0	9	-4
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	7	-5
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5
Little Colorado River	34	37	43	43	7	-27		-34	26	-17	26	-17

Δ indicates change in noise metric data from Alternative A
 Forecast indicates Ten-Year Forecast

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4 **Table 4.232d Modified NPS Preferred Alternative Slant Distances East End**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
96 Mile Camp	1,573	3,168	1,594
Nankoweap at River	1,449	9,653	8,206
Little Colorado River	1,629	2,474	845
Grid Location Point 13	7,925	7,852	-73
Phantom Ranch	11,027	11,313	286
Bass Camp	13,358	13,352	-5

1 **Central** **Modified NPS Preferred Alternative** **Special Status Species**
 2 **Southwestern Willow Flycatcher**
 3 **All Scenarios**

4 *There have been two sightings of SWFL over the past ten years in this area, with no confirmation of territory*
 5 *establishments (birds were determined to be transient). No SWFL nest sites or suitable nesting habitat have*
 6 *been documented in the Central geographic area; therefore, they would not be affected by air-tours in this*
 7 *area. Thus, Central is not analyzed for SWFL impacts.*

8
 9 **West End** **Modified NPS Preferred Alternative** **Special Status Species**
 10 **Southwestern Willow Flycatcher**
 11 **All Scenarios**

12 *There are eight documented West End SWFL nesting sites. Percent Time Audible and Average Sound Level*
 13 *of forecasted proposed conditions are anticipated to decrease slightly compared to current forecasted*
 14 *conditions based on Location Point modeling in Table 4.232e. Location Points in the middle of West End (not*
 15 *including Burnt Springs, Bat Cave, West End, Whitmore Rapids, and Parashant Wash) would remain similar*
 16 *to Alternative A and experience Percent Time Audible forecasted conditions ranging zero to 2%, and Average*
 17 *Sound Level forecasted conditions ranging zero to 43 dBA. Negligible to minor adverse impacts would*
 18 *continue in the middle of West End with negligible beneficial change.*

19
 20 *Whitmore Rapids and Parashant Wash Location Points near Brown Routes would have air-tour aircraft*
 21 *Percent Time Audible 11 to 20% of the day, a 7% increase from current conditions at Whitmore Rapid*
 22 *Location Point due to realignment of Blue Direct North as the Z-shaped Route (realigned Blue Direct). There*
 23 *would be no appreciable change at Parashant Wash Location Point. Aircraft would be more than 2,500*
 24 *meters from locations on the ground.*

25
 26 *Due to Blue Direct North realignment to the Z-shaped Route (realigned Blue Direct), the Sanup/Shivwits area*
 27 *would be less disturbed by air-tour noise. Distances from aircraft to points on the ground would increase to*
 28 *more than 18,000 meters in this area.*

29
 30 *River habitat in proximity to Blue-2 and Green-4 would continue to experience noise impacts similar to*
 31 *Alternative A. A range of aircraft noise intensities and audibility could affect SWFL due to heavy helicopter*
 32 *traffic for river access outside the park, air tours, and current direct-flight routes between Las Vegas and*
 33 *Grand Canyon Airport. Aircraft Percent Time Audible would range 39 to 12% (Base Year and Forecast*
 34 *respectively) greater than 25% of the day in river habitat with Average Sound Level remaining low (25 dBA or*
 35 *less) in 81 to 84% (Base Year and Forecast respectively) of river habitat. A decrease of 11% and 13 to 20 dBA*
 36 *compared to Alternative A. The far West End Ten-Year Forecast, represented by location points Burnt*
 37 *Springs, Bat Cave, and West End would experience Percent Time Audible of 32 to 88% a decrease of 7 to 31%*
 38 *compared to Alternative A. Average Sound Level would range 36 to 43 dBA a 4% decrease from Alternative A.*
 39 *Moderate to major adverse impacts would continue at location points under and near Blue-2 and Green-4*
 40 *with negligible to minor benefits.*
 41

1 **Table 4.232e Modified NPS Preferred Alternative Average Sound Level West End**

Location Point Name	Alternative A				Modified NPS Preferred Alternative							
	Percent Time Audible (%)		Average Sound Level (dBA)		Peak Season				Average Sound Level (dBA)			
	Base Year	Forecast	Base Year	Forecast	Base Year	Δ	Forecast	Δ	Base Year	Δ	Forecast	Δ
	Burnt Springs Canyon	70	75	46	47	63	-7	58	-17	45	-1	43
Bat Cave	93	95	47	48	93	0	88	-7	45	-2	43	-5
West End	58	63	39	40	53	-5	32	-31	39	0	36	-4
Separation Canyon	0	0	7	7	0	0	0	0	7	0	7	0
Three Springs	1	2	8	9	1	0	2	0	8	0	8	-1
Whitmore Rapids	12	13	21	21	19	7	20	7	29	8	28	7
Granite Peak	2	2	17	18	2	0	2	0	15	-2	16	-2
Diamond Creek	0	0	0	0	0	0	0	0	0	0	0	0
Grid Location Point 34	0	0	1	1	0	0	0	0	1	0	1	0
Parashant Wash	12	14	33	33	11	-1	14	0	24	-9	24	-9
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	7	-1

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

2
3
4 **Table 4.232f Modified Preferred Alternative Slant Distances West End**

Location Point Name	Alternative A	Modified NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,215	0
Bat Cave	1,134	1,134	0
West End	1,688	1,688	0
Whitmore Rapids	1,804	1,804	0
Granite Peak	5,264	12,090	6,826
Separation Canyon	16,377	16,328	-49
Three Springs	14,750	22,770	8,020
Diamond Creek	27,108	33,411	6,303
Parashant Wash	2,852	2,852	0
Pumpkin Springs	12,630	19,695	7,065
Grid Location Point 34	28,206	29,373	1,167

Δ indicates change in noise metric data from Alternative A

1 **Cumulative Impact** **Modified NPS Preferred Alternative** **Special Status Species**
 2 **Southwestern Willow Flycatcher**

3
 4 *Cumulative Impacts result from the action when added to other past, present, and reasonably foreseeable future*
 5 *actions. In this context, Cumulative Impacts include impacts on Southwestern Willow Flycatcher from sounds of*
 6 *1) high-altitude aircraft at or above 18,000 feet MSL, plus*
 7 *2) aircraft below 18,000 feet MSL and outside the SFRA, plus*
 8 *3) ground-based noise sources, plus*
 9 *4) noise from air-tour-and-related aircraft under Modified NPS Preferred Alternative*

10
 11 *In addition to noise, recent changes to fluvial hydrology (5) altering flow regimes and resulting in habitat*
 12 *modifications, as well as the increasing trend in recreational activity in riparian areas, present the greatest threat*
 13 *to persistence of SWFL along the Colorado River (USFWS 2002).*

14
 15 *That is, Cumulative Impacts for Modified NPS Preferred Alternative are the sum of 1 plus 2 plus 3 plus 4*
 16 *(Modified NPS Preferred Alternative) plus 5, mostly concentrated in West End areas where occupied and suitable*
 17 *habitat exists and helicopters land near river level on Hualapai tribal lands south of the river.*

18
 19 *Of the 4.5 million GCNP annual visitors, approximately 90,000 stay overnight in the backcountry, while*
 20 *approximately 25,000 run the river (NPS 2005a, b). Noise generated by recreational activity along the Colorado*
 21 *River (3) contributes to Cumulative Impacts from non-natural noise on SWFL and its habitat. More proximal*
 22 *anthropogenic noise (river recreation) may have a greater detrimental impact on SWFL; however, impacts to*
 23 *SWFL in GCNP from backcountry and river corridor use has not been quantified.*

24
 25 *Heavy helicopter traffic outside the SFRA over Hualapai tribal land near Grand Canyon West Airport would*
 26 *continue to have by far the greatest potential for adverse impacts on SWFL West End, as helicopters land in the*
 27 *canyon on the Colorado River's south side, and some helicopters have been observed flying over park lands north*
 28 *of the river at low altitudes. NPS has no control over flights solely over Hualapai tribal lands, but flights over*
 29 *park lands are unauthorized, and NPS will work with FAA and the Hualapai Tribe to eliminate low-altitude*
 30 *flights in the SFRA and over park lands.*

31
 32 *Throughout GCNP, aircraft above and outside the SFRA (1 plus 2) produce Cumulative Impacts Common to All*
 33 *Alternatives with Average Sound Level generally 15 to 35 dBA and Percent Time Audible that varies throughout*
 34 *the park from 10% to more than 65% of the day (Appendix D, Tables 43 to 70) (For high-altitude aircraft at or*
 35 *above 18,000 feet MSL see Appendix D, Figures 87 to 90; and for aircraft below 18,000 feet MSL and outside the*
 36 *SFRA see Appendix D, Figures 91 to 94).*

37
 38 *Noise from ground-based sources is usually very localized. Even though there is some spread into some*
 39 *backcountry areas by a few noise sources such as the train whistle, a very generous estimate of the amount of*
 40 *spread would still keep the extent of such noise impact at less than 10% of the park. In contrast, noise generated*
 41 *by aircraft above and outside the SFRA can be heard in almost 100% of the park. High-altitude flights are often*
 42 *the lone human noise source in remote areas of the SFRA away from air-tour routes—the only reminder of*
 43 *civilization in otherwise very remote, primitive wilderness. When audible much of the time, and visible (lights*
 44 *and/or contrails), high-altitude flights diminish the opportunity for people to experience Grand Canyon's rare*
 45 *and remarkable natural quiet and solitude, even though the source of the sound and visual impact is far above.*
 46 *Aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) contribute by far the most prevalent non-natural*
 47 *noise over most of the park and SFRA; there are no areas in GCNP that are not adversely affected by aircraft*
 48 *noise some of the time.*

49
 50 *Differences in Cumulative Impacts between Alternatives are due mainly to differences in the Alternatives*
 51 *(Modified NPS Preferred Alternative compared to the other Alternatives). Noise sources (1 plus 2 plus 3) are*
 52 *generally not directly affected by the Alternatives, so their noise impact is considered Common to All Alternatives*
 53 *(Appendix D, Tables 43 to 70); however, their noise impact generally increases impacts of noise produced under*
 54 *Alternatives (Modified NPS Preferred Alternative in this case).*

1 *Impacts of Modified NPS Preferred Alternative are described in detail in previous sections, and summarized for*
 2 *Ten-Year Forecast in Conclusions below. In Appendix D, Tables 63 and 65 (Peak Season) and Tables 67 and 69*
 3 *(Off-Peak Season), noise produced by aircraft (1 plus 2 plus 4 Modified NPS Preferred Alternative) is detailed for*
 4 *Developed Zone, Non-Wilderness Zone, Wilderness Zone, and Entire Park, Base Year and Ten-Year Forecast.*
 5 *Noise from ground-based sources (3) was not able to be included in noise modeling for the EIS; however, since*
 6 *noise from ground-based sources affects less than 10% of the park, mostly Developed Zone areas (2% of the*
 7 *park), this is taken into account in interpreting Developed Zone Cumulative Impact results, and in interpreting*
 8 *localized Location Point results near unpaved roads, the Colorado River, and mining activity areas north of the park.*

9
 10 *Comparing noise impacts from just Modified NPS Preferred Alternative by itself (Appendix D Tables 36 (Peak*
 11 *Season) and 41 (Off-Peak Season) Ten-Year Forecast) versus All Aircraft (4 Modified NPS Preferred Alternative*
 12 *plus 1 plus 2) (Appendix D Tables 65 (Peak Season) and 69 (Off-Peak Season) Ten-Year Forecast) gives a good*
 13 *indication of the difference between Cumulative Impacts and the impacts of Modified NPS Preferred Alternative*
 14 *by itself. For the Entire Park Cumulative Impact results (Peak and Off-Peak Season Ten-Year Forecast), All*
 15 *Aircraft are audible 60% or more of the day in 83 to 85% of the park, with Average Sound Level 25 to <35 dBA*
 16 *in 86 to 91% of the park, with zero to 1% of the park below 25 dBA and 8 to 12% at 35 dBA or more. For the*
 17 *Entire Park results for Modified NPS Preferred Alternative by itself (Peak and Off-Peak Season Ten-Year*
 18 *Forecast), aircraft are audible 60% or more of the day in 3 to 6% of the park, with Average Sound Level 25 to*
 19 *<35 dBA in 5 to 10% of the park, with 75 to 81% of the park below 25 dBA and 6 to 9% at 35 dBA or more.*

20
 21 *These results primarily confirm that: (a) noise from cumulative sources is dispersed over the entire SFRA,*
 22 *including Flight-free Zones, whereas noise from Modified NPS Preferred Alternative is more concentrated under*
 23 *and near air-tour routes; (b) Cumulative Impacts increase the impacts of Modified NPS Preferred Alternative,*
 24 *and (c) reducing air-tour-and-related impacts under the Alternatives reduces Cumulative Impacts.*

25
 26 *Again, differences in Cumulative Impacts between Alternatives are most apparent in the detailed impact analysis*
 27 *sections and Conclusions described for each Alternative by itself, due mainly to differences in elements of each*
 28 *Alternative (route locations/number/altitudes/ quiet technology conversion, etc.). When added to noise impacts of*
 29 *the cumulative sources Common to All Alternatives described above (1 plus 2 plus 3), impact levels for each area*
 30 *described for Modified NPS Preferred Alternative would generally increase by one level as shown in the*
 31 *Cumulative Impacts discussion in the Conclusions section below.*

32
 33 **Conclusion** **Modified NPS Preferred Alternative** **Special Status Species**
 34 **Southwestern Willow Flycatcher**

35
 36 *Overall, SWFL would experience a general decrease in noise impacts based on the proposed action throughout*
 37 *surveyed habitat in the SFRA. Within Marble Canyon, where SWFL detections and confirmed nest sightings*
 38 *have been recorded, there would be a slight but beneficial reduction of air-tour impacts. West End, where SWFL*
 39 *detections and occupied territories have been declining, the Soundscape would remain largely unchanged from*
 40 *current conditions under the proposed action. However, adverse cumulative effects due to helicopters landing on*
 41 *Hualapai tribal lands south of the river, flights which are not affected by this EIS, will continue to increase*
 42 *without some controls on numbers of flights and behaviors such as flying unauthorized over park lands north of*
 43 *the river. NPS plans to work with FAA and the Hualapai tribe to control unauthorized behaviors, as well as to*
 44 *initiate another planning effort to address annual allocations, daily caps, and exceptions following the EIS process.*

45
 46 **Conclusion Marble Canyon** **Modified NPS Preferred Alternative** **Special Status Species**
 47 **Southwestern Willow Flycatcher**

48 *SWFL would not be disturbed by air-tour aircraft operations, and removal of flight routes would result in minor*
 49 *to moderate beneficial change in impacts as compared with Alternative A. There would be no air-tour aircraft*
 50 *visible from most points on the ground. Aircraft would be barely audible and at very low decibel levels.*
 51 *Improvements over current conditions would occur at all Marble Canyon Location Points.*

1 **Conclusion East End** **Modified NPS Preferred Alternative** **Special Status Species**
 2 **Southwestern Willow Flycatcher**
 3 **Air-tour aircraft East End would be farther away from points on the ground than Alternative A ranging from**
 4 **2,400 to 13,000 meters. Negligible to major impacts would continue East End with negligible to moderate**
 5 **beneficial impacts.**

6
 7 **Conclusion Central** **Modified NPS Preferred Alternative** **Special Status Species**
 8 **Southwestern Willow Flycatcher**
 9 **No SWFL nest sites or suitable nesting habitat have been documented in the Central geographic area; therefore,**
 10 **they would not be affected by air-tours in this area. Thus, Central is not analyzed for SWFL impacts.**

11
 12 **Conclusion West End** **Modified NPS Preferred Alternative** **Special Status Species**
 13 **Southwestern Willow Flycatcher**
 14 **The number of SWFL detected West End has remained under five individuals since 2002 (Sogge et. al. 1992,**
 15 **1993, 1994, 1997, Laczek-Johnson et. al. 2006, Palarino et al 2010). Deterioration of riparian habitat, primarily**
 16 **due to hydrological impacts from upstream management activities and drought events, is likely limiting**
 17 **availability of appropriate West End SWFL breeding territories.**

18
 19 **Noise impacts to SWFL from air-tour operations would continue at reduced, but similar, levels compared to**
 20 **current conditions under the proposed action and may contribute to the cumulative negative impact on the**
 21 **species in this area. Distance from all known SWFL nesting locations to proposed air-tour routes would remain**
 22 **the same. All slant Distances to known SWFL nest sites would be 0.6 mile or greater West End.**

23
 24 **Under Green-4 and Blue-2, there would be moderate to major adverse impacts with negligible to minor beneficial**
 25 **change in impacts compared to Alternative A.**

26
 27 **In areas near the Z-shaped Route (realigned Blue Direct) and Brown routes minor to moderate adverse impacts**
 28 **would continue with negligible to minor beneficial change in impacts from Alternative A. In areas under and**
 29 **near Sanup Flight-free Zone there would be negligible impacts with negligible change in impacts compared to**
 30 **Alternative A.**

31
 32 **Cumulative Impacts Summary** **Modified NPS Preferred Alternative** **Special Status Species**
 33 **Southwestern Willow Flycatcher**

34
 35 **As described in more detail in the Cumulative Impacts section above, Cumulative Impacts would tend to increase**
 36 **the impact levels for each area described above for Modified NPS Preferred Alternative by one level. That is,**
 37 **Ten-Year Forecast impacts in all three Zones (Developed, Non-Wilderness, Wilderness) and all four sections**
 38 **(Marble Canyon, East End, Central, West End) (would tend to increase to major adverse Cumulative Impacts**
 39 **under and near air-tour routes, and minor to moderate adverse Cumulative Impacts near the middle of the large**
 40 **Flight-free Zones. In comparison with the other Alternatives, Modified NPS Preferred Alternative ranks second**
 41 **behind Alternative E for the lowest overall Cumulative Impacts (Alternative A ranks last).**

42 **SOCIOECONOMIC ENVIRONMENT**

43 **General Methodology and Assumptions**

44
 45 Socioeconomic impact analysis includes impacts of Action Alternatives (E, F, and **Modified** NPS Preferred)
 46 compared to Alternative A for the following groups or categories

- 47 • Air-tour operators
- 48 • American Indian tribes
- 49 • General aviation
- 50 • Regional *economies*
- 51 • **Direct use and intrinsic** values

1 Areas Evaluated for Impacts

2
3 Areas evaluated for impacts are unique to each socioeconomic group listed above. These areas are defined as

4
5 **Air-tour Operators** Changes to each operators' tour characteristics and business operations (for example,
6 number of tours flown, tour routes, and times of day) could occur in the SFRA. Air-tour operators conducting tours
7 in the SFRA are based in locations surrounding GCNP, as described in Chapter 3, Socioeconomic Environment.
8 Financial impacts to operators might result in changes to employment and employee earnings, which could affect
9 economic conditions near the operator's base of operations. Employment and income impacts are generally grouped
10 into impacts to *Coconino County, Arizona* communities and *Clark County, Nevada* communities.

11
12 **American Indian Tribes** Impacts to various tribes include possible economic changes to tribal budgets and
13 populations living on reservations. Three American Indian tribes are discussed in Chapter 3, Ethnographic
14 Resources, each with unique land areas and tribal economies. Analysis of impacts on each tribe is limited to specific
15 land areas and characteristics of that tribe.

16
17 **General Aviation** Socioeconomic impact analysis for general aviation focuses on flights occurring through
18 the SFRA. Although general-aviation flights may originate from or land at any airport throughout the U.S.,
19 geographic area of impact analysis is limited to effects of SFRA changes. Financial impact to aircraft operators is
20 analyzed, and potential for effects on economic activity at the aircraft base of operations is discussed.

21
22 **Regional Economy** As described in Chapter 3, Socioeconomic Environment, air tour operations and
23 employees are predominantly based in *Coconino County, Arizona (Tusayan area) and Clark County, Nevada (Las*
24 *Vegas area)*. *The regional economic effects analysis focuses on these two areas.*

25
26 **Direct Use and Intrinsic Values of Grand Canyon National Park** This section addresses changes to direct-use
27 value, that value which visitors receive beyond actual expenditures, from their park visit. In addition, this section
28 considers changes to park intrinsic or non-use values attributed to the general population, which includes people
29 who may never visit the park.

30 Cumulative Impacts Socioeconomic Environment

31
32 In addition to prospective SFRA flight-rule changes considered in this EIS, there would be a host of potential events
33 and evolving trends that could affect parties addressed in this socioeconomic impact analysis including

- 34
35
36 • **Grand Canyon Air-tour Operators** This industry has evolved considerably and this evolution is likely to
37 continue. Marketing air-tours has become much more sophisticated with packaging and an international
38 orientation. Smaller operators have sold out to larger ones, and such consolidation is likely to continue until a
39 small number of large operators comprise the industry. Helicopters have gained a larger share of the overall
40 market. West End has experienced almost all the industry growth in recent years.
- 41
42 • **Hualapai Excepted Flights** As described in Chapter 3, Socioeconomic Environment, over the past decade
43 or more, the market for air tours, and the air-tour industry, have increasingly shifted to Las Vegas-based
44 flights to Grand Canyon West and the Hualapai Reservation. While the reported number of air-tour flights in
45 the SFRA requiring annual allocations has declined since year 2000, the reported annual number of Hualapai
46 excepted flights has more than doubled over this time period. Hualapai excepted flights appear likely to
47 continue to increase in the future and may grow even more rapidly in response to additional regulations
48 affecting flights requiring annual allocations.
- 49
50 • **Aircraft Technology** Helicopters and fixed-wing aircraft would continue to improve over time. EC-130
51 helicopters, a quiet-technology aircraft, have become a market preference among customers and some operators.
52 The shortage of EC-130 production ability should improve as production capability adjusts to the market and as
53 new aircraft options come on the market. Quieter, larger capacity, more efficient aircraft can be expected
54
- 55 • **National and International Economic Conditions** Economic conditions in the U.S. and abroad will
56 continue to be a primary determinant of park visitation, of air-tour demand, and American Indian reservation

1 tourism. Personal income growth, leisure preferences, foreign exchange rates, international relations, and fuel
 2 prices are all key influences. Tighter travel budgets might be evident in the future. Along with demographic
 3 changes, including growth, these phenomena will bring opportunities and challenges to tourism interests that rely
 4 on Grand Canyon's visitor draw
 5

- 6 • **Regional Economic and Demographic Growth** *Economies and populations of Coconino County, Arizona and Clark County, Nevada are projected to grow over the next decade and beyond irrespective of the socioeconomic effects described in this EIS. New or expanded airport facilities have recently been developed or are in progress to provide greater capacity for future air tours and other air operations at Tusayan, Arizona; Boulder City, Nevada; Grand Canyon West Airport, and in the Las Vegas Area, Nevada (see Appendix G).*
- 7
- 8
- 9
- 10
- 11
- 12 • **Consumer Preferences** U.S. and international traveler preferences will also determine demand for air
 13 tours and park and reservation visitation. In recent years, desire for a unique experience, activities combined in a
 14 package, and a premium on available time, have been important market determinants
 15
- 16 • **Other Cumulative Impacts** Changes related to tribal tourism enterprises other than SFRA flights can be
 17 expected. No projections of flight operations were made for tours that access Hualapai lands from outside the
 18 SFRA; these may or may not grow at the same rate as the GCNP air-tour industry. No projections were made for
 19 other activities occurring on any tribal lands
 20

21 In sum, prospective SFRA rules changes, while important from a *socioeconomic* standpoint, would represent a
 22 relatively minor determinant in activity levels and future prospects for air-tour operations, tribal tourism, and park
 23 visitation.
 24

25 **Socioeconomic Impact Uncertainties**

26 It is important to recognize uncertainties associated with socioeconomic impact estimates for this EIS. To estimate
 27 socioeconomic effects and impact intensity, it was necessary to make a host of assumptions, but these assumptions
 28 might lead to an understatement or overstatement of impacts. Assumptions include:
 29

- 30
- 31 • **Air-tour Industry Conditions** Impact assumptions and estimates are based on trends and industry conditions
 32 which existed *from 2000 through 2010, and on operator-specific information gathered* in 2007 and 2008. This is
 33 a volatile industry undergoing continuous change. Actual impacts will be determined in part by industry
 34 conditions at implementation and beyond
 35
- 36 • **Consumer Response to SFRA Rules Changes** Park air and ground visitors, along with nearby Native
 37 Americans, are subject to both temporary change (i.e., *economic cycles*) and long-term change (i.e., *tastes and*
 38 *preferences*). These *varying* consumer characteristics might *cause* responses to *EIS Alternatives* to change in
 39 unpredictable ways
 40
- 41 • **Operator Responses to SFRA Rule Changes** Although operators indicated their likely response to specific
 42 rule changes during EIS research, they might act differently following implementation, perhaps in response to
 43 unexpected market conditions or business opportunities elsewhere. *Current operators may be replaced by others*
 44 *as the industry continues to consolidate*
 45
- 46 • **Tribal Decisions** Tribal governance and regulation of *tribal-related* air-tour industry will ultimately be
 47 determined by tribal leaders. Their interest in expanding or contracting the air-tour industry, their fee structure,
 48 and development of supporting tourist facilities is fully under respective tribal discretion
 49

50 *Most socioeconomic* impact estimates in this EIS are point estimates. Actual impacts could differ from those
 51 projected (higher or lower). A range of impact estimates was not used since no probabilities could be assigned to
 52 that range; such a range would not be defensible. *However, regional economic impact analyses do provide a range*
 53 *of estimated job impacts based on differing assumptions regarding the geographic distribution of impacts to the*
 54 *air-tour industry and its employees in Coconino County, Arizona and Clark County, Nevada.*
 55

1 Recognizing the challenge of gathering information from parties affected by eventual rule changes and inherent
 2 uncertainties, the EIS study team made a considerable effort to maintain objectivity in *socioeconomic* impact
 3 estimates. *The socioeconomic effects estimates present a “conservative” view, intended to ensure that the analysis*
 4 *does not underestimate potential effects on the air-tour industry or the regional economy.*
 5

6 Over time, intensity of impacts from each Alternative would diminish for two reasons. Cumulative influences on the
 7 Grand Canyon tourism industry would predominantly drive economic and social changes. Secondly, air-tour
 8 operators, general-aviation participants, and tribal interests would adjust to SFRA rules changes as best they can, to
 9 both reduce adverse impacts and take advantage of opportunities.

11 Impact Intensity Threshold Descriptions

Socioeconomic Environment

13 Threshold Levels

15	<i>Negligible</i>	Air-tour Operators Changes in air-tour operations have little effect on profitability of individual air-tour businesses or financial viability of the local air-tour industry
17		
18		American Indian Tribes, General Aviation, Regional Economy Effects on tribes, general aviation, adjacent landowners, businesses, governmental agencies, communities, infrastructure, and social and economic conditions, including relationships with local communities, tribes, or businesses, so small to be barely detectable or affect a very small population.
20		
21	<i>Minor</i>	Air-tour operators Changes in air-tour operations measurably affect some air-tour businesses, and would not be expected to affect financial viability of individual businesses or the local air-tour industry
23		
24		American Indian Tribes, General Aviation, Regional Economy Effects on tribes, general aviation, adjacent landowners, businesses, government agencies, communities, and social and economic conditions, including relationships with local communities, tribes, or businesses, relatively small, but detectable, and affect a small number of people
26		
27	<i>Moderate</i>	Air-tour operators Changes in air-tour operations affect many air-tour businesses, or have effect at local air-tour industry level, and might affect financial viability of a small number of individual businesses, but not the local air-tour industry
29		
30		American Indian Tribes, General Aviation, Regional Economy Effects on tribes, general aviation, adjacent landowners, businesses, governmental agencies, communities, and social and economic conditions, conditions, including relationships with local communities, tribes, or businesses, clearly evident in the Study Area, affecting a population segment and/or local businesses
32		
33	<i>Major</i>	Air-tour operators Changes in air-tour operations substantially affect any air-tour businesses or have a widespread effect on the local air-tour industry, or expected to affect financial viability of many individual businesses or the local air-tour industry
35		
36		American Indian Tribes, General Aviation, Regional Economy Effects on tribes, general aviation, adjacent landowners, businesses, governmental agencies, communities, and social and economic conditions, conditions, including relationships with local communities, tribes, or businesses, apparent in the study area, affecting a large segment of the population and/or many local businesses.
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		

51 Duration

52

53 *Short Term* Impacts *during the first five years following implementation of new provisions to manage air-tour operations at Grand Canyon*

54

55 *Long Term* *Projected impacts five to ten years following implementation of new provisions*

56

1 **Context**

2
3 *Localized* Impacts affect one to a few of the communities *near* the SFRA *or servicing the SFRA*

4
5 *Regional* Impacts affect *numerous* communities *near or servicing* the SFRA and/or other nearby airports
6 and their associated gateway communities

7
8 **Air-tour Operators**

Socioeconomic Environment

9
10 **Methodology and Assumptions for Analysis of Impacts to Air-tour Operators**

11
12 Economic impacts were *estimated based on the estimated effects of each component of the Action Alternatives*
13 *(e.g. seasonal scheduling or route changes) on each air-tour operator's flights and operations based on*
14 *interviews and data collected in 2007/2008. These impacts were* then aggregated to provide a summary of impacts
15 to the industry as a whole. Air-tour operators would experience *socioeconomic* changes from each Alternative
16 resulting from *the* combination of changes to specific components of each Alternative. Impacts to each operator's
17 business environment and finances would mainly be due to changes in *available flight opportunities*, demand for
18 flights, resulting impact on flight operations, and changes in cost of doing business to a lesser extent. Potential
19 *socioeconomic* impacts include changes in Grand Canyon-related flight operations, passenger volume, operator
20 revenues and costs; changes in operator employment and resulting personal income; financial viability; and resulting
21 impacts on local economy. *Impacts on the regional economy are discussed in detail in the regional socioeconomic*
22 *impacts section.* This section of the *socioeconomic* impact analysis describes impacts of each Alternative attribute
23 and specific impacts by Alternative. This section also provides a quantitative analysis of predicted *socioeconomic*
24 effects on the overall air-tour industry with specific discussion of impacts by location, where applicable. *The*
25 *impacts from the Action Alternatives are a comparison to the projected conditions that would result from*
26 *Alternative A.*

27
28 **Data Sources**

Air-Tour Operators

Socioeconomic Environment

29
30 Analysis of impacts to air-tour operators for each Alternative is based on data and information about the Grand
31 Canyon air-tour industry gathered from the FAA and through in-depth interviews with each tour operator (Harvey
32 Economics 2008ab). FAA provided background on the industry, data on operations, and information about specific
33 aircraft characteristics. FAA also provided information on operations for 2005 *and 2008, and daily flight totals for*
34 *2003*, as well as quarterly summaries of total operations 2000 through 2009. This information provided a foundation
35 in terms of annual numbers of flight operations by flight type, aircraft type, and location. *The impact analysis also*
36 *takes into account more recent data on the number of flights by season and location, and long-term data on the*
37 *air-tour industry since the 1980s.*

38
39 Interviews with operators provided information about annual operations, passenger volume, employment, and
40 financial conditions. Grand Canyon air-tour industry dynamics as of 2007 and 2008 were also discussed. Operators
41 provided insight into the air-tour industry, and also provided general information about how they would respond to
42 specific attributes and Alternatives. Two sets of interviews occurred with each of 13 active operators (one operator
43 was inactive at the time of interviews). The first interview round occurred April and May 2007, and focused on
44 gathering information about each operator's business and likely impacts they anticipated from Alternatives B
45 through F. Although Alternatives B, C, and D were subsequently eliminated, valuable information was gathered
46 from discussions of those Alternatives in terms of how operators would respond to various changes in SFRA
47 attributes since certain of those attributes became part of the *DEIS* NPS Preferred Alternative *and the Modified*
48 *NPS Preferred Alternative.* In addition to air-tour operators, a representative of the Hualapai Tribe and two
49 consultants knowledgeable about the air-tour industry were also interviewed in spring 2007. Each of these personal
50 interviews were conducted over the course of several hours, and follow-up contact was initiated, if necessary, to
51 obtain additional data or gain clarification on specific points (Harvey Economics 2008 a,b)

52
53 A similar, second set of interviews was conducted with each air-tour operator October and November 2008; these
54 focused on operator responses to attributes of Alternative G; this Alternative was also subsequently eliminated from
55 consideration as part of this EIS. However, valuable information was gained from these interviews regarding
56 industry workings and likely responses of operators to various types of changes, since certain attributes of this

1 Alternative became a part of the *DEIS* NPS Preferred Alternative *and the Modified NPS Preferred Alternative*.
 2 These interviews were conducted over the phone, and each interview generally occurred over several hours (Harvey
 3 Economics 2008d).

4
 5 Knowledge of the air-tour industry coupled with information on operators' responses to Alternative-specific details
 6 provided the basis for *estimating short-term impacts on the* air-tour operator impact analysis. Although no
 7 interviews were conducted with operators specifically to discuss the *DEIS* NPS Preferred Alternative *and the*
 8 *Modified NPS Preferred Alternative*, information gathered from previous interviews was applied to *DEIS* NPS
 9 Preferred Alternative *and the Modified NPS Preferred Alternative* analysis. *Short-run changes* in flight operations
 10 in each Alternative were estimated based on information gathered from operator interviews and other available
 11 industry data. Development of these flight-operations estimates are discussed below. Estimates of changes to
 12 passenger volume, operator finances and financial viability, and employment and personal income were based on
 13 flight operations data for each Alternative.

