CHAPTER 4 ENVIRONMENTAL CONSEQUENCES

GENERAL METHODOLOGY FOR ESTABLISHING IMPACT 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, FAA, other agency experts, and NPS's 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. 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 NPS 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 area[33] 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

[33] 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.[34] 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

  - ***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 NPS 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
NPS Preferred	May 1-October 31

  - ***Off-Peak Season*** Because Action Alternatives (E, F, and NPS Preferred) propose different seasonal changes to routes, Alternatives are analyzed for different Off-Peak Seasons. Alternative A (No 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
NPS Preferred	November 1-April 30

[34] 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

Effects were characterized based on

- **Direct Effect** Caused by an action and occurs in the same time and place as the action

- **Indirect Effect** Caused by an action but occurs later in time or farther away but still reasonably foreseeable

- **Beneficial Effect** Generally a positive change in resource condition, a positive change in visitor experience, or a change that moves a resource or visitor experience toward a desired condition (consistent with the purpose and/or management objectives of the affected park land or other area)

- **Adverse Effect** Generally a change that moves the resource or visitor experience away from a desired condition or that detracts from visitor experience or resource condition. More specific descriptions of adverse and beneficial impacts may be provided for individual Impact Topics

- **Impact Intensity** Uses four intensity thresholds, **negligible**, **minor**, **moderate**, and **major** as defined for each impact topic and explained below in Impact Intensity Threshold and shown in Table 4.1

- **Duration** Considers length of time a resource would be affected by an event or related series of events. Duration (**short or long term**) varies by impact topic and is addressed in each

- **Timing** Considers sensitive time periods or seasons, sensitive time(s) of day, how often impact would occur, and whether impact is recurring

- **Area** **Marble Canyon, East End, Central**, and **West End** as shown on Map 3.2

- **Context** Generally refers to an impact's geographical extent, whether **regional** or **localized**, but also whether it would occur in a location sensitive to such impacts. Generally, regional impacts in this EIS are associated with a large part of the park or SFRA. Localized impacts are generally associated with specific sites or flight routes. If definitions vary from these, they are discussed under that impact topic

  - **Management Zone** Park Management Zones are an important part of Context (see above) for some Impact Topics. Park Management Zones considered in this EIS are **Wilderness, Non-Wilderness**, and **Developed** (as described in Chapter 3). In general, impact analyses consider that, in the Developed Zone (about 2% of the park), more noise sources are present and more noise impact (from all sources, including aircraft) are accepted than in Wilderness and Non-Wilderness Zones, based on each Management Zone's objectives

- **Cumulative Effect** As described in CEQ's regulation 1508.7 as follows
  - Cumulative impacts are impacts that result from incremental impacts of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions
  - Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time

  Each cumulative impact analysis is additive, considering the overall impact of each Alternative when combined with effects of other past, present, and reasonably foreseeable future actions—in and outside the Area of Potential Effect. Thus, it was

necessary to identify other ongoing or reasonably foreseeable future projects at GCNP and, if applicable, the surrounding region. Because the scope of this project is relatively large, the geographic and temporal scope of the cumulative analysis is similarly large. The geographic scope for this analysis includes actions in and adjacent to park boundaries, while the temporal scope includes projects in a range of generally ten years (except Ethnographic Resources which considers a longer period). Given this, projects were identified for conducting cumulative effects analysis, and are listed in Appendix G

Cumulative effects analysis includes noise from aircraft flying 18,000 feet and above, aircraft flying below 18,000 feet but outside the SFRA, non-aircraft noise sources, and impacts of Alternatives

The park area affected by non-aircraft noise sources is localized to areas of human use, primarily Developed Zone areas (2% of the park), and a small component from vehicles on remote roads, motorboats on the Colorado River, and area mining activities. Aircraft flights above and outside the SFRA are the primary cumulative noise source impacting most of the SFRA

SOUND METRICS AND NOISE MODELING FOR ALL ALTERNATIVES

Noise was characterized based on the following metrics.

The FAA's Integrated Noise Model (INM) was used to predict effects of Alternatives regarding Soundscape and noise impacts. For additional information on metrics and modeling see Appendix D.

- **Percent Time Audible** (%TA)

Also known as Audibility. Percent of time during the 12-hour day used in this analysis (7 a.m. to 7 p.m.) that aircraft sounds can be heard by humans and other animals with normal hearing. Percent Time Audible refers to potential for a human or animal to detect presence of sound, and provides information primarily related to duration of aircraft noise impacts

The extent to which aircraft sounds are actually heard on the ground depends on amplitude (sound pressure level) and sound structure (its frequency content and temporal pattern); hearing ability and attention of the animal or human; and other simultaneous sounds (ambient conditions). Since aircraft sound can be heard at or below ambient conditions, the Percent Time Audible metric is even sensitive to distant noise. However, because Percent Time Audible says nothing about how loud the aircraft is, Percent Time Audible is used in conjunction with Average Sound Level (L_{Aeq12}) and Percent Time Above (%TALA) metrics (both described below) to provide additional insight into the nature of the noise and its potential impacts.

Percent Time Audible was also used to assess restoration of natural quiet to GCNP's Soundscape. Substantial Restoration of Natural Quiet is defined by the NPS to mean 50% or more of the park will achieve natural quiet (no aircraft audible) 75 to 100% of the day, each and every day. All Alternatives must meet Public Law 100-91 provisions to substantially restore natural quiet in the park. However, Substantial Restoration of Natural Quiet is a determination rather than a metric value that lends itself to an impact intensity level definition, and is applicable only to GCNP, not other lands in the SFRA or study area. The amount of Substantial Restoration of Natural Quiet achieved by an Alternative is not reported in terms of negligible, minor, moderate, or major impact intensity level. In addition Percent Time Audible was only calculated within the GCNP boundary

- **Average Sound**

Also known as Equivalent Sound Level. The logarithmic average, on an energy basis, of aircraft sound pressure levels in decibels (dBA) over the 12-hour day used in this

Level (L_{Aeq12}) analysis. Average Sound Level takes into account number of aircraft operations, their time-varying sound levels, and their duration. It provides information primarily related to energy intensity of aircraft noise impacts (in lay terms, loudness). However, occasional loud sound levels may heavily influence (increase) Average Sound Level. Long periods without aircraft sounds may also influence (decrease) Average Sound Level values. The values must be used cautiously. The Average Sound Level metric does not take ambient sound levels into account and only provides a measure of sound levels emitted by aircraft operations by themselves. Average Sound Level is used in conjunction with Percent Time Audible and Percent Time Above to gain fuller insight into the nature of the noise and its potential impacts

- **Distance** in Meters — Distance (**also known as Slant Distance**) relates primarily to **proximity** of aircraft to a location or point of interest on the ground, such as a visitor attraction site or wildlife habitat, not to the relationship of distance and sound levels. Distance impacts include visual aspects such as how big or how close an aircraft appears to visitors or wildlife on the ground, with related issues of disturbance, seclusion, solitude, and privacy

  Distance measures also provide important information about opportunities for air-tour visitors to view specific ground features. (Ground points of interest, known as Location Points, are shown on Map 3.2). **Distances shown in analysis are for Peak Season only**. For routes that change during Off-Peak Season, Distances for routes not in use during Off-Peak Season would be greater than 2,000 meters

- **Percent Time Above** — 35, 45, and 55 dBA (%TALA35, %TALA45, and %TALA55, respectively) Percentage of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively. The 10 dBA increments generally represent a ten-fold increase in number of aircraft (assuming roughly the same amount of noise for each aircraft), and a perceived doubling in loudness. Percent Time Above metrics are used in conjunction with Average Sound Level and Percent Time Audible to gain fuller insight into the nature of the noise and its potential impacts

Two types of noise-modeling analyses were performed for this EIS, 1) Contour Analysis (Percent Time Audible and Average Sound Level), and 2) representative Location Point Analysis (for all metrics).

- **Contour Analysis** — Produced maps presenting SFRA flight tracks and key features, with data values in colored contours for the entire park and and/or SFRA as shown in each map's legend; data tables summarize contour data by Management Zone (Developed, Non-Wilderness, and Wilderness). Contour Analysis was not performed for Marble Canyon, East End, Central, and West End and SFRA (see Appendix D for further information on INM modeling)

- **Location Point Analysis** — NPS identified 127 individual points (shown on Map 3.2 and Table 3.2) to represent noise-sensitive areas for park resources or visitor experiences, or as part of a ten-kilometer grid to ensure sufficient locations throughout the park were included in 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. Because ambient data outside GCNP is limited, and calculations of Percent Time Audible require ambient values as inputs, Percent Time Audible is only calculated for the area inside GCNP. Calculations of Average Sound Level require noise source data as inputs (mostly aircraft in this EIS), so Average Sound Level is calculated for the entire SFRA.

- **Dual-Zone System** Noise modeling for this EIS uses a Dual-Zone System (Audibility and Noticeability),[35] for Percent Time Audible calculations, which generally addresses different objectives for different Management Zones. Specifically, for Noticeability Zone (approximately 66% of the park), natural ambient sound levels were used directly in computing Percent Time Audible 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 Federal Register Notice described in the footnote, when NPS and FAA agreed to use the Dual-Zone System for modeling at GCNP, most of the Developed Zone (including South and North Rim developed areas), GCNP's West End, and Marble Canyon are within the Noticeability Zone

  The Dual-Zone System was used in calculations to assess whether natural quiet has been substantially restored to GCNP. When interpreting modeling results, NPS takes into account that the overall definition of Substantial Restoration of Natural Quiet is based on audibility and natural ambient sound levels (natural Soundscape), not noticeability

Development of Impact Intensity Thresholds

To identify possible consequences of noise exposure, NPS reviewed noise standards accepted by the American National Standards Institute (ANSI) and the Environmental Protection Agency (EPA), the entire body of relevant peer-reviewed scientific literature, park management objectives and mandates (GMP, NPS Management Policies, etc.), natural ambient and other sound data measured at Grand Canyon, and public scoping comments. NPS also consulted applicable agencies, scientists, subject-matter and resource experts, and affiliated tribes.

Consistent with CEQ regulations (40 CFR 1502.22), and NPS Director's Order 12, Conservation Planning, Environmental Impact Analysis and Decision Making (Sections 4.4 and 4.5), and considering the review described above, the NPS determined that

- The current state of scientific knowledge is incomplete or unavailable for some effects of aircraft noise on Impact Topics evaluated in this EIS. For example numerous studies document responses of visitors and wildlife to loud noise events. However chronic exposure to less obvious (less loud) noise sources is less understood. Also evidence of behavioral responses to noise is insufficient to be decisively interpreted or dismissed
- Impact analysis methodology is essential in evaluating reasonably foreseeable significant adverse impacts on the human environment
- Simple comparisons of noise metric values do not provide enough information to understand differences in impacts among Alternatives sufficient to make reasoned decisions based on best available science

After considering the above bulleted items, and incorporating theoretical approaches and research methods generally accepted in the scientific community, NPS used professional judgment regarding consequences requiring management action to develop impact intensity threshold descriptions and select specific values for the quantitative framework shown in Table 4.1. For all Impact Topics except Socioeconomics (to which noise modeling does not apply), NPS applied noise modeling and other data to threshold descriptions to make determinations on Alternative A (No Action/Current Conditions) impact levels, then used a similar approach to evaluate changes in impacts for Action Alternatives compared to Alternative A.