14
 15 *Additional analysis was conducted between the Draft EIS and the Final EIS regarding the Modified NPS*
 16 *Preferred Alternative, to account for certain modifications to that Alternative during this time period. This*
 17 *analysis included further evaluation of potential effects by route and by season.*

18
 19 **Analysis Time Periods and Air-Tour Operators Socioeconomic Environment**
 20 **Growth Estimates**

21
 22 Analysis of impacts to air-tour operators was completed for two time periods for each Alternative: Base Year and
 23 Ten-Year Forecast. Ten-Year Forecast analyses incorporate air-tour industry annual growth assumptions. The
 24 FAA's Statistics and Forecasting Branch developed an estimate of 1.3% annual growth for the GCNP air-tour
 25 industry and flight operations.⁶¹ The estimated growth rate was agreed on by NPS and FAA for the purpose of this
 26 EIS (Volpe 2006).

27
 28 Projected conditions for each Alternative were compared with that Alternative's Base Year and to Alternative A's
 29 Ten-Year Forecast.

30
 31 **Flight Operations in the SFRA Air-Tour Operators Socioeconomic Environment**

32
 33 Percentage changes Base Year (*first year following new regulations*) for Action Alternatives were developed based
 34 on specific attributes of each Alternative, operator responses to those attributes, and knowledge of the overall air-
 35 tour industry (Harvey Economics 2008a and 2008b). Components of each Alternative are described in detail in
 36 Chapter 2. A general description of impacts to air-tour operators resulting from changes to each Alternative
 37 component is outlined below. *Projected effects from individual components are not necessarily additive because*
 38 *they may apply to different portions of the overall air-tour industry (e.g. only East End flights, all flights*
 39 *requiring annual allocations, etc.) and because they were applied sequentially.*

40
 41 *Long-term projections of changes in flight operations (Ten-Year Forecast) were based on projected adaptation of*
 42 *the air-tour industry and the air-tour market to provisions under each Alternative. The rate of adaptation was*
 43 *based on historical experience with regulatory changes, particularly following the late 1980s implementation of*
 44 *the Overflights Act.*

45
 46 **Seasonal Curfews Air-Tour Operators Socioeconomic Environment**
 47 **Flight Operations in the SFRA**

48
 49 East End seasonal curfew indicates allowable hours of operation for fixed-wing and helicopter air-tours on East End
 50 routes. Curfew times change depending on time of year, generally with longer hours of flight time available in late
 51 spring, summer, and early fall, and shorter hours in other months. Generally, the longer the available flight times,
 52 the better for tour operators; however, operators prefer to fly in morning hours for several reasons including more
 53 stable air conditions for flying, and opportunity for coordination with land-based visitor activities such as bus tours.

⁶¹ Annual growth estimate is based on FAA forecasts of air-taxi operations for three airports with towers that serve GCNP. Air-tours are included in air-taxi operations. Air taxi operations do not include larger commercial operations

1 Therefore, extended (or curtailed) curfew hours in the morning generally have more impact on operators than
 2 changes in evening curfew hours. This is especially relevant in winter with earlier darkness; late evening tours are
 3 not possible due to lack of visibility. However, several operators rely on running afternoon tours to coordinate with a
 4 larger tour package (i.e., ground tours). There are no curfews on West End routes.

- 5
- 6 • **Alternatives A and F** would not include any changes to the existing seasonal curfew

- 7
- 8 • **Alternative E** Curfew is linked to sunrise and sunset, which would have an adverse impact on tour
 9 operations. There is also potential for confusion by both operators and air-tour visitors about curfew hours as
 10 sunrise and sunset times change over the year. Curfew hours would change almost daily, affecting flight
 11 operation hours on a continuous basis. Linkage to sunrise would also make it difficult to coordinate air-tours
 12 with land-based activities. In addition, non-quiet-technology aircraft would be required to hold off flights for an
 13 additional 1.5 hours in morning, and 2.5 hours in evening, reducing operations even further. The one-hour mid-
 14 day curfew would also have an adverse impact on operators. Some flights would be re-scheduled for times
 15 outside the curfew, but many flights would be lost. A 15% reduction in flight operations was applied to East
 16 End tour operations to account for effects of curfew changes in Alternative E

- 17
- 18 • **Modified NPS Preferred Alternative** A fixed, seasonal curfew would apply to the entire East End. *April 1*
 19 through *November 14* flight times would be 8 a.m. to 5 p.m.; *November 15* through *March 31* flight times
 20 would be 9 a.m. to 4 p.m. Flight times would be reduced by one hour in the afternoon, year-round, compared to
 21 Alternative A. Loss of available Off-Peak Season flight time would have an adverse impact on two operators
 22 who offer late afternoon tours. Based on loss of tours for those operators, a 3% reduction in flight operations
 23 was applied to East End tour operations to account for effects of curfew changes in the **Modified NPS Preferred**
 24 **Alternative**

25

26 <i>Annual Allocation of Tour Operations</i>	<i>Air-Tour Operators</i>	Socioeconomic Environment
27 Flight Operations in the SFRA		

28

29 Currently, each tour operator has a certain number of air-tour annual allocations for SFRA operations, meaning each
 30 operator is authorized to fly a specific **annual** number of SFRA **commercial air-tour** flights. Aggregate annual
 31 allocations for air-tour operations are currently set at a total 93,971. Each operator can use their annual allocations
 32 on existing routes throughout the year on any days they choose, and there is no daily cap on number of tours flown.
 33 As described in Chapter 3, Socioeconomic Environment, the GCNP air-tour industry is a seasonal business, with a
 34 greater number of operations occurring in summer, and a lesser number in other months.

- 35
- 36 • **Alternatives A and F** would not include any changes to annual allocations

- 37
- 38 • **Alternative E** Includes the current annual allocation (93,971 flights) with a daily cap of 364 flights,
 39 including all air-tours and air-tour-related operations. The air-tour business is highly seasonal for most
 40 operators; the majority of tours flown and revenue generated occurs during summer season. ***Between 2005 and***
 41 ***2009, the number of daily air tours (excluding support flights and Hualapai excepted flights) exceeded the***
 42 ***proposed cap of 364 flights only once, on August 11, 2008 (366 air tours). The proposed daily cap could lead***
 43 ***air-tour operators to shift support flights outside the SFRA during busy periods and could also require***
 44 ***rescheduling some air-tour flights to spread out peak activity levels if the industry grows substantially in the***
 45 ***future. Additionally, daily caps and annual allocations are likely to result in operators becoming more***
 46 ***reluctant to trade or lease daily caps and annual allocations to each other on the chance they would be***
 47 ***needed at some point in the year, potentially limiting operations of some tour companies. Risk and***
 48 ***uncertainty discourage business activities, especially capital-intensive businesses such as air tours. For these***
 49 ***reasons, a flight-operations reduction of 7% was applied to SFRA commercial tour operations Peak Season***
 50 ***to account for daily cap and annual allocation system effects in Alternative E.***

- 51
- 52 • **Modified NPS Preferred Alternative** Includes a daily cap of 364 commercial air-tours, and an
 53 annual **allocation** of 65,000 air-tours **and air-tour related flights**. All air-tour-related operations (**except limited**
 54 **training and maintenance flights**) would occur outside the SFRA **or would need to use an annual allocation**
 55 **to fly in the SFRA**, and flights in the SFRA in support of the Hualapai would **not be subject to** annual

1 allocations and caps. *In addition, quiet-technology aircraft operations would not be required to use annual*
 2 *allocations January 1 to March 31 each year.* Air-tour operators in the aggregate are operating substantially
 3 below the daily cap and annual allocation now, but individual operators might be much closer than others.
 4 Operators would not necessarily be subject to individual daily caps if the total daily cap was not exceeded, but
 5 would be required to adhere to their annual allocation. An adaptive management approach would be taken by
 6 the NPS to monitor and manage SFRA sound levels. In the *Modified* NPS Preferred Alternative, there is some
 7 uncertainty regarding how the daily cap would be implemented and enforced and whether a reduction in flights
 8 would occur to reach target sound levels. Additionally, daily caps and annual allocations are likely to result in
 9 operators becoming more reluctant to trade or lease caps and annual allocations to each other on the chance they
 10 would be needed at some point in the year, potentially limiting operations of some tour companies. Risk and
 11 uncertainty discourage business activities, especially capital-intensive businesses such as air tours. For these
 12 reasons, a flight-operations reduction of 7% was applied to SFRA commercial tour operations Peak Season to
 13 account for *daily cap and* annual allocation system effects in the *Modified* NPS Preferred Alternative. *Given*
 14 *the smaller number of flights occurring outside Peak Season, no* reductions were applied to operations Off-
 15 Peak Season as a result of the modified annual allocation system. *In aggregate, air tours requiring annual*
 16 *allocations are not projected to reach the proposed annual cap of 65,000 tours, or the proposed daily cap of*
 17 *364 air tours, within the Ten-Year Forecast period based on the 1.3% annual growth rate assumed for this*
 18 *analysis.*

20 Changes to Tour Routes 21 Flight Operations in the SFRA

Air-Tour Operators

Socioeconomic Environment

23 Action Alternatives include various changes to fixed-wing and helicopter air-tour routes, including route length,
 24 route movement over different areas of the canyon, or route elimination. Changes to each route for each Alternative
 25 are described in Chapter 2. Tour aspects most appreciated by customers include time over the canyon and landscape
 26 features and scenery viewed during flight. Shortened flight times, changes to route locations, or reduction in number
 27 of different tour options offered could impact air-tour marketability, reducing operations. Elimination of routes that
 28 serve as entry points for certain operators would also reduce air-tour operations. A general description of route
 29 changes follows, with a projection of anticipated operator responses.

- 31 • **Alternative A** would not include any changes.
- 32
- 33 • **Alternative E** Marble Canyon fixed-wing routes and East End southern-entry fixed-wing routes would
 34 be eliminated. Additionally, only one East End short-loop route would be available for helicopters and fixed-
 35 wing aircraft during the year, and all long-loop route options would be eliminated. These changes would
 36 substantially limit tour options available to operators, and could reduce East End tour marketability. Impacts to
 37 individual operators would vary, depending on which routes they use, how they use them, and on operator-
 38 specific business characteristics. However, overall reduction in East End route operations due to route changes
 39 would amount to about 21%. Blue Direct routes would be modified, but no change in operations would be
 40 expected as a result. No West End tour routes would be modified in Alternative E; therefore, no changes in
 41 West End flight operations would be expected
- 42
- 43 • **Alternative F** Changes in East End routes would be slight compared to Alternative A. Flights in
 44 Nankoweap basin would be eliminated, and modified routes would occur in Dragon Corridor December and
 45 January. These minor changes would not have any impact on number of East End flight operations. Operations
 46 on Blue Direct routes would shift somewhat due to quiet technology and directional flight restrictions on Blue
 47 Direct North. Overall operations on Blue Direct routes would increase by about 12% due to the more attractive
 48 Blue Direct North. West End helicopter routes would be modified to eliminate Green-4's southern portion,
 49 reducing overall West End helicopter operations by about 4%
- 50
- 51 • **Modified NPS Preferred Alternative** Southern fixed-wing entry routes and Black-3 entry route from
 52 the east would be eliminated which would result in small reductions of operations on other East End fixed-wing
 53 routes. *Both Dragon and Zuni Point Corridor short-loop options and the long-loop option would be available*
 54 *during Peak Season (April 1-November 14) for both fixed-wing aircraft and helicopters, while only the*
 55 *Dragon Corridor short-loop option would be available during Off-Peak Season (November 15-March 31) for*

1 **both fixed-wing aircraft and helicopters.** These options are important from a marketability standpoint in
 2 attracting a variety of customers. **Marble Canyon fixed-wing routes would be eliminated, though flights taking**
 3 **passengers from Grand Canyon National Park Airport to Page would be able to fly outside the SFRA and**
 4 **could take a flight path more direct than the current route in the SFRA though it could be more difficult to**
 5 **market as an “air tour.”**

6
 7 The single **Z-shaped Route (realigned Blue Direct)** included in the **Modified NPS Preferred Alternative** would
 8 accommodate all operations **currently** flown on Blue Direct North and South in Alternative A; no change in
 9 overall cross-canyon operations would occur. West End routes would **be the same as described in Alternative A**
 10 **and therefore, no changes would occur** in flight operations. Overall, flight operations would be reduced by
 11 about 9% due to **Modified NPS Preferred Alternative** route changes

13 Seasonal Route Scheduling 14 Flight Operations in the SFRA

Air-Tour Operators

Socioeconomic Environment

15 Action Alternatives include seasonal route scheduling on some East End routes.

- 16
- 17 • **Alternative A** does not include seasonal route scheduling
- 18
- 19 • **Alternative E** All East End tours would take place in Dragon Corridor September 16 to June 30, and in
 20 Zuni Point Corridor July 1 to September 15. Availability of only one corridor at any time of the year would
 21 limit both offered tour options and tour marketability. Reductions of 25 to 75% were applied to specific
 22 operators, depending on routes each currently uses, to account for changes in East End air-tour routes including
 23 seasonal route scheduling
- 24
- 25 • **Alternative F** includes use of a modified Dragon Corridor, located west of the current corridor, December and
 26 January. Flight distances and times on specific routes would be lengthened December and January, when the
 27 modified corridor would be in use, but use of the modified corridor would not affect number of tour operations.
 28 The same tour opportunities would exist December and January as during other times of year; certain routes
 29 would just be located in a slightly different location. No reductions were applied to flight operations as a result
 30 of Alternative F's seasonal route scheduling
- 31
- 32 • **Modified NPS Preferred Alternative** Dragon Corridor would be open for short-loop flights **year-**
 33 **round, while** Zuni Point Corridor **would be available** for short-loop flights **only Peak Season (April 1 through**
 34 **November 14)**. The long-loop route between Zuni Point and Dragon Corridors would be open **during Peak**
 35 **Season only and would only be available** to quiet technology aircraft **after a four-year transition period.**
 36 **Based on current distribution of flights among these East End route options, a 10% reduction was estimated**
 37 **for East End flights in the short term (Base Year).**

39 Changes to SFRA Boundaries and Flight-free Zones

40 Flight Operations in the SFRA

Air-Tour Operators

Socioeconomic Environment

- 41
- 42 • **Alternative A** does not include boundary changes
- 43
- 44 • **Alternative F.** The SFRA notch (the notch) around Grand Canyon West Airport would be modified to protect
 45 specific areas important to the Hualapai. This change would have a large impact on one operator, substantially
 46 reducing the operator's SFRA operations, and reducing overall West End helicopter flights by about 5%
- 47
- 48 • **Alternative E and the Modified NPS Preferred Alternative** would raise all Flight-free Zone ceilings to
 49 17,999 feet MSL; no flights would be allowed below that altitude in Alternative E. **Exceptions are provided in**
 50 **the Modified NPS Preferred Alternative for certain operations in transit and administrative flights.**
 51 Additionally, **Alternatives E, F, and the Modified NPS Preferred** include a variety of changes to other SFRA
 52 Flight-free Zone boundaries. However, air-tours occur on defined air-tour routes outside Flight-free Zones;
 53 changes to ceilings or other boundaries of these zones would not affect number of air-tour operations in any
 54 Alternative
- 55

1 Quiet-technology Conversion and Incentives

2 Flight Operations in the SFRA Air-Tour Operators Socioeconomic Environment

3 Action Alternatives include requirements for conversion to quiet-technology aircraft.⁶² Many operators have already
4 converted some or all of their fleets to quiet-technology aircraft. However, quiet-technology conversion
5 requirements potentially place financial pressure on operators that currently fly non- quiet-technology aircraft.
6 Operators may be unable to finance new aircraft in a specified time frame or may be unable to acquire aircraft
7 necessary to completely change their fleet to meet demand if the wait for quiet-technology aircraft is lengthy.
8 Smaller operators may be disproportionately affected by these requirements.

- 9
- 10 • **Alternative A** does not include conversion requirements
- 11
- 12 • **Alternative E** Conversion time frame defined only as “by an agreed upon date,” which makes operator
13 planning somewhat difficult. *For purposes of analysis, it was assumed full conversion would take place*
14 *within ten years.*
- 15
- 16 • **Alternative F** Includes a 10- to 12-year conversion time frame
- 17
- 18 • **Modified NPS Preferred Alternative** Requires full conversion within ten years of implementation
- 19

20 For purposes of this EIS, a ten-year conversion time frame from implementation has been assumed for all *Action*
21 *Alternatives*. Impacts of conversion to quiet-technology aircraft vary by operator, depending on a number of factors,
22 including current fleet composition and capabilities to finance fleet conversion. *Based on 2005 and 2008 Peak Day*
23 *data regarding specific routes and aircraft, it was estimated that 39% of flights in the SFRA used quiet-*
24 *technology aircraft in 2008, compared to just 28% in 2005. At this rate of conversion, approximately 50% of all*
25 *flights in the SFRA in 2011 were likely flown by quiet-technology aircraft, and quiet-technology aircraft are*
26 *projected to make up 75% of the air-tour fleet by about 2023 (the end of the Ten-Year Forecast period) under*
27 *Alternative A.*

28

29 Action Alternatives (E, F, and the *Modified NPS Preferred*) also include a variety of quiet-technology incentives as
30 described in Chapter 2. Incentives *vary by Alternative, but include provisions such as* routes 1) open only to quiet-
31 technology aircraft or 2) open only to quiet-technology aircraft for a specific part of the day. Until quiet-technology
32 conversion is complete, operators flying quiet-technology aircraft would benefit from additional flight time,
33 especially in morning, or from monopoly of specific routes. Air traffic would be lessened, at least initially, due to
34 fewer aircraft and because quiet-technology aircraft tend to have increased passenger capacity, thereby providing
35 benefits to the customer. Non-quiet-technology operators would be required to re-route tours or ground aircraft
36 during quiet-technology-only hours, which would impact operations. Alternative F also includes overflight fee
37 forgiveness for quiet-technology aircraft, which would provide a financial benefit to operators, but would not likely
38 affect number of operations, which is generally driven by customer demand. In addition to quiet-technology routes,
39 the *Modified NPS Preferred Alternative* also eliminates *the requirement to use* annual allocations for quiet-
40 technology flights January 1 to March 31.⁶³ Lifting the annual allocation requirement during this period would be
41 somewhat helpful to operators in that they would be able to use those annual allocations during other, perhaps
42 busier, times of year; however, in combination with daily caps, the impact of this incentive becomes uncertain.
43 *Under all Action Alternatives, 100% conversion to quiet-technology equipment is assumed achieved by the end of*
44 *the Ten-Year Forecast period.*

46 Flight Operations Estimates, Base Year

47 Flight Operations in the SFRA Air-Tour Operators Socioeconomic Environment

48

49 Percent changes described above were applied to Base Year operations data for Alternative A to estimate number of
50 flight operations for Action Alternatives' Base Year. *These Base Year effects estimates essentially provide a worst-*
51 *case view of impacts on the air-tour industry short term. As described previously, effects estimates were developed*
52 *by considering potential impacts of proposed regulatory changes on each operator's existing flight schedule as of*

⁶² Aircraft designated quiet-technology aircraft for SFRA use are described in Chapter 3, Socioeconomic Environment

⁶³ Subject to monitoring to ensure legal noise provisions are met

1 *2007/2008 and were based, in part, on input from air-tour operators during interviews prior to the DEIS. Little*
 2 *allowance was made for potential to substitute flights (e.g. shift flights that would occur after evening curfew to*
 3 *earlier hours during the day or shift flights from routes that would not be available during certain seasons to*
 4 *routes that would be available). No allowance was made for potential adjustments by the air-tour industry prior to*
 5 *implementation of Action Alternatives, though the time needed to complete the rulemaking process is likely to*
 6 *allow the industry at least a year to begin to make adjustments between the Record of Decision on this EIS and*
 7 *actual implementation of the provisions of any of the Action Alternatives. Adjustments by the industry in*
 8 *anticipation of implementation would likely result in smaller Base Year effects than described in this analysis.*
 9

10 **Flight Operations Estimates, Ten-Year Forecast**

11 **Flight Operations in the SFRA** **Air-Tour Operators** **Socioeconomic Environment**

12
 13 Estimates of flight operations, Ten-Year Forecast, incorporate Base Year impact on flight operations for that
 14 Alternative, a 1.3% annual growth rate, and conversion of all non-quiet-technology aircraft to quiet-technology *by*
 15 *the end of the Ten-Year Forecast period.* The annual growth rate was applied to Base Year operations for each
 16 Alternative; subsequently, conversion of operations from non-quiet-technology aircraft to quiet-technology was
 17 applied. Conversion ratios are documented in Volpe (2006), and passenger seat information in FAA (2008). Quiet-
 18 technology aircraft are generally larger than non-quiet-technology aircraft models that fly over the park, and
 19 therefore, quiet-technology conversion would result in a reduction in number of flights with the same customer
 20 demand *and same capacity utilization.*⁶⁴
 21

22 For Action Alternatives in which conversion to quiet-technology aircraft would be required operator financial
 23 capability to make those conversions was incorporated into the analysis. Revenue, expenditure, and debt service
 24 obligation data obtained from operators were weighed against capital costs of quiet-technology aircraft, changes in
 25 operating costs, and the market effect of flying tours on quiet-technology aircraft.
 26

27 *The Ten-Year Forecast also reflects estimates of the rate at which the market and the air-tour industry would*
 28 *adjust to the new regulatory requirements under each Action Alternative. As described in Chapter 3,*
 29 *Socioeconomic Affected Environment, the air-tour industry and market required about five years to recover to*
 30 *pre-regulatory levels of activity following implementation of the Overflights Act during 1987/1988. A similar five-*
 31 *year recovery period was projected for the Modified NPS Preferred Alternative. Under Alternative F, which*
 32 *involves relatively minor changes and minimal Base Year effects, the market and industry were projected to*
 33 *recover within three years following adoption of new regulations. For Alternative E, which is projected to have*
 34 *more profound short-term effects on the market and air-tour industry, it was estimated that 50% of Base Year*
 35 *reduction in air-tour operations would be recovered by the end of the first five years following new regulations.*
 36 *The 1.3% annual growth rate in flight operations was applied to each Alternative following the recovery period.*
 37

38 *Basing projected air-tour industry and market recovery on the experience following Overflights Act*
 39 *implementation again provides a worst case view of potential effects on the industry. The types of changes*
 40 *incorporated in any of the Action Alternatives for this EIS are modest compared to changes that resulted from*
 41 *Overflights Act implementation.*
 42

43 *The analysis compares Ten-Year Forecast flight operations (and other air-tour-related metrics) for each Action*
 44 *Alternative to the Ten-Year Forecast under Alternative A to evaluate long-term effects on the air-tour industry.*
 45 *Ten-Year Forecast flight operations for each Alternative are also compared to Alternative A Base Year to provide*
 46 *further perspective.*
 47

48 **Passenger Volume** **Air-Tour Operators** **Socioeconomic Environment**
 49 **Flight Operations in the SFRA**

50
 51 The ratio of passengers per flight for each operator in Alternative A was held constant Base Year for other
 52 Alternatives to estimate passenger volume. For example, if an operator averaged 5.5 persons per flight in Alternative

⁶⁴ *Capacity utilization refers to how many passenger seats in an aircraft are filled.* The EC-130 is larger than *commonly used* non-quiet-technology helicopters by one passenger seat. The fixed-wing Vistaliner is larger than most non-quiet-technology models by several seats, or more, when compared to smaller Cessna models commonly flown on East End

A that ratio was applied to the number of flights for that same operator in other Alternatives. Ten-Year Forecast Alternative A (no required quiet-technology conversion), passenger volume for each operator was increased by 1.3% per year along with number of flights. Ten-Year Forecast for Action Alternatives (quiet-technology conversion required), aircraft load factors (number of passengers on a flight as a portion of number of available seats) specific to aircraft type and route were applied to projections of flight operations for each Alternative (accounting for annual growth and quiet-technology conversion) to calculate passenger volume.

Total Gross Revenue, GCNP Flights
Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

The ratio of gross revenue per passenger for each operator in Alternative A was held constant Base Year and Ten-Year Forecast for Action Alternatives; that is, unit prices were held constant. Financial viability was based on assessment of changes in business volume largely attributable to tour marketability, flight time capability, and access to the canyon compared to individual company financial conditions to the extent known.

GCNP-Related Employment and Employee Personal Income
Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

Ratios of GCNP-related employment to flight operations and *passenger enplanements* and employee personal income per employee in Alternative A were held constant for Base Year and Ten-Year Forecast in Action Alternatives. Current ratios of employment to flight operations *and passenger enplanements* are assumed to reflect normal business conditions for each tour operator; in Alternatives E, F, and the *Modified NPS Preferred*, operators would be expected to adjust *the* number of employees with *changes in the* number of *tour operations and passenger enplanements*. Wage levels per employee are not expected to change as a result of any Alternative, therefore ratio of personal income per employee is assumed to remain constant.

Total Operating Costs
Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

In addition to wage data, certain operators also provided information on annual operating costs. Operating costs include items such as aircraft rental or debt service, fuel, insurance, maintenance, commissions, advertising, landing fees, and other expenses. These costs are unique to each operator, depending on specific conditions. Due to number of operators that did not make operating cost data readily available, a comprehensive analysis of impacts to operating costs was not conducted for the industry. However, a more general, qualitative analysis of changes in operating costs due specifically to changes in routes is estimated for each Alternative.

According to operator interviews, operating costs largely vary directly with business volume. Changes in operating costs as a result of additional flight time and distance were based on information gathered from operators. Increased operating costs from additional flight time would reduce profitability, but these increased costs were not found to threaten operator viability.

Impacts by Alternative
Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

Socioeconomic impact analysis for each Alternative incorporates effects of each component discussed above into an overall impact to the industry. Base Year *socioeconomic* impacts represent impacts to the industry at selected Alternative implementation; Ten-Year Forecast impacts also incorporate quiet-technology conversion requirements, assuming a ten-year conversion timeframe for all Alternatives, *market and industry adjustments to the new regulations under each Alternative* and assumptions of annual industry growth. Tables 4.268 to 4.271 show impact conclusions for each Alternative on *socioeconomic* elements and activities and are provided at the end of the analysis.

It is important to note that Hualapai excepted flights comprise approximately 40% of the air-tour industry as of 2012. These flights would continue to be excepted, and would not be directly affected by, each Alternative evaluated in this EIS.

ALTERNATIVE A NO ACTION SOCIOECONOMIC ENVIRONMENT
AIR-TOUR OPERATORS

Air-Tour Operators Alternative A Socioeconomic Environment
Base Year

Alternative A Base Year economic impacts reflect current conditions as described in Chapter 3 for the air-tour industry and air-tour operators. There would be no change in rules or regulations regarding SFRA air-tour flights, and therefore, air-tour operators would not experience any changes in flight operations or financial conditions. Table 4.233 summarizes current operator information to facilitate comparison with other Alternatives. Operator information has been aggregated to ensure operator confidentiality. **Flight operations reflect the 2004-2009 annual average.**

Table 4.233 Alternative A Air-tour Operators Economic Impacts Base Year

Economic Measure	Alternative A Base Year
Flight Operations in the SFRA	99,000
Passenger Volume	757,800
Total Gross Revenue <i>Air-tour operators</i>	\$212,820,000
<i>Air Tour</i> -Related Employment	1,281
Employee Earnings	\$41,567,000

Sources: Harvey Economics 2007a; Harvey Economics, 2010; **BBC Research & Consulting 2012**
 Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights as reported by operators, including Hualapai *excepted* flights

Air-Tour Operators Alternative A Socioeconomic Environment
Ten-Year Forecast

Assumed air-tour industry growth of 1.3% per year would result in a 13.8% increase in air-tours flying over Grand Canyon. This amounts to an increase of about 13,700 flight operations. **Due to ongoing quiet-technology conversion to larger aircraft, passenger volume is expected to increase more than number of operations. Percent changes in employment reflect the average of changes in flight operations and changes in passenger volume. Operator conditions are shown in Table 4.234.**

Table 4.234 Alternative A Air-tour Operators Economic Impacts
Ten-Year Forecast

Economic Measure	Alternative A Ten Year Forecast	Change from Alternative A, Base Year
Flight Operations in the SFRA	112,600	14%
Passenger Volume	912,200	20%
Total Gross Revenue <i>Air-tour operators</i>	\$256,203,300	20%
<i>Air Tour</i> -Related Employment	1,501	17%
Employee Earnings	\$48,701,000	17%

Source: Harvey Economics 2010; **BBC Research & Consulting 2012**

Cumulative Effects Alternative A Air-Tour Operators Socioeconomic Environment

Past, present, and reasonably foreseeable influences on Grand Canyon air-tour operators are described in Chapter 4, Socioeconomic Environment, General Methodology and Assumptions, and Appendix G. In sum, this industry is volatile and subject to many uncertainties. Companies that survive these challenges through adaptable and opportunistic business practices should experience fluctuating business levels but expansion longer term. By itself, Alternative A Base Year represents continuation of current provisions governing air-tour operations at Grand Canyon and consequently has no impact on the air-tour industry.

1 West End operators would experience smaller changes in flight operations, passenger volume, and economic
 2 characteristics for several reasons: 1) operations are not limited by seasonal curfew hours, 2) many operators fly
 3 tours considered support for the Hualapai, and are therefore excluded from the annual allocation requirement,
 4 and 3) there would be no change to West End fixed-wing or helicopter routes or to the SFRA boundary on the
 5 West End (the notch) in Alternative E.

6
 7 Changes in operating costs due specifically to route changes in Alternative E would likely only occur for those
 8 operators flying cross canyon on Blue Direct North and South, and for the operator flying to Supai Village on
 9 Brown-6.⁶⁵ Blue Direct North would be realigned as described in Chapter 2, resulting in about an eight-nautical
 10 mile or 10% increase in Distance; Blue Direct South would be moved outside the SFRA, about a 16-nautical
 11 mile or 20% increase in Distance. Operating costs would increase for flights using these routes due to additional
 12 fuel requirements, flight time, and aircraft depreciation on a per-flight basis. Operators using Blue Direct North
 13 and South fly a number of different aircraft types; changes in operating costs would be specific to individual
 14 aircraft types. Brown-6 would increase by about four nautical miles, about a 14% increase in Distance. West End
 15 tour routes would not change, and therefore no changes in operating costs would occur related to those routes.
 16 East End tour routes would undergo many changes in Alternative E; however, Black-1 and Green-1 through Zuni
 17 Point Corridor would remain about the same in terms of length and flight time, and Black-1A and Green-2
 18 through Dragon Corridor would also remain about the same in terms of length, resulting in negligible changes to
 19 operating costs on these routes. Additional operating costs would also be incurred by operators if they chose to
 20 re-route transportation, repositioning, and other non-tour flights outside the SFRA. Changes in operating costs
 21 for these flights would depend on chosen flight route.

22
 23 *Alternative E Air-Tour Operators Socioeconomic Environment*
 24 *Ten-Year Forecast*

25 Impacts of Alternative E route and attribute changes, annual air-tour industry growth, and quiet-technology
 26 conversion would impact operators, *relative to the Ten-Year Forecast for Alternative A*, as shown in Table
 27 4.236.

28
 29 **Table 4.236 Alternative E Air-tour Operators Economic Impacts**
 30 **Ten-Year Forecast**

Economic Measure	Alternative E Ten Year Forecast	Difference from Alternative A Ten Year Forecast
Flight Operations in the SFRA	95,900	-15%
Passenger Volume	801,400	-12%
Total Gross Revenue <i>All-tour operators</i>	\$225,073,000	-12%
<i>Air-Tour-Related Employment</i>	1,299	-13%
Employee Earnings	\$42,166,000	-13%

Source: Harvey Economics 2010; BBC Research & Consulting 2012

31
 32
 33 Alternative E Ten-Year Forecast *flight operations forecast begins with the projected Alternative E Base Year*
 34 *reductions and assumes that 50% of these reductions would be regained by the end of a five-year recovery*
 35 *period as the market and air-tour operators adjust to new regulations. Following the recovery period,*
 36 *operations were increased by 1.3% per year. Alternative E requires full conversion to quiet-technology aircraft*
 37 *by a yet-to-be-agreed date. For analysis purposes, conversion is assumed to be completed ten years from*
 38 *implementation. Due to the larger quiet-technology aircraft, passenger volume would decrease less than*
 39 *operations since larger aircraft hold more customers. Percent changes in employment reflect the average of*
 40 *changes in flight operations and changes in passenger volume.*

41
 42 *Almost all fixed-wing operators are already mostly or fully converted to quiet-technology aircraft.* One small
 43 operator would be unable to convert to quiet-technology aircraft and would therefore be excluded from SFRA

⁶⁵ Changes in operating costs resulting from changes in marketing strategies, or changes to fees applied to operators were not considered material and were therefore excluded in this analysis

1 flights Ten-Year Forecast; for this operator, GCNP air-tours are only a small part of overall business. Each
 2 partially converted operator would need to purchase a small number of aircraft for full conversion. Although
 3 these operators' debt service would increase as a result of additional aircraft purchase, they would be able to do
 4 so given their current financial circumstances. Of the six helicopter operators at the time of analysis, two are
 5 currently fully converted, two have plans for full conversion in the near future, and the other two would need the
 6 full ten years allowed for conversion.