The quantitative framework in Table 4.1 is only one part of the impact intensity determination process. While this framework is integrated into impact intensity threshold descriptions as applicable for individual Impact Topics, it is 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

[35] 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, 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

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 a12-hour Day[bc]	Less than or equal to 5%	Greater than 5% and less than or equal to 10%	Greater than 10% and less than or equal to 25%	Greater than 25%
Average Sound Level (L_{Aeq12}) Energy Average of Aircraft Sound Levels during a 12-hour Day[d]	Less than or equal to 15 dBA	Greater than 15 dBA and less than or equal to 25 dBA	Greater than 25 dBA and less than or equal to 35 dBA	Greater than 35 dBA
Distance between Points of Interest on the Ground and Aircraft Routes	Greater than or equal to 2,000 meters	Less than 2,000 meters and greater than or equal to 1,000 meters	Less than 1,000 meters and greater than or equal to 500 meters	Less than 500 meters

[a]See text above for definitions of these metrics
[b]Percent Time Audible and Average Sound Level consider a 12-hour time period (7 a.m. to 7 p.m.)
[c]The 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 or equal to 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
[d]Specific 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), and a perceived doubling of loudness

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

Indirect and Direct Effects *and* **Beneficial And/or Adverse Impacts** *and* **Mitigation Measures to Reduce Impact**

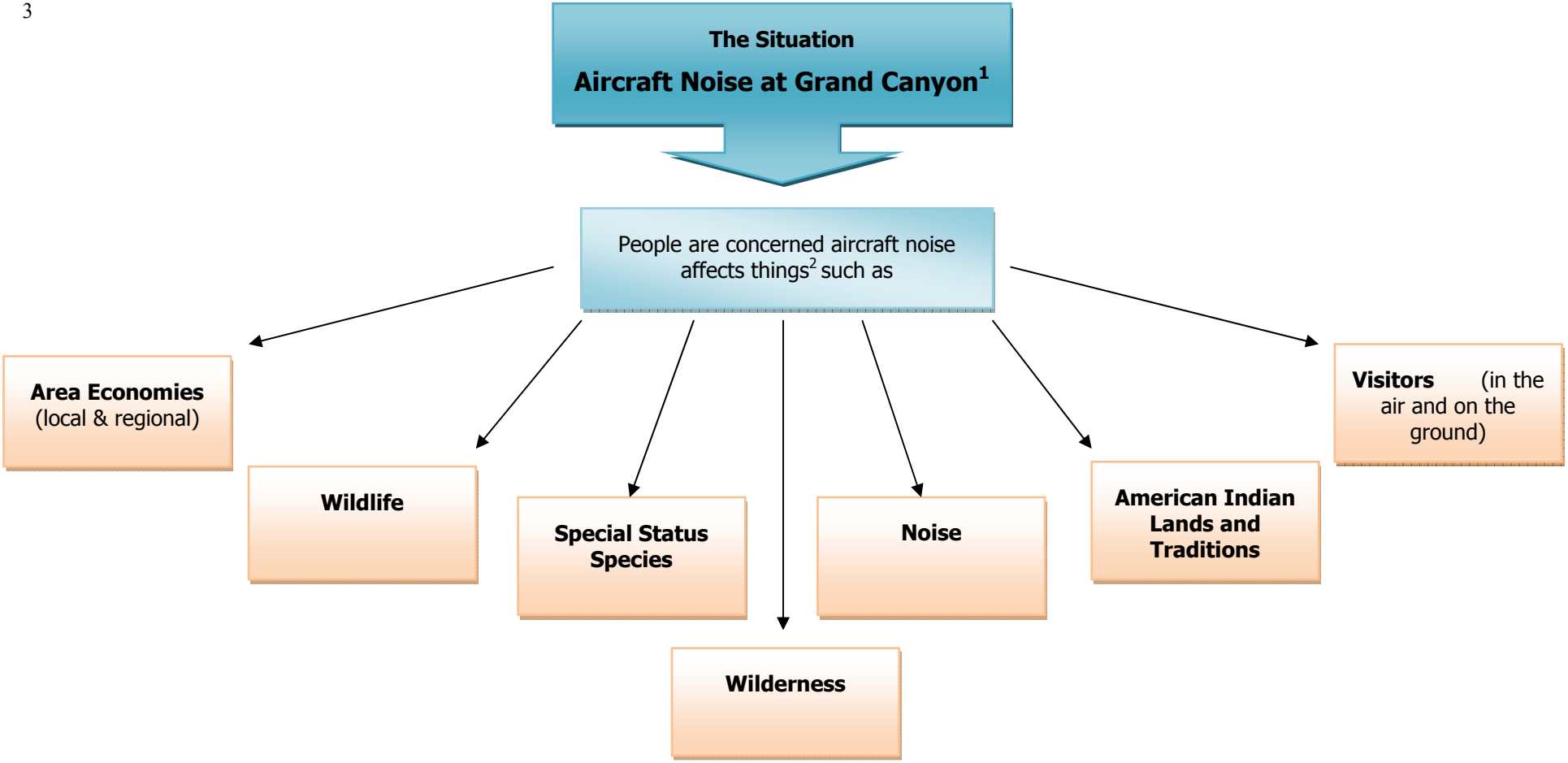
AND

Intensity	*and*	Context	*and*	Duration	*and*	Timing	*leads to*	Impact of Alternative
Negligible Minor Moderate Major		**Local or Regional and/or NPS Mgmt. Zone (as applicable)**		**Short term or Long term**		**Sensitive Times and/or Frequency of Impact**		

AND

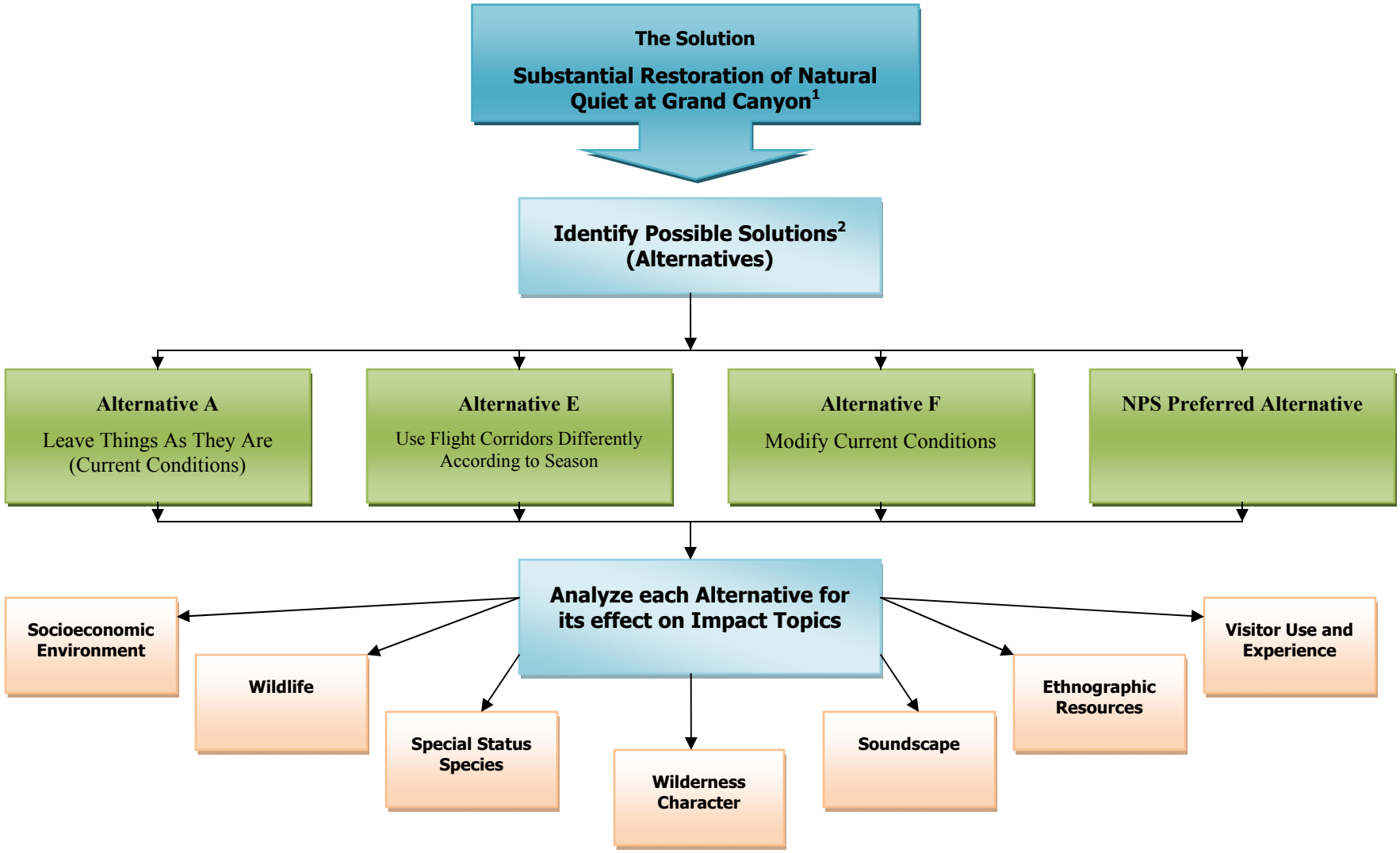
Cumulative Effects *leads to* **Impact Determination**

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



[1]As directed by law and policy; see Chapter 1 and Appendix A
[2]Alternatives 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

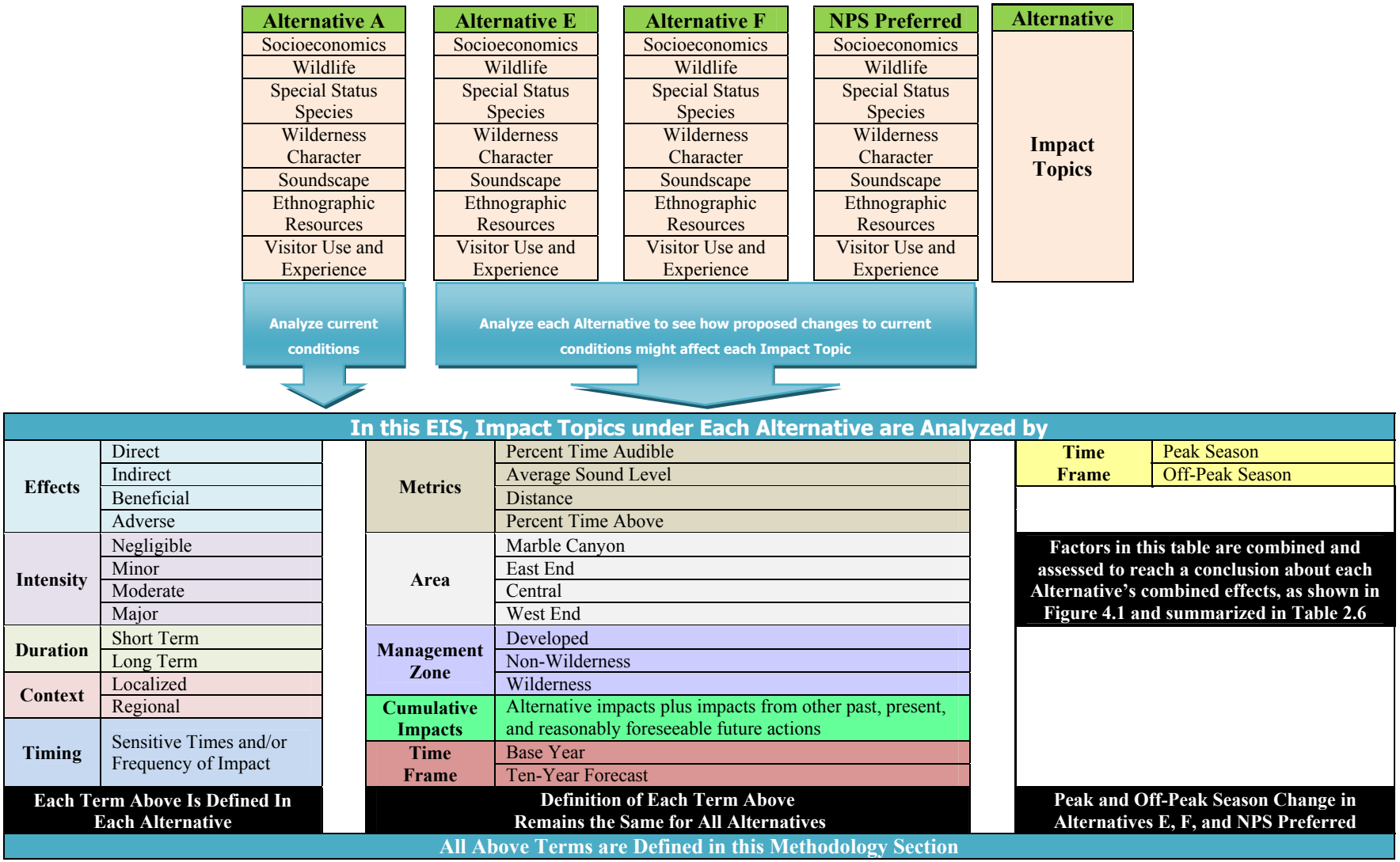
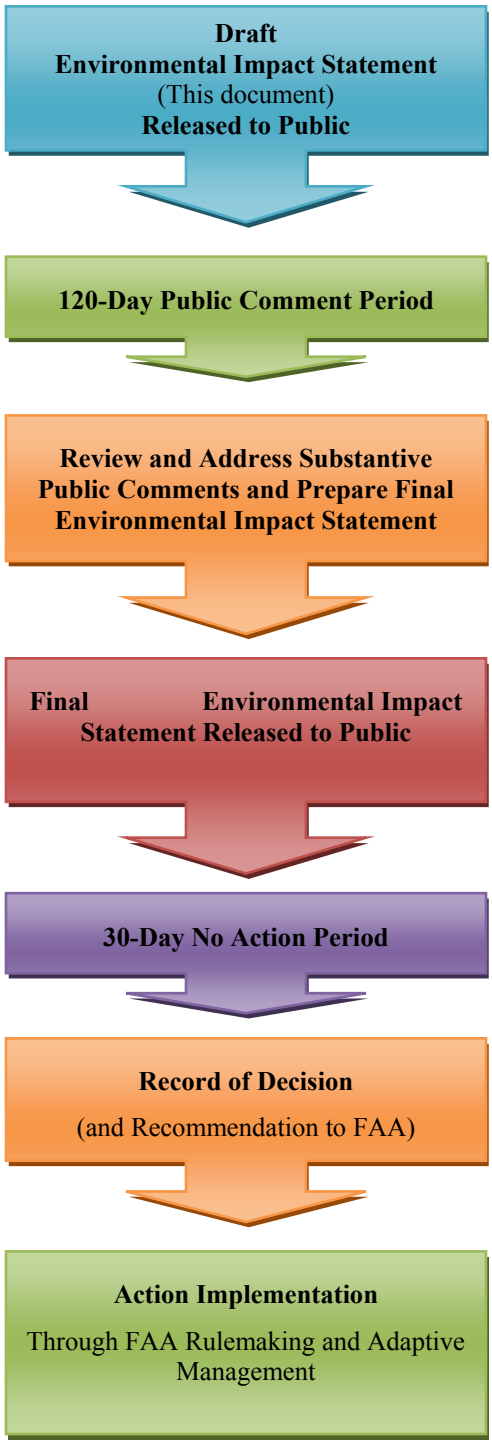


FIGURE 4.5 THE EIS PROCESS STEP FOUR



SOUNDSCAPE

General Methodology Soundscape

Methods and impact thresholds used for Soundscapes 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. 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*.

Because Soundscapes are recognized as a resource throughout the national park system, for the purpose of this EIS these 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. The conclusion for this section addresses overall impact to all NPS units in the SFRA in addition to Grand Canyon National Park.

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

Negligible Aircraft noise rarely audible, aircraft audible less than or equal to 5% of the 12-hour day used in this analysis. Natural sounds predominate

Average aircraft noise intensity in a specific area less than or equal to 15 dBA

Minor Aircraft noise audible for a small portion of applicable time periods, aircraft audible greater than 5% and less than or equal to 10% of the 12-hour day

Average aircraft noise intensity in a specific area greater than 15 dBA and less than or equal to 25 dBA

Moderate Aircraft noise audible for an intermediate portion of applicable time periods, aircraft audible greater than 10% and less than or equal to 25% of the 12-hour day

Average aircraft noise intensity in a specific area greater than 25 dBA and less than or equal to 35 dBA

Major Aircraft noise audible for a large portion of applicable time periods, aircraft audible greater than 25% of the 12-hour day

Average aircraft noise intensity in a specific area greater than 35 dBA

Type of Impact Soundscape

Adverse Impacts detract from achieving substantial restoration of natural quiet, increase aircraft noise intensity, and/or duration of aircraft noise events

Beneficial Impacts contribute toward achieving substantial restoration of natural quiet, decrease aircraft noise intensity, and/or duration of aircraft noise events

Context **Soundscape**

Regional Impacts affect majority of the park or SFRA, or multiple backcountry use areas, attraction sites, trails, or flight routes

Localized Impacts affect a small area, such as a single backcountry use area, a specific attraction site, a specific trail, or flight route

Park Management Zone Non-natural sound has greatest intensity of impact in NPS areas in the Wilderness Zone, then Non-Wilderness Zone, and least in the Developed Zone. For example, an 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 while the same level in the Non-Wilderness Zone may be considered minor-to-moderate, depending on other factors including duration and timing

Duration **Soundscape**

Short Term Impacts associated with individual, infrequent, and/or non-repetitive actions impact Soundscape only during and shortly after specified actions

Long Term Impacts persist well beyond completion of individual actions, generally impacting Soundscape longer than the day action occurs. Related actions frequent or repetitive over more than a few days would also be considered long-term impacts

Timing Frequency of occurrence and time of day can be important considerations in assessing Soundscape impacts. Seasonality and sensitive time periods are described in impact topics where most relevant (Visitor Use and Experience, Wildlife), and not in Soundscape analysis

Background Information **Soundscape**

In national park units, Soundscape is the aggregate of all sounds in an area; it is the park's total acoustic environment. In a national park setting, Soundscape can be composed of both natural ambient sound and a variety of human-made sounds. Natural Soundscapes are composed completely of natural sounds without the presence of human-made sounds (NPS 2006b). The NPS recognizes the natural Soundscape of each national park unit as an inherent resource, and manages this resource to "restore degraded Soundscapes to the natural conditions wherever possible, and protect natural Soundscapes from degradation due to noise" (NPS 2006b).

This section describes potential noise impacts of the Alternatives using various noise metrics to determine the extent to which each Alternative would 1) achieve and improve substantial restoration of natural quiet, and 2) result in impacts to Soundscape in NPS units in the study area.

The NPS considers a park's natural Soundscape to be a resource just like other natural and cultural resources found in a park. Soundscapes have their own inherent value that is susceptible to impacts from air-tours. Soundscapes can also serve as a guide to evaluating impacts to other park resources such as wildlife, cultural resources, and visitor experience. Noise modeling results for each Alternative were used to determine level of impact aircraft overflights might have on Soundscapes of NPS lands in the SFRA.