7
 8 **Compared to current conditions (Alternative A Base Year), Alternative E Ten-Year Forecast would result in a**
 9 **small reduction in flight operations. Due to the conversion to larger, quiet-technology aircraft, Alternative E**
 10 **Ten-Year Forecast would result in a 6% increase in passenger volume and air-tour operator gross revenue,**
 11 **relative to current conditions. This information is summarized in Table 4.237.**

12
 13 **Table 4.237 Alternative E Air-tour Operators Economic Impacts**
 14 **Ten-Year Forecast Compared to Current Conditions**

<i>Economic Measure</i>	<i>Alternative E Ten Year Forecast</i>	<i>Current Conditions</i>
<i>Flight Operations in the SFRA</i>	95,900	-3%
<i>Passenger Volume</i>	801,400	6%
<i>Total Gross Revenue Air-tour operators</i>	\$225,073,000	6%
<i>Air Tour-Related Employment</i>	1,299	0%
<i>Employee Earnings</i>	\$42,166,000	1%

Source: Harvey Economics 2010; BBC Research & Consulting 2012

Current conditions are represented by Alternative A Base Year and based on 2004-2009 annual average flight operations

15
 16
 17 **Cumulative Effects Alternative E Air-Tour Operators Socioeconomic Environment**

18
 19 *Cumulative Effects Alternative E Air-Tour Operators Socioeconomic Environment*
 20 *Base Year*

21 Past, present, and reasonably foreseeable influences on Grand Canyon air-tour operators are described in Chapter
 22 4, Socioeconomic Environment, General Methodology and Assumptions. In sum, this industry is volatile and
 23 subject to many uncertainties. Companies that survive these challenges through adaptable and opportunistic
 24 business practices should experience fluctuating business levels but an expansion longer term. By itself,
 25 Alternative E Base Year represents a moderate to major adverse impact on the Grand Canyon air-tour industry
 26 **compared to Alternative A Base Year.** Considering Alternative E Base Year impacts with effects of reasonably
 27 foreseeable influences, net changes are likely to **be** moderate to major adverse as challenges of Alternative E
 28 combine with *the* chronically high level of industry uncertainty.

29
 30 *Cumulative Effects Alternative E Air-Tour Operators Socioeconomic Environment*
 31 *Ten-Year Forecast*

32 Past, present, and reasonably foreseeable influences on Grand Canyon air-tour operators are described in Chapter
 33 4, Socioeconomic Environment, General Methodology and Assumptions. In sum, this industry is volatile and
 34 subject to many uncertainties. Companies that survive these challenges through adaptable and opportunistic
 35 business practices should experience fluctuating business levels but an expansion longer term. **Additional**
 36 **regulatory requirements facing air-tour operators on East End under Alternative E may lead to a further shift**
 37 **by the market and industry to West End and Hualapai excepted flights.** By itself, Alternative E Ten-Year
 38 Forecast represents a moderate adverse impact on the Grand Canyon air-tour industry **compared to Alternative A**
 39 **Ten-Year Forecast.** Considering Alternative E Ten-Year Forecast with effects of reasonably foreseeable
 40 influences, net changes are likely to be moderate adverse as challenges of Alternative E combine with *the*
 41 chronically high level of industry uncertainty.

Conclusion Alternative E Air-Tour Operators Socioeconomic Environment

Base Year impacts of Alternative E on air-tour operators would be *short* term moderate to major adverse *compared to Alternative A Base Year*. East End air-tour industry impacts would be widespread, and viability of air-tour companies operating there could be threatened. Ten-Year Forecast Alternative E impacts would be long-term moderate adverse compared Alternative A Ten-Year Forecast, *but minor adverse compared to current condition (Alternative A Base Year)*. Air-tour operators would adjust over time to SFRA rule changes and would *at least partly* mitigate *the initial, short-term* adverse impacts of Alternative E.

ALTERNATIVE F MODIFIED CURRENT CONDITIONS SOCIOECONOMIC ENVIRONMENT AIR-TOUR OPERATORS

Alternative F Air-Tour Operators Socioeconomic Environment Base Year

Alternative F would include the following attributes and resulting effects on operations *compared to Alternative A*

- Minor changes to East End tour routes, including seasonal route modifications, would not result in any reduction in operations
- Changes in Blue Direct North and South would result in an overall increase in flight operations of about 12% on those routes
- Changes to Green-4 would result in a 4% reduction in overall West End flight operations

Overall impacts of route changes described above would be less than a 2% decrease in total flight operations in Alternative F compared to Alternative A. Impacts of Alternative F on flight operations, passenger volume, revenue, employment, and income Base Year are shown in Table 4.238.

Table 4.238 Alternative F Air-tour Operators Economic Impacts Base Year

Economic Measure	Alternative F Base Year	Change from Alternative A Base Year
Flight Operations in the SFRA	97,000	-2%
Passenger Volume	744,700	-2%
Total Gross Revenue <i>Air-tour operators</i>	\$209,162,000	-2%
<i>Air-Tour-Related Employment</i>	1,257	-2%
Employee Earnings	\$40,796,000	-2%

Source: Harvey Economics 2010/BBJ Research & Consulting 2012

Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights as reported by operators, including Hualapai *excepted* flights

In Alternative F, one West End helicopter operator would be excluded from GCNP air-tour business as a result of SFRA boundary changes at the notch. Although this operator would be out of the Grand Canyon air-tour business, other business ventures outside the park would keep the operator's business viable. A second West End helicopter company would experience a smaller reduction in tours due to the change in the notch. Reduced employment and personal income as a result of these flight reductions would generally occur in the Boulder City and Las Vegas areas. The small decrease in gross revenues in Alternative F is due to reduced operations for these two operators. These operators' local and regional purchases would be decreased by a very small amount, as would purchases made from vendors outside the immediate area.

Operators flying cross canyon on Blue Direct North and South could experience operations increases due to route realignment in Alternative F. Other operators would not experience changes in operations or economic conditions Base Year.

Small Alternative F modifications to routes would not likely result in any detectable changes to operating costs.

Alternative F Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

1 *Alternative F Ten-Year Forecast flight operations forecast begins with the projected Alternative F Base Year*
 2 *reductions and assumes the market and air-tour operators would adjust to new regulations, and passenger*
 3 *volume would return to the pre-Alternative implementation level within three years following implementation*
 4 *of the Alternative. Following the recovery period, operations were increased by 1.3% per year.*
 5

6 Alternative F requires full conversion to quiet-technology aircraft in 10 to 12 years; a ten-year conversion period
 7 is assumed for this analysis. Ten-Year Forecast operators would experience *larger* decreases in flight operations
 8 *than in* passenger volume due to annual-growth assumptions for the air-tour industry coupled with conversion to
 9 larger, quiet-technology aircraft. *Percent changes in employment reflect the average of changes in flight*
 10 *operations and changes in passenger volume.* Impacts in Alternative F Ten-Year Forecast are illustrated in
 11 Table 4.239.
 12

13 **Table 4.239 Alternative F Air-tour Operators Economic Impacts**
 14 **Ten-Year Forecast**

Economic Measure	Alternative F Ten Year Forecast	Difference from Alternative A Ten Year Forecast
Flight Operations in the SFRA	108,200	-4%
Passenger Volume	906,700	-1%
Total Gross Revenue <i>Air-tour operators</i>	\$254,654,000	-1%
<i>Air-Tour-Related Employment</i>	1,468	-2%
Employee Earnings	\$47,653,000	-2%

Source: Harvey Economics 2010; *BBC Research & Consulting*2012

15
 16
 17 *Almost all fixed-wing operators are already mostly or fully converted to quiet-technology aircraft.* One small
 18 operator would be unable to convert to quiet-technology aircraft and would therefore be excluded from SFRA flights
 19 Ten-Year Forecast; for this operator, GCNP air-tours are only a small part of the overall business. Each partially
 20 converted operator would need to purchase a small number of aircraft for full conversion. Although these operators'
 21 debt service would increase as a result of additional aircraft purchase, they would be able to do so, given their
 22 current financial circumstances. Of the six helicopter operators at the time of analysis, two are currently fully
 23 converted, two have plans for full conversion in the near future, and the other two will need the full ten years
 24 allowed for conversion.
 25

26 *Compared to current conditions (Alternative A Base Year), the Alternative F Ten-Year Forecast indicates a 9%*
 27 *cumulative increase in flight operations. Due to conversion to larger, quiet-technology aircraft, Alternative F*
 28 *Ten-Year Forecast would result in a 20% increase in passenger volume and air-tour operator gross revenue,*
 29 *relative to current conditions. This information is summarized in Table 4.240.*
 30

31 **Table 4.240 Alternative F Air-tour Operators Economic Impacts**
 32 **Ten-Year Forecast Compared to Current Conditions**

Economic Measure	Alternative F Ten Year Forecast	Current Conditions
Flight Operations in the SFRA	108,200	9%
Passenger Volume	906,700	20%
Total Gross Revenue <i>Air-tour operators</i>	\$254,654,000	20%
<i>Air Tour-Related Employment</i>	1,468	15%
Employee Earnings	\$47,653,000	15%

Source: Harvey Economics 2010; *BBC Research & Consulting* 2012

Current conditions are represented by Alternative A Base Year and based on 2004-2009 annual average flight operations

1 **Cumulative Effects Alternative F** **Air-Tour Operators** **Socioeconomic Environment**

2
3 *Cumulative Effects Alternative F* *Air-Tour Operators* *Socioeconomic Environment*
4 *Base Year*

5 Past, present, and reasonably foreseeable influences on Grand Canyon air-tour operators are described in Chapter
6 4, Socioeconomic Environment, General Methodology and Assumptions. In sum, this industry is volatile and
7 subject to many future uncertainties. Companies that survive these challenges through adaptable and
8 opportunistic business practices should experience fluctuating business levels but expansion longer term. By
9 itself, Alternative F Base Year represents a negligible to minor impact on the Grand Canyon air-tour industry
10 **compared to Alternative A Base Year**. Considering Alternative F Base Year impacts with effects of reasonably
11 foreseeable influences, net changes **compared to Alternative A Base Year** are likely adverse but negligible as
12 changes and impacts of Alternative F Base Year lie in range of fluctuation and uncertainty common to this
13 industry.

14
15 *Cumulative Effects Alternative F* *Air-Tour Operators* *Socioeconomic Environment*
16 *Ten-Year Forecast*

17 Including impacts of Alternative F Ten-Year Forecast, cumulative effects on air-tour operators will be relatively
18 lessened, given all the industry, technological, economic, demographic, and consumer preference factors that
19 face the air-tour industry. **Prospective** SFRA rule changes would add to industry uncertainty, representing in a
20 **negligible** adverse cumulative impact **compared to Alternative A Ten-Year Forecast**.

21
22 **Conclusion Alternative F** **Air-Tour Operators** **Socioeconomic Environment**

23
24 **Base Year** Impacts would be **short** term negligible to minor adverse, with one operator excluded from flying SFRA
25 tours. **Ten-Year Forecast long-term impacts would be negligible change** compared to Alternative A Ten-Year
26 Forecast. **Compared to current conditions (Alternative Base Year), Alternative F Ten-Year Forecast would have**
27 **moderate beneficial impacts**.

28
29 **MODIFIED NPS PREFERRED ALTERNATIVE AIR-TOUR OPERATORS** **SOCIOECONOMIC ENVIRONMENT**

30
31 *Modified NPS Preferred Alternative* *Air-Tour Operators* *Socioeconomic Environment*
32 *Base Year*

33 The **Modified** NPS Preferred Alternative would include the following attributes and resulting effects on
34 operations **compared to Alternative A**

- 35 • Seasonal curfew would apply to entire East End and would reduce flight time by one hour in the afternoon.
36 The change in curfew hours could result in a 3% reduction in East End operations
- 37 • A daily cap of 364 commercial-tour operations, along with 65,000 annual allocations. All air-tour-related flight
38 operations (**except limited training and maintenance flights**) would **occur** outside the SFRA **or would need to**
39 **use an annual allocation to fly in the SFRA; potentially** resulting in re-routing about 14% of total flight
40 operations (**mainly repositioning and transportation flights**)
- 41 • Flights in support of the Hualapai would continue **to be not subject to** annual allocations or daily cap
- 42 • Changes to East End tour routes, including seasonal route scheduling, would result in an overall decrease in
43 operations of about **12%**. **No changes to** West End routes, **same as Alternative A**

44
45 Combined **short-term** impact of changes described above would be about a **19%** reduction in flight operations
46 **requiring annual allocations. For the industry as a whole, including Hualapai excepted flights, short-term**
47 **operations would be reduced by about 12%**. Impacts of the **Modified** NPS Preferred Alternative on flight
48 operations, passenger volume, revenue, employment, and income Base Year are shown in Table 4.241.

49
50 In the **Modified** NPS Preferred Alternative, one small fixed-wing operator would be completely excluded from
51 flying air-tours over Grand Canyon due to elimination of several routes. This operator would likely focus on
52 scenic tours offered in other areas, and on other aviation-related business and would not go out of business due to
53 these route changes. All other operators would experience some decreased operations due to route changes and

1 other **Modified** NPS Preferred Alternative attributes.⁶⁶ The majority of these operators would experience
 2 decreases in operations ranging 4 to 9%. East End operators would generally experience higher flight reductions
 3 due to route changes coupled with other Alternative attributes, including curfews and annual allocation
 4 requirements. West End *tour routes would not change; therefore, no changes in costs would occur to those*
 5 *routes.*

7 **Table 4.241 Modified NPS Preferred Alternative Air-tour Operators Economic Impacts**
 8 **Base Year**

Economic Measure	Modified NPS Preferred Alternative Base Year	Change from Alternative A Base Year
Flight Operations in the SFRA	87,100	-12%
Passenger Volume	668,600	-12%
Total Gross Revenue <i>Air-tour operators</i>	\$187,784,000	-12%
<i>Air Tour</i> -Related Employment	1,129	-12%
Employee Earnings	\$36,629,000	-12%

Source: Harvey Economics 2010; *BBC Research & Consulting 2012*

Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights as reported by operators, including Hualapai excepted flights

9
10
11 Small changes in operating costs due specifically to route changes in the **Modified** NPS Preferred Alternative
 12 would likely occur for several types of operators or operations: 1) those that would have to fly **farther on the**
 13 **single new Z-shaped (realigned Blue Direct) route, rather than using current Blue Direct North or Blue Direct**
 14 **South routes,** 2) the operator flying to Supai Village on Brown-6, and 3) operators flying Green-2 or Black-2A in
 15 Dragon Corridor **year-round.** Additional flight times are limited but uncertain due to varying aircraft velocities,
 16 wind direction, and speed. Brown-6 would increase by about 4 nautical miles, or about a 14% increase in
 17 Distance. Green-2 would include a dogleg, which would add about 8 nautical miles to the loop or about 20% to
 18 overall flight Distance. Black-2A would be affected similarly to Green-2. Operating costs would increase due to
 19 additional fuel requirements, flight time, and aircraft depreciation on a per-flight basis. Operators using these
 20 routes fly a number of different aircraft types; changes in operating costs would be specific to individual aircraft
 21 types. **No change in West End tour routes from Alternative A.**

22
23 Additional operating costs **could** also be incurred by operators as a result of re-routing transportation,
 24 repositioning, and other non-tour flights outside the SFRA. **If operators choose to move these flights outside the**
 25 **SFRA to avoid using annual allocations, about 14% of total flight operations could be re-routed;** changes in
 26 operating costs for these flights would depend on chosen flight route.

27
28 **Modified NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment**
 29 **Ten-Year Forecast**

30 **Modified NPS Preferred Alternative Ten-Year Forecast flight operations forecast begins with the projected**
 31 **Modified NPS Preferred Alternative Base Year reductions. Ten-Year Forecast assumes passenger volume on**
 32 **flights requiring annual allocations would return to the level preceding Alternative implementation by the end**
 33 **of a five-year recovery period as the market and air-tour operators adjust to new regulations, much as they did**
 34 **following adoption of the original Overflights Act in 1987/1988. Following the recovery period, operations**
 35 **were increased by 1.3% per year. Due to conversion to larger quiet-technology aircraft under the Modified**
 36 **NPS Preferred Alternative, the difference in passenger volume between the Modified NPS Preferred**
 37 **Alternative and Alternative A would be less than the difference in operations since larger aircraft hold more**
 38 **customers. Percent changes in employment reflect the average of changes in flight operations and changes in**
 39 **passenger volume.**

66 Several operators currently flying Blue Direct North as a transportation flight would reclassify these operations as air-tours under the **Modified** NPS Preferred Alternative; these flights would then become subject to the annual allocation requirement. Total flights, passengers, and revenues would not change for these operators as a result of the reclassification

Operator impacts in Table 4.242 reflect *Modified* NPS Preferred Alternative changes, conversion to quiet-technology aircraft, *and* industry growth assumptions.

Table 4.242 Modified NPS Preferred Alternative Air-tour Operators Economic Impacts Ten-Year Forecast

Economic Measure	Modified NPS Preferred Alternative Forecast	Difference from Alternative A, Forecast
Flight Operations in the SFRA	104,800	-7%
Passenger Volume	877,400	-4%
Total Gross Revenue <i>Air-tour operators</i>	\$246,429,000	-4%
<i>Air Tour</i> -Related Employment	1,421	-5%
Employee Earnings	\$46,127,000	-5%

Source: Harvey Economics 2010; *BBC Research & Consulting*2012

Similar to the other Alternatives, changes in flight operations *relative to Alternative A* are greater than *changes in passenger volume and other metrics* due to *greater conversion to* quiet-technology aircraft *and their larger capacity*. Almost all fixed-wing operators are either currently fully converted or have plans to convert. Although these operators' debt service would increase as a result of the purchase of additional aircraft, they would be able to do so, given their current financial circumstances. Of the six helicopter operators at the time of analysis, two are currently fully converted, two have plans for full conversion in the near future, and the other two will need the full ten years allowed for conversion.

Compared to current conditions (Alternative A Base Year), the Modified NPS Preferred Alternative Ten-Year Forecast indicates a 6% cumulative increase in flight operations. This increase reflects the 1.3% projected annual growth rate in air-tour operations discussed previously, beginning after the air-tour industry and market have recovered from the short-term impacts of this Alternative (assumed to be following year five). Due to the conversion to larger, quiet-technology aircraft, the Modified NPS Preferred Alternative Ten-Year Forecast would result in a 16% increase in passenger volume and air-tour operator gross revenue, relative to current condition (Alternative A Base Year). This information is summarized in Table 4.243.

Table 4.243 Modified NPS Preferred Alternative Air-tour Operators Economic Impacts Ten-Year Forecast Compared to Current Conditions

Economic Measure	Modified NPS Preferred Alternative Forecast	Current Condition
Flight Operations in the SFRA	104,800	6%
Passenger Volume	877,400	16%
Total Gross Revenue <i>Air-tour operators</i>	\$246,429,000	16%
<i>Air Tour</i> -Related Employment	1,421	11%
Employee Earnings	\$46,127,000	11%

Source: Harvey Economics 2010; *BBC Research & Consulting* 2012

Current conditions are represented by Alternative A Base Year and based on 2004-2009 annual average flight operations

Cumulative Effects

Modified NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment

Past, present, and reasonably foreseeable influences on Grand Canyon air-tour operators are described in Chapter 4 Socioeconomic Environment, General Methodology and Assumptions. In sum, this industry is volatile and subject to many future uncertainties. Companies that survive these challenges through adaptable and opportunistic business practices should experience fluctuating business levels but expansion longer term. By itself, the *Modified* NPS Preferred Alternative Base Year represents a minor to moderate *short-term* adverse impact on the Grand Canyon air-tour industry *compared to Alternative A Base Year. Considering Modified NPS Preferred Alternative Base*

1 *Year impacts with effects of reasonably foreseeable influences, net changes compared to Alternative A Base Year*
 2 *remain minor to moderate short-term adverse for the air-tour industry. Operators that rely on East End air-tours*
 3 *as their primary market would be most affected.*

4
 5 *Ten-Year Forecast, additional regulatory provisions facing air-tour operators East End under the Modified NPS*
 6 *Preferred Alternative may lead to a further shift by the market and industry to West End and Hualapai excepted*
 7 *flights. By itself, the Modified NPS Preferred Alternative Ten-Year Forecast represents a long-term minor adverse*
 8 *impact on the Grand Canyon air-tour industry compared to Alternative A Ten-Year Forecast. Considering Modified*
 9 *NPS Preferred Alternative Ten-Year Forecast impacts with effects of reasonably foreseeable influences, net changes*
 10 *compared to Alternative A Ten-Year Forecast are likely minor adverse as changes and impacts of the Modified*
 11 *NPS Preferred Alternative Ten-Year Forecast lie near the range of fluctuation and uncertainty common to this*
 12 *industry.*

13
 14 **Conclusion**

15 **Modified NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment**

16
 17 *Proposed new regulations under the Modified NPS Preferred Alternative would require adjustments by air-tour*
 18 *operators short term, but it is quite possible these potential operational changes would be essentially invisible to*
 19 *consumers. Base Year impacts would be short term minor to moderate adverse compared to Alternative A Base*
 20 *Year. Many operators would experience measurable impacts from changes, but operator viability would generally*
 21 *not be threatened with the possible exception of one or two operators whose current routes would be changed or*
 22 *eliminated and who rely entirely or primarily on air-tours over East End.*

23
 24 *Based on past experience, changes in routes, scheduling requirements, and related regulations are unlikely to*
 25 *have a substantial long-term impact on the air-tour industry. Impacts would be long-term minor adverse compared*
 26 *to Alternative A Ten-Year Forecast. Initial, short-term impacts would diminish over time as operators adjusted to*
 27 *new flight rules. Compared to current conditions (Alternative A Base Year), Modified NPS Preferred Alternative*
 28 *Ten-Year Forecast would have moderate beneficial impacts.*

29
 30 **AIR-TOUR OPERATORS ALTERNATIVE SUMMARIES SOCIOECONOMIC ENVIRONMENT**

31
 32 Tables 4.244 and 4.245 provide summaries of air-tour industry characteristics Base Year and Ten-Year Forecast for
 33 each Alternative.

34
 35 **Table 4.244 Summary of Economic Impacts Air-tour Operators Base Year**

Economic Measure	Air-tour Operators			Base Year
	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Flight Operations in the SFRA	99,000	78,200	97,000	87,100
Passenger Volume	757,800	600,100	744,700	668,600
Total Gross Revenue GCNP Flights	\$212,820,000	\$168,544,000	\$209,162,000	\$187,784,000
GCNP-Related Employment	1,281	1,013	1,257	1,129
Employee Earnings	\$41,657,000	\$32,880,000	\$40,796,000	\$36,629,000

Source: Harvey Economics 2010; BBC Research & Consulting 2012

Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights as reported by operators, including Hualapai excepted flights

36
 37

1 **Table 4.245 Summary of Economic Impacts Air-tour Operators Ten-Year Forecast**

Economic Measure	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Flight Operations in the SFRA	112,600	95,900	108,200	104,800
Passenger Volume	912,200	801,400	906,700	877,400
Total Gross Revenue GCNP Flights	\$256,203,300	\$225,073,000	\$254,654,000	\$246,429,000
GCNP-Related Employment	1,501	1,299	1,468	1,421
Employee Earnings	\$48,701,000	\$42,166,000	\$47,653,000	\$46,127,000

Source: Harvey Economics 2010; *BBC Research & Consulting* 2012

AMERICAN INDIAN TRIBES

SOCIOECONOMIC ENVIRONMENT

Methodology and Assumptions for Analysis of Impacts to American Indian Tribes

Socioeconomic impacts on American Indian tribes are based on information about tribes' current economic and social conditions as described in Chapter 3, Socioeconomic Environment, and on changes in tourism-based activities such as visitation by ground- or air-tour visitors. Changes in tourist activities would potentially impact tribal revenues and employment and might have resulting social impacts. For this analysis, changes in tourist activity are based on impacts to visitor experience as described in Chapter 4, Visitor Use and Experience, and on analysis of changes to air-tours or other flight operations relevant to each tribe. Changes in tourism and resulting impacts to tribal economies and social conditions are described for the Hualapai, Havasupai, and Navajo Tribes. Impacts to each tribe are addressed Base Year and Ten-Year Forecast. Impacts of each Action Alternative (E, F, and *Modified NPS Preferred*) are compared relative to Alternative A, No Action/Current Conditions.

NPS intends to examine the entire allocation system parkwide, including flights currently not subject to allocations, in a subsequent planning effort building on this EIS process. This will likely require additional NEPA compliance and FAA rulemaking.

HUALAPAI TRIBE

AMERICAN INDIAN TRIBES

SOCIOECONOMIC ENVIRONMENT

The Hualapai Tribe is largely dependent on tourism to provide employment and income opportunities for tribal members and the tribe itself. The tribe owns and operates several tourist oriented ventures, including Grand Canyon West, a facility that offers numerous attractions, and is also a base for ground tours and river trips. Air-tour operations are an important piece of the tribe's tourism economy. Many commercial air-tour companies land either at Grand Canyon West Airport or Quartermaster Canyon landing pads as part of their tour package to allow visitors to participate in additional activities on Hualapai land. Additionally, several helicopter companies offer trips specifically from reservation to canyon bottom; these are commonly referred to as Over the Edge or Elevator Flights. Tourism comprises about 90% of the tribe's budget each year, with air-tour-related operations about 60% of that amount.

Hualapai Tribe Alternative A

American Indian Tribes

Socioeconomic Environment

Current Hualapai Tribe demographic, economic, and social conditions are detailed in Chapter 3, Socioeconomic Environment. That chapter also describes historical and current volume of air-tour operations flown in support of the Hualapai. In 2010, about 39,000 fixed-wing and helicopter flights landed at either Grand Canyon West Airport or at Quartermaster Canyon landing pads; these flights are *excepted* from annual allocation requirements. In addition, 25,000 to 27,000 Over the Edge flights are provided to visitors yearly. The Hualapai collect about \$3 million per year in charges and fees from various air-tour operators that land on the reservation.

Ten-Year Forecast Alternative A flights that land at Grand Canyon West Airport or other locations on the Hualapai Reservation via SFRA air-tour routes are expected to increase by about 14% based on assumed annual growth for the GCNP air-tour industry. This would result in an increase in revenues generated specifically by those operations. No change to overall economic or social conditions of the tribe would be expected.

1	Hualapai Tribe	Alternative E	American Indian Tribes	Socioeconomic Environment
---	-----------------------	----------------------	-------------------------------	----------------------------------

2				
3	<i>Hualapai Tribe</i>	<i>Alternative E</i>	<i>American Indian Tribes</i>	<i>Socioeconomic Environment</i>
4	<i>Base Year</i>		<i>Tourism</i>	

Although Alternative E would include a daily cap on SFRA flights, tours in support of the Hualapai Tribe would continue **excepted** from annual allocation and daily cap requirements. Because Green-4 and Blue-2 route configuration would be unchanged, and due to the annual allocation **exception** for Hualapai support flights, no changes in air-tour operations to Grand Canyon West Airport or to Quartermaster Canyon would result **from** Alternative E. Additionally, no changes to the Over the Edge flights would occur.

Changes in other SFRA air-tour routes (East End and cross-canyon routes) are unlikely to have **short-term effects** on flights landing on the Hualapai Reservation, or on reservation tourism in general. Flights arriving at Grand Canyon West Airport from outside the SFRA would not be affected by any changes included in Alternative E. Ground-based visitation to Grand Canyon West would also be unaffected by Alternative E.

Overall, Hualapai Reservation tourism opportunities and activity would not be affected by Alternative E and would be expected to remain unchanged compared to Alternative A.

19	<i>Hualapai Tribe</i>	<i>Alternative E</i>	<i>American Indian Tribes</i>	<i>Socioeconomic Environment</i>
20	<i>Ten-Year Forecast</i>		<i>Tourism</i>	

Ten-Year Forecast Alternative E flights **that land at Grand Canyon West Airport or other locations on the Hualapai Reservation** via SFRA air-tour routes **are expected to** increase by about **14% based on assumed annual growth for the GCNP air-tour industry. This would result in an increase in revenues generated specifically by those operations. No change to overall economic or social conditions of the tribe would be expected. It is also possible that some operators using routes subject to annual allocations and other Alternative E regulations, especially East End routes, may respond to the anticipated flight-option decrease by offering flights to the Hualapai Reservation, which might increase tourism at Grand Canyon West to some degree.**

29	<i>Hualapai Tribe</i>	<i>Alternative E</i>	<i>American Indian Tribes</i>	<i>Socioeconomic Environment</i>
30	<i>Base Year and Ten-Year Forecast</i>		<i>Ranching Operations</i>	

Cattle ranching is an important Hualapai Reservation activity (Arizona Department of Commerce 2005b, Harvey Economics 2007b). Since Blue-2 and Green-4 would remain unchanged from Alternative A, and since no changes to number of flight operations landing on the reservation would occur, no impact to ranching on the Hualapai Reservation is anticipated as a result of Alternative E. However, a projected decrease in helicopter tours on Green-4 in Alternative E could provide modest benefits to cattle in terms of reduced Average Sound Level depending on grazing area location.⁶⁷

38	<i>Hualapai Tribe</i>	<i>Alternative E</i>	<i>American Indian Tribes</i>	<i>Socioeconomic Environment</i>
39	<i>Base Year and Ten-Year Forecast</i>		<i>Economy and Financial Conditions</i>	

Tourism activity and number of flights to the Hualapai Reservation would not change in Alternative E; additionally, no impacts to ranching activity would occur in Alternative E. Therefore, no impacts to Hualapai Tribe economy or financial conditions would be expected in Alternative E. No changes to income or employment levels in the tribal population would be expected.

The increased number of passengers landing on the Hualapai Reservation Ten-Year Forecast would result in an equivalent increase in revenues generated specifically by air-tour operations. **The** increase in total revenues Ten-Year Forecast would not be enough to **noticeably** impact overall economic conditions of the tribe.

49	<i>Hualapai Tribe</i>	<i>Alternative E</i>	<i>American Indian Tribes</i>	<i>Socioeconomic Environment</i>
50	<i>Base Year and Ten-Year Forecast</i>		<i>Social Conditions</i>	

No changes to tourism on the Hualapai Reservation or to tribal economy are anticipated. Additionally, no changes to the economic conditions of the Hualapai are expected Ten-Year Forecast. Therefore, no population or other demographic changes would be expected in the tribe. As a result, no impacts to Hualapai Tribe social conditions are expected.

⁶⁷ No changes to Blue-2 air-tour operations are anticipated under Alternative E

Cumulative Effects Alternative E American Indian Tribes Socioeconomic Environment Hualapai Tribe

Base Year and Ten-Year Forecast, the Hualapai air-tour industry will be subject to many influences affecting the nontribal industry since the tribe depends on contracted operators to provide the service. Past, present, and reasonably foreseeable influences on Grand Canyon air-tour operators and visitation are described in Chapter 4 Socioeconomic Environment, General Methodology and Assumptions. In sum, this industry is volatile and subject to many future uncertainties. Companies that survive these challenges through adaptable and opportunistic business practices should experience fluctuating levels of business but expansion longer term. The Hualapai air-tour and tourism industry is guided by the tribal enterprise. Customer demand is more closely tied to Las Vegas tourism than the rest of the industry. Hualapai tourism will likely continue to grow.

Conclusion Alternative E American Indian Tribes Socioeconomic Environment Hualapai Tribe

By itself, Alternative E Base Year and Ten-Year Forecast represents a negligible beneficial impact on the Hualapai. Combining Alternative E impacts with effects of reasonably foreseeable influences, Cumulative Impacts on the Hualapai would be negligible. Table 4.246 summarizes impacts to the Hualapai Tribe by Alternative.

Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment

Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment Base Year Tourism

In Alternative F, Blue 2 would remain unchanged from Alternative A, but the southern portion of Green-4 loop route would be eliminated, and flight altitudes on that route adjusted.⁶⁸ No changes in operations on Blue-2 would occur in Alternative F, including flights in support of the Hualapai. However, changes to Green-4 would result in slightly decreased operations, both to air-tour flights on Green-4 as well as to flights in support of the Hualapai. Number of flights and passengers flying Green-4 in the SFRA and subsequently landing on the Hualapai reservation would decrease by about 3%. No changes to Over the Edge flights would occur.

In addition to West End route changes, notch size around Grand Canyon West Airport would be reduced as requested by the Hualapai tribe. The notch change would not result in any changes in number of flights landing at Grand Canyon West Airport or Quartermaster Canyon or any changes in ground-based Hualapai Reservation visitation.

Relatively minor changes in other SFRA air-tour routes (East End and cross-canyon routes) are unlikely to have effect on flights landing on the Hualapai Reservation or on reservation tourism in general. Flights arriving at Grand Canyon West Airport from outside the SFRA would not be affected. Ground-based visitation to Grand Canyon West would also be unaffected.

Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment Ten-Year Forecast Tourism

Ten-Year Forecast **Alternative F** flights **that land at Grand Canyon West Airport or other locations** on the **Hualapai Reservation** via SFRA air-tour routes **are expected** to increase by about **14% based on assumed annual growth for the GCNP air-tour industry. This would result in an increase in revenues generated specifically by those operations.**

Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment Base Year and Ten-Year Forecast Ranching Operations

Modification of Green-4 and resulting reduction in Green-4 flight operations to the reservation may have a slight beneficial impact on cattle in terms of reduced Average Sound Level depending on grazing area location.

⁶⁸ Quiet-technology aircraft would have the option of an out-and-back trip on modified Green-4, while all other aircraft would exit the SFRA east of the notch

1 Additionally, anticipated reductions of Green-4 air-tour operations may also have a benefit to cattle ranching
2 operations, again depending on grazing area location.⁶⁹

3
4 *Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment*
5 *Base Year Economy and Financial Conditions*

6 No measurable changes to Hualapai economic conditions would occur as a result of potentially improved
7 ranching conditions.

8
9 The 3% decrease in Green-4 flights in support of the Hualapai would result in a small decrease in revenues to the
10 Hualapai Tribe. Reduced revenues would result from lost fees and charges applied to passengers landing on the
11 reservation plus loss of any additional spending on the part of tour passengers. Reduction of fee revenue is
12 estimated to be about \$84,000, or less than 2% of total annual tribal revenues (Harvey Economics 2007b).
13 Amount of revenue lost would be sufficiently small compared with total annual Hualapai revenues that
14 negligible changes in employment or wage income would be expected. Economic impacts to the Hualapai as a
15 result of reduced flights would be negligible.

16
17 *Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment*
18 *Ten-Year Forecast Economy and Financial Conditions*

19 Increase in number of passengers landing on the Hualapai Reservation would result in an equivalent increase in
20 revenues generated specifically by air-tour operations compared to Base Year. The small increase in total
21 revenues would not be enough to impact overall economic conditions of the tribe.

22
23 *Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment*
24 *Base and Ten-Year Forecast Social Conditions*

25 Small amount of revenue lost to the Hualapai Base Year would not result in any changes to the population,
26 demographic conditions, education levels, or poverty levels of the Hualapai Tribe. Likewise, change in revenue
27 would not be expected to affect population, demographic conditions, education levels, or poverty levels of the
28 Hualapai Tribe. Therefore, no impacts to Hualapai social conditions would occur.

29
30 *Cumulative Effects Alternative F American Indian Tribes Socioeconomic Environment*
31 *Hualapai Tribe*

32
33 Base Year and Ten-Year Forecast, Hualapai air-tour industry will be subject to many of the same influences
34 affecting the nontribal industry, since the tribe depends on contracted operators to provide the service. Past, present
35 and reasonably foreseeable influences on Grand Canyon air-tour operators and visitation are described in Chapter 4
36 Socioeconomic Environment, General Methodology and Assumptions. In sum, this industry is volatile and subject to
37 many future uncertainties. Companies that survive these challenges through adaptable and opportunistic business
38 practices should experience fluctuating levels of business but expansion longer term. The Hualapai air-tour and
39 tourism industry is guided by the tribal enterprise. Customer demand is more closely tied to Las Vegas tourism than
40 the rest of the industry. Hualapai tourism will likely continue to grow.

41
42 *Conclusion Alternative F American Indian Tribes Socioeconomic Environment*
43 *Hualapai Tribe*

44
45 By itself, Alternative F Base Year and Ten-Year Forecast represent a negligible beneficial impact on the Hualapai.
46 Combining Alternative F impacts with effects of reasonably foreseeable influences, Cumulative Impacts on the
47 Hualapai would be negligible. Table 4.246 summarizes impacts to the Hualapai Tribe by Alternative.

48
49 **Hualapai Tribe American Indian Tribes Socioeconomic Environment**
50 **Modified NPS Preferred Alternative**

51
52 *Hualapai Tribe*
53 **Modified NPS Preferred American Indian Tribes Socioeconomic Environment**
54 *Base Year Tourism*

⁶⁹ No changes to Blue 2 air-tour operations are anticipated under Alternative F

1 In the **Modified** NPS Preferred Alternative, **there would be no changes to West End tour routes, same as**
 2 **Alternative A.** Although the **Modified** NPS Preferred Alternative would include a daily cap **and lower annual**
 3 **allocation limit** on other SFRA flights, tours in support of the Hualapai Tribe would continue **excepted** from the
 4 annual allocation requirement and daily cap. No changes to Over the Edge flights would occur.

5
 6 Changes in other SFRA air-tour routes (East End and cross-canyon routes) are unlikely to affect flight landings
 7 on the Hualapai Reservation or on reservation tourism in general. Flights arriving at Grand Canyon West Airport
 8 from outside the SFRA would not be affected by any changes. Ground-based visitation to Grand Canyon West
 9 would also be unaffected by the **Modified** NPS Preferred Alternative.

10 Overall, tourism opportunities and activity on the Hualapai Reservation would not be affected by the **Modified**
 11 NPS Preferred Alternative, and would be expected to remain unchanged compared to Alternative A.

12
 13
 14 *Hualapai Tribe*

15 **Modified NPS Preferred** *American Indian Tribes* *Socioeconomic Environment*
 16 *Ten-Year Forecast* *Tourism*

17 **Ten-Year Forecast Modified NPS Preferred Alternative flights that land at Grand Canyon West Airport or**
 18 **other locations on the Hualapai Reservation via SFRA air-tour routes are expected to increase by about 14%**
 19 **based on assumed annual growth for the GCNP air-tour industry. This would result in an increase in**
 20 **revenues generated specifically by those operations. No change to overall economic or social conditions of the**
 21 **tribe would be expected. It is also possible that some operators using routes subject to annual allocations and**
 22 **other Modified NPS Preferred Alternative regulations, especially East End routes, may respond to the**
 23 **anticipated flight-option decrease by offering flights to the Hualapai Reservation, which might increase**
 24 **tourism at Grand Canyon West to some degree.**

25
 26 *Hualapai Tribe*

27 **Modified NPS Preferred** *American Indian Tribes* *Socioeconomic Environment*
 28 *Base Year and Ten-Year Forecast* *Ranching Operations*

29 **Cattle ranching is an important Hualapai Reservation activity (Arizona Department of Commerce 2005b,**
 30 **Harvey Economics 2007b). Since Blue-2 and Green-4 would remain unchanged from Alternative A, and since**
 31 **no changes to number of flight operations landing on the reservation would occur, no impact to ranching on**
 32 **the Hualapai Reservation is anticipated as a result of the Modified NPS Preferred Alternative.**

33
 34 *Hualapai Tribe*

35 **Modified NPS Preferred** *American Indian Tribes* *Socioeconomic Environment*
 36 *Base Year* *Economy and Financial Conditions*

37 No measurable changes to Hualapai economic conditions would occur as a result of potentially improved
 38 ranching conditions. Since tourism activity and number of flights to the Hualapai reservation would not change,
 39 impacts to Hualapai Tribe economy or financial conditions would not be expected. No changes to income or
 40 employment levels in the tribal population would be expected.

41
 42 *Hualapai Tribe*

43 **Modified NPS Preferred** *American Indian Tribes* *Socioeconomic Environment*
 44 *Ten-Year Forecast* *Economy and Financial Conditions*

45 Increased passenger volume to the Hualapai Reservation would result in an equivalent increase in revenues
 46 generated specifically by air-tour operations. The small increase in total revenues would have negligible impacts
 47 overall on tribal economic conditions.

48
 49 *Hualapai Tribe*

50 **Modified NPS Preferred** *American Indian Tribes* *Socioeconomic Environment*
 51 *Base Year and Ten-Year Forecast* *Social Conditions*

52 No changes to tourism on the Hualapai Reservation or to the economy of the tribe are anticipated. Additionally,
 53 no changes to economic conditions of the Hualapai are expected Ten-Year Forecast. Therefore, no population or
 54 other demographic changes would be expected in the tribe. As a result, no impacts to Hualapai Tribe social
 55 conditions are expected.

1 Current demographic, economic, and social conditions of the Havasupai Tribe are detailed in Chapter 3,
 2 Socioeconomic Environment. Papillon Airways flies about 330 flights per year to the Havasupai Reservation,
 3 carrying about 1,350 passengers. Many of these passengers are Havasupai tribal members; some are tourists.
 4 Although not classified as air-tours, flights to Supai Village would increase by about 14% (an increase of about
 5 45 flights) Ten-Year Forecast, based on assumption of annual growth for GCNP air-tour industry. This increase
 6 in support flights would result in an equivalent increase in number of passengers (14% or about 200 passengers).
 7 The overall economic or social conditions of the Havasupai Tribe would not be greatly affected by these small
 8 changes in flights or passengers.
 9

10 **Alternatives E, F, and Modified NPS Preferred American Indian Tribes Socioeconomic Environment**
 11 **Havasupai Tribe**

12
 13 *Alternatives E, F, and Modified NPS Preferred American Indian Tribes Socioeconomic Environment*
 14 *Base Year and Ten-Year Forecast Havasupai Tribe*

15 Number of flights flown to Supai Village on Brown-6 would not change as a result of Alternatives E, F, or the
 16 **Modified NPS Preferred**. Number of flights to Supai Village in these Alternatives would be the same as in
 17 Alternative A, Base Year and Ten-Year Forecast. Flights on Brown support routes do not require use of annual
 18 allocations, and the small number of flights offered daily on Brown-6 would not be impacted by changes in
 19 seasonal curfews. In Alternatives E and the **Modified NPS Preferred**, Brown-6 location would change slightly to
 20 include a dogleg as requested by the Havasupai tribe described in Chapter 2. The dogleg would result in a
 21 slightly longer flight, but would not result in any changes to number of flights offered or number of passengers
 22 flown to Supai Village. No changes in ground-based visitation to Supai Village are anticipated as a result of
 23 Alternatives E, F, or the **Modified NPS Preferred**.
 24

25 *Alternatives E, F, and Modified NPS Preferred American Indian Tribes Socioeconomic Environment*
 26 *Base Year and Ten-Year Forecast Havasupai Tribe Tourism*

27 No changes in number or spending patterns of ground-based or air-tour visitors are anticipated Base Year. There
 28 would, however, be an increase in number of passengers flown to the reservation Ten-Year Forecast; spending
 29 patterns of these additional visitors would likely be similar to those of existing visitors. No changes to tourist
 30 facilities or activities offered by the Havasupai are expected as a result of Alternatives E, F, or the **Modified NPS**
 31 **Preferred**. Therefore no impacts to Havasupai-related tourism would be expected Base Year from these
 32 Alternatives, and a small increase in number of tourists would be expected Ten-Year Forecast.
 33

34 *Alternatives E, F, and Modified NPS Preferred American Indian Tribes Socioeconomic Environment*
 35 *Base Year and Ten-Year Forecast Havasupai Tribe Economy and Financial Conditions*

36 Since tourism activity and number of daily flights to Supai Village would not change Base Year, no impacts to
 37 Havasupai Tribe economy or financial conditions would be expected. Ten-Year Forecast, tourism would
 38 increase; however, this increase would not likely affect overall tribal economy or financial conditions. No
 39 changes to income or employment levels in the tribal population would be expected in any Alternative.
 40

41 *Alternatives E, F, and Modified NPS Preferred American Indian Tribes Socioeconomic Environment*
 42 *Base Year and Ten-Year Forecast Havasupai Tribe Social Conditions*

43 No changes to Havasupai Reservation tourism or economy are anticipated. No population or other demographic
 44 changes would be expected in the tribe. Therefore, no impacts to Havasupai Tribe social conditions are expected
 45 as a result of any Action Alternative.
 46

47 *Cumulative Effects American Indian Tribes Socioeconomic Environment*
 48 *Alternatives E, F, and Modified NPS Preferred Havasupai Tribe*

49
 50 The Havasupai tourism industry is guided by customer demand and the tribal enterprise. Havasupai tribal tourism,
 51 economic and social conditions are likely to continue at similar levels to present with a negligible growth in tourism.
 52 None of the Alternatives are expected affect cumulative conditions for the Havasupai.
 53

54 **Conclusion American Indian Tribes Socioeconomic Environment**
 55 **Havasupai Tribe**
 56

1 Table 4.247 summarizes impacts to the Havasupai Tribe by Alternative.
 2

3 **Table 4.247 Havasupai Tribe Summary of Impacts**

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Tourism	<i>Base Year</i> No change	<i>Base Year</i> No change	<i>Base Year</i> No change	<i>Base Year</i> No change
	<i>Ten-Year Forecast</i> 14% increase in flight operations and passengers	<i>Ten-Year Forecast</i> 14% increase in flight operations and passengers	<i>Ten-Year Forecast</i> 14% increase in flight operations and passengers	<i>Ten-Year Forecast</i> 14% increase in flight operations and <i>passengers</i>
Economic Conditions	No change	No change	No change	No change
Social Conditions	No change	No change	No change	No change

Source: Harvey Economics 2010

4
5
6 **NAVAJO NATION AMERICAN INDIAN TRIBES SOCIOECONOMIC ENVIRONMENT**

7
8 **Alternative A Navajo Nation American Indian Tribes Socioeconomic Environment**

9
10 *Alternative A American Indian Tribes Socioeconomic Environment*
 11 *Base Year and Ten-Year Forecast Navajo Nation Tourism, Economic, and Social*

12 Tourism is part of the Navajo Nation economy, including the Cameron Chapter, but neither the Navajo Nation
 13 nor Cameron Chapter is currently *directly* involved in the air-tour industry, *though air tours do currently fly*
 14 *routes over Navajo lands in Marble Canyon and the Little Colorado River confluence.* This would continue
 15 and no *additional* tourism, economic, or social impacts to the Navajo Nation would result Base Year or Ten-
 16 Year Forecast. Current Navajo Nation demographic, economic, and social conditions are detailed in Chapter 3.

17
18 **Alternatives E, F and American Indian Tribes Socioeconomic Environment**
 19 **Modified NPS Preferred Navajo Nation**

20
21 *Alternatives E, F and Modified NPS Preferred American Indian Tribes Socioeconomic Environment*
 22 *Base Year and Ten-Year Forecast Navajo Nation Tourism, Economic, and Social*

23 No new air-tour routes would be created over Navajo Nation land and no new tourism activities would be
 24 promoted by *Alternatives E, F, or the Modified NPS Preferred. Under the Modified NPS Preferred*
 25 *Alternative, the air-tour route over Navajo lands in Marble Canyon would be eliminated, though flights may*
 26 *still occur between Tusayan and Page outside the SFRA. Tour routes would also be moved away from the*
 27 *Little Colorado River confluence.* Demographic, economic, and social conditions of the Navajo Nation and its
 28 members would not be *measurably* impacted by these Alternatives, and conditions would remain *essentially* the
 29 same as Alternative A Base Year and Ten-Year Forecast.

30
31 **Cumulative Effects**
 32 **Alternatives E, F, and Modified NPS Preferred American Indian Tribes Socioeconomic Environment**
 33 **Navajo Nation**

34
35 The Navajo Nation is a large area with a diversified economy. Growth and social improvement is likely to continue
 36 consistent with past trends. Alternatives E *and F* impacts, when combined with reasonably foreseeable influences,
 37 *would* not change air-tour impacts on the Navajo Nation. *The Modified NPS Preferred Alternative would reduce*
 38 *air-tour impacts on the Navajo Nation, but would not facilitate connection through GCNP to any potential air-*
 39 *tour-related tourism to or from Navajo lands. However, flights between Grand Canyon National Park Airport*
 40 *and Navajo lands could continue to occur outside GCNP and, if proposals emerge in the future concerning such*
 41 *flights, the proposals would be subject to a future compliance action following this EIS process (see Methodology*
 42 *and Assumptions for analysis of impacts to American Indian Tribes).*

43
44 **Conclusion**
 45 **Alternatives E, F and Modified NPS Preferred American Indian Tribes Socioeconomic Environment**

1 Navajo Nation

2
3 Table 4.248 provides summarizes impacts to the Navajo Nation by Alternative.

4
5 **Table 4.248 Navajo Nation Summary of Impacts**

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Tourism	No change	No change	No change	<i>No change</i>
Economic Conditions	No change	No change	No change	<i>No change</i>
Social Conditions	No change	No change	No change	<i>No change</i>

6 Source: Harvey Economics 2010; *BBC Research & Consulting*2012

9 GENERAL AVIATION

SOCIOECONOMIC ENVIRONMENT

11 Methodology and Assumptions for Analysis of Impacts 12 General Aviation

Socioeconomic Environment

13
14 General aviation is defined as takeoffs and landings of all civil aircraft, except those classified as air carriers or air
15 taxis (FAA 2009). This includes all aircraft not carrying cargo or passengers for hire or compensation. General-
16 aviation aircraft are allowed to fly over GCNP at specific altitudes depending on flight location and direction.
17 General-aviation flights occur in the SFRA's general-aviation corridors, over Flight-free Zones, or over other park
18 areas in accordance with FAA regulations regarding flight altitude.

19
20 Impacts to SFRA general-aviation operations could result from *components such as* the following *which are*
21 *included in one or more EIS Alternative*

- 22 • Closure of *one or more* general-aviation corridor(s)
- 23 • Changes to general-aviation corridor boundaries
- 24 • *Raising* Flight-free Zone *ceilings*

25
26 *Such* changes may result in changes in flight *paths* or costs if *pilots* need to adjust their *flight paths* to comply with
27 new regulations. For example, longer flights would result in additional operating costs as well as additional time.

28
29 Maps and descriptions provided in Chapter 2 for each Alternative were relied on to determine general-aviation
30 aircraft flight-path changes, including estimates of changes to total flight mileage. Changes in operating costs and
31 time required when using modified flight routes or *flight paths* would be specific to each aircraft type and could
32 vary greatly depending on flight route or *path*, and *pilot choices such as whether to fly over or around a Flight-*
33 *free Zone*. No annual or longitudinal data on number of SFRA general-aviation operations or distribution of aircraft
34 types for annual flights was available. However, information on general-aviation flight activity over Grand Canyon
35 Peak Day 2005 indicates a total of four general-aviation flights occurred in the SFRA on the following aircraft
36 types: Beech Baron, Cessna Conquest, and an unspecified single-engine aircraft. The Cessna Conquest 441 was
37 chosen as a representative general-aviation aircraft type for this analysis since operating costs were readily available;
38 *however, it is recognized that many common general aviation aircraft are not as high performance or as costly to*
39 *operate as a Cessna Conquest*. Impacts are presented on a per-flight basis. The quantitative Cessna Conquest
40 impacts represent maximum impact or worst case scenarios; actual changes in flight times and operating costs would
41 depend on specific *aircraft types, and pilot choices for operational settings and flight paths*. Cessna Conquest 411
42 operating costs include fuel; maintenance labor; parts, airframe, engine and avionics costs; inspections, component
43 overhauls, and engine restoration; and miscellaneous expenses, including landing and parking fees, crew expenses,
44 and supplies and catering (Harvey Economics 2008c). Specific assumptions are

- 45 • Total variable operating costs, *including fuel*, for the Cessna Conquest 441 amount to about \$1,111 per hour, or
46 about \$18.50 per minute
- 47 • The Cessna Conquest 441 flies at an average speed of 270 knots, which equals about 311 miles per hour or
48 about five miles per minute once cruising altitude is reached. At this speed, variable operating costs amount to
49 about \$3.60 per mile
- 50 • The aircraft's rate of climb is 2,435 feet per minute

1 *Flight-free Zones, Alternative E* *General Aviation* *Socioeconomic Environment*
 2 *Base Year and Ten-Year Forecast*

3 Toroweap/Shinumo and Bright Angel Flight-free Zones would be extended to the SFRA’s northern boundary.
 4 These expansions would cause general-aviation flights to fly at higher **altitudes** for longer periods **if they chose**
 5 **to fly over the Flight-free Zones rather than around in** general-aviation corridors, but **the Flight-free Zone**
 6 **extensions** would not increase overall flight distances, times, or costs with the exception of flights over Marble
 7 Canyon, as described below.
 8

9 Bright Angel Flight-free Zone would include Marble Canyon in Alternative E. Pilots flying over Marble Canyon
 10 in an east-west direction would be required to fly above the Flight-free Zone, increasing both flight time and fuel
 11 use. **Another** possibility would be to fly around Bright Angel Flight-free Zone, which would add a number of
 12 miles to flight distance, depending on flight **path**.
 13

14 All Flight-free Zone ceilings would be raised to 17,999 feet MSL **in Alternative E**. General-aviation pilots would
 15 be required to fly at altitudes over 17,999 feet MSL when flying over Flight-free Zones; **however, they could fly**
 16 **as low as 10,500 feet in general aviation flight corridors depending on direction of travel, or as low as the**
 17 **minimum sector altitude in areas outside flight corridors and Flight-free Zones. Flying over Flight-free Zones**
 18 would cause general-aviation flights to increase their altitudes by 3,500 feet (Desert View, Bright Angel and
 19 Toroweap/ Shinumo Flight-free Zones) or by 10,000 feet (Sanup Flight-free Zone). Increased altitudes would
 20 increase flight time and fuel costs for pilots flying over Flight-free Zones. Single-engine piston-aircraft types
 21 generally **have difficulty flying** at altitudes greater than 14,500 feet MSL, **so they would probably** fly in general-
 22 aviation corridors or around Flight-free Zones, which would result in increased flight times and fuel costs.
 23

24 *Cessna Conquest Flights* *General Aviation* *Socioeconomic Environment*
 25 *Base Year and Ten-Year Forecast* *Alternative E*

26 Table 4.249 provides per-flight impacts to Cessna Conquest general-aviation flights over the SFRA, in terms of
 27 distance, flight times, and operating costs in Alternative E.
 28

29 **Cumulative Effects Alternative E** **General Aviation** **Socioeconomic Environment**

30
 31 Base Year and Ten-Year Forecast, general-aviation pilots represent a highly diverse group with different flight
 32 objectives, and different economic, demographic, and social backgrounds. These aircraft operators have many
 33 aircraft to choose from, and those aircraft will continue to change with technological advances. By itself, Alternative
 34 E will generate a negligible to minor adverse impact on most SFRA general-aviation flights. Combining impacts of
 35 Alternative E with reasonably foreseeable changes to general-aviation, net impacts will be negligible.
 36

37 **Conclusion Alternative E** **General Aviation** **Socioeconomic Environment**

38
 39 Base Year and Ten-Year Forecast, impacts to general-aviation flights in Alternative E include increased flight
 40 distances, increases in operating costs, and additional minutes of flight time. Impacts would vary based on aircraft
 41 type and flight route; however, based on quantified impacts to single Cessna Conquest 441 flights, impacts to
 42 individual general-aviation flights would be negligible to minor adverse in Alternative E as a worst case. Based on a
 43 two-hour flight, increases in operating costs would range from less than one up to about 14%, depending on flight
 44 route, in Alternative E. A 14% increase in operating costs would result from the need to fly around Marble Canyon
 45 due to the increased minimum flight altitude; however, it is unlikely this would affect many flights.
 46
 47

1 **Table 4.249 Alternative E General-aviation Operations Impacts to Cessna Conquest**
 2 **Base Year and Ten-Year Forecast**

Change in Flight route	Altitude Change (feet)	Increased Flight Distance (nautical miles)	Change in Operating Cost	Additional Time (minutes)
Fossil Canyon GAC ^a diverted to Dragon GAC	NA	32	\$133	7
Fossil Canyon GAC diverted to Tuckup GAC	NA	37	\$151	8
Dragon GAC modified to include dog leg – East End	NA	5	\$22	1
Dragon GAC modified to include dog leg – West End	NA	3	\$11	1
Northern extension of Tuckup, Dragon and Zuni Point GACs	NA	NA	\$0	0
Sanup FFZ ^b increase in minimum flight altitude	10,000	NA	\$152	8
Toroweap/ Shinumo FFZ increase in minimum flight altitude	3,499	NA	\$53	3
Bright Angel FFZ increase in minimum flight altitude	3,499	NA	\$53	3
Desert View FFZ increase in minimum flight altitude	3,499	NA	\$53	3
Marble Canyon increase in minimum flight altitude flyover	10,000	NA	\$152	8
Marble Canyon fly around	NA	73	\$300	16

Source: Harvey Economics 2010

Numbers rounded to nearest mile, dollar, or minute

^aGAC General-aviation corridor

^bFFZ Flight-free Zone

3
4
5 **ALTERNATIVE F**

GENERAL AVIATION

SOCIOECONOMIC ENVIRONMENT

6
7 *Alternative F*

General Aviation

Socioeconomic Environment

8 *General-aviation Corridors*

9 *Base Year and Ten-Year Forecast*

10 Fossil Canyon general-aviation corridor would be closed in Alternative F. General-aviation flights using would
 11 either use Tuckup or Dragon Corridors depending on flight route *or path*. These diversions would result in
 12 increased flight distance, flight time, and operating costs.

13
 14 Dragon Corridor would change locations seasonally. Year-round use for general-aviation flights would occur in
 15 the existing Dragon Corridor. Seasonal corridor use for air-tours would not have any impact on general-aviation
 16 flights

17
 18 Eastern and western boundaries of the general-aviation Dragon Corridor would be modified *to make it consistent*
 19 *with all other corridors (i.e., four-nautical-miles wide)*. Modified boundaries would result in slightly longer
 20 flight distances for general-aviation aircraft.

21
22 *Alternative F*

General Aviation

Socioeconomic Environment

23 *Flight-free Zones*

24 *Base Year and Ten-Year Forecast*

25 Sanup Flight-free Zone's northern boundary would move south. This would not affect general-aviation flights
 26 since minimum flight altitudes outside Sanup Flight-free Zone for general-aviation aircraft in that area are the
 27 same as over the Flight-free Zone, 7,999 feet MSL

1 Toroweap/Shinumo Flight-free Zone’s eastern boundary would move west to accommodate modified Dragon
 2 Corridor. General-aviation flights would not be affected by this boundary change
 3

4 *Alternative F* *General Aviation* *Socioeconomic Environment*
 5 *Cessna Conquest Flights*
 6 *Base Year and Ten-Year Forecast*

7 Table 4.250 provides per flight impacts to Cessna Conquest general-aviation flights over the SFRA in terms of
 8 distance, flight times, and operating costs in Alternative F.
 9

10 **Table 4.250 Alternative F General-aviation Operations Impacts to Cessna Conquest**
 11 **Base Year and Ten-Year Forecast**

Change in Flight route	Altitude Change (feet)	Increased Flight Distance (nautical miles)	Change in Operating Cost	Additional Time (minutes)
Fossil Canyon GAC ^a diverted to Dragon GAC	NA	32	\$133	7
Fossil Canyon GAC diverted to Tuckup GAC	NA	37	\$151	8
Dragon GAC modified to include dog leg – East End	NA	5	\$20	1
Dragon GAC modified to include dog leg – West End	NA	3	\$11	1
Sanup FFZ ^b boundary change	NA	NA	\$0	0
Toroweap/ Shinumo FFZ boundary change	NA	NA	\$0	0

Source: Harvey Economics 2010
 Numbers rounded to nearest mile, dollar, or minute
^aGAC General-aviation corridor
^bFFZ Flight-free Zone

12
 13
 14 **Cumulative Effects Alternative F** **General Aviation** **Socioeconomic Environment**

15
 16 Base Year and Ten-Year Forecast, general-aviation pilots represent a highly diverse group with different flight
 17 objectives, and different economic, demographic and social backgrounds. These aircraft operators have many
 18 aircraft to choose from, and those aircraft will continue to change with technological advances. By itself, Alternative
 19 F will generate a negligible to minor adverse impact on most general-aviation flights in the SFRA. Combining
 20 impacts of Alternative F with reasonably foreseeable changes to general-aviation, net impact will be negligible.
 21

22 **Conclusion Alternative F** **General Aviation** **Socioeconomic Environment**

23
 24 Base Year and Ten-Year Forecast, impacts to general-aviation flights in Alternative F include increased flight
 25 distances, operating costs, and minutes of flight time. Impacts would vary based on aircraft type and flight route;
 26 however, based on quantified impacts to single Cessna Conquest 441 flights, it appears impacts to individual
 27 general-aviation flights would be negligible to minor adverse in Alternative F, as a worst case. Based on a two-hour
 28 flight, increases in operating costs would range from less than one percent up to about 7%, depending on flight
 29 route, in Alternative F.
 30

31 **MODIFIED NPS PREFERRED ALTERNATIVE GENERAL AVIATION SOCIOECONOMIC ENVIRONMENT**

32
 33 *Modified NPS Preferred Alternative* *General Aviation* *Socioeconomic Environment*
 34 *Base Year and Ten-Year Forecast*

35 Fossil Canyon Corridor would be pivoted slightly southeast to move the corridor away from Great Thumb Mesa
 36 and Supai Village. Location of the pivoted Fossil Canyon Corridor would likely benefit general-aviation pilots
 37 who would be able to avoid a potentially sharp turn out of the corridor and around the Toroweap/Shinumo
 38 Flight-free Zone boundary.
 39

1 Dragon Corridor’s southeast boundary would be modified to accommodate a dogleg proposed for air-tour routes
 2 through this corridor **and to make it consistent with the four-nautical-mile width of all other general aviation**
 3 **flight corridors**. As a result, general-aviation flights routed through Dragon Corridor could increase in distance
 4 by **up to five nautical** miles.

5
 6 Bright Angel Flight-free Zone’s southwestern edge would be expanded in response to Dragon Corridor’s dogleg.
 7 This expansion would not have an impact on general-aviation flights.

8
 9 The upper boundary of all Flight-free Zone ceilings would be raised to 17,999 feet MSL. No flights would be
 10 allowed below 18,000 feet MSL except 1) aircraft in transit on Victor airways V210, V257, and V293 at or
 11 above 14,500 feet (**the current minimum en route altitude for those airways in that area**), 2) aircraft under
 12 positive control of an air-traffic control center or tower when necessary for safety, 3) administrative use under an
 13 appropriate written waiver **issued by FAA at the request of** the manager(s) of the over-flown land(s). **General**
 14 **aviation pilots could also choose to deviate around Flight-free Zones to a nearby corridor where they could fly**
 15 **between 10,500 feet and 17,999 feet depending on direction of travel, or as low as the minimum sector altitude**
 16 **in areas outside the corridors**. Except under these conditions, general-aviation pilots would be required to fly at
 17 elevations over 17,999 feet MSL when flying over Flight-free Zones. This could cause general-aviation flights
 18 flying over these zones to increase their flight altitudes by 3,500 feet (Desert View, Bright Angel and
 19 Toroweap/Shinumo Flight-free Zones) or by 10,000 feet (Sanup Flight-free Zone). Increased elevation
 20 requirements would result in additional flight time and fuel costs for pilots flying over Flight-free Zones. Single-
 21 engine piston-aircraft types generally **have difficulty flying** at altitudes greater than 14,500 feet MSL, **so they**
 22 **would probably** fly in general-aviation corridors or around Flight-free Zones, which would result in increased
 23 flight times and fuel costs.

24
 25 **Modified NPS Preferred Alternative** **General Aviation** **Socioeconomic Environment**
 26 **Cessna Conquest Flights**

27 Table 4.251 provides per-flight impacts to Cessna Conquest general-aviation flights over the SFRA, in terms of
 28 distance, flight times, and operating costs, in the **Modified NPS Preferred Alternative**.

29
 30 **Table 4.251** **Modified NPS Preferred General-aviation Operations Impacts to Cessna Conquest**
 31 **Base Year and Ten-Year Forecast**

Change in Flight route	Altitude Change (feet)	Increased Flight Distance (nautical miles)	Change in Operating Cost	Additional Time (minutes)
Dragon GAC ^a modified to include dogleg	NA	5	\$20	1
Fossil Canyon GAC pivoted to the southeast	NA	3	\$13	1
Sanup FFZ ^b increase in minimum flight altitude	10,000	NA	\$152	8
Toroweap/Shinumo FFZ increase in minimum flight altitude	3,499	NA	\$53	3
Bright Angel FFZ increase in minimum flight altitude	3,499	NA	\$53	3
Desert View FFZ increase in minimum flight altitude	3,499	NA	\$53	3

Source: Harvey Economics 2010
 Numbers rounded to the nearest mile, dollar, or minute
^aGAC General-aviation corridor
^bFFZ Flight-free Zone

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1 **Cumulative Effects**

2 **Modified NPS Preferred**

General Aviation

Socioeconomic Environment

3
4 Base Year and Ten-Year Forecast, General-aviation pilots represent a highly diverse group with different flight objectives, and different economic, demographic, and social backgrounds. These aircraft operators have many aircraft to choose from, and those aircraft will continue to change with technological advances. By itself, the **Modified** NPS Preferred Alternative will generate a negligible to minor adverse impact on most general-aviation flights through the SFRA. Combining impacts of the **Modified** NPS Preferred Alternative with reasonably foreseeable changes to general-aviation, net impacts will be negligible.

10 **Conclusion**

General Aviation

Socioeconomic Environment

11 **Modified NPS Preferred**

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13
14 Base Year and Ten-Year Forecast, impacts to general-aviation flights include increased flight distances, increases in operating costs, and additional minutes of flight time. Impacts would vary based on aircraft type and flight route; however, based on quantified impacts to single Cessna Conquest 441 flights, it appears impacts to individual general-aviation flights would be negligible to minor adverse in the **Modified** NPS Preferred Alternative, as a worst case. Based on a two-hour flight, increases in operating costs would range from less than one percent up to about 7% depending on flight route.