FIGURE 4.6 ALTERNATIVE A PERCENT TIME AUDIBLE BASE YEAR

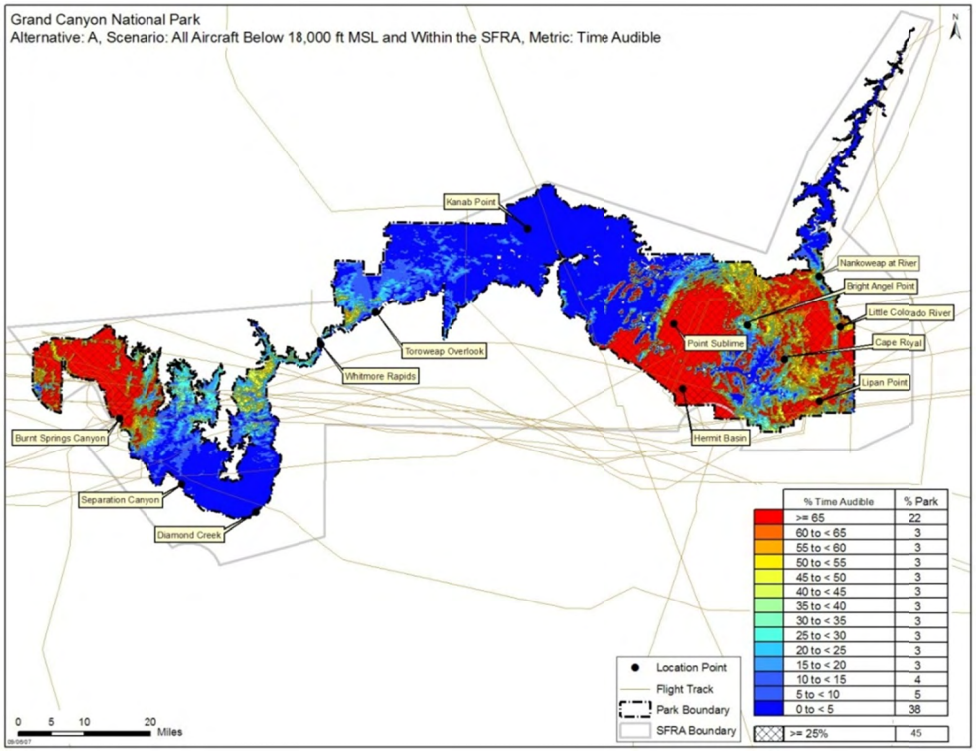


FIGURE 4.7 ALTERNATIVE A PERCENT TIME AUDIBLE TEN-YEAR FORECAST

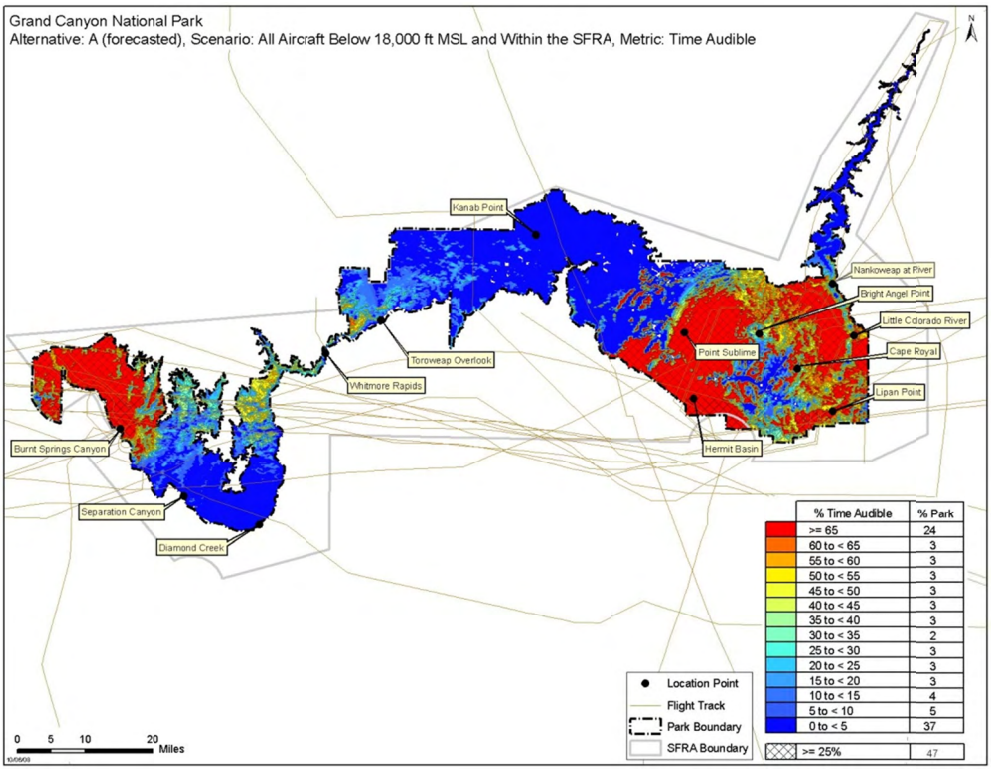


FIGURE 4.8 ALTERNATIVE A AVERAGE SOUND LEVEL BASE YEAR

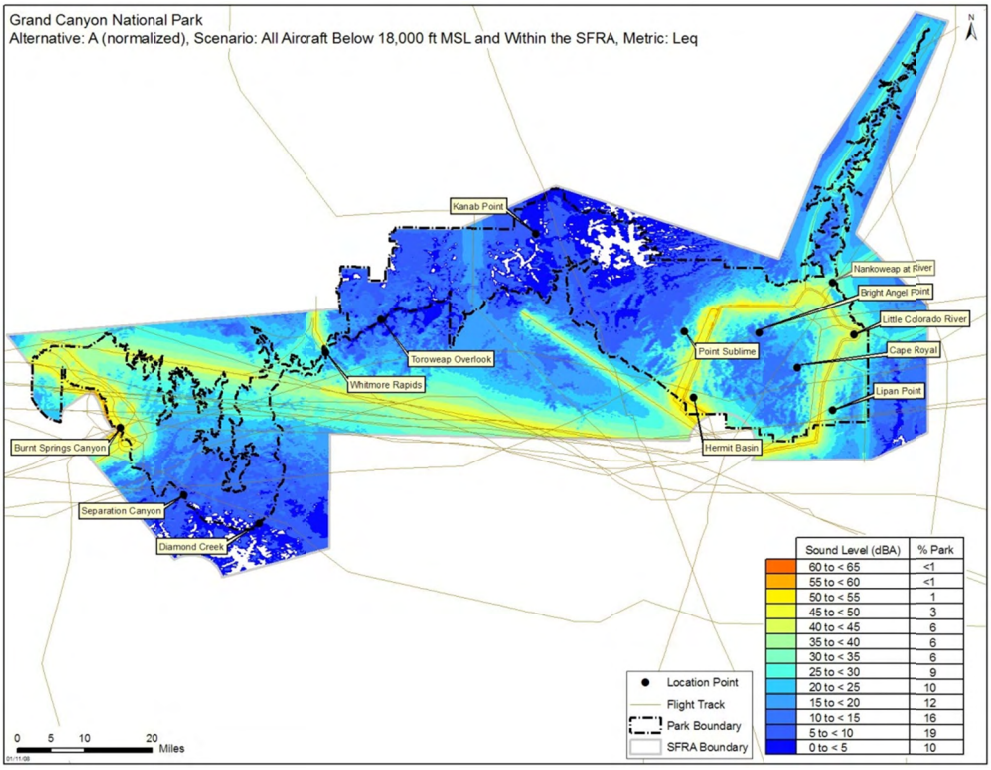


FIGURE 4.9 ALTERNATIVE A AVERAGE SOUND LEVEL TEN-YEAR FORECAST

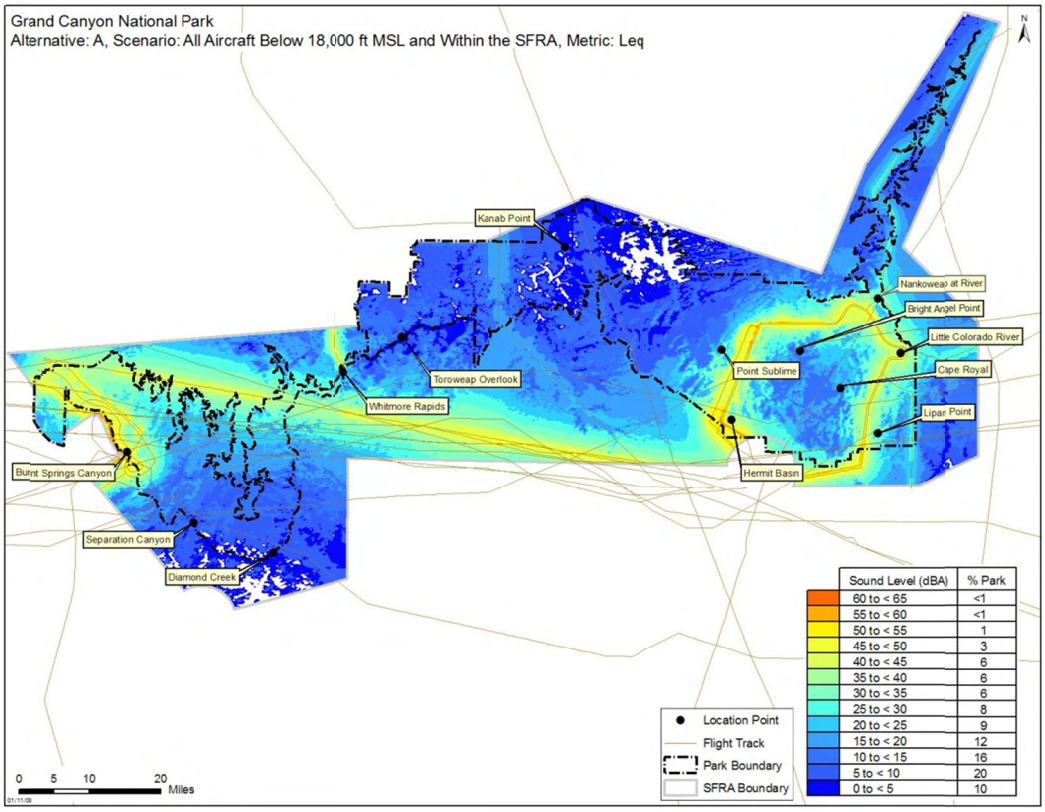


TABLE 4.2 ALTERNATIVE A PERCENT TIME AUDIBLE CONTOUR ANALYSIS RESULTS [abc]

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
Percent Park Restored				**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%

[a]Due to rounding differences, totals shown in this table may differ from Appendix D by up to 2%
[b]Because 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
[c]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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%	2%	10%	38%	37%	41%
> 0 to < 15	3%	14%	48%	46%	40%	0%	1%	13%	13%	24%

[a]Due to rounding differences, totals shown in this table may differ from Appendix D by up to 2%
[b]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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. NOTE: Blank areas in contour maps indicate where aircraft noise was not audible or below 0 dBA.

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 the East End. Audibility calculations for the Developed Zone added 10 dBA to natural ambient sound levels due to the Dual-Zone System explained further 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 seasonal route changes in this Alternative**.

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%

[a]Because 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

[b]Max 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

[c]TAUD = Percent Time Audible

[d]L_{Aeq12} = Average Sound Level

[e]TALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively

Developed Zone *Alternative A* *Soundscape*
Base Year

Average Sound Level would generally be greater than 25 dBA in 65% of the Developed Zone (25 to 35 dBA in 55% of the Developed Zone, and greater than 35 dBA in 10%). Percent Time Audible would generally be greater than 25% of the day in 88% of the Developed Zone, and 10 to 25% Percent Time Audible in 6% of the Developed Zone. Thus the majority of the Developed Zone would experience moderate to major adverse impacts due to amount of air-tour activity in both Zuni Point and Dragon Corridors. Although major adverse impacts would occur, effects would be a mix of short and long term given amount of visitor activity and presence of non-natural sound sources.

Developed Zone *Alternative A* *Soundscape*
Ten-Year Forecast

Because Alternative A includes growth in operations, but does not include quiet-technology incentives or conversion requirements, adverse impacts would increase to 98% of the Developed Zone experiencing Average Sound Level greater than 25 dBA, and 95% of the Developed Zone with air-tour aircraft Percent Time Audible greater than 10% of the day (areas with moderate to major adverse impacts). This would represent a minor to moderate adverse change in impacts due to forecasted increase in air-tour operations from Base Year to Ten-Year Forecast.

Non-Wilderness Zone (4% of GCNP) Alternative A Soundscape

Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone area where 10 dBA is added to natural ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The majority of the Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis for audibility calculations in this EIS, consistent with Non-Wilderness Zone management objectives that call for mostly natural conditions to prevail in the Zone.

Non-Wilderness Zone Alternative A Soundscape
Base Year

Average Sound Level would generally be greater than 25 dBA in 58% of the Non-Wilderness Zone (25 to 35 dBA in 37%, and greater than 35 dBA in 21%). Percent Time Audible would generally be greater than 25% of the day in 79% of the Non-Wilderness Zone, and 10 to 25% Percent Time Audible in 8% of the Non-Wilderness Zone (areas with moderate to major adverse impacts). Thus the majority of the Non-Wilderness Zone would experience moderate to major adverse impacts due to amount of air-tour activity in Zuni Point and Dragon Corridors. Although long-term major adverse impacts would occur, some effects would be short term given amount of visitor activity and presence of non-natural sound sources in some of the Zone.

Non-Wilderness Zone Alternative A Soundscape
Ten-Year Forecast

Because Alternative A includes growth in operations but does not include quiet-technology incentives or conversion requirements, adverse impacts would increase to 90% of the Non-Wilderness Zone with Average Sound Level greater than 25 dBA, and 87% of the Non-Wilderness Zone with air-tour aircraft Percent Time Audible greater than 10% of the day (areas with moderate to major adverse impacts). This would represent a minor to moderate adverse change in impact due to forecasted increase in air-tour operations from Base Year to Ten-Year Forecast.

Wilderness Zone (about 94% of GCNP) Alternative A Soundscape

In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the Wilderness Zone's increased size and geographic extent compared to the others. Most of the Wilderness Zone is in the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

Wilderness Zone Alternative A Soundscape
Base Year

Average Sound Level would generally be greater than 25 dBA in 27% of the Wilderness Zone (25 to 35 dBA in 12%, and greater than 35 dBA in 15%). Percent Time Audible would generally be greater than 25% of the day in 43% of the Wilderness Zone, and 10 to 25% Percent Time Audible in 8% of the Wilderness Zone (areas with moderate to major adverse impacts). Thus, percentage of the Wilderness Zone experiencing moderate to major adverse impacts would be almost half, and impacts would mostly be concentrated in East and West Ends as shown in Figures 4.6 to 4.9. In the Wilderness Zone, major adverse impacts would mostly be long-term with reduced visitor use and absence of non-natural sound sources in the Zone.

Wilderness Zone Alternative A Soundscape
Ten-Year Forecast

Because Alternative A includes growth in operations, but does not include quiet-technology incentives or conversion requirements, adverse impacts would increase to 48% of the Zone with Average Sound Level greater than 25 dBA, and 55% of the Wilderness Zone with air-tour aircraft Percent Time Audible greater than 10% of the day (areas with moderate to major adverse impacts). This would represent a negligible to minor adverse change in impacts due to forecasted increase in air-tour operations from Base Year to Ten-Year Forecast.

Marble Canyon **Alternative A** **Soundscape**

Marble Canyon's west side is located in the Wilderness Zone; its east side is in the Non-Wilderness Zone. It is also entirely in the Dual-Zone noticeability area in which 10 dBA is added to natural ambient sound levels in calculating Percent Time Audible (see Chapter 4, Methodology).

Marble Canyon *Alternative A* *Soundscape*
Base Year

Localized long- and short-term impacts would generally be negligible to minor adverse (based on Figures 4.6 to 4.9, Average Sound Level would generally be less than 15 dBA and Percent Time Audible less than 5%). Location Points range zero to 3% Percent Time Audible, and Average Sound Level zero to 24 dBA.

Marble Canyon *Alternative A* *Soundscape*
Ten-Year Forecast

Localized long- and short-term impacts would generally be negligible to minor adverse (based on Figures 4.6 to 4.9, Average Sound Level would generally be less than 15 dBA and Percent Time Audible less than 5%). Results would increase negligibly (no increase in median Percent Time Audible and one to 2 dBA in median Average Sound Level) Base Year to Ten-Year Forecast.

East End **Alternative A** **Soundscape**

Under Alternative A, greatest exposure to noise and visual impacts would continue East End, which contains over half the Peak Day air-tour operations. East End includes all three Management Zones: Developed, Non-Wilderness, and Wilderness, and heavily-used air-tour routes in Zuni Point and Dragon Corridors for both short-loop tours and the long-loop tour between Zuni Point and Dragon Corridors over North Rim. Also, most of East End's land area is contained in Bright Angel Flight-free Zone.

East End *Alternative A* *Soundscape*
Base Year

Although the majority of East End 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,** and **Tower of Ra**) show Average Sound Level as high as 45 to 55 dBA, and Percent Time Audible 5 to 50% of the day. Air-tour aircraft in locations away from the river (represented by the **Little Colorado River** and **Nankoweap Mesa** Location Points) Percent Time Audible would be 34 to 87% of the day with Average Sound Level 43 dBA. Close to the river, as represented by the **Nankoweap River** Location Point, these effects would be less, with aircraft Average Sound Level of 34 dBA and Percent Time Audible approximately 7%. Areas beneath Zuni Point and Dragon Corridor routes and Black-1A/Green-1A over North Rim would experience nearly continuous noise at 52 to almost 100% Percent Time Audible, with Average Sound Level at 28 to 49 dBA. Amid Bright Angel Flight-free Zone, represented by **Grid Location Points 12 and 13**, air-tour operations would have negligible impact on natural Soundscape with Percent Time Audible of less than one percent, and aircraft Average Sound Level 12 to 13 dBA.

East End Location Points Percent Time Audible range zero to almost 100% with Average Sound Level 6 to 49 dBA. Average Sound Level for individual aircraft events would not exceed 35 dBA for most locations; however, at some locations, aircraft events would exceed 35 dBA 100% of the day, 45 dBA 51% of the day, and 55 dBA 5% of the day. Areas under and near East End air-tour routes would experience long-term major adverse impacts (Average Sound Level greater than 40 dBA with Percent Time Audible greater than 50%). Areas amid Bright Angel Flight-free Zone would experience negligible to minor adverse impacts.

East End *Alternative A* *Soundscape*
Ten-Year Forecast

East End areas would see negligible increases in impacts (3% increase in median Percent Time Audible and one dBA in median Average Sound Level) Base Year to Ten-Year Forecast.

Central Alternative A Soundscape

The Central area is in the Wilderness Zone, with exception of a few Non-Wilderness Zone dirt road corridors, and a very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System audibility area in which natural ambient sound levels are used directly in Percent Time Audible calculations. This area comprises most of the Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.

Central Alternative A Soundscape
Base Year

Central area Location Points range zero to 22% Percent Time Audible with Average Sound Level zero to 27 dBA. Average Sound Level for the loudest individual aircraft events would exceed 35 dBA 4% of the day. Localized long- and short-term impacts would be negligible to moderate adverse (based on Figures 4.6 to 4.9, Average Sound Level would generally be less than 10 dBA and Percent Time Audible less than 5%).

Central Alternative A Soundscape
Ten-Year Forecast

Central area Location Point results would increase negligibly (3% increase in median Percent Time Audible and no increase in median Average Sound Level) Base Year to Ten-Year Forecast.

West End Alternative A Soundscape

West End is 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 Percent Time Audible calculations. West End impacts depend on proximity to Blue Direct and Blue-2/Green-4.

West End Alternative A Soundscape
Base Year

Location Points range zero to 93% Percent Time Audible with Average Sound Level zero to 47 dBA. Average Sound Level for individual aircraft events would not exceed 35 dBA for most locations; however, at some locations, aircraft events would exceed 35 dBA 71% of the day, 45 dBA 29% of the day, and 55 dBA 4% of the day. Beneath West End 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**, there would be high Percent Time Audible of air-tour aircraft 70 to 93% of the day, and Average Sound Level would be high at 42 to 47 dBA. Under Brown routes (**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. Areas under Blue Direct North and South, including **Grid Location Points 28 and 32**, would have a Percent Time Audible 14% to 44% and Average Sound Level 17 to 27 dBA.

In the **northern West End** near air-tour routes, localized long- and short-term impacts would be major adverse (Figures 4.6 to 4.9), Average Sound Level would be greater than 40 dBA with Percent Time Audible greater than 65%). In the southern West End (mostly Sanup Flight-free Zone), localized long-term impacts would be negligible to minor adverse (Figures 4.6 to 4.9). Average Sound Level would be 10 to 20 dBA with Percent Time Audible less than 20%).

West End Alternative A Soundscape
Ten-Year Forecast

Because Alternative A includes growth in operations but does not include quiet-technology incentives or conversion requirements, **West End area** adverse impacts would increase a negligible amount (2% in median Percent Time Audible, and one dBA in Average Sound Level) from Base Year to Ten-Year Forecast.

NPS Units in the SFRA outside Grand Canyon National Park Alternative A Soundscape

For park lands directly under and within five miles of Blue Direct routes (Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument) and other busy GCNP air-tour corridors, adverse impacts would be

considered major adverse Base Year (Average Sound Level would range 40 to 50 dBA) with negligible increases Ten-Year Forecast.

Cumulative Impacts Alternative A Soundscape

Other than air-tour aircraft sounds, impacts on Soundscape result from sounds of high-altitude aircraft above 18,000 feet MSL and, to a lesser degree, aircraft below 18,000 feet MSL and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA contributes the most non-natural noise over most of the SFRA and overwhelms any localized cumulative benefits realized under the Alternatives.

At Location Points in Marble Canyon and nearby areas, noise from aircraft above and outside the SFRA Percent Time Audible is 16 to 36% of the day. At East End Location Points, except those close to the river, aircraft above and outside the SFRA are audible 27 to 71% of the day. At Central Location Points, noise from aircraft above and outside the SFRA is audible 16 to 65% of the day. At West End Location Points, noise from aircraft above and outside the SFRA is audible 12 to 51% of the day. Average Sound Level from aircraft above and outside the SFRA would generally be less than 30 dBA in all areas.

Cumulative noise from aircraft flying over 18,000 feet, as well as aircraft flying below 18,000 feet but outside the SFRA's lateral extents, would have minor to moderate localized short-term adverse impacts in the entire SFRA; however, long-term impacts would be major adverse (aircraft Percent Time Audible would generally be greater than 25%). There are no areas in GCNP where the natural Soundscape would not be adversely affected by aircraft noise at least some of the time. When effects of air-tour aircraft in Alternative A are added to these effects, overall, there would be a long-term moderate to major adverse cumulative impact in the study area.

Conclusion Alternative A Soundscape

Under Alternative A, a range of aircraft Average Sound Level and Percent Time Audible would affect GCNP Soundscapes. Alternative A would achieve Substantial Restoration of Natural Quiet in 55% of the park 75 to 100% of the day Base Year; which would decrease slightly to 53% of the park Ten-Year Forecast due to increases in air-tour operations (a negligible change in impacts).

Because Alternative A includes growth in operations, but no quiet-technology conversion requirements, noise impacts would increase Base Year to Ten-Year Forecast in all Zones and areas. However, increases in impacts would generally be negligible. Near busy air-tour corridors, such as those in East End, changes might not be discernable as some affected areas already experience close to 100% audibility. However, for areas where Percent Time Audible is less than, but close to 25%, future increases might jeopardize achievement of substantial restoration of natural quiet.

Conclusion by Zone Alternative A Soundscape
Ten-Year Forecast
Wilderness Zone (94% of GCNP); area of moderate to major adverse impacts would be 48 to 55% of the Zone.

Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impacts would be 87 to 90% of the Zone.

Developed Zone (about 2% of GCNP); area of moderate to major adverse impacts would be 95 to 98% of the Zone.

Conclusion by Area Alternative A Soundscape
In Marble Canyon, Central areas, and West End's southern portion, localized long- and short-term impacts would generally be negligible to minor adverse (Average Sound Level would often be less than 15 dBA and Percent Time Audible less than 5%). Greatest exposure to noise impacts would occur under and near East and West End heavily-used air-tour routes where long- and short-term major adverse impacts would occur Base Year and Ten-Year

Forecast (aircraft Average Sound Level 40 to 50 dBA, and Percent Time Audible greater than 65%). Away from routes amid Flight-free Zones, impacts would be negligible to minor adverse.

Cumulative Impacts Alternative A Soundscape

Cumulative impacts from all actions would be long term moderate to major adverse due primarily to high aircraft Percent Time Audible levels.

ALTERNATIVE E ALTERNATING SEASONAL USE SOUNDSCAPE

Alternative E, Alternating Seasonal Use, would maximize park area in Flight-free Zones, and seasonally alternate use of Zuni Point and Dragon Corridor routes.

Base Year Peak Season, Alternative E would achieve Substantial Restoration of Natural Quiet in 75% of the park 75 to 100% of the day. This represents moderate beneficial change in impacts with a 20% increase in park area restored as shown in Table 4.23 compared to Alternative A. Base Year Off-Peak Season Alternative E would achieve Substantial Restoration of Natural Quiet in 78% of the park as shown in Table 4.23. This represents moderate beneficial change in impacts with a 23% increase in park area restored compared to Alternative A.

Ten-Year Forecast Peak Season Substantial Restoration of Natural Quiet would be achieved in 84% of the park as shown in Table 4.24. This represents major beneficial change in impacts with a 31% increase in park area restored compared to Alternative A. Ten-Year Forecast Off-Peak Season Substantial Restoration of Natural Quiet would be achieved in 86% of the park as shown in Table 4.24. This represents major beneficial changes in impacts compared to Alternative A with a 33% increase in park area restored.

Mapped results of noise modeling for Alternative E for Percent Time Audible and Average Sound Level are shown in Figures 4.10 through 4.17. Table 4.5 through 4.10 present Contour Analysis and Location Point results computed for Alternative E Peak and Off-Peak Seasons, respectively, and includes comparisons with Alternative A, No Action/Current Condition.