20 **REGIONAL IMPACTS**

SOCIOECONOMIC ENVIRONMENT

21 **Methodology and Assumptions**

Regional Impacts

Socioeconomic Environment

22 **for Analysis**

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25
26 Socioeconomic impacts to regional *economies could* result from changes in number of park visitors (ground visitors) and these *visitors' expenditures or from changes in air-tour operations.*⁷⁰ Specific methodologies and data sources used to analyze impacts to regional economy are explained below.

27 *Direct* Socioeconomic Impacts

Regional Impacts

Socioeconomic Environment

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32 *Direct socioeconomic impacts could result from changes in the number of ground-based visitors to GCNP or changes in air-tour activity and employment.* Park visitation changes are based on analysis of impacts to visitor experience described in Chapter 4, Visitor Use and Experience. Ground-based visitor experience can be affected by aircraft noise perception, nature, and duration. However, ground-based visitors are motivated to visit the park for a host of reasons, such as viewscapes, unique environment, etc. The air-tour visitor's experience is largely influenced by views of Grand Canyon features *from the air* and amount of time over the canyon. *The analysis of impacts to the air-tour industry, including estimates of changes in number of air-tour customers and air-tour industry employment under each Alternative, were described earlier in Socioeconomic Environment, Air-tour Operators.*

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41 Park visitation described for Alternative A includes only those people who entered the park by ground-based vehicle; visitors who did not enter the park by ground-based vehicle were not included in visitation numbers. A small portion of air-tour passengers may visit the park by air only; however, many air-tour passengers also enter the park by ground-based vehicle. Therefore, analysis of visitor days for each Alternative assumes air-tour visitors have been accounted for in visitor estimates. Additionally, changes in number of air-tour passengers are not directly related to park visitation; a visitor may decide not to take an air tour for any number of reasons, but may still enter the park to experience the canyon in other ways.

42 **Regional Impacts**

Regional Impacts

Socioeconomic Environment

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51 *Ground-based visitor spending and subsequent economic impacts* are described in Chapter 3. *The ground-based visitor impact data were obtained from a 2010 study sponsored by the NPS that estimated visitation and economic impact of national parks and national monuments across the United States.* Total impacts account for direct

52
53

⁷⁰ Changes in employment and spending patterns of air-tour operators, which result from changes in flight demand, have been previously discussed as part of air-tour operator impact analysis

1 employment, income, and *value added* created by visitor spending *and national park payroll* as well as secondary
 2 effects of spending.⁷¹

3
 4 Air-tour operators purchase a portion of their total goods and services in the local area, and the remainder from
 5 vendors outside the region. Purchases include such items as employment hours, aircraft parts and supplies, and
 6 marketing and advertising services. Changes in number of flight operations and resulting impact on revenues for
 7 these operators would influence amount of spending, both in the region and outside the local area. *The IMPLAN*
 8 *model was used to estimate the overall impacts of changes in air tour activity on two separate regional economies*
 9 *(Coconino County, Arizona and Clark County, Nevada).*⁷² *The air-tour industry is encompassed in IMPLAN*
 10 *Sector 338 (Scenic and sightseeing transportation and support activities for transportation). Because this sector*
 11 *also includes bus tours and other forms of sightseeing transportation, the sector was customized to be consistent*
 12 *with air-tour industry economic characteristics as described in Chapter 3, Socioeconomic Affected Environment.*
 13 *Regional economic impacts were apportioned between the two regional economies based on distribution of air-*
 14 *tour industry employees (Chapter 3, Socioeconomic Affected Environment).*

15
 16 **ALTERNATIVE A REGIONAL IMPACTS SOCIOECONOMIC ENVIRONMENT**

17
 18 Number of annual park visitors *and* visitor contributions to the regional economy in Alternative A are described
 19 below, *followed by a discussion of regional socioeconomic impacts of the air-tour industry under Alternative A.*
 20 Additional descriptions and details can be found in Chapter 3, Socioeconomic Environment.

21 *Visitor Days Alternative A Regional Impacts Socioeconomic Environment*

22
 23 Table 4.252 identifies number of GCNP visitors *in 2010* by type in Alternative A. *This includes visitors accessing*
 24 *the park through North and South Rims.*

25
 26
 27 **Table 4.252 Alternative A Number of Park Visitors and Visitor Party Days/Nights**
 28 **by Visitor Type, 2010**

Visitor Type	Annual Number of Visitors	Number of Party Days/ Nights
Day Trip	1,160,662	379,582
In-Park Hotel	462,775	202,664
In-Park Camp	265,963	126,492
Backcountry Camper	156,003	93,193
Outside Park Hotel	1,976,635	681,609
Outside Park Camp	350,007	146,918
River Runners	23,405	77,023
Total	4,389,450	1,707,481

Sources: Stynes and Sun 2005; Stynes 2011; Harvey Economics 2010; BBC Research & Consulting 2012
 Notes: Visitors and party days/nights were calculated based on information and methodologies included
 in *Economic Impacts of GCNP Visitor Spending on the Local Economy, 2003* by Daniel Stynes and Ya-
 Yen Sun, Michigan State University 2005, and *2010 visitation data from the Economic Benefits to Local
 Communities from National Park Visitation and Payroll, 2010* by Daniel Stynes.
 Air-tour visitors are excluded if they did not also enter the park in another way

29
 30
 31 **Ground-Visitor Economic Impacts Regional Impacts Socioeconomic Environment**
 32 *Alternative A*

33
 34 *As discussed in Chapter 3, 83% of visitation, visitor spending, and economic impacts of the park are allocated to*
 35 *Coconino County, corresponding to South Rim share of total visitation. Total non-local visitor spending in*

⁷¹ Secondary effects are changes in economic activity resulting from re-circulation of money spent by visitors
⁷² *IMPLAN is a regional economic input-output modeling system originally developed by the U.S. Forest Service and widely
 used for economic impact studies throughout the United States*

1 **Coconino County** in Alternative A was \$416 million in 2010. Table 4.253 provides information on *the value added,*
 2 *labor* income, and employment *resulting from* that visitor spending *and of the National Park Service payroll.*
 3 **Impacts include direct and secondary effects.** Direct effects accrue to tourism-related businesses and their
 4 employees that sell directly to park visitors. These businesses include accommodations, restaurants, retail outlets,
 5 and other tourist attractions. Secondary effects relate to businesses that provide goods and services to directly
 6 impacted businesses and also include spending by households that earn income from visitor spending.

8 **Table 4.253 Alternative A Economic Impacts of GCNP on Coconino County, 2010**

	Total Value Added* (000's)	Labor Income (000's)	Employment
Visitor Impact	\$220.6	\$139.4	5,119
NPS Payroll Impact	\$33.3	\$30.9	546
Total Impact	\$254.0	\$170.3	5,665

Sources: Stynes 2011

*Value Added reflects contribution to Gross Regional Product, or economic output net of purchases of intermediate inputs

Note: Based on results of the 2005 NAU GCNP tourism study, 83% of park visitation, visitor spending, and economic impacts was allocated to Coconino County (corresponding to South Rim share of total visitation)

9
10
11 **Air Tour Economic Impacts** Regional Impacts Socioeconomic Environment
 12 *Alternative A*
 13 *Base Year*

14 Local spending by air-tour operators occurs near where operators are domiciled. For East End-domiciled
 15 operators, **the primary economic impact** occurs in Coconino County, *Arizona*, for West End, **the primary**
 16 **economic impact** generally occurs in Clark County, Nevada. *Purchases of goods and services by the air-tour*
 17 *industry, as well as purchases of household goods by air-tour industry employees, produce additional*
 18 *economic impacts within these regions. These indirect impacts are often referred to as “multiplier effects.”*

19
20 **Direct and indirect effects of the air-tour industry** contribute an estimated \$66 million in output to Coconino
 21 County and \$257 million in output to Clark County (IMPLAN 2009). *The air-tour industry directly employs*
 22 *1,226 employees in these two counties, accounting for 96% of total air-tour employees. The total employment*
 23 *effect of the air-tour industry (including indirect or “multiplier” effects) accounts for an estimated 2,335 total*
 24 *jobs in these two counties. In Coconino County, direct and indirect air-tour-related employment impacts*
 25 *represent 0.8% of total county employment; in Clark County air-tour-related employment impacts represent*
 26 *0.2% of total county employment. Table 4.254 summarizes current employment impacts of the air-tour*
 27 *industry on Coconino and Clark Counties.*

28
29 **Table 4.254 Alternative A Air-Tour Economic Impacts Regional Employment**
 30 *Base Year*

	Coconino County	Clark County
Direct Employment (Air-tour industry)	305	921
Indirect Employment Effect of Air-tour industry	237	872
Total Employment Effect of Air-tour industry	542	1,793
Total County Employment	64,410	907,510

Source: Implan 2009, 2006-2010 ACS and BBC Research & Consulting 2012

Note: Total county employment reflects the 2006-2010 annual average

31
32
33 **Air Tour Economic Impacts** Regional Impacts Socioeconomic Environment
 34 *Alternative A*
 35 *Ten-Year Forecast*

1 *Growth of the air-tour industry (as described in Chapter 4, Air-Tour Operators) was incorporated into the*
 2 *IMPLAN model to analyze the Ten-Year Forecast of air-tour impacts on the regional economy. Table 4.255*
 3 *shows the Ten-Year Forecast of air-tour impacts on regional employment.*

4
 5 **Table 4.255** *Alternative A* *Air Tour Economic Impacts* *Regional Employment*
 6 *Ten-Year Forecast*

	<i>Coconino County</i>	<i>Clark County</i>
<i>Direct Employment (Air-tour industry)</i>	<i>357</i>	<i>1,080</i>
<i>Indirect Employment Effect of Air-tour industry</i>	<i>277</i>	<i>1,022</i>
<i>Total Employment Effect of Air-tour industry</i>	<i>634</i>	<i>2,102</i>
<i>Percent Change from Alternative A Base Year</i>	<i>17%</i>	<i>17%</i>

7 *Source: IMPLAN 2009 and BBC Research & Consulting 2012*

8
 9 **ALTERNATIVE E** **REGIONAL IMPACTS** **SOCIOECONOMIC ENVIRONMENT**

10
 11 In Alternatives E, F, and the *Modified* NPS Preferred, number of visitors to GCNP would remain the same as
 12 Alternative A based on the underlying assumption that, in general, people want to visit Grand Canyon and the
 13 National Park in order to experience the extraordinary and unique aspects of this land feature, and the magnitude of
 14 change in noise would be insufficient to encourage more frequent visits or increase number of visitor days beyond a
 15 negligible extent. Grand Canyon exerts a powerful draw for millions of visitors from all over the world each year
 16 due to its scenic beauty, recreational opportunities, and other features. Trip lengths are normally planned well in
 17 advance, so length of stay would not be noticeably affected by changes in noise as envisioned in Alternatives E, F,
 18 and the *Modified* NPS Preferred; reduced audibility might have a beneficial impact on certain visitors overall park
 19 experience and perception once they were onsite, as discussed in Chapter 4, Visitor Use and Experience. Changes in
 20 audibility would vary by location for each Alternative as explained in Chapter 4, Soundscape, inside the park. This
 21 might entice a small number of visitors, such as backcountry campers, to visit more frequently, but effect would be
 22 negligible.

23
 24 *Regional economic impacts from ground-based visitation would also remain the same under Alternatives E, F,*
 25 *and the Modified NPS Preferred as under Alternative A. Regional economic impacts of the air-tour industry*
 26 *would vary among Alternatives as discussed below. The following discussion focuses on employment effects of*
 27 *the air-tour industry. Effects on other economic metrics (e.g. employee earnings and industry output) would be*
 28 *generally proportionate to effects on regional employment.*

29
 30 *Air Tour Economic Impacts* *Regional Impacts* *Socioeconomic Environment*
 31 *Alternative E*
 32 *Base Year*

33 *As discussed in Chapter 4, Air-tour operators, Base Year impact of Alternative E on air-tour operations is a*
 34 *33% reduction in air-tour flights requiring annual allocations and a 21% reduction in flights overall,*
 35 *including both flights requiring annual allocations and Hualapai excepted flights. Most East End operations*
 36 *require annual allocations and most West End operations are Hualapai excepted flights; thus economic*
 37 *impacts are likely to be more severe in Coconino County, which serves as the base for most East End air tours.*
 38 *To capture this distinction, regional economic impact estimates in Table 4.256 display a range of employment*
 39 *impacts, based on differing assumptions regarding geographic distribution of impacts to the air-tour industry*
 40 *and its employees.*

41
 42 *In Coconino County, Base Year short-term impacts were estimated to range from 21% (representing the*
 43 *percentage impact of Alternative E on the overall air-tour industry) to 33% (representing the impact to annual*
 44 *allocation flights). It was assumed that Coconino and Clark Counties will continue to support 96% of all jobs*
 45 *in the Grand Canyon air-tour industry. Base Year direct employment in the air-tour industry under*
 46 *Alternative E was estimated to be 206-241 jobs in Coconino County and 729-765 in Clark County. Table 4.256*
 47 *displays estimated total employment impacts of Alternative E Base Year on regional economies.*

1 **Table 4.256** *Alternative E* *Air Tour Economic Impacts* *Regional Employment*
 2 *Base Year*

	Coconino County	Clark County
<i>Direct and Indirect Employment</i>	366 to 428	1,419 to 1,489
<i>Percent Change in Employment from Alt A</i>	-21% to -32%	-17% to -21%
<i>Percent Change in Total County Employment</i>	-0.2% to -0.3%	0.0%

Source: IMPLAN 2009, 2006-2010 ACS and BBC Research & Consulting 2012

3
 4
 5 *In the first year following implementation of the regulation, employment impacts of the air-tour industry*
 6 *under Alternative E are expected to be 21%-32% lower than Alternative A Base Year in Coconino County.*
 7 *Overall, this represents a 0.2%-0.3% decrease in total county employment in Coconino County. The*
 8 *percentage effect on jobs in Tusayan is likely to be larger than the overall percentage effect on Coconino*
 9 *County as a whole. In Clark County, the 17%-21% decrease in direct and indirect air-tour industry*
 10 *employment, compared to Alternative A Base Year, represents less than one tenth of a percent change in total*
 11 *county employment. Projected impacts on air-tour-related employment are also small compared to the number*
 12 *of jobs supported by ground-based visitation at Grand Canyon National Park (see Table 4.253).*

14 *Air-Tour Economic Impacts* *Regional Impacts* *Socioeconomic Environment*
 15 *Alternative E*
 16 *Ten-Year Forecast*

17 *A similar geographic distribution of impacts was assumed for the Ten-Year Forecast. Direct employment in*
 18 *the air-tour industry in Coconino County was estimated to be between 283 and 500 jobs for the Ten-Year*
 19 *Forecast under Alternative E. Again, the lower impact estimate is consistent with the projected decrease in*
 20 *total air-tour industry employment, which represents a 13% decrease from Alternative A Ten-Year Forecast.*
 21 *The higher impact estimate applies the estimated percentage impact specific to annual allocation flights.*
 22 *Under Alternative E Ten-Year Forecast, this represents a 21% decrease from Alternative A Ten-Year*
 23 *Forecast.*

25 **Table 4.257** *Alternative E* *Air Tour Economic Impacts* *Regional Employment*
 26 *Ten-Year Forecast*

	Coconino County	Clark County
<i>Direct and Indirect Employment</i>	502 to 550	1,820 to 1,871
<i>Percent Change in Employment from Alt A</i>	-13% to -21%	-11% to -13%
<i>Percent Change in Total County Employment</i>	-0.1% to -0.2%	0.0%

Source: IMPLAN 2009, 2006-2010 ACS and BBC Research & Consulting 2012

27
 28
 29 *As discussed in Chapter 4, Air-Tour Operators, the air-tour industry is expected to adapt to regulations, and*
 30 *Ten-Year Forecast impacts are less than the initial (Base Year) impacts of Alternative E. The same is true for*
 31 *direct and indirect employment impacts. In Coconino County, the Alternative E Ten-Year Forecast results in*
 32 *a 0.1%-0.2% decrease in total county employment compared to projected employment under Alternative A*
 33 *Ten-Year Forecast. The percentage impact on employment in Tusayan would likely be larger. In Clark*
 34 *County, the impact to total county employment is less than one tenth of a percent compared to Alternative A*
 35 *Ten-Year Forecast.*

36
 37 *Although the Ten-Year Forecast for Alternative E indicates the air-tour industry would support fewer jobs*
 38 *than Ten-Year Forecast for Alternative A, the number of jobs would not differ substantially from the total*
 39 *employment the industry currently supports in Coconino County and Clark County under Alternative A Base*
 40 *Year, as shown in Figure 4.26.*

Table 4.258 Alternative E Air Tour Economic Impacts Regional Employment Ten-Year Forecast Compared to Current Conditions

	Coconino County	Clark County
Direct and Indirect Employment	502 to 550	1,820 to 1,871
Percent Change in Employment from Current Conditions	-7% to 1%	2% to 4%
Percent Change in Total County Employment	-0.1% to 0.0%	0.0%

Source: *IMPLAN 2009, 2006-2010 ACS and BBC Research & Consulting 2012*

Current conditions are represented by Alternative A Base Year and based on 2004-2009 annual average flight operations

Cumulative Effects Alternative E Regional Impacts Socioeconomic Environment

The total population and number of jobs are projected to increase in Coconino County, Arizona and Clark County, Nevada over the Ten-Year Forecast period.

The most recent available projections indicate total employment is projected to increase by 0.4% per year, or a total of 5% over the Ten-Year Forecast in Coconino County. This rate of employment growth would offset the projected reduction in air-tour industry jobs under Alternative E Ten-Year Forecast (relative to Alternative A) within a period of less than six months.

The most recent available projections indicate that total employment is projected to increase by 0.6% per year, or a total of 8% over the Ten-Year Forecast in Clark County. This rate of employment growth would offset the projected reduction in air-tour industry jobs under the Alternative E Ten-Year Forecast (relative to Alternative A) within a period of less than one month.

Conclusion Alternative E Regional Impacts Socioeconomic Environment

Base Year (short-term) impacts of Alternative E on regional socioeconomics would range negligible to moderate adverse compared to Alternative A Base Year. Impacts in Coconino County would be minor adverse compared to Alternative A Base Year. Impacts would be less pronounced in Clark County where the impacts on a regional scale would be negligible. In the small community of Tusayan, where a comparatively large percentage of the workforce appears to be employed by the air-tour industry (see Chapter 3, Socioeconomic Affected Environment), impacts would likely be moderate adverse compared to Alternative A Base Year.

Ten-Year Forecast (long-term) Alternative E impacts would also range from negligible to moderate adverse compared to Alternative A Ten-Year Forecast. Impacts in Coconino County would be minor adverse and impacts in Tusayan would be moderate adverse compared to Alternative A Ten-Year Forecast. Impacts would be less pronounced in Clark County where the impacts on a regional scale would be negligible compared to Alternative A Ten-Year Forecast. Compared to current conditions (Alternative A Base Year), Alternative E Ten-Year Forecast would represent a negligible change in regional socioeconomic conditions.

ALTERNATIVE F REGIONAL IMPACTS SOCIOECONOMIC ENVIRONMENT

Regional economic impacts from ground-based visitation would remain the same under Alternative F as under Alternative A. Regional economic impacts of the air-tour industry would vary among Alternatives. The following discussion focuses on employment effects of the air-tour industry.

Air Tour Economic Impacts Alternative F Regional Impacts Socioeconomic Environment

Base Year

As discussed in Chapter 4, Air-tour operators, Alternative F is expected to result in a 3% reduction in operations for air tours requiring annual allocations and a 2% reduction in total flights (includes both flights

1 *requiring annual allocations and Hualapai excepted flights). Using the same methodology and assumptions*
 2 *described in Alternative E, Table 4.259 displays a range of employment impacts in Coconino and Clark*
 3 *Counties.*

4
 5 *Direct employment in the air-tour industry in Coconino County was estimated to be between 296 and 299 jobs.*
 6 *This range corresponds to a 3% decrease relative to Alternative A (representing the impact to annual*
 7 *allocation flights) and a 2% decrease from Alternative A (consistent with the overall impact on the air-tour*
 8 *industry). Again, it was assumed that Coconino and Clark Counties will continue to support 96% of all jobs in*
 9 *the Grand Canyon air-tour industry. In Clark County, direct employment in the air-tour industry under*
 10 *Alternative F was estimated to range from 904 to 908.*

11
 12 **Table 4.259** *Alternative F* *Air Tour Economic Impacts* *Regional Employment*
 13 *Base year*

	<i>Coconino County</i>	<i>Clark County</i>
<i>Direct and Indirect Employment</i>	<i>526 to 531</i>	<i>1,760 to 1,767</i>
<i>Percent Change in Employment from Alt A</i>	<i>-2% to -3%</i>	<i>-1% to -2%</i>
<i>Percent Change in Total County Employment</i>	<i>0.0%</i>	<i>0.0%</i>

Source: IMPLAN 2009, 2006-2010 ACS and BBC Research & Consulting 2012

14
 15
 16 *In the first year following regulation, direct and indirect jobs related to the air-tour industry under Alternative*
 17 *F are expected to be 2%-3% lower than Alternative A in Coconino County and 1% lower than Alternative*
 18 *A in Clark County. In both counties, the air-tour industry-related employment impacts represent less than one*
 19 *tenth of a percent change in total county employment compared to projected employment under Alternative A.*

20
 21 *Air Tour Economic Impacts* *Regional Impacts* *Socioeconomic Environment*
 22 *Alternative F*
 23 *Ten-Year Forecast*

24 *A similar geographic distribution of impacts was assumed Ten-Year Forecast. Direct employment in the air-*
 25 *tour industry in Coconino County was assumed to be between 346 and 350. Again, the lower impact estimate*
 26 *is consistent with the projected decrease in overall air-tour industry-related employment, representing a 2%*
 27 *decrease from Alternative A. The higher impact estimate applies the estimated percentage impact specific to*
 28 *annual allocation flights. Under the Alternative F Ten-Year Forecast, this represents a 3% decrease from*
 29 *Alternative A. In Clark County, direct employment in the air-tour industry was estimated to range from 1,056*
 30 *to 1,061. Table 4.260 displays air-tour industry employment impacts Ten-Year Forecast for Alternative F.*

31
 32 **Table 4.260** *Alternative F* *Air Tour Economic Impacts* *Regional Employment*
 33 *Ten-Year Forecast*

	<i>Coconino County</i>	<i>Clark County</i>
<i>Direct and Indirect Employment</i>	<i>614 to 621</i>	<i>2,055 to 2,065</i>
<i>Percent Change in Employment from Alt A</i>	<i>-2% to -3%</i>	<i>-2% to -2%</i>
<i>Percent Change in Total County Employment</i>	<i>0.0%</i>	<i>0.0%</i>

Source: IMPLAN 2009, 2006-2010 ACS and BBC Research & Consulting 2012

34
 35
 36 *As was the case in the Base Year estimate for Alternative F, air-tour industry-related employment impacts*
 37 *represent less than one tenth of a percent change in total county employment in both Coconino and Clark*
 38 *Counties compared to projected employment under Alternative A.*

39
 40 *Although Alternative F Ten-Year Forecast indicates the air-tour industry would support slightly fewer jobs*
 41 *than Alternative A Ten-Year Forecast, there would be a considerable increase in the number of jobs*
 42 *compared to the total employment the industry currently supports in Coconino County and Clark County*
 43 *under Alternative A Base Year, as shown in Table 4.261.*

Table 4.261 Alternative F Air Tour Economic Impacts Regional Employment Ten-Year Forecast Compared to Current Conditions

	Coconino County	Clark County
<i>Direct and Indirect Employment</i>	614 to 621	2,055 to 2,065
<i>Percent Change in Employment from Current Conditions</i>	13% to 15%	15% to 15%
<i>Percent Change in Total County Employment</i>	0.1%	0.0%

Source: IMPLAN 2009, 2006-2010 ACS and BBC Research & Consulting 2012
 Current conditions are represented by Alternative A Base Year and based on 2004-2009 annual average flight operations

Cumulative Effects Alternative F Regional Impacts Socioeconomic Environment

The total population and number of jobs are projected to increase in Coconino County, Arizona and Clark County, Nevada over the Ten-Year Forecast period.

The most recent available projections indicate total employment is projected to increase by 0.4% per year, or a total of 5% over the Ten-Year Forecast in Coconino County. This rate of employment growth would offset the projected reduction in air-tour industry jobs under Alternative F Ten-Year Forecast (relative to Alternative A Ten-Year Forecast) within a period of less than one month.

The most recent available projections indicate that total employment is projected to increase by 0.6% per year, or a total of 8% over the Ten-Year Forecast in Clark County. This rate of employment growth would offset the projected reduction in air-tour industry jobs under the Alternative F Ten-Year Forecast (relative to Alternative A Ten-Year Forecast) within a period of less than one month.

Conclusion Alternative F Regional Impacts Socioeconomic Environment

Base Year impacts of Alternative F on regional socioeconomics would be negligible compared to Alternative A Base Year. Ten-Year Forecast Alternative F impacts would be negligible compared to the Alternative A Ten-Year Forecast. Compared to current conditions (Alternative A Base Year), Alternative F Ten-Year Forecast would represent moderate beneficial change to Regional Socioeconomic conditions.

MODIFIED NPS PREFERRED REGIONAL IMPACTS SOCIOECONOMIC ENVIRONMENT

Regional economic impacts from ground-based visitation would also remain the same under the Modified NPS Preferred Alternative as under Alternative A. Regional economic impacts of the air-tour industry would vary among Alternatives. The following discussion focuses on employment effects of the air-tour industry.

Air Tour Economic Impacts Modified NPS Preferred Base Year Regional Impacts Socioeconomic Environment

As discussed in Chapter 4, Air-tour operators, the Modified NPS Preferred Alternative is expected to result in a 19% reduction in operations for flights requiring annual allocations compared to Alternative A Base Year. This corresponds to a 12% reduction in operations for total flights compared to Alternative A Base Year (given that Hualapai excepted flights, which make up at least 40% of all air tours, would be unaffected). Using the same methodology and assumptions described in Alternative E, Table 4.262 displays a range of employment impacts in Coconino and Clark Counties.

Direct employment in the air-tour industry in Coconino County was estimated to range from 248 to 269. This range corresponds to a 12% decrease relative to Alternative A (representing the percentage impact on the overall air-tour industry) and a 19% decrease from Alternative A (representing the impact to annual allocation flights). Again, it was assumed Coconino and Clark Counties will continue to support 96% of all

1 *jobs in the Grand Canyon air-tour industry. In Clark County, direct employment in the air-tour industry*
 2 *under the Modified NPS Preferred was estimated to range from 812 to 833. Table 4.262 displays employment*
 3 *impacts of the Modified NPS Preferred Base Year on the regional economy.*

5 **Table 4.262 Modified NPS Preferred Alternative Air-Tour Economic Impacts**
 6 **Regional Employment Base year**

	Coconino County	Clark County
<i>Direct and Indirect Employment</i>	440 to 478	1581 to 1621
<i>Percent Change in Employment from Alt A</i>	-12% to -19%	-10% to -12%
<i>Percent Change in Total County Employment</i>	-0.1% to -0.2%	0.0%

7 *Source: IMPLAN 2009 and BBC Research & Consulting2012*

8
 9 *In the first year following implementation of new provisions, total contribution of the air-tour industry to*
 10 *employment in Coconino County (including multiplier effects) would be expected to be 12%-19% lower under the*
 11 *Modified NPS Preferred Alternative than Alternative A. Overall, this would represent a 0.1-0.2% decrease in total*
 12 *county employment in Coconino County. The percentage reduction in employment in Tusayan would likely be*
 13 *larger. In Clark County, the 10%-12% decrease in direct and indirect air-tour industry employment compared to*
 14 *Alternative A Base Year represents less than one tenth of a percent change in total county employment. Projected*
 15 *impacts on air-tour-related employment are also small compared to the number of jobs supported by ground-*
 16 *based visitation at Grand Canyon National Park (see Table 4.253).*

18 **Air Tour Economic Impacts Regional Impacts Socioeconomic Environment**
 19 **Modified NPS Preferred**
 20 **Ten-Year Forecast**

21 *A similar geographic distribution of impacts was assumed for the Ten-Year Forecast. Direct employment in*
 22 *the air-tour industry in Coconino County was projected to be between 328 and 339 jobs. Again, the higher end*
 23 *of the range is consistent with the projected 5% lower level of overall air-tour industry-related employment*
 24 *compared to Alternative A. The lower end of the range applies the estimated percentage impact specific to*
 25 *flights requiring annual allocations to projected air-tour related employment in Coconino County. Under the*
 26 *Modified NPS Preferred Ten-Year Forecast this projection is 8% lower than under Alternative A. In Clark*
 27 *County, direct employment in the air-tour industry was projected to range from 1,023 to 1,033. Table 4.263*
 28 *displays projected Modified NPS Preferred Ten-Year Forecast air-tour industry employment impacts.*

30 **Table 4.263 Modified NPS Preferred Alternative Air Tour Economic Impacts**
 31 **Regional Employment Ten-Year Forecast**

	Coconino County	Clark County
<i>Direct and Indirect Employment</i>	582 to 602	1991 to 2011
<i>Percent Change in Employment from Alt A</i>	-5% to -8%	-4% to -5%
<i>Percent Change in Total County Employment</i>	0.0% to -0.1%	0.0%

32 *Source: IMPLAN 2009 and BBC Research & Consulting2012*

33
 34 *As discussed in Chapter 4, Air-tour operators, the air-tour industry is expected to adapt to regulations, and*
 35 *Ten-Year Forecast impacts are less than Base Year impacts of the Modified NPS Preferred. The same is true*
 36 *for direct and indirect employment impacts. At most, the 5%-8% decrease in direct and indirect air-tour*
 37 *industry employment would represent a 0.1% decrease in total county employment in Coconino County*
 38 *(relative to Alternative A). Again, the percent change in total county employment in Clark County is less than*
 39 *one tenth of a percent.*

40
 41 *Although the Ten-Year Forecast for the Modified NPS Preferred Alternative indicates the air-tour industry*
 42 *would support fewer jobs than Ten-Year Forecast Alternative A, the Modified NPS Preferred Alternative*
 43 *would still allow for growth in the number of air-tour related jobs compared to total employment the industry*

1 *currently supports in Coconino County and Clark County under Alternative A Base Year, as shown in Table*
 2 *4.264.*

3
 4 **Table 4.264 Modified NPS Preferred Alternative Air Tour Economic Impacts**
 5 **Regional Employment Ten-Year Forecast Compared to Current Conditions**

	Coconino County	Clark County
<i>Direct and Indirect Employment</i>	582 to 602	1,991 to 2,011
<i>Percent Change in Employment from Current Conditions</i>	7% to 11%	11% to 12%
<i>Percent Change in Total County Employment</i>	0.1%	0.0%

Source: IMPLAN 2009 and BBC Research & Consulting 2012

Current conditions are represented by Alternative A Base Year and based on 2004-2009 annual average flight operations

6
 7
 8 **Cumulative Effects Regional Impacts Socioeconomic Environment**
 9 **Modified NPS Preferred**

10
 11 *The total population and number of jobs are projected to increase in Coconino County, Arizona and Clark*
 12 *County, Nevada Ten-Year Forecast.*

13
 14 *The most recent available projections indicate total employment is projected to increase by 0.4% per year, or a*
 15 *total of 5% over the Ten-Year Forecast in Coconino County. The rate of projected employment growth in*
 16 *Coconino County would offset the projected reduction in air-tour industry jobs under the Modified NPS*
 17 *Preferred Ten-Year Forecast (relative to Alternative A Base Year) within a period of approximately one month or*
 18 *less. A number of projects are underway or in the planning stage in Tusayan, including development of a new*
 19 *terminal at GCN, which may stimulate further growth in that community.*

20
 21 *The most recent available projections indicate total employment is projected to increase by 0.6% per year, or a*
 22 *total of 8% Ten-Year Forecast in Clark County. This rate of employment growth would offset the projected*
 23 *reduction in air-tour industry jobs under the Modified NPS Preferred Ten-Year Forecast (relative to Alternative*
 24 *A Ten-Year Forecast) within a period of less than one month.*

25
 26 **Conclusion Regional Impacts Socioeconomic Environment**
 27 **Modified NPS Preferred**

28
 29 *Base Year (short-term) impacts of Modified NPS Preferred on regional socioeconomics would range from*
 30 *negligible to moderate adverse compared to Alternative A Base Year. Impacts in Coconino County would be*
 31 *minor adverse and impacts in Tusayan would be moderate adverse. Impacts would be less pronounced in Clark*
 32 *County where the impacts on a regional scale would be negligible compared to Alternative A Base Year.*

33
 34 *Ten-Year Forecast (long-term) Modified NPS Preferred impacts would range negligible to minor adverse*
 35 *compared to the Alternative A Ten-Year Forecast. Impacts in Coconino County would be negligible, but impacts*
 36 *in Tusayan could be minor adverse. Anticipated growth and developments in these areas may offset some or all of*
 37 *these impacts. Impacts would be less pronounced in Clark County where the impacts on a regional scale would*
 38 *be negligible. Compared to current conditions (Alternative A Base Year), Modified NPS Preferred Alternative*
 39 *Ten-Year Forecast would represent moderate beneficial change in Regional Socioeconomic conditions.*

40
 41 **PARK VALUES Socioeconomic Environment**

42
 43 **Methodology and Assumptions for Analysis Park Values Socioeconomic Environment**

44
 45 *Estimating impacts to park values involves values placed on the park both by visitors and non-visitors. Specific*
 46 *methodologies and data sources used to analyze impacts to park values are explained below.*
 47

1 **Impacts to Direct Use**
2 **and Intrinsic Values**

Park Values

Socioeconomic Environment

3
4 *Direct-use values, also referred to as consumer surplus, use benefits, or visitor day values, are defined as the*
5 *additional value of the park to park visitors beyond actual trip expenditures. The park’s intrinsic value to park*
6 *visitors was estimated based on number of park visitors in each Alternative, average length of stay for each type*
7 *of park visitor, and per-day use values of visitors described in Chapter 3. These use values were estimated by FAA*
8 *for 1998 using a benefits-transfer methodology and updated to 2010 for this analysis to reflect changes in*
9 *visitation and in estimated direct use values per visitor day. An explanation of uses and drawbacks of this*
10 *methodology can be found in Chapter 3.*

11
12 *Non-use park values refer to values placed on GCNP by park visitors and people who do not plan on visiting the*
13 *park. Non-use values are independent of on-site or direct-use values. Non-use values are influenced by general*
14 *park perceptions, likely driven by the landscape, the Colorado River, the history, culture, and physical*
15 *environment. Presence of aircraft and associated noise is one aspect of that environment. Current non-use park*
16 *values are described in Chapter 3.*

17 **ALTERNATIVE A DIRECT USE AND INTRINSIC PARK VALUES SOCIOECONOMIC ENVIRONMENT**

18
19
20 *There were approximately 4.4 million visitor days at GCNP in 2010. A more detailed discussion of direct-use*
21 *values is provided in Chapter 3. Table 4.265 offers an estimate of direct-use park values by park visitors in*
22 *Alternative A (dollar values are reported in 2010 dollars).*

23
24 **Table 4.265 Alternative A Direct-use Value GCNP**

Visitor Type	Total Visitor Days	Use Value per Visitor Day ^a	Total Use Value
Backcountry	73,839	\$60.14	\$4,440,677
River Runner	101,137	\$116.49	\$11,781,449
Other	4,213,410	\$56.12	\$236,877,910
Total	4,388,386	N/A^b	\$253,100,036

Source: Federal Aviation Administration, Docket No. FAA-1999-5927-280;
NPS.gov Park Statistics; Grand Canon River Office Statistics Calendar Year 2010;
Loomis 2005; Bureau of Labor Statistics Inflation Calculator
^b These values are not additive

25
26
27 *Non-use values were also discussed in Chapter 3. Total non-use value for the Glen Canyon National Recreation*
28 *Area/Grand Canyon area, as obtained from previous studies, was estimated between \$3.0 to \$4.3 billion (2004*
29 *dollars) based on per-household non-use values ranging from about \$17 to \$26 (Welsh et al. 1995, Loomis,*
30 *Douglas, and Mapman 2005). This is assumed to be Alternative A’s non-use value.*

31
32 **Alternatives E, F and Modified NPS Preferred Direct Use and Intrinsic Park Values Socioeconomic Environment**

33
34
35 Park visitation would not be expected to change in Alternatives E, F, and the **Modified** NPS Preferred compared to
36 Alternative A; therefore, total visitor days in these Alternatives would also remain the same as Alternative A. Per-
37 day direct-use values for park visitors would also remain unchanged for most visitors, with exception of backcountry
38 visitors.