FIGURE 4.10 ALTERNATIVE E PERCENT TIME AUDIBLE BASE YEAR PEAK SEASON

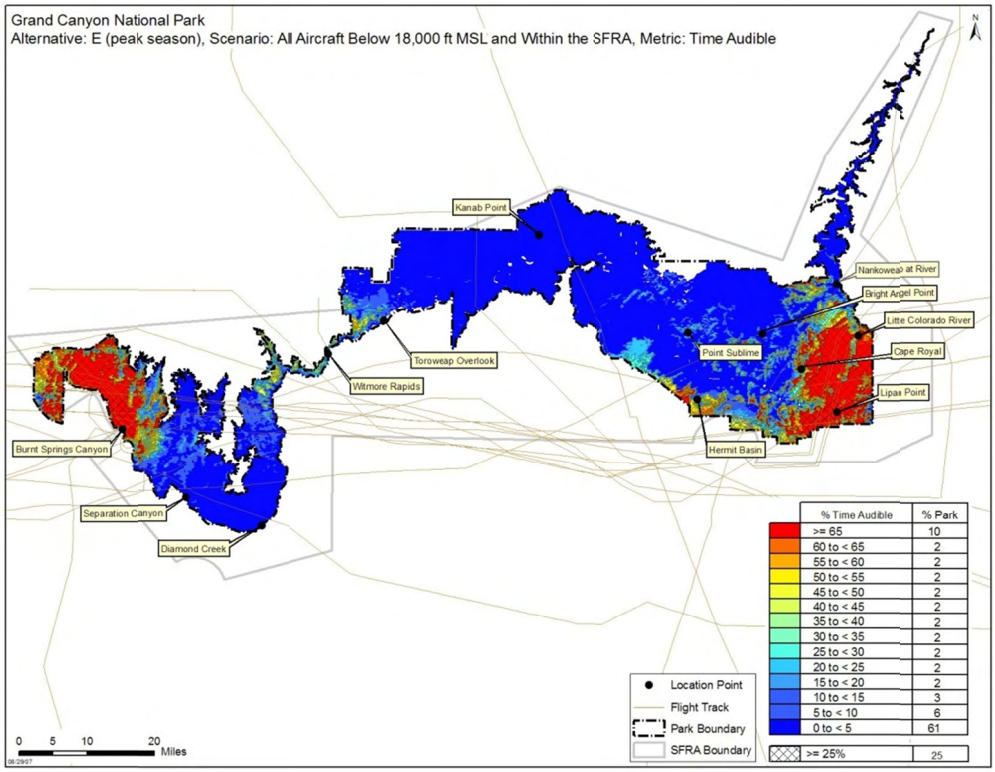


FIGURE 4.11 ALTERNATIVE E PERCENT TIME AUDIBLE TEN-YEAR FORECAST PEAK SEASON

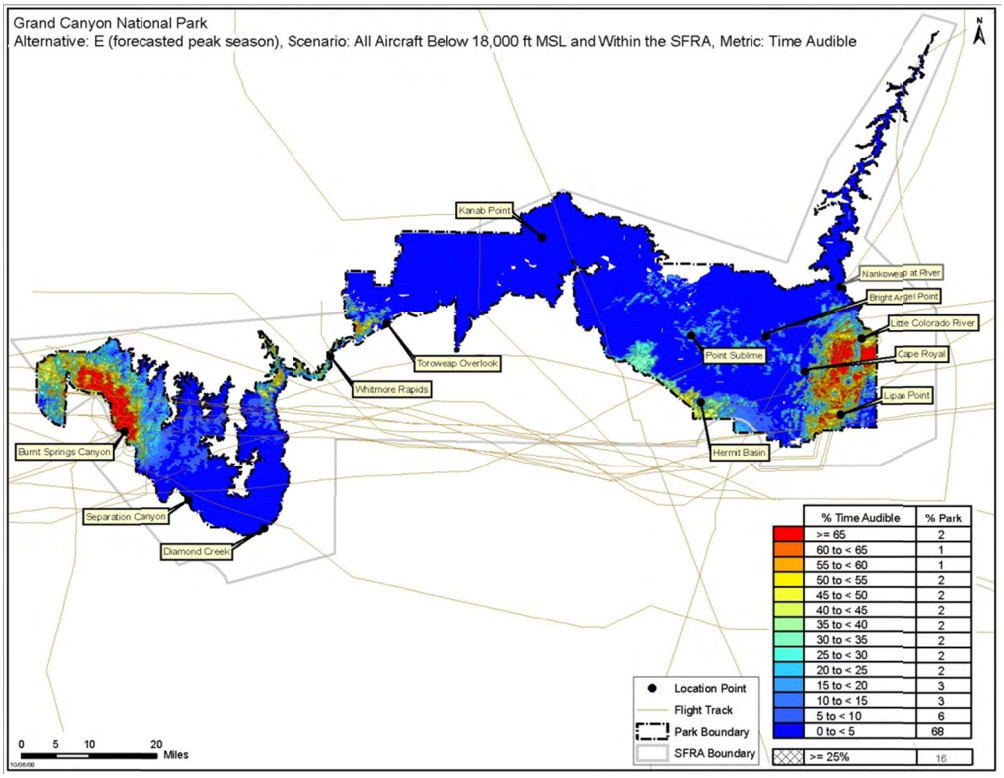


FIGURE 4.12 ALTERNATIVE E PERCENT TIME AUDIBLE BASE YEAR OFF-PEAK SEASON

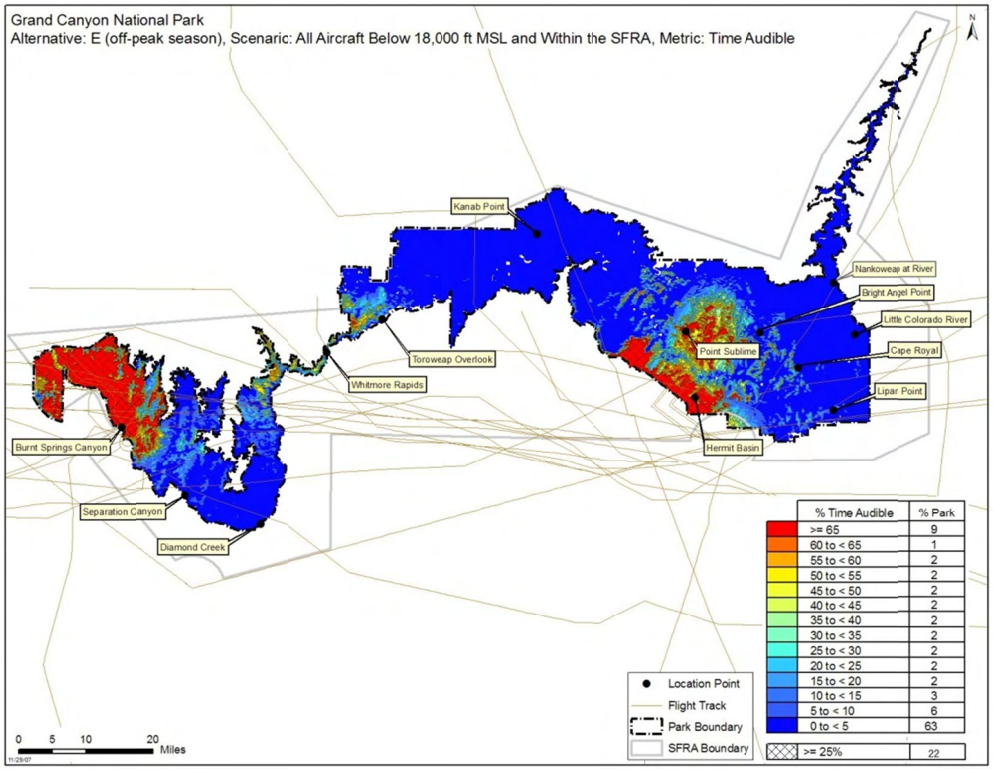


FIGURE 4.13 ALTERNATIVE E PERCENT TIME AUDIBLE TEN-YEAR FORECAST OFF-PEAK SEASON

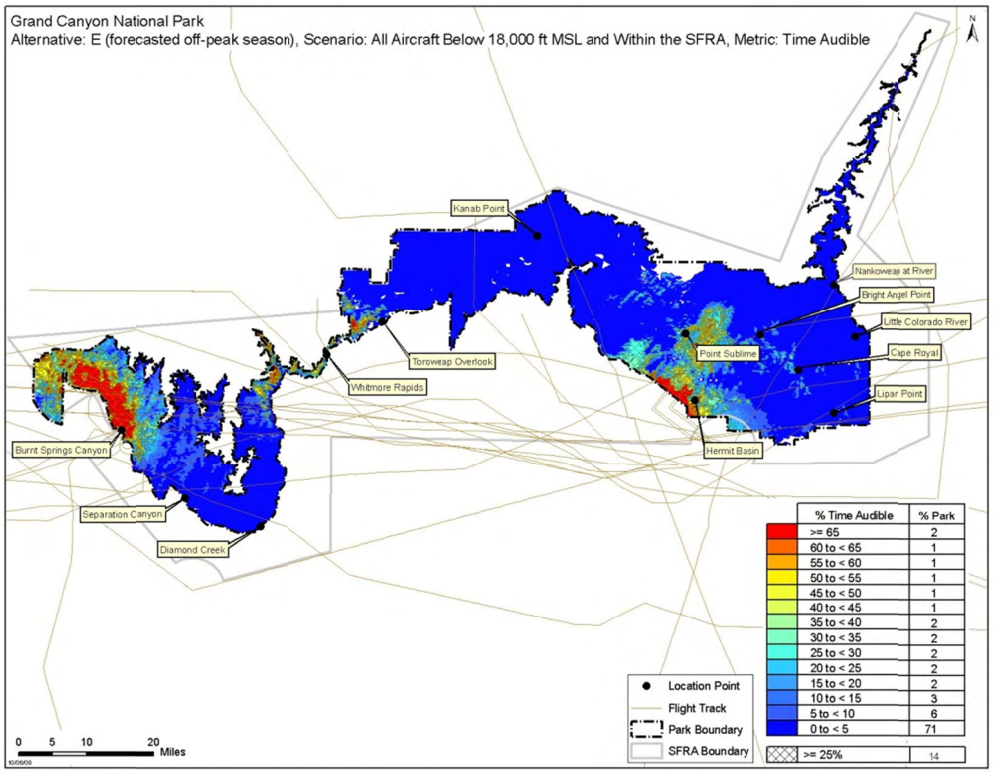


FIGURE 4.14 ALTERNATIVE E AVERAGE SOUND LEVEL BASE YEAR PEAK SEASON

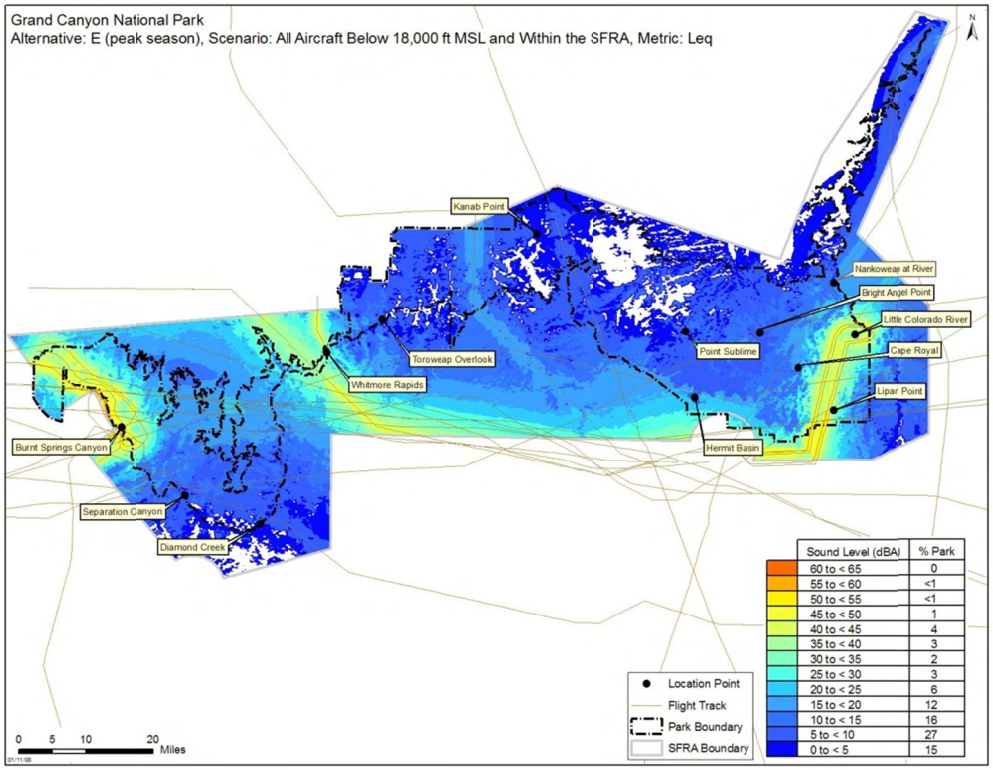


FIGURE 4.15 ALTERNATIVE E AVERAGE SOUND LEVEL TEN-YEAR FORECAST PEAK SEASON

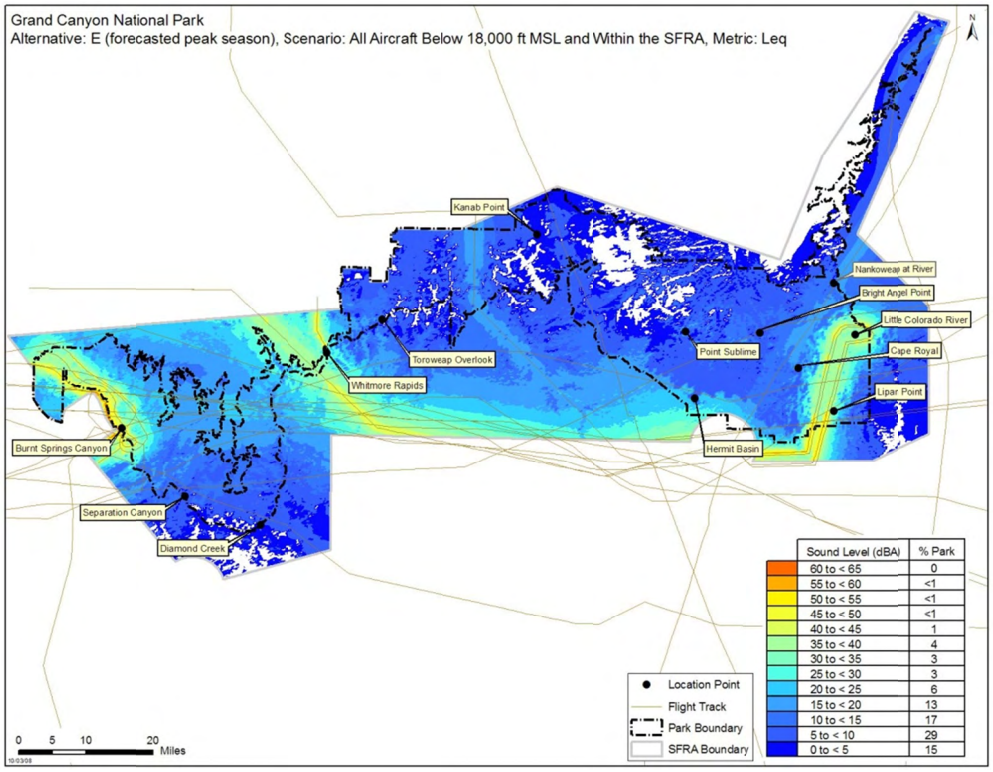


FIGURE 4.16 ALTERNATIVE E AVERAGE SOUND LEVEL BASE YEAR OFF-PEAK SEASON

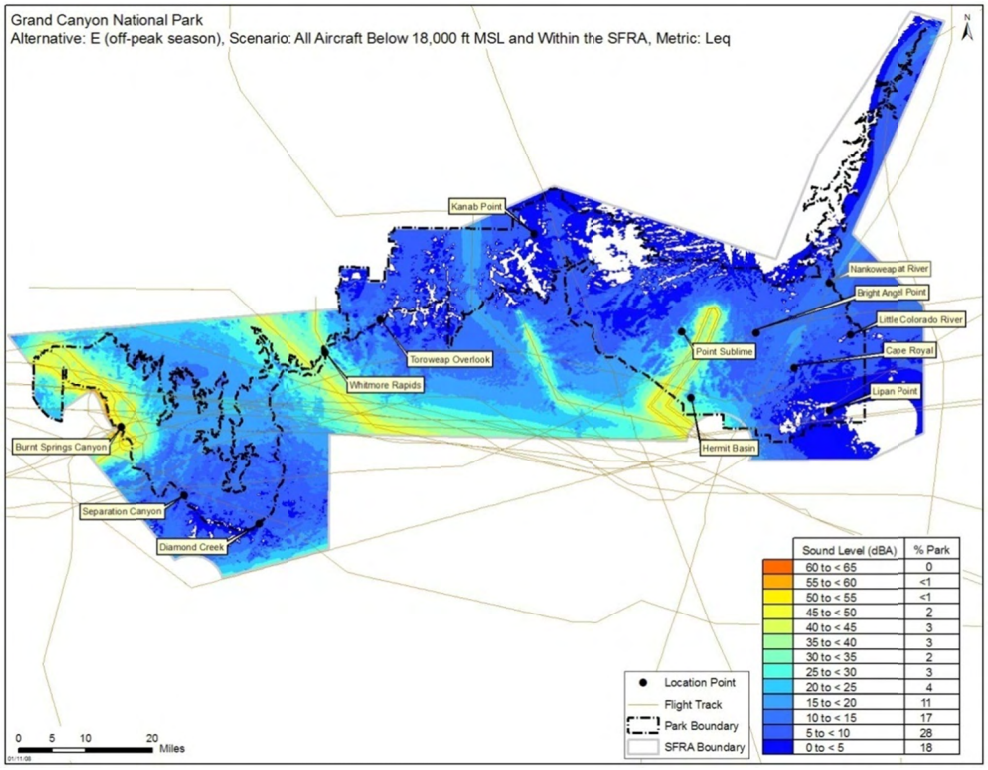


FIGURE 4.17 ALTERNATIVE E AVERAGE SOUND LEVEL TEN-YEAR FORECAST OFF-PEAK SEASON

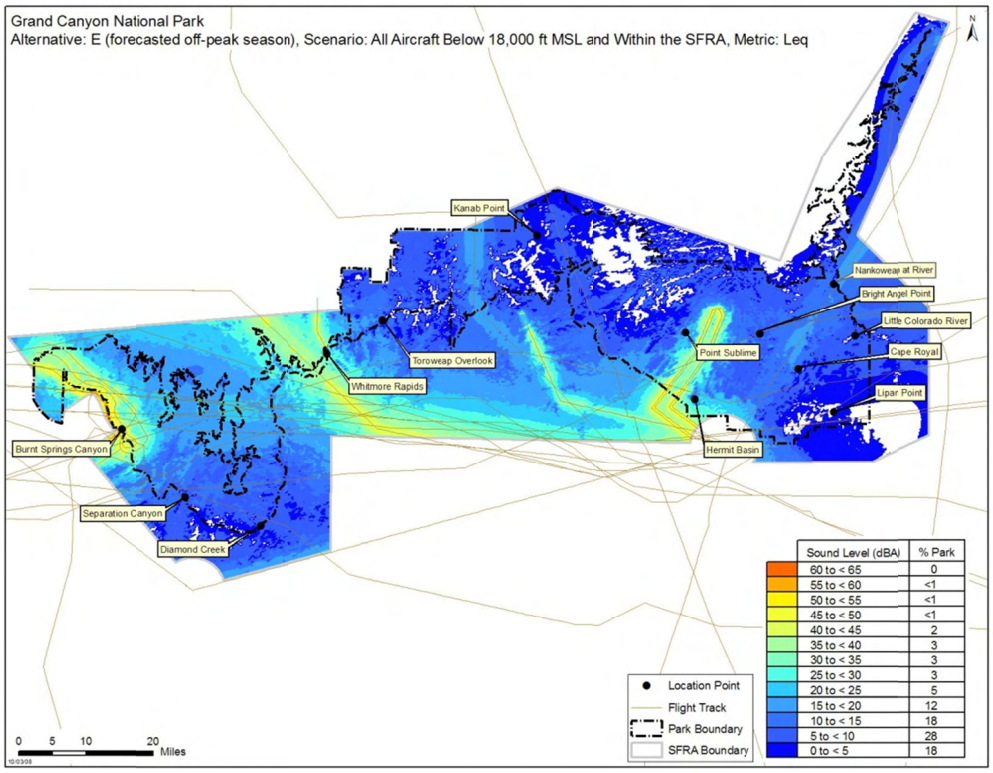


TABLE 4.5 ALTERNATIVE E PERCENT TIME AUDIBLE CONTOUR ANALYSIS RESULTS PEAK SEASON[abc]

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
Percent Park Restored				**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%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%

[b]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

[c]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

TABLE 4.6 ALTERNATIVE E AVERAGE SOUND LEVEL CONTOUR ANALYSIS RESULTS[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%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%

[b]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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%	5 dBA	0%	0%	0%	9%	8 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

[a]Max 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

[b]TAUD = Percent Time Audible

[c]L_{Aeq12} = Average Sound Level

[d]TALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively

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 Restored				**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%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%
[b]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
[c]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%
[b]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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	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	7%	3 dBA	66%	41%	2%	21%	6 dBA	71%	50%	3%
	Median	63%	20 dBA	5%	0%	0%	66%	19 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%	2 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%

[a]Max 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

[b]TAUD = Percent Time Audible

[c]L_{Aeq12} = Average Sound Level

[d]TALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively

Developed Zone (about 2% of GCNP) Alternative E Soundscape

With exception of a very small Developed Zone area at Tuweep, all GCNP Developed Zone areas are in East End. Developed Zone audibility calculations added 10 dBA 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 Alternative E Soundscape
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 19% of the Developed Zone; that is, Average Sound Level would be 25 to 35 dBA in 12% of the Zone (moderate adverse impact) and greater than 35 dBA in 7% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 69% of the Zone; that is Percent Time Audible of 10 to 25% in 17% of the Zone (moderate adverse impact) and greater than 25% in 52% of the Zone (major adverse impact). This would represent a reduction of 46% in area with Average Sound Level 25 dBA or more, and a reduction of 25% in area of 10% or more Percent Time Audible compared to Alternative A (a 25 to 46% reduction in areas of moderate to major adverse impact), resulting in a moderate to major beneficial change in impacts compared to Alternative A.

Developed Zone Alternative E Soundscape
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 6% of the Developed Zone; that is, Average Sound Level would be 25 to 35 dBA in 6% of the Zone (moderate adverse impact) and no areas greater than 35 dBA in the Zone (no areas of major adverse impact in terms of Average Sound Level). Percent Time Audible would generally be 10% or more of the day in 48% of the Zone; that is 10 to 25% Percent Time Audible in 17% of the Zone (moderate adverse impact) and Percent Time Audible greater than 25% in 31% of the Zone (major adverse impact). This would represent a reduction of 59% in area with Average Sound Level of 25 dBA or more, and a reduction of 46% in area of 10% or more Percent Time Audible compared to Alternative A (a 46 to 59% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Developed Zone Alternative E Soundscape
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 12% of the Developed Zone; that is, Average Sound Level would be 25 to 35 dBA in 7% of the Zone (moderate adverse impact), and greater than 35 dBA in 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 58% of the Zone; that is, 10 to 25% Percent Time Audible in 32% of the Zone (moderate adverse impact), and greater than 25% Percent Time Audible in 26% of the Zone (major adverse impact). This would represent a reduction of 86% in area with Average Sound Level of 25 dBA or more, and a reduction of 37% in area of 10% or more Percent Time Audible compared to Alternative A (a 37 to 86% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Developed Zone Alternative E Soundscape
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 5% of the Developed Zone; that is, Average Sound Level would be 25 to 35 dBA in 5% of the Zone (moderate adverse impact), and no areas in the Zone would be greater than 35 dBA (no areas of major adverse impact). Percent Time Audible would generally be 10% or more in 49% of the Zone; that is, 10 to 25% Percent Time Audible in 32% of the Zone (moderate adverse impact), and greater than 25% Percent Time Audible in 17% of the Zone (major adverse impact). This would represent a reduction of 94% in area with Average Sound Level of 25 dBA or more, and a reduction of 46% in area of 10% or more Percent Time Audible compared to Alternative A (a 10 to 94% reduction in areas of moderate to major adverse impact), resulting in a moderate to major beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone (6% of GCNP) Alternative E Soundscape

Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone System area where 10 dBA is added to natural ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The majority of the Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis for audibility calculations, consistent with Non-Wilderness Zone management objectives that call for mostly natural conditions to prevail in the Zone.

Non-Wilderness Zone Alternative E Soundscape
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 19% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 13% of the Zone (moderate adverse impact), and greater than 35 dBA in 6% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 65% of the Zone; that is, 10 to 25% Percent Time Audible in 13% of the Zone (moderate adverse impact), and greater than 25% Percent Time Audible in 52% of the Zone (major adverse impact). This would represent a reduction of 39% in area with Average Sound Level of 25 dBA or more, and a reduction of 47% in area of 10% or more Percent Time Audible compared to Alternative A (a 39 to 47% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone Alternative E Soundscape
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 12% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 11% of the Zone (moderate adverse impact), and greater than 35 dBA in one percent of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 39% of the Zone; that is, 10 to 25% Percent Time Audible in 13% of the Zone (moderate adverse impact), and greater than 25% Percent Time Audible in 26% of the Zone (major adverse impact). This would represent a reduction of 46% in area with Average Sound Level of 25 dBA or more, and a reduction of 48% in area of 10% or more Percent Time Audible compared to Alternative A (a 46 to 48% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone Alternative E Soundscape
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 15% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 10% of the Zone (moderate adverse impact), and greater than 35 dBA in 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 39% of the Zone; that is, 10 to 25% Percent Time Audible in 18% of the Zone (moderate adverse impact), and greater than 25% Percent Time Audible in 21% of the Zone (major adverse impact). This would represent a reduction of 74% in area with Average Sound Level of 25 dBA or more, and a reduction of 47% in area of 10% or more Percent Time Audible compared to Alternative A (a 47 to 74% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone Alternative E Soundscape
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 11% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 11% of the Zone (moderate adverse impact), and no areas of the Zone would be greater than 35 dBA (no areas of major adverse impact in the Zone). Percent Time Audible would generally be 10% or more in 32% of the Zone; that is, 10 to 25% Percent Time Audible in 18% of the Zone (moderate adverse impact), and greater than 25% Percent Time Audible in 14% of the Zone (major adverse impact). This would represent a reduction of 78% in area with Average Sound Level of 25 dBA or more, and a reduction of 61% in area of 10% or more Percent Time Audible compared to Alternative A (a 61 to 78% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Wilderness Zone (94% of GCNP) Alternative E Soundscape

In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the Wilderness Zone increased size and geographic extent as compared to the others. Most of the Wilderness Zone is in the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

Wilderness Zone Alternative E Soundscape
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 13% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 5% of the Zone (moderate adverse impact), and greater than 35 dBA in 8% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 30% of the Zone; that is, one to 25% Percent Time Audible in 7% of the Zone (moderate adverse impact), and greater than 25% Percent Time Audible in 23% of the Zone (major adverse impact). This would represent a 37% reduction in area with Average Sound Level of 25 dBA or more and a reduction of 32% in area of 10% or more Percent Time Audible compared to Alternative A (a 32 to 37% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Wilderness Zone Alternative E Soundscape
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 13% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 5% of the Zone (moderate adverse impact) and greater than 35 dBA in 8% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 29% of the Zone; that is 10 to 25% Percent Time Audible in 7% of the Zone (moderate adverse impact) and greater than 25% Percent Time Audible in 22% of the Zone (major adverse impact). This would represent a reduction of 15% in area with Average Sound Level of 25 dBA or more and a reduction of 24% in area of 10% or more Percent Time Audible compared to Alternative A (a 15 to 24% reduction in areas of moderate to major adverse impact), resulting in a moderate beneficial change in impacts compared to Alternative A.