39
40 Direct-use values for visitors *to developed areas* would be **largely** unchanged primarily because noise changes
41 would be insufficient to appreciably change visitor experience, as described in Chapter 4, Visitor Use and
42 Experience. **Developed area** visitors are subject to other sound sources, i.e., vehicles **and** other people, **although in**
43 **a national park setting even noise in Developed Zones can reach inappropriate levels.** Backcountry visitors, such
44 as backpackers, often make a considerable effort to experience wilderness away from others. In absence of other
45 intrusions, aircraft noise **is often the only non-natural noise source in over 90% of the park and** would detract
46 from intrinsic direct-use values of those backcountry visitors who encountered it.

1 Alternatives E and the **Modified** NPS Preferred include seasonal routing, and attempt to avoid popular backcountry
2 trails and campsites. Both Alternatives would result in fewer flight operations **short term, but** these reductions
3 would **diminish** Ten-Year Forecast.

4
5 An estimated increase in direct-use value of \$20 per day is assumed for backcountry visitors in Alternative E and
6 **Modified** NPS Preferred. This one-third increase in direct-use value beyond Alternative A conditions reflects the
7 importance of natural Soundscapes for backcountry visitors. **Alternatives E** and the **Modified** NPS Preferred would
8 generate small incremental benefits for backcountry visitors due to a reduced number of flights and **conversion to**
9 quiet-technology aircraft, in addition to seasonal routing and other changes described previously. **Table 4.266**
10 **summarizes total visitor days and direct-use values for GCNP in Alternatives E and the Modified NPS Preferred.**

11 **Table 4.266 Alternatives E and Modified NPS Preferred Direct-use Value GCNP**

Visitor Type	Total Visitor Days	Use Value per Visitor Day ^a	Total Use Value
Backcountry	73,839	\$80.14 ^c	\$5,917,457
River Runner	101,137	\$116.49	\$11,781,449
Other	4,213,410	\$56.22	\$236,877,910
Total	4,388,386	N/A^b	\$254,576,816
Percent Change from Alternative A	0.0%		0.6% ^c

12 *Source: Harvey Economics 2010; BBC Research & Consulting 2012*

^aA visitor day is one person visiting the park for one day. Many visitors come to the park for multiple days. Therefore, visitor days are calculated as number of visitors multiplied by number of days at the park

^bThese values are not additive

^cThis represents a 33% increase in backcountry visitor values

13
14
15 **Alternative F would not represent a sufficient change in routes or curfew, or seasonal use to change impacts of**
16 **aircraft noise on backcountry visitors. Table 4.267 summarizes total visitor days and direct-use values for GCNP**
17 **in Alternative F, which are the same as Alternative A.**

18
19 **Table 4.267 Alternative F Direct-use Value GCNP**

Visitor Type	Total Visitor Days	Total Use Value
Backcountry	73,839	\$4,440,677
River Runner	101,137	\$11,781,449
Other	4,213,410	\$236,877,910
Total	4,388,386	\$253,100,036
Percent Change from Alternative A	0.0%	0.0%

Source: Harvey Economics 2010; BBC Research & Consulting 2012

A visitor day is one person visiting the park for one day. Many visitors come to the park for multiple days. Therefore, visitor days are calculated as number of visitors multiplied by number of days at the park

20
21
22 Any change in non-use park values would be driven by

- 23 • Magnitude of change in park sound levels
- 24 • Noise in the context of the park's characteristics which create non-use values

25
26 Both these factors are considered in turn.

27
28 Magnitude of change in park sound levels is addressed in Chapter 4, Soundscape, and the significance of those
29 changes to humans is indicated in Chapter 4, Visitor Use and Experience. In sum, changes vary in intensity by
30 location. Assuming a change in visitor experience would be one indicator of a change in non-use park values, these
31 values would be expected to be similar to visitor experience impacts. Whereas a specific study or survey was not
32 found to measure relative importance of park characteristics in the public's mind, park features which make it well
33 known throughout the world are clear enough: scenery, geologic features, the Colorado River, history, American

1 Indian culture, desert landscape, and environment, among others. Soundscape is one element of that environment,
2 and aircraft noise is one element of the sound environment. Given all its prominent characteristics, aircraft noise is
3 likely to be a small consideration with most non-park users, although this has not been documented.

4
5 In sum, non-use park values are approximately between \$3.0 and \$4.3 billion. A reduction in park aircraft noise
6 might or might not increase non-use values. There is potential benefit in knowing an effort has been made to protect
7 the park's resources, presumably for future generations, a basic tenet of non-use values. Such values are recognized
8 in the Organic Act which established national park system's fundamental purpose as preserving park resources for
9 enjoyment and value.

10
11 **Cumulative Effects** **Direct Use and Intrinsic Park Values** **Socioeconomic Environment**
12 **Alternatives E, F, Modified NPS Preferred**

13
14 Intrinsic direct-use values will mirror visitation impact, except backcountry visitors would experience some use
15 value benefits from Alternatives E and the **Modified NPS Preferred**. Cumulative Impacts suggest a minor to
16 moderate benefit for those visitors, but a negligible benefit in intrinsic direct-use values overall since backcountry
17 visitors are a small portion of total visitors.

18
19 Intrinsic non-use values for GCNP have probably changed little in past years since those values are driven by a
20 perception rooted in literature, history, and other records of the country's heritage. The Alternatives by themselves
21 would not generate a change sufficient to change non-use value measurably from a relative standpoint. Over time,
22 Cumulative Impacts other than prospective SFRA rule changes examined in this EIS, would dominate changes to
23 intrinsic values. Overall, relative importance of rule changes would diminish over time.

24
25 **SOCIOECONOMIC IMPACT SUMMARY**

SOCIOECONOMIC ENVIRONMENT

26
27 Tables 4.268 and 4.269 provide summaries of *socioeconomic* conditions and effects by Alternative Base Year and
28 Ten-Year Forecast, respectively. Tables 4.270 and 4.271 provide summaries of *socioeconomic* impact intensity
29 determinations by Alternative Base Year and Ten-Year Forecast, respectively.

30
31 Base Year (short-term) *effects on the air-tour industry* are projected to range negligible to minor adverse under
32 **Alternative F** to moderate to major adverse under **Alternative E**. *Proposed provisions under the Modified NPS*
33 *Preferred Alternative would require adjustments for air-tour operators short term, but it is quite possible these*
34 *potential operational changes will be essentially invisible to consumers. Short-term effects on the air-tour*
35 *industry are projected to range minor to moderate adverse.*

36
37 *Based on past experience, changes in routes, scheduling requirements and related regulations are unlikely to*
38 *have a substantial long-term impact on the air-tour industry. Effects on the air-tour industry are expected to*
39 *decline as the air-tour market and industry adjust to the proposed changes under Alternatives. Longer-term*
40 *effects (Ten-Year Forecast) on the air-tour industry are projected to range negligible under Alternative F to*
41 *moderate adverse under Alternative E. Modified NPS Preferred Alternative long-term effects are projected to be*
42 *minor adverse.*

43
44 American Indian tribes are expected to be negligibly affected by any **Action** Alternative.

45
46 General-aviation would likely experience a negligible to minor adverse *socioeconomic* effect in all **Action**
47 Alternatives.

48
49 *Regional socioeconomic impacts would vary by Alternative, due to differences in impacts on air-tour industry-*
50 *related employment and economic activity. Notwithstanding some DEIS comments, economic impacts of*
51 *proposed Alternatives are not a substantial regional economic issue. Base Year short-term socioeconomic impacts*
52 *are anticipated to be negligible for Clark County and Las Vegas under all Action Alternatives due to the large*
53 *overall size of those economies. Short-term socioeconomic effects in Coconino County would range negligible*
54 *under Alternative F to minor adverse under Alternative E and the Modified NPS Preferred Alternative. In the*
55 *small community of Tusayan, Base Year short-term socioeconomic effects are projected to be negligible under*
56 *Alternative F and moderate adverse under Alternative E and the Modified NPS Preferred Alternative. Ten-Year*

1 *Forecast (long-term) regional socioeconomic effects are anticipated to be negligible in most cases, with the*
2 *following exceptions. Long-term regional socioeconomic effects are projected to be minor adverse in Coconino*
3 *County under Alternative E. In Tusayan, long-term socioeconomic effects are projected to be minor adverse*
4 *under the Modified NPS Preferred Alternative, and moderate adverse under Alternative E. These long-term*
5 *effects may be offset by new development projects and anticipated regional economic growth.*

6
7 *The number of park and other regional visitors is unlikely to change in any Action Alternative. Direct-use values*
8 *for park visitors are projected to increase for backcountry users under Alternative E and the Modified NPS*
9 *Preferred Alternative, but the overall effect on total direct use value of the park is likely to be essentially*
10 *negligible.*

11
12 *Intrinsic park values, largest of the socioeconomic resource categories, would be unchanged by any Action*
13 *Alternative.*

14
15
**DRAFT
Not Finalized
FOIA Discretionary Release**

1 **Table 4.268 Summary of Socioeconomic Conditions Base Year**

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Air-tour Operators^a				
Flight Operations	99,000	78,200	97,000	87,100
Passenger Volume	757,800	600,100	744,700	668,600
Total Gross Revenue	\$212,820,000	\$168,544,000	\$209,162,000	\$187,784,000
Employment	1,281	1,013	1,257	1,129
Personal Income	\$41,567,000	\$32,880,000	\$40,796,000	\$36,629,000
General-aviation^b				
General-aviation Corridors	Current Conditions	Up to a \$150 increase in operating costs and eight additional minutes of flight time due to closures and modifications	Up to a \$150 increase in operating costs and eight additional minutes of flight time due to closures and modifications	Up to a \$20 increase in operating costs and one additional minute of flight time due to modifications
Flight-free Zones	Current Conditions	Up to \$150 increase in operating costs and 8 additional minutes of flight time <i>if pilots choose to go over the top rather than around FFZs</i> due to increased flight altitudes	No additional operating costs or flight time <i>if pilots choose to go over the top rather than around FFZs</i> required from boundary changes	Up to \$150 increase in operating costs and eight additional minutes of flight time due to increased flight altitudes
Other	NA	Flying over Marble Canyon would increase operating costs by \$150 and flight time 6 minutes	NA	NA
American Indian Tribes				
Hualapai Tribe	Current Conditions	No change	One to 2% reduction in air-tour landings and associated revenues	No change
Havasupai Tribe	Current Conditions	No change	No change	No change
Navajo Nation	Current Conditions	No change	No change	No change
Regional Economy^a				
<i>From Ground-based Park Visitors</i>				
Employment^c	5,665	No change	No change	No change
<i>From Air-tour industry</i>				
Coconino County employment	542	366 to 428	526 to 531	440 to 478
Clark County employment	1,793	1,419 to 1,489	1,760 to 1,767	1,581 to 1,621
Intrinsic Values^d				
Park Intrinsic use value	\$384.7 million	No change	No change	No change
Park Intrinsic non-use value	\$3.0 to \$4.3 billion	No change	No change	No change

Source: Harvey Economics 2010; *BBC Research & Consulting* 2012

^aImpacts to air-tour operators and regional economy are reported on an annual basis

^bImpacts to general-aviation are reported on a per flight basis

^c**Employment** measures for regional economy include both direct and secondary effects. *Regional economic analysis includes Coconino County, Arizona and Clark County, Nevada. North Rim ground visitation not included*

^dPark intrinsic values are in addition to visitor spending

2

1 **Table 4.269 Summary of Socioeconomic Conditions Ten-Year Forecast**

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Air-tour Operators				
Flight Operations	112,600	95,900	108,200	104,800
Passenger Volume	912,200	801,400	906,700	877,400
Total Gross Revenue	\$256,203,300	\$225,073,000	\$254,654,000	\$246,429,000
Employment	1,501	1,299	1,468	1,421
Personal Income	\$48,701,000	\$42,166,000	\$47,653,000	\$46,127,000
General-aviation				
General-aviation Corridors	Same as Base Year	Same as Base Year	Same as Base Year	Same as Base Year
Flight-free Zones	Same as Base Year	Same as Base Year	Same as Base Year	Same as Base Year
American Indian Tribes				
Hualapai Tribe ^a	14% increase in air-tours, passengers and landing revenue	14% increase in air-tours, passengers and landing revenue	14% increase in air-tours, passengers and landing revenue	14% increase in air-tours, passengers and landing revenue
Havasupai Tribe	14% increase in support flights to Supai Village	14% increase in support flights to Supai Village	14% increase in support flights to Supai Village	14% increase in support flights to Supai Village
Navajo Nation	No change	No change	No change	No change
Regional Economy^b				
<i>From Ground-based Park Visitors</i>				
<i>Employment^c</i>	5,665	No change	No change	No change
<i>From Air-tour industry</i>				
<i>Coconino County employment</i>	634	502 to 550	614 to 621	582 to 602
<i>Clark County employment</i>	1,102	1,820 to 1,871	2,055 to 2,065	1,991 to 2,011
Intrinsic Values				
Park Users	No change	No change	No change	No change
Non-Park Users	No change	No change	No change	No change

Source: Harvey Economics 2010; BBC Research & Consulting 2012

^aLanding revenue to the Hualapai in Alternatives E, F, and the Modified NPS Preferred would depend on whether fees are by flight or by passenger Ten-Year Forecast

^b Impacts to regional economy are reported on an annual basis

^cEmployment measures for regional economy include both direct and secondary effects. Regional economic analysis includes Coconino County, Arizona and Clark County, Nevada. North Rim ground visitation not included

2

1 **Table 4.270 Summary of Socioeconomic Impact Intensity Base Year**

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Air-tour Operators	Baseline for comparison	<i>Short-term moderate to major adverse</i>	<i>Short-term negligible to minor adverse</i>	<i>Short-term minor to moderate adverse</i>
American Indian Tribes				
Hualapai Tribe	Baseline for comparison	Negligible	<i>Negligible</i>	Negligible
Havasupai Tribe	Baseline for comparison	Negligible	Negligible	Negligible
Navajo Nation	Baseline for comparison	Negligible	Negligible	<i>Negligible</i>
General-aviation	Baseline for comparison	<i>Short-term negligible to minor adverse</i>	<i>Short-term negligible to minor adverse</i>	<i>Short-term negligible to minor adverse</i>
Regional Economy	Baseline for comparison	Negligible	Negligible	Negligible
<i>Clark County, NV</i>	<i>Baseline for comparison</i>	<i>Negligible</i>	<i>Negligible</i>	<i>Negligible</i>
<i>Coconino County, AZ</i>	<i>Baseline for comparison</i>	<i>Short-term minor adverse</i>	<i>Negligible</i>	<i>Short-term minor adverse</i>
<i>Tusayan, AZ</i>	<i>Baseline for comparison</i>	<i>Short-term moderate adverse</i>	<i>Negligible</i>	<i>Short-term moderate adverse</i>
Intrinsic Park Values	Baseline for comparison	Negligible	Negligible	Negligible

Source: Harvey Economics 2010; *BBC Research & Consulting 2012*

2
3
4 **Table 4.271 Summary of Socioeconomic Impact Intensity Ten-Year Forecast**

	Alternative A	Alternative E	Alternative F	Modified NPS Preferred Alternative
Air-tour Operators	Baseline for comparison	Long-term moderate adverse	Long-term <i>negligible</i>	Long-term minor adverse
American Indian Tribes				
Hualapai Tribe	Baseline for comparison	<i>Negligible</i>	<i>Negligible</i>	<i>Negligible</i>
Havasupai Tribe	Baseline for comparison	<i>Negligible</i>	<i>Negligible</i>	<i>Negligible</i>
Navajo Nation	Baseline for comparison	Negligible	Negligible	<i>Negligible</i>
General-aviation	Baseline for comparison	Long term negligible to minor adverse	Long term negligible to minor adverse	Long term negligible to minor adverse
Regional Economy	Baseline for comparison	Negligible	Negligible	Negligible
<i>Clark County, NV</i>	<i>Baseline for comparison</i>	<i>Negligible</i>	<i>Negligible</i>	<i>Negligible</i>
<i>Coconino County, AZ</i>	<i>Baseline for comparison</i>	<i>Long-term minor adverse</i>	<i>Negligible</i>	<i>Negligible</i>
<i>Tusayan, AZ</i>	<i>Baseline for comparison</i>	<i>Long-term moderate adverse</i>	<i>Negligible</i>	<i>Long-term minor adverse</i>
Intrinsic Park Values	Baseline for comparison	Negligible	Negligible	Negligible

Source: Harvey Economics 2010; *BBC Research & Consulting 2012*

5
6

CHAPTER 5 CONSULTATION AND COORDINATION

INTRODUCTION

Chapter 5 describes consultation and coordination during preparation of this EIS. Consultation, coordination, and public involvement are integral in identifying relevant issues and concerns and to ensure issues are addressed. Formulation of issues was achieved through public meetings and workshops, agency meetings, individual contacts, news releases, and Federal Register notices.

PUBLIC SCOPING

Public scoping is part of the National Environmental Policy Act (40 CFR 1501.7) requirements for preparing an environmental impact statement. Scoping helps determine the range of issues and opportunities considered in developing Alternatives and assessing environmental effects. The scoping process must be open to the public and include state, local, and tribal governments and affected Federal agencies. According to NPS Director's Order 12, Conservation Planning, Environmental Impact Analysis and Decision Making, scoping objectives are

- Involve as many interested parties as possible in the environmental review process
- Provide clear, easily understood, factual information to potentially affected parties
- Provide meaningful and timely opportunities for public input
- Identify, consider, and evaluate issues raised by interested parties to prepare the plan and EIS
- Identify, and eliminate from detailed study, insignificant issues
- Consider public comments throughout the decision-making and review process

The process used during public scoping, *Draft EIS public comment*, consultation, and coordination for this EIS is described below.

On January 25, 2006, NPS and FAA published a Notice of Intent to Prepare an Environmental Impact Statement (EIS) for Actions to Substantially Restore Natural Quiet to Grand Canyon National Park and Public Scoping” in the Federal Register (71 FR 4192).

During the ensuing 90-day public scoping period, NPS and FAA mailed scoping letters and held three public scoping meetings (details below). The purpose of the letter and meetings was to provide information on the project and solicit public input on issues to be addressed in this EIS. Public scoping ended April 27, 2006.

Written responses to the scoping letter and comments from public meetings helped identify issues and concerns, a suitable range of Alternatives, and environmental impacts to address in this EIS.

Public Input to the Planning Process

A public scoping letter dated January 25, 2006, was mailed to members of the public identified by the NPS as those who normally receive notification of park NEPA actions. Federal, state, and local governmental agencies, traditionally associated American Indian Tribes, and air-tour operators in the region also received the scoping letter.

A similar notice was then published in three Arizona and one Nevada newspaper February 3, 2006 to February 8, 2006. A news release was emailed on January 25, 2006, to an NPS list of media contacts. The same media contacts were emailed a calendar announcement approximately one month later.

During the scoping period the NPS and FAA invited the public, agencies, and other interested parties to provide comments, suggestions, and input regarding but not limited to

- The scope, issues, and concerns related to development of proposed and Alternative actions at GCNP that provide for Substantial Restoration of Natural Quiet and experience of the park and protection of public health and safety from significant adverse effects associated with all aircraft overflights
- Past, present, and reasonably foreseeable future actions which, when considered with any Alternatives, may result in significant Cumulative Impacts
- Potential Alternatives

1 Comments were received in the following formats

- 2 • oral comments to a stenographer during open house meetings
- 3 • comments written on flip charts during open house meetings
- 4 • comments submitted via the Docket Management System of the U.S. Department of Transportation
- 5 • written comments accepted via comment card and email

6
7 A total 1,267 responses were received from individuals, organizations, and other interested parties. These comments
8 addressed the scope, issues, and concerns related to the EIS including substantial restoration of natural quiet, visitor
9 experiences, and protection of public health and safety in GCNP. Appendix C contains a summary of comments
10 received.

11 **Public Scoping Meetings**

12 NPS and FAA organized and managed a series of three scheduled public meetings, held on these dates and in these
13 communities

- 14 • February 21, 2006 Phoenix, AZ
- 15 • February 22, 2006 Flagstaff, AZ
- 16 • February 23, 2006 Las Vegas, NV

17
18 Meetings were structured as open houses. Information about the EIS process was presented through posters and
19 handouts. Attendees were invited to submit comments either in writing using a comment form or verbally via a
20 provided audio recorder.

21 **Review and Evaluation of Public Scoping Comments**

22
23 Members of the planning team read every submission, identified specific comments in each submission, and coded
24 them according to developed criteria. A coding structure was developed in a database to help sort comments as
25 substantive or nonsubstantive then separate them into general headings. *See Appendix C for summary of DEIS*
26 *public scoping comments.*

27 **Draft Environmental Impact Statement Public Comment**

28
29 CEQ regulations state that a Final EIS must respond to all substantive comments on a Draft EIS. CEQ regulations
30 and guidance do not define the term substantive. National Park Service guidance⁷³ states a comment is considered
31 substantive if it raises specific issues or concerns regarding the project or the study process, but not if it merely
32 expresses support for or opposition to the project or a particular Alternative.

33
34
35 *On February 4, 2011, NPS released the Draft Environmental Impact Statement, Special Flight Rules Area in the*
36 *Vicinity of Grand Canyon National Park, Actions to Substantially Restore Natural Quiet (NPS 2011), through a*
37 *Notice of Availability posting in the Federal Register, for public review and comment. The DEIS was designed to*
38 *provide a comprehensive look at impacts to natural and cultural resources and visitor experience from current*
39 *overflight activity in Grand Canyon National Park and from proposed actions to substantially restore natural*
40 *quiet. The DEIS evaluated four Alternatives proposed to help NPS achieve its mission to preserve park resources*
41 *while achieving goals and objectives listed in Chapter 1.*

42
43 *The DEIS NOA posting by EPA in the Federal Register (February 18, 2011), initiated a formal 120-day public*
44 *comment period ending June 20, 2011. On March 9, 2011 a press release announced DEIS public meetings to*
45 *provide a DEIS overview and accept public comment. Meetings were held in Phoenix (April 6, 2011) and*
46 *Flagstaff (April 7, 2011), Arizona, and Henderson (April 14, 2011), Nevada, and attended by 174 people.*
47 *Comments were accepted at public meetings in the following formats: oral comments to a stenographer,*
48 *comments written by participants on flip charts, and written comments accepted via comment card. Press*

⁷³ National Park Service NEPA guidance states that substantive comments “(a) question, with reasonable basis, the accuracy of information in the EIS; (b) question, with reasonable basis, the adequacy of environmental analysis; (c) present reasonable Alternatives other than those presented in the EIS; [or] (d) cause changes or revisions in the proposal.” NPS guidance also states that “[c]omments in favor of or against the proposed action or Alternatives, or comments that only agree or disagree with NPS policy, are not considered substantive.” See NPS Director’s Order 12, Conservation Planning, Environmental Impact Analysis and Decision Making, Section 4.6, Environmental Impact Statements—The Final EIS (Jan. 8, 2001)

1 *releases, website updates, and public meetings were used to request public input and disseminate information*
2 *about DEIS Alternatives and their impacts. During the public comment period, NPS received approximately*
3 *29,000 submissions (correspondence) at public meetings, via the NPS Planning, Environmental and Public*
4 *Comment website, email, and regular mail from the public, tribes, agencies, organizations, and businesses.*
5 *Substantive comments are addressed as revisions to this Final Environmental Impact Statement in bold italic text*
6 *or as responses to comments in Appendix H.*

8 **Review and Evaluation of DEIS Public Comment**

10 **Substantive and Non-Substantive Comments**

11 *Respondents invested considerable time and effort to submit comments on the DEIS. Comments covered a wide*
12 *spectrum of thoughts, opinions, ideas, and concerns. While each viewpoint was diligently considered, comments*
13 *were determined to be substantive or non-substantive. NEPA regulations require responses to substantive*
14 *comments. Comments are substantive if they*

- 15 • *challenge accuracy of analysis*
- 16 • *dispute information accuracy*
- 17 • *suggest different viable alternatives*
- 18 • *provide new information that makes a change in the proposal*

19
20 *In other words, substantive comments raise, debate, or question a point of fact or policy. Several submissions*
21 *were over 100 pages long. Submissions also included four large list serves which provided the majority of the*
22 *29,000 comments. Approximately 2,500 submissions were received separate from list serve comments. Individual*
23 *substantive comments were extracted from nearly 29,000 submissions. Per NEPA guidance, these comments were*
24 *summarized and are presented, along with a response, per issue or impact topic in Appendix H.*

25
26 *Comments in favor of or against Alternatives, or comments that only agree or disagree with NPS policy, are not*
27 *considered substantive (NPS Director's Order 12). Non-substantive comments offer opinions or provide*
28 *information not directly related to issues or impact analyses. Non-substantive comments have been considered by*
29 *the planning team, but do not require and have not received a formal response.*

31 **Methodology for Collecting Comments**

32
33 *The NPS planning team read all comments and determined which were substantive and which non-substantive.*
34 *Pursuant to NEPA, responses were prepared for all substantive comments; the content of this FEIS also*
35 *demonstrates responsiveness to public input. Methodology consisted of*

37 **Develop Coding Structure**

38 *Initially, a coding structure was developed to help sort comments into logical groups by topics and issues,*
39 *derived from analysis of the range of topics covered in the DEIS, NPS legal guidance, the scoping process, and*
40 *the comments themselves. The coding structure used was inclusive rather than restrictive; an attempt was made*
41 *to capture all comment content. Codes were assigned to comments within letters, oral transcripts, public*
42 *meeting comment forms, electronic mail, and PEPC entries.*

44 **Read and Code Public Comment Submissions**

45 *As each submission was read, distinct comments were identified and given a code based on, among other*
46 *things, topics addressed and whether the comment was substantive or non-substantive (according to criteria set*
47 *forth in Council on Environmental Quality regulations). Submissions could, and often did, contain several*
48 *comments.*

50 **Create Comment Database**

51 *For each correspondence, comments were entered into a database.*

53 **Prepare Comment Summary**

54 *The database was used to construct a summary of all comments. Opinions, feelings, and preferences of one*
55 *element or one Alternative over another, and comments of personal and philosophical nature were all read and*

1 *analyzed. All comments were considered, whether thousands of people voiced the same concern or a single*
2 *person or organization raised a technical point, but only listed once in the summary (See Appendix H).*
3

4 *The purpose of reading, coding, and analyzing contents was to assist the team in determining if substantive*
5 *issues raised by the public warranted further modification of Alternatives or further analysis of issues and*
6 *impacts. With information provided through the public review process, the agency reconsidered the DEIS NPS*
7 *Preferred Alternative and developed a FEIS Modified NPS Preferred Alternative as described in Chapter 2.*
8

9 *Although the content analysis process attempted to capture the full range of public concerns, it is*
10 *acknowledged that comments from people who chose to respond do not necessarily represent the sentiments of*
11 *the entire public. Further, this is not a vote-counting process; emphasis in this process was on comment*
12 *content rather than the number of times a comment was received.*
13

14 *Comments and responses are categorized by topics and issues. A topic is a category of subject matter. These*
15 *categories were developed through the scoping process and were selected to track major subjects through the*
16 *Draft and Final EIS.*
17

18 *Respond to Comments*

19 *After all public comments were entered into the database by issue, substantive issue reports were generated per*
20 *topic and issue. Due to the large number of comments, many expressing the same content, the team analyzed*
21 *comments, grouped comments with similar subject matter, and reduced recurring, essentially identical*
22 *comments to a representative statement.*
23

24 *Some more detailed comments appear verbatim, while others were summarized, reflecting the content of*
25 *several similar comments. Issue statements were then sent to professionals in respective fields (i.e.,*
26 *Soundscape, Ethnographic Resources, Wilderness, Wildlife and Special Status Species) for analysis and*
27 *response. Comment summaries and responses were reviewed by the planning team for accuracy and*
28 *completeness.*
29

30 **Organizations and Agencies Consulted**

31 In addition to *DEIS* public scoping *and public comment* during the NEPA decision-making processes, Federal
32 agencies are required to consult with American Indian tribes and Federal and state agencies and entities due to
33 jurisdictional responsibilities (40 CFR 1502.25).
34

35 **Tribal Consultations**

36 In keeping with provisions of NEPA, the National Historic Preservation Act, NPS Management Policies 2006,
37 Executive Memorandum on Government-to-Government Relations with Native American Tribal Governments;
38 Executive Orders 13007 and 13175; 512 Department of the Interior Manual 2; and Director's Order 71,
39 Relationships with American Indian Tribes, the following traditionally associated American Indian Tribes were
40 consulted regarding this EIS

- 41 • Havasupai Tribe
- 42 • Hopi Tribe
- 43 • Hualapai Tribe
- 44 • Kaibab Band of Paiute Indians
- 45 • Las Vegas Paiute Tribe
- 46 • Moapa Band of Paiute Indians
- 47 • Navajo Nation
- 48 • Paiute Indian Tribe of Utah
- 49 • Pueblo of Zuni
- 50 • San Juan Southern Paiute Tribe
- 51 • Yavapai-Apache Nation
- 52

53 Federal agencies routinely consult with tribal and other governments during NEPA and other processes. For
54 management of GCNP overflights, governmental discussions and consultations have been ongoing for many years.
55 Specific to this EIS process, the NPS and FAA issued a Consultation Plan in January 2006 outlining procedures for

1 establishing and maintaining government-to-government relationships among traditionally associated tribes and
 2 Federal agencies. The plan stressed that consultation meetings would be scheduled to provide maximum
 3 opportunities for tribal input and information sharing throughout all project phases. Opportunities were extended to
 4 all traditionally associated tribes and Federal agencies to participate in the EIS process as cooperating agencies. The
 5 Navajo Nation and Bureau of Indian Affairs expressed interest in cooperating agency status, and separate
 6 cooperating agency agreements were drafted and went through several iterations of review and revision. However,
 7 the agreements were never finalized (Table 5.1). ***Section 106 consultation with the park's traditionally associated***
 8 ***tribes was initiated in a January 31, 2006, letter. Consultations are ongoing. The DEIS was sent to the tribes***
 9 ***February 14, 2011. A Section 106 finding of effect letter will be sent to tribes when the FEIS is distributed.***

10
 11 The Havasupai Tribe, Hopi Tribe, Hualapai Tribe, and Navajo Nation participated as members of the Grand Canyon
 12 Working Group established to address overflight issues.

13
 14 Table 5.1 below details tribal consultations that occurred 2006 through 2012, and includes consulting parties, dates,
 15 nature of discussions, and meeting locations.

16 **Arizona State Historic Preservation Office**

17 NHPA requires agencies consult with the State Historic Preservation Officer (SHPO) regarding undertakings that
 18 may affect historic properties. Formal consultation regarding this EIS was initiated with SHPO on January 31, 2006.
 19 Consultations are ongoing. ***A consultation letter was sent to SHPO on February 14, 2011, regarding DEIS release***
 20 ***and stating obligations under Section 106 of the NHPA would occur outside the NEPA process. A finding of***
 21 ***effect for the FEIS will be sent to the SHPO when the FEIS is distributed.***

22 **U.S. Fish and Wildlife Service**

23
 24 USFWS was a member of the Grand Canyon Working Group and attended all meetings. Informal consultation was
 25 initiated in July 2005 with the USFWS to begin discussions regarding effects to threatened and endangered species.
 26 ***The Biological Assessment was submitted to USFWS on December 28, 2011. A final Biological Opinion (BO)***
 27 ***was received from USFWS on May 4, 2012. The BO stated reasonable and prudent measures, terms and***
 28 ***conditions, and recommended mitigation measures for Mexican spotted owl and California condor, which have***
 29 ***been included in FEIS Chapter 2.***

30 **Grand Canyon Working Group**

31
 32 The Grand Canyon Working Group was established in 2005 as a subgroup within the National Parks Overflights
 33 Advisory Group (NPOAG) to provide advice and recommendations to NPS and FAA regarding implementation of
 34 the 1987 Overflights Act with respect to Grand Canyon. The Grand Canyon Working Group consisted of co-chairs
 35 from the NPS and FAA and representatives from air-tour operators, environmental groups, American Indian Tribes,
 36 commercial and general-aviation interests, recreational interests, and other Federal agencies. Information about the
 37 Grand Canyon Working Group is Accessed at
 38 http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/grand_canyon_overflights/.
 39
 40

Meeting dates include

- July 13-14, 2005, Flagstaff, AZ
- October 26 - 27, 2005, Tusayan, AZ
- January 31-February 2, 2006, Phoenix, AZ
- March 20-22, 2006, Las Vegas, NV
- May 31-June 2, 2006, Scottsdale, AZ
- July 25-27, 2006, Phoenix, AZ
- September 27-28, 2006, Phoenix, AZ
- December 12-13, 2006, Scottsdale, AZ
- June 12-13, 2007, Scottsdale, AZ
- September 19-20, 2007, Scottsdale, AZ
- December 4-5, 2007, Scottsdale, AZ
- July 28, 2009, Flagstaff, AZ

41

Table 5.1 Tribal Consultations for Special Flights in the Vicinity of GCNP

Consulting Parties	Date/Location	Topics
Cooperating Agency status for the EIS offered to all traditionally associated tribes associated with GCNP and to the BIA in conjunction with a Draft tribal consultation plan	January 31, 2006	<i>Consultation with the park's traditionally associated tribes initiated in a January 31, 2006, letter</i> Navajo Nation, Hualapai Tribe, and BIA expressed interest in cooperating agency status for the EIS, but the Hualapai Tribe withdrew. A General Agreement was Drafted between the NPS, FAA, and Navajo Nation, and a separate agreement between NPS, FAA, and BIA. Multiple Drafts were reviewed, comments made and addressed, followed by a new cycle of reviews and comments. Because the project moved beyond primary tasks identified in the Draft General Agreement, the agreements were never finalized. Rather, the BIA continued as a member of the project team, and the Navajo Nation continued as a member of the Grand Canyon Working Group, as well as through government-to-government and NHPA Section 106 consultations
Havasupai Tribe Hopi Tribe Hualapai Tribe Navajo Nation as members of the Grand Canyon Working Group	Grand Canyon Working Group meetings Jul 13-14 2005 Flagstaff AZ Oct 26 - 27 2005 Tusayan AZ Jan 31-Feb 2 2006 Phoenix AZ Mar 20-22 2006 Las Vegas NV May 31-Jun 2 2006 Scottsdale AZ Jul 25-27 2006 Phoenix AZ Sep 27-28 2006 Phoenix AZ Dec 12-13 2006 Scottsdale AZ Jun 12-13 2007 Scottsdale AZ Sep 19-20 2007 Scottsdale AZ Dec 4-5 2007 Scottsdale AZ Jul 28 2009 Flagstaff AZ	Various issues, Alternatives, and topics related to overflights
All eleven traditionally associated tribes	January 2006	NPS and FAA issued a Consultation Plan outlining procedures for establishing and maintaining government-to-government relationships among traditionally associated tribes and Federal agencies for the project. The plan stressed consultation meetings would be scheduled to provide maximum opportunities for tribal input and information sharing throughout all project phases. Opportunities were extended to traditionally associated tribes and Federal agencies to participate in the EIS process as cooperating agencies
Havasupai Tribe Hualapai Tribe Navajo Nation (Chapters: Window Rock and Tuba City, Cameron, Bodaway/Gap) Pueblo of Zuni Yavapai Apache Nation NPS (GCNP) FAA BIA DOI Solicitor's Office	April 19-20, 2006 Flagstaff, AZ	Pan-tribal meeting to establish protocols for consultation with traditionally associated tribes. Among items discussed were recommended consultation approaches among various tribes and tribal offices; opportunities for participation in the EIS process; role of consulting agencies; and area of potential effect based on noise monitoring data and analysis of noise modeling information for flight routes

Table 5.1 Tribal Consultations for Special Flights in the Vicinity of GCNP

Consulting Parties	Date/Location	Topics
Hualapai Tribe NPS (GCNP) FAA DOI Solicitor’s Office	May 12, 2006 Peach Springs, AZ	Discussion included status update on EIS and Alternative flight routes; agreements for information transfer among consulting parties; defining restoration of natural quiet; retention of existing Hualapai air-tour <i>exceptions</i> ; quiet-aircraft technology incentives; and tribal involvement opportunities
Havasupai Tribe NPS (GCNP) FAA DOI Solicitor’s Office.	May 13, 2006 Supai, AZ	Tribal representatives expressed concern for low-flying planes observed over tribal lands in Grand Canyon. FAA provided contact information to report incidents of suspected unauthorized low-flying aircraft. Tribal members expressed desire to relocate air-tour routes that enter Supai, and possible seasonal restrictions on Dragon Corridor use
Navajo Nation NPS (GCNP) FAA	August 29, 2006 Flagstaff, AZ	The preliminary range of EIS reviewed. Air-tour corridors discussed and potential modifications to routes (including seasonal limitations) that could affect Alternatives and associated impacts. Tribal representatives indicated supported for flights into the Navajo Nation provided tour operators commit to eventual phased adoption of quiet technology
Hopi Tribe NPS (GCNP) FAA	August 29, 2006 Flagstaff, AZ	Discussion included history of Grand Canyon overflights; continuing opportunities for Hopi involvement in EIS process; role of Grand Canyon Working Group; range of preliminary Alternatives; consideration of high-altitude flights; and definitions of natural quiet restoration. Hopi representative emphasized tribal desire to provide input into EIS process and development of Alternatives
Navajo Nation NPS (GCNP) FAA Parsons Corporation (Denver)	September 5, 2007 Window Rock, AZ	Consultation meeting; project-area maps presented showing existing air-tour routes and representative culturally sensitive areas where noise impacts may be of concern. EIS Alternatives maps of proposed flight routes and SFRA boundary also presented. Navajo representatives expressed concern over Alternative C (the Navajo Alternative proposed by the Cameron Chapter of the Navajo Nation) which they indicated was not proposed or fully analyzed/endorsed by the Navajo Nation. They did not favor air-tour flights over the Little Colorado River, noting sacred sites and traditional use areas located at the Colorado and Little Colorado Rivers confluence. Noise from low-flying helicopters and other aircraft destroy the canyon’s integrity and disrupt offerings and other traditional activities carried out year-round. FAA representatives noted air tour routes could be modified to avoid going over the confluence area, and elements of various Alternatives could be modified or combined in the Preferred Alternative selection process

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Not Finalized
FOIA Discretionary Release

Table 5.1 Tribal Consultations for Special Flights in the Vicinity of GCNP

Consulting Parties	Date/Location	Topics
Hualapai Tribe NPS (GCNP) FAA	September 6, 2007 Peach Springs, AZ	Meeting held as part of the Hualapai Tribal Council's regular scheduled meeting. Project-area maps presented by the NPS and FAA showing EIS Alternatives, existing flight routes, flight free zones, and representative culturally sensitive areas. It was explained that no Preferred Alternative had been selected, and further analysis (including metrics for modeling aircraft noise) was underway to assist the Grand Canyon Working Group with recommending elements of a Preferred Alternative. NPS and FAA representatives reaffirmed Hualapai tribal interests and the air-space <i>exception</i> at the West End of the Study Area
Hopi Tribe NPS (GCNP) FAA	September 6, 2007 Flagstaff, AZ	Project-area maps presented by the NPS and FAA showing EIS Alternatives, existing flight routes, flight free zones, and representative culturally sensitive areas. The Hopi representative expressed cultural concern for the river confluence area, Salt Mines/pilgrimage trail, and Sipapuni (origin place). NPS and FAA representatives affirmed recognition that the area (identified as a traditional cultural property) is culturally sensitive, and discussed efforts underway through the EIS process to evaluate and control air-tour noise impacts
Havasupai Tribe Hualapai Tribe Hopi Tribe Navajo Nation Kaibab Band of Paiute Indians BIA DOI NPS (GCNP) FAA	January 10-11, 2008 GCNP	Various options and elements of the Preferred Alternative reviewed. Tribal representatives and agency staff flew certain Grand Canyon air-tour routes. Hualapai representative expressed concern with proximity of routes near traditional cultural properties. GCNP staff suggested changes proposed by Navajo representative to Alternative C would best be incorporated into the Preferred Alternative
Letter from Tim Begay Navajo Nation, Traditional Culture Program to GCNP	March 26, 2008 Letter	Mr. Begay referred to the air tour along Zuni Point Corridor tribal representatives flew during January 10 /11, 2008, consultation meetings. Mr. Begay again expressed Navajo Nation desire to have air-tour routes relocated west of the Colorado River/Little Colorado River confluence. Re-locating routes away from the confluence area would avoid impacts to traditional cultural properties significant to the Navajo, Hopi, and other tribes, and would restore quiet to the sacred area
Navajo Nation NPS (GCNP) FAA	May 30, 2008 Window Rock, AZ	Meeting part of a tribal consultation to clarify Nation's preference for a new air-tour route for helicopters connecting with the Green-1 route to the east to provide a connection between tours over the park and proposed tours of the Navajo Nation (especially in the vicinity of the Little Colorado River gorge)
Recipients Timothy Begay and Tony Joe , Navajo Nation	December 19, 2008 Letter	GCNP requested input on routes to be modeled for Alternative G from Tusayan and Cameron, with detailed maps attached
Navajo Nation Havasupai Tribe Hualapai Tribe Kaibab Band of Paiutes Moapa Band of Paiutes NPS (GCNP) FAA	January 28, 2009 Flagstaff, AZ	Government-to-government tribal meeting with goal to get tribal feedback on overflights. Presentation of Alternative G. Tribes were provided opportunity to meet with park management individually

Table 5.1 Tribal Consultations for Special Flights in the Vicinity of GCNP

Consulting Parties	Date/Location	Topics
Recipients Tribal representatives present at January, 28, 2009 meeting	February 2009 Letter	Correspondence included text of NPS Preferred Alternative, Alternative G, and notes from Jan 28 meeting
Navajo Nation NPS (GCNP) FAA	March 2, 2009 Gap, AZ	Discussion on Navajo Nation economic development initiatives adjacent to GCNP and Alternative G
Kaibab Band of Paiute Indians NPS (GCNP)	September 2009 Fredonia, AZ	Review NPS Alternatives and EIS schedule. Tribe appreciated latest maps and were pleased with avoidance of particularly sensitive cultural areas
Zuni Tribe NPS (GCNP)	October 2009 Pueblo of Zuni	Review NPS Alternatives and EIS schedule. Zuni asked questions and reiterated interest in flights being pulled away from the confluence
Navajo Nation NPS (GCNP)	October 2009 Window Rock, AZ	Review NPS Alternatives and EIS schedule. Large scale maps and supporting information provided. Navajo Nation expressed overarching interest in economic development; not wanting efforts on overflights to impede it
Hopi Tribe NPS (GCNP)	November 2009 Hopi Reservation, AZ	Review NPS Draft Preferred Alternative and EIS schedule. A Hopi follow-up letter (November 24, 2009) stated they intend to support the Preferred Alternative given it adequately addresses Hopi concerns
Hualapai Tribe NPS (GCNP)	November 2009 Peach Springs, AZ	Meeting with full Tribal Council to review NPS Draft Preferred Alternative and EIS schedule. Tribe expressed concerns about traditional cultural properties, and NPS committed to continue to work with Hualapai to re-identify and minimize impacts to important cultural site locations
Recipients Las Vegas Tribe of Paiute Indians Paiute Indian Tribe of Utah San Juan Southern Paiute Tribe Havasupai Tribe Moapa Band of Paiute Indians	December 2009 Letter	Formal GCNP correspondence letter providing tribes who had not recently met with the park opportunity to do so prior to EIS publication
Recipient Tim Begay, Navajo Nation Historic Preservation Department	January 4, 2010 Visit	Janet Cohen hand delivered two large-scale maps to Tim Begay of the NNHPD while he was at the Flagstaff Coconino GCNP Offices on other business. He was going to give one of the two maps to Ray Russell at Navajo Nation Parks and Recreation
Navajo Nation NPS (GCNP) FAA	March 8, 2010 GCNP	Discuss Draft NPS Preferred Alternative. A large-scale map and other supporting information provided to Navajo Nation
Havasupai Tribe NPS (GCNP)	March 15, 2010 Supai Village, AZ	Provided an overflights status report on Alternatives and EIS timeline
<i>All associated tribes and agencies</i>	<i>February 14, 2011</i>	<i>DEIS released; copies to all associated tribes and agencies</i>
<i>Navajo Nation-Cameron Chapter</i>	<i>October 6, 2011 Cameron, AZ</i>	<i>Provided DEIS presentation and update of EIS process. NPS requested official comments from Navajo Nation</i>
<i>Navajo Nation-Bodaway Chapter</i>	<i>October 26, 2011</i>	<i>Began DEIS presentation but meeting terminated by Navajo Nation chairwoman</i>
<i>All associated tribes and SHPO</i>	<i>June 2012</i>	<i>Finding of Effect letter sent to SHPO and tribes</i>
<i>All associated tribes and agencies</i>	<i>June 2012</i>	<i>FEIS released and distributed to all associated tribes and agencies</i>

1 **List of Recipients**

2
3 This EIS will be posted on the internet where it can be downloaded from the NPS Planning Environment and Public
4 Comment (PEPC) website at <http://parkplanning.nps.gov/grca>

5
6 DVDs and/or paper copies of this EIS or a notice of its availability for review and comment may also be sent to

FEDERAL AGENCIES**Advisory Council on Historic Preservation****Department of Agriculture**

Coconino National Forest

Kaibab National Forest

Department of the Interior

Bureau of Indian Affairs

Bureau of Land Management Arizona Strip

Bureau of Reclamation

Fish and Wildlife Service

Geological Survey

National Park Service

Bryce Canyon National Park

Canyonlands National Park

Flagstaff Area Parks

Hawaii Volcanoes National Park

Glen Canyon National Recreation Area

Grand Canyon-Parashant National Monument

Grand Teton National Park

Intermountain Regional Office

Lake Mead National Recreation Area

Natural Sounds Program

Pipe Springs National Monument

Zion National Park

Department of Transportation

Federal Aviation Administration

U.S. Environmental Protection Agency**CONGRESSIONAL DELEGATIONS****Arizona**

Office of Representative Jeff Flake

Office of Representative Trent Franks

Office of Representative *vice* Gabrielle Giffords

Office of Representative Paul Gosar

Office of Representative Raul Grijalva

Office of Representative Ed Pastor

Office of Representative Ben Quayle

Office of Representative David Schweikert

Office of Senator John Kyl

Office of Senator John McCain

Nevada

Office of Representative Shelley Berkley

Office of Representative Joe Heck

Office of Representative *Mark Amodei*

Office of Senator Harry Reid

Office of Senator *Dean Heller***STATE AND LOCAL AGENCIES****State of Arizona**

Attorney General

Office of the Governor

State Historic Preservation Office

Department of Environmental Quality

Department of Transportation and Planning

Game and Fish Department

City Government

City of Flagstaff (AZ)

City of Fredonia (AZ)

City of Kanab (UT)

City of Las Vegas (NV)

City of Page (AZ)

City of Phoenix (AZ)

City of Tusayan (AZ)

City of Williams (AZ)

County

Clark County Department of Aviation (NV)

Coconino County Board of Supervisors (AZ)

Mohave County (AZ)

Local Libraries

Flagstaff, AZ

Las Vegas, NV

Phoenix, AZ

Northern Arizona University, AZ

TRIBAL GOVERNMENTS

Havasupai Tribe

Hopi Tribe

Hualapai Tribe

Kaibab Band of Paiute Indians

Las Vegas Paiute Tribe

Moapa Band of Paiute Indians

Navajo Nation

Paiute Indian Tribe of Utah

Pueblo of Zuni

San Juan Southern Paiute Tribe

Yavapai-Apache Nation

ORGANIZATIONS AND BUSINESSES

A.V.I. Inc. dba Air Vegas
 Air Bridge, Inc.
 Air Grand Canyon
 Air Star Helicopters
 Air Transport Association of America
 Aircraft Owners and Pilots Association
 Arizona Pilots Association
 Arizona Raft Adventures
 Arizona Wilderness Coalition
 Aviation Ventures, Inc. dba Vision Air
 Deer Valley Pilot Association
 Delaware North Parks Services
 Eagle Canyon Airlines, Inc. dba Scenic Airlines
 Environmental and International Programs,
 Air Transport Association of America
 Grand Canyon Airlines
 Grand Canyon Airport
 Grand Canyon Association
 Grand Canyon Helicopters
 Grand Canyon Hikers and Backpackers Association
 Grand Canyon Private Boaters Association
 Grand Canyon Resort Corporation
 Grand Canyon River Guides Association
 Grand Canyon River Outfitters Association
 Grand Canyon Trust
 Grand Canyon Wildlands Council
 Heli USA Airways Inc.
 Helicopter Association International
 King Airlines, Inc.
 Las Vegas Helicopters, Inc.
 Marble Canyon Outfitters
 Maverick Helicopter Tours
 National Business Aviation Association, Inc.
 National Parks Conservation Association
 National Parks Visitors Alliance
 Papillon Airways, Inc. dba Papillon Grand Canyon
 Helicopters
 Paul Revere Transportation
 Sierra Club
 Sky Harbor Center, Embry-Riddle Aeronautical
 University
 Southern Utah Wilderness Alliance
 Sundance Helicopters, Inc.
 The Wilderness Society
 US Air Tour Association
 Vista Helicopters, Inc.
 Western River Expeditions
 Westwind Aviation, Inc.
 Xanterra Parks & Resorts

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Individuals

List on file at the Office of Planning and Compliance, Grand Canyon National Park

Preparers and Contributors

All individuals who helped prepare this Draft or *Final* Environmental Impact Statement or who contributed to its preparation are listed below (Table 5.2).

National Park Service team members with experience in Grand Canyon National Park resources met frequently throughout Overflights EIS development. The Federal Aviation Administration's team, which included experienced aviation safety members, also met frequently with NPS *through all but the following: FAA was not involved in final selection of the DEIS NPS Preferred Alternative or the analysis of impacts, in accordance with the January 2011 agreement between the Department of Transportation and Department of the Interior. NPS was solely responsible for NEPA analysis and documentation, and for decisions leading to NPS recommendations under the 1987 Overflights Act.* The National Park Service's Denver Service Center was designated in 2005 as a contractor for *DEIS* preparation.

Harvey Economics was hired by the subcontractor, Parsons Corporation, to produce a *DEIS* section. Parsons Corporation was hired as a subcontractor by NPS, Denver Service Center, to prepare *the DEIS*. Amy Heuslein from the Bureau of Indian Affairs was part of the team to review the *DEIS* as a tribal coordinator. *In 2011 Parsons Corporation, and BBC International as subcontractor, was hired for their socioeconomic expertise to assist in Socioeconomic Resource FEIS comment response and analysis.* The Department of Transportation's Volpe Transportation Systems Center was contracted to perform modeling and to assist with EIS sections.

Table 5.2 Preparers NPS Team Members

Name	Title	Qualifications	Sections Worked On
Scott Amirault	Environmental Protection Specialist Office of Planning and Compliance GCNP	1 year NEPA Specialist	Entire document (FEIS)
Jill Beshears	Environmental Protection Specialist Office of Planning and Compliance GCNP	12 Years NEPA specialist	Entire document (DEIS and FEIS)
Jennifer Carpenter	Former Grand Teton National Park Environmental Protection Specialist	NEPA specialist	Peer Review DEIS
Greer Chesher	Writer/Editor, Office of Planning and Compliance GCNP		Entire document (DEIS and FEIS)
Janet Cohen	Tribal Consultation Coordinator		Reviewed Tribal sections of document (DEIS and FEIS)
Rick Ernenwein	Outdoor Recreation Planner Office of Planning and Compliance GCNP	30 years Federal land management, planning, and NEPA experience	Entire document (DEIS and FEIS)
Kurt Frstrup	Natural Sounds, Senior Acoustician, NPS		Soundscapes, Wildlife (DEIS and FEIS)
Mary Killen	Chief, Office of Planning and Compliance, GCNP		Reviewed entire document (DEIS and FEIS)
Catherine Lentz	Section 106 Coordinator, Office of Planning and Compliance, GCNP		Peer Review entire document DEIS for HUVO Reviewed Cultural resources Sections of FEIS
Steve Martin	Former GCNP Superintendent		Reviewed
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Ken McMullen	Former Environmental Protection Specialist Office of Planning and Compliance GCNP (retired)		Reviewed Chapters 1-3 (DEIS)
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Jane Rodgers	Deputy Chief, Socio-Cultural Resources, Science and Resource Management, GCNP		Reviewed Chapter 3 & 4 (DEIS)
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Dave Uberaga	GCNP Superintendent		Reviewed FEIS
Gigi Wright	Writer/Editor, Visitor and Resource Protection, GCNP		Chapter 1-5, Appendices (DEIS)

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TABLE 5.2 PREPARERS DENVER SERVICE CENTER INTERDISCIPLINARY TEAM DEIS

Name	Title	Qualifications	Sections Worked On
Nell Blodgett	GIS Specialist	B.A.(Geography); M.S.(GIS Science); expertise in Geographic Information Systems (GIS); 5 years with the National Park Service	Chapter 2, Google Earth Application, Maps for FAA Safety Review
Kerri Cahill	Visitor Use Technical Specialist	B.A. (Environmental Policy), M.S.P. (Environmental Planning), PhD (Natural Resource Recreation Management); expertise in Visitor Use and Experience management; 7 years with the National Park Service; 5 years as park planner for Florida State Parks and private consulting firms	Chapters 3 & 4
Greg Cody	Technical Specialist for Cultural Resources	B.A/M.A. (History); expertise in cultural resources and compliance with NHPA; 18 years with the National Park Service	Chapters 1, 3, 4
Aaron Gagne	Project Manager	B.S. (Environmental Planning), M.C.R.P. (Master of City and Regional Planning); expertise in planning, economics, finance and contracting; less than 1 year with the National Park Service, 14 years with local, county, state and other Federal agencies, 5 years with planning, consulting, and private development firms	Chapters 1, 2, 3,5
BJ Johnson	DSC Planning Division Chief	Master of Science in Environmental Science, BA in both Environmental Biology and Environmental Conservation, 25 years working within the professional disciplines of NEPA analysis and community planning	Entire document
David Kreger	Planning Branch Chief	B.S. (Environmental Resource Management); expertise in NEPA and natural resources management; 19 years with the National Park Service and 12 years with environmental consulting firms	Entire document
Cynthia Nelson	Project Manager		Entire document through early 2009
Dan Niosi	Project Manager	B.A. (Environmental Studies-Natural Resources Management); Expertise in NEPA and natural resources management; less than one year with the National Park Service and 11 years with environmental consulting firms	Entire document
Michael Rees	Natural Resource Specialist	B.A. (Environmental Studies) and M.F.S. (Master of Forest Science); Expertise in NEPA, park planning, and wilderness; 19 years with the National Park Service and 8 years with the U.S. Fish & Wildlife Service	Entire document
Paul Wharry	NEPA Technical Specialist	B.A. (Biology) Expertise in NEPA, and natural resources management; 5 years with the National Park Service and 11 years with environmental consulting firms; 13 years in academics	Entire document

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TABLE 5.2 PREPARERS VOLPE CENTER DEIS AND FEIS

Name	Title	Qualifications	Sections Worked On
Cyndy Lee	USDOT / Volpe Center, Acoustics Facility		Chapter 4 analysis for Soundscape, reviewed Chapter 4, Appendix D

1 **Table 5.2** **Preparers** **Parsons Corporation Interdisciplinary Team (Contractor)**

Name	Title	Qualifications	Sections Worked On
Timberley Belish	Managing Scientist	B.S., Biology and M.S., Ecology and Evolution 16 years experience	<i>DEIS</i> Document production coordination and NEPA requirement assurance for entire document. Focused writing for wildlife and T&E species. <i>FEIS Developed response to Socioeconomic Resources comments</i>
Jacklyn Bryant	Environmental Planner	B.S., Natural Resource Management and M.S., Watershed Sciences 13 years experience	<i>DEIS</i> Visitor Use and Experience
Gabriel Cosyleon	Scientist	B.S., Biology and M.S., Zoology 6 years experience	<i>DEIS</i> Wildlife and T&E species support
Areg Gharabegian	Noise Specialist	B.S. and M.S., Mechanical Engineering 31 years experience	<i>DEIS</i> Noise Analysis and technical support to writers
Ed Harvey	Economist, Harvey Economics	B.A., Economics and M.S., Economics 35 years experience	<i>DEIS</i> Socioeconomics, Air Operator Impacts, Land Use
John Hoesterey	Project Manager	B.A., Zoology and M.A., Geography and Environmental Science 34 years experience	<i>DEIS</i> Project Management <i>FEIS Revised Socioeconomic Resource Affected Environment (Chap 3) and Environmental Analysis (Chap 4)</i> <i>Assisted with response to Socioeconomic Resource comments Appendix H</i>
<i>Doug Jeavons</i>	<i>BBC International Inc</i>	M.A., Economics, University of Colorado Field of Specialization: Quantitative methods and natural resource economics B.A., International Affairs, Lewis and Clark College 21 years	<i>FEIS Revised Socioeconomic Resources Affected Environment (Chap 3) and Environmental Analysis (Chap 4)</i> <i>Assisted with Socioeconomic Resource response to comments Appendix H</i>
Scott Lowry	Writer/Editor	B.S., Psychology; J.D.; M.A. and Ph.D., English 19 years experience	<i>DEIS</i> Writing/editing support, Park Operations
Alexa Mudgett	Landscape Architect/Graphics Specialist	B.A., Environmental Studies and M.S., Landscape Architecture 8 years experience	<i>DEIS</i> Wilderness and graphic production
Diane Rhodes	Cultural Resource Specialist	M.A., Anthropology/Archeology 11 years experience	<i>DEIS</i> Cultural Resources
Jan Snyder	Writer/Editor	B.S., Zoology 35 years experience	<i>DEIS</i> Writing and editing
Bruce Snyder	Technical Director	B.S., Biology and M.S., Wildlife Biology 40 years experience	<i>DEIS</i> Technical Direction, QA/QC Review
Susan Walker	Economist, Harvey Economics	B.A., Forestry and M.S., Forest Economics 7 years experience	<i>DEIS</i> Socioeconomics, Air Operator Impacts, Land Use

2
3

1 **Contributors**
2

TABLE 5.2 CONTRIBUTORS FAA TEAM MEMBERS ON DRAFT EIS

Name	Title	Qualifications	Sections Worked On
Barry Brayer	Manager Special Programs Staff, NEPA & Tribal Consultation Project Lead, FAA	NEPA, 24 years, Tribal, 18 years, BS Engineering	Entire document
Rebecca Cointin	Operations Research Analyst, Noise Division, Office of Environment and Energy, FAA	Aviation Noise, 8 years	Noise Analysis
Norman Elrod	Economist, Flight Standards Part 135/136 Air Carrier Operations Branch, FAA	Air Tour Industry and Operations Database Analyst, 14 years, PhD, Economics	Chapter 2 and various sections Chapters 3 & 4
Tina Gatewood	Manager, Environmental Programs, System Operation Airspace and AIM, FAA	NEPA, 19 years, Tribal, 14 years	Entire document
Carol Gaelick	Economist		Reviewed Socioeconomics
Raquel Girvin	Manager, Noise Division, Office of Environment and Energy, FAA		
Paul Joly	Air Tour Safety Specialist, Las Vegas Flight Standards District Office, FAA	Air-tour operational Safety and Analysis: 15 years. NEPA team: 10 years. Tribal: 10 years	
Keith Lusk	Program Manager, Special Programs Staff, Western Pacific Region, FAA	NEPA, 23 years	Entire document
Lynne Pickard	Deputy Director, Office of Environment and Energy, FAA	NEPA with emphasis on aircraft noise impacts and mitigation, compatible land use, DOT Section 4(f), 34 years	Entire document

3
4
5 **TABLE 5.2 CONTRIBUTORS BUREAU OF INDIAN AFFAIRS ON DRAFT EIS**

Name	Title	Qualifications	Sections Worked On
Amy Heuslein	Tribal Coordination		Entire document

6

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1 GLOSSARY

2
3 National park air-tour planning and the EIS process require use of technical terms. Some of the most important are
4 defined in this section. Terms below in ***bold italics*** are defined separately in this glossary.

5
6 **Acoustics** The science of ***sound***

7
8 **Acoustic Zone** Areas with similar vegetation, terrain, animals, and weather likely have similar acoustic
9 characteristics including sound sources and sound attenuation characteristics. These areas are referred to as acoustic
10 zones and may be helpful in describing acoustic conditions in areas with similar characteristics

11
12 **Adverse Effect** Generally a change that moves a resource or visitor experience away from a desired condition or
13 that detracts from visitor experience or resource condition, as opposed to a ***beneficial effect*** which is generally a
14 positive change in resource condition, a positive change in visitor experience, or a change that moves a resource or
15 visitor experience toward a desired condition (consistent with the purpose and/or management objectives of the
16 affected park land or other area)

17
18 **Airway** A corridor of controlled airspace whose centerline is established by radio navigational aids. Low-altitude
19 airways (3,000 to 18,000 feet MSL) are identified by number with the letter V as a prefix. High altitude airways
20 (above 18,000 feet MSL) are known as Jet airways and are identified by number with J as a prefix

21
22 **All Scenarios** Base Year and Ten-Year Forecast Peak and Off-Peak Season

23
24 **Allocation** 14 CFR 93.303 (regulations that implement the 2000 National Parks Air Tour Management Act)
25 states that an Allocation is an authorization to conduct a commercial air tour in Grand Canyon National Park
26 (GCNP) Special Flight Rules Area (SFRA). Allocations are not a property interest, but an operating privilege
27 subject to absolute FAA control. FAA retains the right to redistribute, reduce, or revoke allocations

28
29 **Ambient Noise** Total sum of noise from all sources in a given place and time. Also known as ***Existing Ambient***
30 ***Noise***; see also ***Natural Ambient Noise***

31
32 **Ambient Sound Conditions** Many different soundscapes occur in national parks. In some areas natural
33 sounds predominate, while in others both natural and non-natural sounds occur. To understand and manage
34 Soundscapes, ambient conditions for different Soundscapes need to be acoustically described. Definitions of
35 common ambient sound conditions are provided below

36
37 **Ambient Sound, Existing** All sounds in a given area (all natural and non-natural sounds)

38
39 **Ambient Sound, Natural** All natural sounds in a given area, excluding all non-natural sounds. Natural
40 ambient sound is considered synonymous with the term natural quiet, although natural ambient sound is more
41 appropriate because nature is often not quiet

42
43 **Amplitude** Instantaneous magnitude of an oscillating quantity such as sound pressure. The peak amplitude is
44 the maximum value

45
46 **Attenuation** Reduction of sound intensity by various means (e.g., air, humidity, and porous materials)

47
48 **Area of Audibility** Area within which a specific sound or sounds is audible

49
50 **Audibility** Audibility is the ability of animals, ***including*** humans, with normal hearing to hear a given sound,
51 and is affected by the animal's hearing ability, ***masking effects of*** other simultaneous interfering sounds or stimuli,
52 by frequency content and amplitude ***of the sound***, and whether the sound contains information the animal has
53 learned to pay attention to or ignore

54
55 **Audiogram** Graph showing hearing acuity as a function of frequency and amplitude

1 **Average Sound Level** Also called *Equivalent Sound Level*, it is the logarithmic energy average of aircraft noise
2 pressure levels in *A-weighted decibels (dBA)* experienced over a given period of time (for this EIS, the 12-hour day
3 described in Chapter 4, Methodology
4

5 **A-Weighted Decibels (dBA)** System for measuring *sound* energy designed to represent the human ear's
6 response to sound. Energy at frequencies more readily detected by the human ear is more heavily weighted in the
7 measurement, while frequencies less well detected are assigned lower weights. A-weighted sound measurements are
8 commonly used in studies where the human response to sound is the object of the analysis
9

10 **A-Weighting** See *Weighting*
11

12 **Bar Ten** Generally a reference to helicopter operations conducted between Bar Ten airstrip and the boat
13 pullout at the base of Whitmore Canyon. Bar Ten Ranch is located nine miles north of Grand Canyon, in Grand
14 Canyon—Parashant National Monument, 80 miles southeast of St. George, Utah.
15

16 **Base Year** 2005 is the Base Year used for noise modeling in this EIS. The best available data as of the end of
17 2005 is used as the base for noise modeling for the Alternatives. Since 2005, the 2005 database has been checked
18 against data from subsequent years, and although there are some differences, given all factors contributing to those
19 differences, the 2005 database has proven consistent enough to continue as a reasonable base for evaluating impacts
20 of the Alternatives in this EIS
21

22 **Beneficial Effect** Generally a positive change in resource condition, a positive change in visitor experience,
23 or a change that moves a resource or visitor experience toward a desired condition (consistent with the purpose
24 and/or management objectives of the affected park land or other area), as opposed to an *adverse effect* which is
25 generally a change that moves the resource or visitor experience away from a desired condition or that detracts from
26 visitor experience or resource condition
27

28 **Central area** See Map 3.2
29

30 **Clean Air Act, as amended in 1990 (CAA)** Serious efforts to control air pollution began in California in
31 the 1950s in response to the southern coast's increasingly worsening smog problem. By the 1960s the U.S.
32 Government began significant and continuing regulatory efforts to reduce emissions. As the nation's air quality
33 continued to deteriorate, Congress passed the Clean Air Act of 1963. This Act has evolved through four major
34 revisions, the most recent being Amendments of 1990. The result of these ongoing efforts is an evolving ambient air
35 pollution control strategy based on the National Ambient Air Quality Standards and a provision that states would
36 develop implementation plans to meet and maintain the standards
37

38 **Commercial Aviation** Aviation industry's commercial sector consisting of air carriers providing passenger and
39 cargo transportation for hire in domestic and international service. Commercial aviation includes air carriers that
40 operate large passenger or cargo jets and regional/commuter/charter carriers operating smaller aircraft
41

42 **Commercial Air-tours** Advertised air-tour flights and charter flights offered by commercial air-tour operators.
43 The category of air-tour operation to which annual allocations and daily caps apply
44

45 **Contour** See *Noise Contours*
46

47 **Cooperating Agency** Agency or tribal government with jurisdiction by law or has special expertise with
48 respect to an environmental issue, and cooperatively works with the lead agency to prepare an environmental impact
49 statement
50

51 **Council on Environmental Quality (CEQ)** The Council on Environmental Quality coordinates Federal
52 environmental efforts and works closely with agencies and other White House offices in the development of
53 environmental policies and initiatives. CEQ was established within the Executive Office of the President by
54 Congress as part of the National Environmental Policy Act of 1969 (NEPA) and additional responsibilities were
55 provided by the Environmental Quality Improvement Act of 1970
56

1 **Current Condition** *Existing condition* or conditions prior to future development, which serve as a
2 foundation for analysis

3
4 **Day-Night Average Sound Level (DNL)** Noise measure used to describe the Average Sound Level over a 24-
5 hour period, typically an average day over the course of a year. In computing DNL, an extra weight of 10 *decibels* is
6 assigned to noise occurring 10:00 p.m. to 7:00 a.m. to account for increased annoyance when *ambient Average*
7 *Sound Level* are lower and people are trying to sleep. DNL may be determined for individual locations or expressed
8 in noise contours

9
10 **dB** See *Weighting*

11
12 **Decibel (dB)** Logarithmic measure of any measured physical quantity, and commonly used in sound pressure-
13 level measurement. The decibel provides the possibility of representing a large span of signal levels in a simple
14 manner as opposed to using the basic unit Pascal. The difference between the sound pressure for silence versus a
15 loud sound is a factor of 1,000,000:1 or more; therefore, it is less cumbersome to use a small range of equivalent
16 values: 0 to 130 decibels. *Amplitude* is the relative strength of a sound wave described in decibels. Amplitude is
17 related to what we commonly call loudness or volume. An increase of 10 dBA represents a perceived (to human
18 hearing) doubling of sound pressure level; meaning 20 dBA would be perceived as twice as loud as 10 dBA; 30
19 dBA would be perceived as four times louder than 10 dBA; 40 dBA as eight times louder than ten dBA, etc.
20 Humans with normal hearing can hear sounds as low as 0 dB at 1,000 Hz.

21
22 **Detectability** Noise detected by an actively listening human on the ground. The measure of whether aircraft
23 noise is audible in Grand Canyon National Park's backcountry areas

24
25 **Direct Effect** A direct effect is caused by an action and occurs in the same time and place, as opposed to an
26 *indirect effect* which is caused by an action but is later in time or farther away but still reasonably foreseeable

27
28 **East End** See Map 3.2

29
30 **EIS Planning Team** The *DEIS* Planning Team was made up of representatives from the NPS (Grand Canyon
31 National Park, AZ; Natural Sounds Program, Feet, Collins, CO; Denver Service Center [DSC], Denver, CO;
32 Intermountain Regional Office, Denver, CO), FAA Bureau of Indian Affairs (BIA), Parsons Corporation (DSC
33 subcontractor). *The FEIS Planning Team was made up of representatives from the NPS (Grand Canyon National*
34 *Park, AZ; Natural Sounds Program, Feet, Collins, CO)*

35
36 **Elevator Flights (or Over the Edge Flights)** A helicopter descent from Grand Canyon West Airport to
37 Colorado River pads conducted wholly on and within the Hualapai Reservation

38
39 **Energy Equivalent Sound Level** Level of a constant sound over a specific time period that has the same
40 sound energy as the actual (unsteady) sound over the same period

41
42 **Enplanements** Number of passengers boarding an aircraft at an airport

43
44 **En Route System** That part of the *National Airspace System* where aircraft are operating between origin
45 and destination airports

46
47 **Environmental Impact Statement (EIS)** A detailed, concise document discussing significant environmental
48 impacts resulting from a proposed Federal action; informs decision-makers and the public of reasonable Alternatives
49 which would avoid or minimize adverse impacts. Public participation and consultation with other Federal, state, and
50 local agencies is a cornerstone of the EIS process

51
52 **Equivalent Sound Level (LAeq₁₂)** Also called *Average Sound Level*, it is the logarithmic energy average
53 of aircraft noise pressure levels in *A-weighted decibels (dBA)* experienced over a given period of time (for this EIS,
54 the 12-hour day described in Chapter 4, Methodology

- 1 **Events per Hour** Number of times a non-natural sound source is heard, on average, in one hour (this may
2 be specific to a particular human-caused sound or to all human-caused sounds)
3
- 4 **Existing Ambient Noise** See *Ambient Noise*; see also *Natural Ambient Noise*
5
- 6 **Existing Condition** See *Current Condition*
7
- 8 **Federal Aviation Regulations (FAR)** Federal regulations relating to aviation published as Title 14 of the
9 Code of Federal Regulations
10
- 11 **Federal Interagency Committee on Aviation Noise (FICAN)** Committee formed in 1993 to provide
12 forums for discussion of public and private sector proposals on aviation noise, and to identify and encourage needed
13 research. All Federal agencies concerned with aviation noise are represented on the committee, including the
14 Department of Defense (Air Force, Army, Navy), Department of Interior (NPS), Department of Transportation
15 (FAA), Environmental Protection Agency (EPA), National Aeronautics and Space Administration (NASA), and
16 Department of Housing and Urban Development (HUD)
17
- 18 **Frequency** Number of times per second the sine wave of sound repeats itself. It can be expressed in cycles per
19 second or Hertz (Hz). Frequency equals Speed of Sound/Wavelength
20
- 21 **Frequency Spectrum** A standard frequency spectrum is made up of 12 octave bands, representing acoustic
22 wave length ranges, centered from 20 Hz to 3000 GHz. A sound source can have many different frequencies mixed
23 together. Each frequency stimulates a different length receptor in our ears. When only one wave length is dominant,
24 we hear a pure tone, while other sounds are made up of a combination of frequencies. When displayed in graphic
25 form, the magnitude of the sound pressure level at each frequency comprises a frequency spectrum. In some
26 instances, more detailed information is needed than what the octave band analysis gives. Narrower bands, such as
27 one-third octave bands, are selected for such analysis
28
- 29 **General Aviation** Aviation industry's private sector consisting of privately owned and operated aircraft not
30 for hire. Aircraft size and range vary widely from small (single engine) aircraft to large jet aircraft
31
- 32 **Grand Canyon National Park Airport** Airport located outside Grand Canyon National Park in the town of
33 Tusayan, Arizona, also referred to in this document as Grand Canyon Airport
34
- 35 **Grand Canyon West** Airport located on the Hualapai Reservation at Grand Canyon National Park's West End
36
- 37 **Grand Canyon Working Group** Established under authority of the *National Parks Overflights Advisory Group*,
38 and consists of representatives from NPS, FAA, air-tour operators, environmental groups, tribes, commercial and
39 general aviation, recreational interests, and other Federal agencies. The Working Group developed recommendations
40 for proposed actions to meet the statutory mandate contained in the 1987 Overflights Act. Specifically, the group's
41 purpose was to: review data and analysis, identify and review issues related to overflight noise, and consider a
42 variety of Alternatives to address issues. Information Accessed at
43 [http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/grand_canyon_overflights/documents/docu](http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/grand_canyon_overflights/documents/documents_list.cfm)
44 [ments_list.cfm](http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/grand_canyon_overflights/documents/documents_list.cfm)
45
- 46 **Grid Analysis** Type of aircraft noise analysis that evaluates Average Sound Level at individual points rather than
47 through generation of *noise contours*
48
- 49 **Ground Effect** Noise *attenuation* attributed to absorption or reflection of noise by human-made or natural
50 features on the ground surface
51
- 52 **Hearing Range (human)** An average healthy young person can hear frequencies from approximately 20 Hz to
53 20000 Hz, and sound pressure levels from 0 dB to 130 dB or more (threshold of pain)
54
- 55 **Hualapai Excepted Flights** Air tours conducted in support of the Hualapai Tribe are *not subject to*
56 annual allocations and daily caps to which other tours are subject. This *exception* is the result of concerns regarding

1 potential impacts flight limitations would have on the Tribe's economic development (Federal Register, Vol. 65, No.
2 65). These flights are accounted for separately from commercial tours described

3
4 **Human-caused Sound** Any sound attributable to a human source. May be used interchangeably with non-
5 natural, human-made, man-caused, or human-made sound

6
7 **Indirect Effect** An indirect effect which is caused by an action but later in time or farther away but still reasonably
8 foreseeable as opposed to a *direct effect* which is caused by an action and occurs in the same time and place

9
10 **Infrasound** Frequencies below 20 Hz. Humans perceive frequencies below about 20 Hz as pressure rather than
11 sound

12
13 **Instrument Flight Rules (IFR)** Rules governing conduct of flight using instruments and air traffic services to
14 avoid obstacles, terrain, and other air traffic

15
16 **Integrated Noise Model (INM)** Computer model developed, updated, and maintained by FAA to predict noise
17 exposure generated by aircraft operations

18
19 **Integrated Noise Model Version 6.2 (INM 6.2)** FAA's computer model for calculating aircraft noise. Version
20 6.2 of INM includes the capability to calculate aircraft audibility

21
22 **Intensity** Sound energy flow through a unit area in a unit time

23
24 **kilohertz (kHz)** A measure of frequency, or the number of times something occurs in a second. In terms
25 of sound, 1 Hz (Hertz) = 1 cycle of the sound waveform per second. 1 kHz (kilohertz) = 1000 Hz

26
27 **L50** L50 represents the sound pressure level, in decibels, of all sounds (natural plus non-natural) exceeded 50%
28 of the time (the median)

29
30 **Ldn** See *Day-Night Average Sound Level (DNL)*. Ldn is used in place of DNL in mathematical equations only

31
32 **LAeq₁₂** See *Equivalent Sound Level*

33
34 **L_(nat)** The natural ambient sound level, or sound level of all natural sounds in a given area, excluding all
35 mechanical, electrical and other human-caused sounds. The L_(nat) is the sound level associated with an exceedence
36 value calculated by removing the percent time human-caused sounds are audible

37
38 **Local Operation** Aircraft flight that begins and ends at the same airport

39
40 **Location Point** As described in Appendix D, 127 Location Points were selected by the NPS for
41 EIS noise modeling. NPS selected 25 Location Points (GC008-GC033) corresponding to monitoring sites where
42 acoustic data was collected by GCNP personnel. Other named points were selected as representative locations for
43 visitor experience and/or park resources (e.g., Wilderness Character, Ethnographic Resources, wildlife).
44 Additionally, Location Points GRID01 through GRID36 were selected based on a ten-kilometer grid to provide
45 spatial coverage throughout the park. Map 3.2 shows all 127 Location Points referred to throughout this EIS

46
47 **Loudness** Subjective judgment of sound intensity by humans. Loudness depends on stimulus sound pressure
48 and frequency

49
50 **Masking** Process by which the threshold of audibility for a sound is raised by presence of another (masking)
51 sound. A masking sound is one that renders inaudible or unintelligible another sound also present

52
53 **Maximum Average Sound Level (L_{Amax})** Maximum sound pressure for a given event adjusted toward the
54 frequency range of human hearing

- 1 **Mean Sea Level (MSL)** Average height of the surface of the sea for all stages of the tide; used as a reference for
 2 elevations; also called sea level datum
 3
- 4 **National Airspace System (NAS)** Common network of U.S. airspace, air navigation facilities, equipment, services,
 5 airports, or landing areas; aeronautical charts, information, and services; rules, regulations, and procedures; technical
 6 information, staffing, and materials, all of which are used in aerial navigation
 7
- 8 **National Environmental Policy Act of 1969 (NEPA)** Legislation establishing a national policy for the
 9 environment that requires preparation of an environmental impact statement for major Federal actions significantly
 10 affecting the environment
 11
- 12 **National Historic Preservation Act of 1966 (NHPA)** Legislation requiring projects on Federal lands, funded
 13 by Federal monies, or requiring a Federally-issued permit, be evaluated for impacts to historic properties
 14
- 15 **National Parks Overflights Advisory Group (NPOAG)** Advisory group of representatives of FAA, NPS,
 16 general aviation, air-tour operators, environmental concerns, and tribes established by the Air Tour Management Act
 17 of 2000 to provide continuing advice and counsel on commercial air-tour operations over and near national parks
 18
- 19 **Natural Ambient Noise** *Existing Ambient Noise*, minus manmade sounds. See also *Ambient Noise* and
 20 *Existing Ambient Noise*
 21
- 22 **Natural Quiet** All natural sounds in a given area, excluding all non-natural sounds. See *Ambient Sound, Natural*
 23
- 24 **Noise** Traditionally, noise has been defined as unwanted, undesired, or unpleasant sound. This makes noise a
 25 subjective term. Sounds unwanted and undesired by some may be wanted and desired by others. The
 26 appropriateness of any sound in a given area of a park will depend on a variety of factors including area
 27 management objectives
 28
- 29 **Noise Abatement** Measure or action minimizing impact of noise on environs of an airport. Noise abatement
 30 measures include aircraft operating procedures and use or disuse of certain runways or flight tracks
 31
- 32 **Noise Contours** Continuous lines on a map connecting all points of the same noise exposure level
 33
- 34 **Noise Floor** Lowest amplitude measurable by sound monitoring equipment. Most commercially available
 35 sound-level meters and microphones detect sound levels to about 15 to 20 dBA; however, there are microphones
 36 capable of measuring sound levels below 0 dBA
 37
- 38 **Noise-Free Interval** The length of time during which only natural sounds are audible
 39
- 40 **Notch, The** *In the DEIS*, the SFRA boundary *was modified to form* a notch around Grand Canyon West
 41 Airport so the airport area *was* outside the SFRA to facilitate traffic to and from the airport. The notch is entirely
 42 over Hualapai tribal lands south of the Colorado River. In Alternatives A and E, it is approximately 6 statute miles
 43 long, and 6.5 miles wide at its northeastern end narrowing to approximately 5 miles wide at its southwestern end. In
 44 Alternative F and the *DEIS* NPS Preferred, the notch *was* narrowed to approximately 5 miles wide throughout to
 45 include visitor areas at Eagle and Guano Points inside the SFRA. *In the Modified NPS Preferred Alternative, The*
 46 *Notch was removed and conditions returned to Alternative A*
 47
- 48 **Notice of Proposed Rulemaking (NPRM)** Draft of a proposed rule for public input and comment. Under
 49 the Administrative Procedures Act, in most cases, before a Federal agency may adopt a Final Rule, the agency must
 50 publish in the Federal Register a Draft rule and seek public comment. An NPRM contains a preamble that describes
 51 the rule and its purpose, commenting information and deadlines, and text of the proposed rule
 52
- 53 **Noticeability** *Noticeability refers to noise noticed by a human engaged in an activity other than actively*
 54 *listening. As discussed in FEIS Chapter 4, Methodology and Appendix D, the Dual-Zone System Noticeability*
 55 *Zone used for noise modeling (about 34% of GCNP) added 10 dB to natural ambient sound levels to account for*
 56 *factors such as visitor activity and presence of non-natural sound sources (64 Federal Register 3969).*

1 **Octave Band, One-Third** Frequency band whose cutoff frequencies have a ratio of two to the one-third
 2 (approximately 1.26). One-third octave bands reflect reasonably the human ability to differentiate tones
 3

4 **Off-Peak Season** Because Action Alternatives (E, F, and the *Modified* NPS Preferred) propose seasonal
 5 route changes, Alternatives are analyzed for different **Peak and Off-Peak Seasons**. Peak and Off-Peak Seasons refer
 6 more to analysis than visitation levels. Dates may correspond to avian nesting, non-motorized vs. motorized river
 7 use, and spring/fall high-demand Wilderness backpacking use to provide opportunity to experience these under
 8 quieter conditions

Alternative	Peak Season	Off Peak Season
E	July 1- September 15	September 16-June 30
F	February 1-November 30	December 1-January 31
<i>Modified</i> NPS Preferred	April 1-November 14	November 15-March 31

9
 10
 11 **Over the Edge (or Elevator Flights)** A helicopter descent from Grand Canyon West Airport to
 12 Colorado River pads conducted wholly on and within the Hualapai Reservation
 13

14 **Peak Day** Noise analysis for this EIS is based on a 12-hour time period of 7 a.m. to 7 p.m. on the Peak Day;
 15 the day with the highest total number of air-tour and air-tour-related operations. Based on a review of the best
 16 available data at the time EIS noise modeling analysis began, Peak Day occurred August 8, 2005, with a total 635
 17 operations. This day forms the basis for Base Year analyses for the Alternatives. Data for subsequent years was
 18 checked to ensure use of 2005 Peak Day as the basis for Base Year analysis was still reasonable
 19

20 **Peak Season** Because Action Alternatives (E, F, and the *Modified* NPS Preferred) propose seasonal route
 21 changes, Alternatives are analyzed for different Peak and **Off-Peak Seasons**. Peak and Off-Peak Seasons refer more
 22 to analysis than visitation levels. Dates may correspond to avian nesting, non-motorized vs. motorized river use, and
 23 spring/fall high-demand Wilderness backpacking use to provide opportunity to experience these under quieter
 24 conditions

Alternative	Peak Season	Off Peak Season
E	July 1- September 15	September 16-June 30
F	February 1-November 30	December 1-January 31
<i>Modified</i> NPS Preferred	April 1-November 14	November 15-March 31

25
 26
 27 **Percent Exceedence (L_x)** These metrics are the sound levels (L), in decibels, exceeded *x*% of the time.
 28 The L50 value represents the sound level exceeded 50% of the measurement period. L50 is the same as the median.
 29 The L90 value represents the sound level exceeded 90% of the time during the measurement period
 30

31 **Percent Time Audible** Time various sound sources are audible to animals, including humans, with normal
 32 hearing (hearing ability varies among animals)
 33

34 **Propagation** **Sound** propagation is the spreading or radiating of sound energy from the noise source. It
 35 usually involves a reduction in sound energy with increased distance from the source. Atmospheric conditions,
 36 terrain, natural objects, and manmade objects affect sound propagation
 37

38 **Quiet Technology** Procedures for determining the Grand Canyon National Park SFRA quiet-aircraft
 39 technology designation status for different aircraft are defined in Part 93 of chapter I of Title 14, Code of Federal
 40 Regulations. Designation of Grand Canyon National Park quiet-aircraft technology is generally based on measured
 41 flyover Average Sound Level of an aircraft and seating configuration. Table 3.15 shows types of aircraft designated
 42 Grand Canyon National Park quiet-aircraft technology. Requirements and identification of aircraft that meet them
 43 are in a Final Rule published by FAA in the Federal Register on March 29, 2008, Average Sound Level for Aircraft
 44 Used for Commercial Operations in Grand Canyon Special Flight Rules Area. FAA Advisory Circulars are
 45 Accessed at <http://www.faa.gov>
 46

- 1 **Record of Decision (ROD)** Official notice of an agency's findings after review of a final *Environmental*
 2 *Impact Statement*
 3
- 4 **Scoping** An early and open process for determining the scope or range of issues addressed in the
 5 *Environmental Impact Statement*, and identifying significant issues related to a proposed Federal action. Issues
 6 important to the public and local, state, and Federal agencies are solicited through direct mailing, public notices, or
 7 meetings. Scoping is generally conducted before development of the *Environmental Impact Statement* scope of
 8 work.
 9
- 10 **SFAR 50-2** Special Federal Aviation Regulation, codified at Part 93 of the Federal Aviation Regulation that
 11 contains the Special Flight Rules for aircraft operations in the vicinity of Grand Canyon National Park
 12
- 13 **Signal-to-Noise Ratio (SNR)** Ratio between amplitude of a signal (meaningful information) and amplitude of
 14 background noise. Because many signals have a very wide dynamic range, SNRs are often expressed in terms of the
 15 logarithmic decibel scale
 16
- 17 **Single event** One noise event. For many kinds of analysis, sound from single event is expressed using the
 18 *Sound Exposure Level* metric
 19
- 20 **Sound** Wave motion in air, water, or other media; the rapid oscillatory compressional changes in a
 21 medium that propagate to distant points characterized by changes in density, pressure, motion, and temperature as
 22 well as other physical properties. Not all rapid changes in the medium are sound (wind distortion on a microphone
 23 diaphragm)
 24
- 25 **Soundscape** Soundscape refers to the total acoustic environment associated with a given area. In a national
 26 park setting, Soundscapes can be composed primarily of natural sounds, or of both natural and non-natural sounds
 27
- 28 **Sound Exposure Level (SEL)** The total sound energy of an actual sound calculated for a specific time period,
 29 usually expressed using a time period of one second. This metric is useful in comparing two sounds that differ in
 30 amplitude and duration. A very long, very low-level sound may have the same 1-second SEL as a very short, very
 31 loud sound
 32
- 33 **Sound Level** Generally refers to the weighted sound pressure level obtained by frequency *weighting*, usually A-
 34 or C-weighted
 35
- 36 **Sound Pressure** Fluctuations in air pressure caused by presence of sound waves. Sound pressure is the
 37 instantaneous difference between the actual pressure produced by a sound wave and the average barometric pressure
 38 at a given point in space. Sound pressure is measured in Pascals (Pa), Newtons per square meter, which is the metric
 39 equivalent of pounds per square inch
 40
- 41 **Sound Pressure Level (SPL)** Logarithmic form of sound pressure; also expressed by attachment of the word
 42 decibel to the number
 43
- 44 **Sound Speed** Speed of sound in air is about 344 m/sec (1,130 feet/sec or 770 mph) at 70°F at sea level. It varies
 45 substantially depending on temperature and type of medium
 46
- 47 **Special Federal Aviation Regulation (SFAR)** A regulation adopted by FAA for unique and specific
 48 situations. SFARs generally have expiration dates that can be extended. **SFAR 50-2**, codified at FAR Part 93, is the
 49 rule containing regulations for the Special Flight Rules Area over Grand Canyon National Park
 50
- 51 **Special Flight Rules Area (SFRA)** A portion of airspace, with both vertical and lateral dimensions,
 52 wherein special operational rules and restrictions apply. The Grand Canyon Special Flight Rules Area overlies
 53 Grand Canyon National Park and portions of surrounding lands. It extends from the surface to 17,999 feet MSL
 54

1 **Special Use Airspace (SUA)** Airspace of defined dimensions identified by an area on the earth's surface
 2 wherein activities must be confined because of their nature, and/or wherein limitations may be imposed on aircraft
 3 operations that are not part of those activities
 4

5 **Spectrum (Frequency Spectrum)** Amplitude of sound at various frequencies; given by a set of numbers
 6 that describe the amplitude at each frequency or band of frequencies
 7

8 **Stage 2 Aircraft** Aircraft that meet Average Sound Level prescribed by *Federal Aviation Regulations*
 9 Part 36, which are less stringent than those established for the quieter *Stage 3* designation. The Airport Noise and
 10 Capacity Act required phase-out of all Stage 2 aircraft over 75,000 pounds by December 31, 1999, with potential for
 11 case-by-case exceptions through 2003
 12

13 **Stage 3 Aircraft** Aircraft that meet the most stringent Average Sound Level set in *Federal Aviation*
 14 *Regulations* Part 36
 15

16 **Substantial Restoration of Natural Quiet (SRNQ)** A legislatively mandated requirement associated with
 17 recommendations by the Secretary of the Interior with respect to aircraft noise at Grand Canyon National Park.
 18 Substantial Restoration of Natural Quiet has been clarified by NPS as the achievement of natural quiet (i.e., no
 19 aircraft audible) in 50% or more of the park for 75-100% of any given day
 20

21 **Substantive vs. Nonsubstantive Comments** The general rule under CEQ regulations is that a Final EIS
 22 must respond to all “substantive” comments on a Draft EIS. CEQ regulations and guidance do not define the term
 23 “substantive.” The National Park Service issued guidance stating that a comment is considered substantive if it
 24 raises specific issues or concerns regarding the project or the study process, but not if it merely expresses support for
 25 or opposition to the project or a particular Alternative.
 26

27 National Park Service NEPA guidance states that substantive comments “(a) question, with reasonable basis, the
 28 accuracy of information in the EIS; (b) question, with reasonable basis, the adequacy of environmental analysis; (c)
 29 present reasonable Alternatives other than those presented in the EIS; or (d) cause changes or revisions in the
 30 proposal.” NPS guidance also states that “[c]omments in favor of or against the proposed action or Alternatives, or
 31 comments that only agree or disagree with NPS policy are not considered substantive.” See NPS Director’s Order
 32 12, Conservation Planning, Environmental Impact Analysis and Decision Making, Section 4.6, Environmental
 33 Impact Statements, Final EIS (Jan. 8, 2001)
 34

35 **Ten-Year Forecast** For each Alternative, analysis includes assessment of impact during the *Base Year* and
 36 Ten-Year Forecast. Ten-Year Forecast is the best estimate of what will occur ten years after implementing each
 37 Alternative, starting from the Base Year scenario. For the Ten-Year Forecast, growth in aircraft operations was
 38 assumed as explained in Appendix D. Also, full implementation of each Alternative’s action elements is assumed to
 39 be achieved in the Ten-Year Forecast (for example, full conversion to quiet-technology aircraft if that is an
 40 Alternative element).
 41

42 **Time above Natural Ambient** Time sound levels from non-natural sounds are greater than natural sound levels
 43

44 **Transportation or Repositioning** Aggregate category of all flight operations in support of commercial air tours.
 45 Transportation is typically the return leg of the Las Vegas/Tusayan (South Rim) fixed-wing commercial air tour,
 46 while repositioning refers to movement of empty aircraft in support of trans-Canyon commercial air-tour operations
 47

48 **Ultrasound** Sounds of a frequency higher than 20,000 Hz
 49

50 **Visual Flight Rules (VFR)** Rules pilots may operate under in appropriate airspace when weather meets
 51 certain criteria allowing ample visual ability to see and avoid other aircraft, obstacles, and terrain
 52

53 **Volpe Center** U.S. Department of Transportation, Volpe National Transportation Systems Center online
 54 at <http://www.volpe.dot.gov>. See Chapter 5 for explanation of Volpe Center’s involvement in this EIS
 55

- 1 **Wavelength** Distance a wave travels in the time it takes to complete one cycle. A wavelength can be
2 measured between successive peaks or between any two corresponding points on the cycle. Wavelength (feet) =
3 Speed of Sound (feet) / Frequency (Hz)
4
- 5 **West End** See Map 3.2
6
- 7 **Weighting** Adjustment of sound level data to achieve a desired measurement. A-Weighting is used to account
8 for changes in human-hearing sensitivity as a function of frequency. The A-weighting network de-emphasizes high
9 (6.3 kHz and above) and low (below 1 kHz) frequencies, and emphasizes frequencies between 1 kHz and 6.3 kHz in
10 an effort to simulate the relative response of human hearing. C-Weighting is linear over the mid-frequency range
11 from 200 Hz to 1.6 kHz, and de-emphasizes the low (below 200 Hz) and high (above 1.6 kHz) frequencies
12
- 13 **Windscreen** Porous device covering a sound-level measurement system microphone. Windscreens are designed
14 to minimize effects of wind disturbance on sound levels being measured while minimizing attenuation (<0.5 dB) of
15 signal. When using windscreens that attenuate sound levels >0.5 dB, amount of attenuation for each one-third octave
16 band must be known and corrections applied
17
- 18 **Yearly Day-Night Average Sound Level** See *Day-Night Average Sound Level (DNL)*
19
20

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ACRONYMS

AGL	Above ground level
ANSI	American National Standards Institute
ARD	Alternative Dispute Resolution
ATC	<i>Air Traffic Control</i>
AZGFD	Arizona Game and Fish Department
BA	Biological Assessment
BAT	<i>Best Available Technology</i>
BAQT	<i>Best Available Quiet Technology</i>
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BO	Biological Opinion
CAA	Clean Air Act, as amended in 1990
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CRMP	Colorado River Management Plan
dB	decibel
dBA	A-Weighted Sound
DEIS	Draft Environmental Impact Statement
DNL	Day-Night Average Sound Level
DOT	Department of Transportation
DSC	Denver Service Center (NPS)
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FAR	Federal Aviation Regulations
FEIS	Final Environmental Impact Statement
FICAN	Federal Interagency Committee on Aviation Noise
FL180	Flight Level 180
FONSI	Finding of No Significant Impact
FPL	Federal Poverty Level
FSDO	<i>Flight Standards District Office (FAA)</i>
FTE	Full-Time Equivalent
FY	Fiscal Year
GCNP	Grand Canyon National Park
GMP	General Management Plan
IFR	Instrument Flight Rules
INM	Integrated Noise Model
INM 6.2	Integrated Noise Model Version 6.2
kHz	kiloHertz
LAeq12	Equivalent (Average) Sound Level
MSL	Mean sea level

NAS	National Airspace System
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NMSIM	Noise Map Simulation Model
NNL	National Natural Landmark
NOI	Notice of Intent
NPATMA	<i>National Parks Air Tour Management Act</i>
NPOAG	National Parks Overflights Advisory Group
NPRM	Notice of Proposed Rulemaking
NPS	National Park Service
NRPM	Notice of Proposed Rule Making
NTSB	National Transportation Safety Board
PAC	Protected Activity Center (for Mexican spotted owl)
PEPC	Planning Environment and Public Comment Website (NPS)
RNA	Research Natural Area
ROD	Record of Decision
SEL	Sound Exposure Level
SFAR	Special Federal Aviation Regulation
SFRA	Special Flight Rules Area
SHPO	State Historic Preservation Office/Officer
SNR	Signal-to-Noise Ratio
SPL	Sound Pressure Level
SRNQ	Substantial Restoration of Natural Quiet
VFR	Visual Flight Rules
VOR	Very high frequency Omnidirectional Range
USATA	U.S. Air Tour Association
UNESCO	United Nations Educational, Scientific and Cultural Organization
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

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