Wilderness Zone Alternative E Soundscape
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 11% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 5% of the Zone (moderate adverse impact) and greater than 35 dBA in 6% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 24% of the Zone; that is, 10 to 25% Percent Time Audible in 8% of the Zone (moderate adverse impact) and greater than 25% Percent Time Audible in 16% of the Zone (major adverse impact). This would represent a reduction of 37% in area with Average Sound Level of 25 dBA or more and a reduction of 32% in area of 10% or more Percent Time Audible compared to Alternative A (a 32 to 37% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Wilderness Zone Alternative E Soundscape
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 10% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 5% of the Zone (moderate adverse impact) and greater than 35 dBA in 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 20% of the Zone; that is, 10 to 25% Percent Time Audible in 6% of the Zone (moderate adverse impact) and greater than 25% Percent Time Audible in 14% of the Zone (major adverse impact). This would represent a reduction of 38% in area with Average Sound Level of 25 dBA or more and a reduction of 35% in area of 10% or more Percent Time Audible compared to Alternative A (a 35 to 38% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Marble Canyon Alternative E Soundscape

Marble Canyon's west side is in the Wilderness Zone; it's 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). Seasonal use of Dragon and Zuni Point Corridors would not affect

this area. In Marble Canyon, based on Figures 4.10 to 4.17, air-tour aircraft Average Sound Level would be barely audible at less than 15 dBA), due to Bright Angel Flight-free Zone being substantially enlarged by extending its boundary north to include all of Marble Canyon.

Marble Canyon *Alternative E* *Soundscape*
All Scenarios

Marble Canyon Location Points Percent Time Audible range zero to one percent, and Average Sound Level zero to 13 dBA Peak and Off-Peak Seasons. Results would be nearly identical (within Percent Time Audible of one percent and one dBA Average Sound Level) Base Year to Ten-Year Forecast. These values represent negligible impacts and negligible to minor beneficial changes in impacts compared to Alternative A.

East End **Alternative E** **Soundscape**

Under Alternative E, as in Alternative A, greatest exposure to noise and visual impacts would continue East End. However, air-tour sounds would be reduced beneath Dragon Corridor when closed Peak Season and conversely, beneath Zuni Point Corridor when closed Off-Peak Season. This would result in a major beneficial change in impacts compared to Alternative A. Alternative E curfews would benefit Soundscape in all East End Management Zones.

East End *Alternative E* *Soundscape*
Base Year Peak Season

East End Location Points would range zero to 88% Percent Time Audible (median 17%), and zero to 53 dBA (median 13 dBA). At some locations, aircraft events would exceed 35 dBA for 54% of the day, 45 dBA for 15% of the day, and 55 dBA for 5% of the day. Because this represents a 47% reduction in median Percent Time Audible and a 12% reduction in maximum Percent Time Audible, this would be a moderate to major beneficial change in East End impacts compared to Alternative A. Localized long- and short-term adverse impacts would be major in areas near Zuni Point Corridor, and comparable to Alternative A (from Figures 4.10 to 4.17, Average Sound Level would be 40 to 50 dBA, Percent Time Audible would be greater than 75%). Impacts would be negligible to minor in areas near Dragon Corridor; a major beneficial change in impacts compared to Alternative A. Although the majority of Location Points do not experience Average Sound Level greater 35 dBA, two Location Points (**Grid Location Point 14 and Temple Butte**) show Average Sound Level as high as 45 to 55 dBA with Percent Time Audible 5 to 10%.

East End *Alternative E* *Soundscape*
Base Year Off-Peak Season

East End Location Points would range zero to 93% Percent Time Audible (median 1%), and zero to 46 dBA (median 8 dBA). At some locations, aircraft events would exceed 35 dBA for 34% of the day, 45 dBA for 10% of the day, and 55 dBA for 3% of the day. Because this represents a 63% reduction in median Percent Time Audible and a 7% reduction in maximum Percent Time Audible, this would be a minor to major beneficial change in East End impacts compared to Alternative A. Localized long- and short-term adverse impacts would be major in areas near Dragon Corridor and comparable to Alternative A (from Figures 4.10 to 4.17, Average Sound Level would be 40 to 50 dBA, Percent Time Audible would be greater than 75%). Impacts would be negligible to minor adverse in areas near Zuni Point Corridor, a major beneficial change in impacts compared to Alternative A. Although the majority of Location Points do not experience Average Sound Level greater 35 dBA, three Location Points (**96-mile Camp, Eremita Mesa, and Tower of Ra**) show Average Sound Level as high as 45 to 55 dBA with Percent Time Audible 5 to 10% of the day.

East End *Alternative E* *Soundscape*
Ten-Year Forecast Peak Season

East End Location Points would range zero to 66% Percent Time Audible (median 10%); a 20% reduction in maximum Percent Time Audible Base Year to Ten-Year Forecast, and a 5% reduction in median Percent Time Audible Base Year to Ten-Year Forecast, because Alternative E includes quiet-technology incentives and conversion requirements. Average Sound Level would range one to 51 dBA (median 12 dBA), within one dBA of Average Sound Level Base Year. This represents a 58% reduction in median Percent Time Audible, and a 34% reduction in maximum Percent Time Audible. Impacts would be negligible to minor adverse under and near Dragon Corridor (a major beneficial change from Alternative A); major adverse under and near Zuni Point

Corridor (a negligible change from Alternative A); negligible across North Rim (a moderate to major beneficial change from Alternative A); and negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone (a negligible change from Alternative A).

East End *Alternative E* *Soundscape*
Ten-Year Forecast Off-Peak Season

East End Location Points Percent Time Audible would range zero to 78% (median one percent), and Average Sound Level zero to 44 dBA (median 9 dBA). Compared to Base Year Off-Peak Season, this represents no change in median Percent Time Audible but a 15% reduction in maximum Percent Time Audible; this also represents negligible change in median and Average Sound Level (changes of one and 2 dBA). This represents a 66% reduction in median Percent Time Audible, and a 21% reduction in maximum Percent Time Audible, due in large part to Alternative E quiet-technology conversion requirements. Impacts would be major adverse under and near Dragon Corridor (a negligible change from Alternative A); negligible to minor adverse under and near Zuni Point Corridor (a major beneficial change from Alternative A); negligible across North Rim (a moderate to major beneficial change from Alternative A); and negligible to minor adverse away from active routes and amid Bright Angel Flight-free Zone (a negligible change from Alternative A).

Central **Alternative E** **Soundscape**

The Central area is located in the Wilderness Zone, with exception of a few Non-Wilderness Zone dirt road corridors, and a very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System audibility area in which natural ambient sound levels are used directly in calculations of Percent Time Audible. This area comprises most of the Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.

Central *Alternative E* *Soundscape*
Base and Ten-Year Forecast Peak Season

Base Year **Central area Location Points** range zero to 15% Percent Time Audible (median one percent), and Average Sound Level zero to 18 dBA (median 7 dBA). Impacts would be negligible to minor adverse, a minor beneficial change in impacts compared to Alternative A. Results are nearly identical (one percent and one dBA) Ten-Year Forecast. Modified Blue Direct routes contribute to slightly lower Average Sound Level and Percent Time Audible.

Central *Alternative E* *Soundscape*
Base Year and Ten-Year Forecast Off-Peak Season

Central area Location Points Percent Time Audible range zero to 25% (median one percent), and Average Sound Level zero to 26 dBA (median 8 dBA). These increases over Peak Season results are due to increased operations on the modified Blue Direct route Off-Peak Season. There would be negligible changes in impacts Base Year to Ten-Year Forecast. Impacts would range from negligible to moderate adverse with negligible change in impacts compared to Alternative A Base Year Off-Peak Season.

West End **Alternative E** **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 Percent Time Audible calculations. Impacts to West End areas tend to be much localized, depending on proximity to Blue Direct and Blue-2/Green-4 routes. Blue-2/Green-4 would be the same as under Alternative A. Blue Direct North would be moved east and shortened over GCNP, and Blue Direct South would be eliminated.

West End *Alternative E* *Soundscape*
Base Year and Ten-Year Forecast Peak Season

West End Location Points Percent Time Audible ranges zero to 92% (median 5%), and Average Sound Level zero to 47 dBA (median 18 dBA). At some locations, aircraft events would exceed 35 dBA for 70% of the day, 45 dBA for 28% of the day, and 55 dBA for 4% of the day. Peak Season Ten-Year Forecast, Average Sound Level would be essentially unchanged from Base Year, but maximum Percent Time Audible would be reduced 8% due to Alternative E quiet-technology conversion requirements. Median Percent Time Audible would be

reduced 14% Base Year and 17% Ten-Year Forecast, which represent minor to moderate beneficial changes in impacts compared to Alternative A.

For areas near Blue-2 and Green-4 routes (**West End's northern portion**), localized long- and short-term impacts would be moderate to major adverse (from Figures 4.5 to 4.12, Average Sound Level would be 40 to 50 dBA, Percent Time Audible would be greater than 65%), with negligible change in impacts compared to Alternative A. In **West End's southern portion**, localized long-term impacts would be negligible to minor adverse (from Figures 4.10 to 4.17, Average Sound Level would be 10 to 20 dBA, Percent Time Audible would be less than 20%), with negligible change in impacts compared to Alternative A.

West End *Alternative E* *Soundscape*

Base Year and Ten-Year Forecast Off-Peak Season

For West End Location Points, results for Base Year and Ten-Year Forecast Off-Peak Season are very similar, and also similar to Peak Season. Because operation growth is anticipated Ten-Year Forecast, and Alternative E quiet-technology incentives and conversion requirements would provide some mitigation with a decrease in affected area size, those areas still affected would see an increase in localized impacts. Overall impacts would see reduction in Percent Time Audible of 5 to 10% and one dBA Average Sound Level reduction compared to Base Year, and a reduction in Percent Time Audible of 12 to 17% and 2 to 4 dBA Average Sound Level compared to Alternative A. There would be moderate to major adverse impacts in **West End's northern portion** near air-tour routes (a minor beneficial change in impacts from Alternative A), and negligible to minor adverse impacts in **West End's southern portion** away from routes (a negligible to moderate beneficial change from Alternative A).

NPS Units in SFRA Outside Grand Canyon National Park **Alternative E** **Soundscape**

For **NPS lands directly under and within five miles of Blue Direct Blue-2 and Green-4 routes** (Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument), impacts would be major adverse (Average Sound Level 40 to 50 dBA). Impacts to these lands as a result of modified Blue Direct routes would shift from more remote and sensitive Wilderness areas in Grand Canyon-Parashant National Monument's southern portion to somewhat less sensitive areas in the Monument's more northern areas. Also, due to elimination of Blue Direct South, some aircraft would likely fly outside the SFRA south along existing airways. Because growth in operations is anticipated Ten-Year Forecast, and although Alternative E quiet-technology incentives and conversion requirements would provide some mitigation with decreased affected area size, those areas still affected would see an increase in localized impacts. The **remainder of the SFRA outside GCNP** would experience Average Sound Level less than 25 dBA. Localized long- and short-term impacts would be minor adverse. As with GCNP, **the SFRA as a whole** would benefit from Alternative E quiet-technology incentives and conversion requirements.

Cumulative Impacts **Alternative E** **Soundscape**

Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed in Alternative A, and 2) noise generated from aircraft under Alternative E as discussed above, would continue to have long-term moderate to major adverse cumulative impacts on Soundscape throughout all four areas (Marble Canyon, East End, Central, and West End), similar to cumulative impacts described for Alternative A. Quiet-technology incentives and conversion requirements under Alternative E would mitigate a small amount of those impacts over the Ten-Year Forecast period.

Conclusion **Alternative E** **Soundscape**

As further explained in Chapter 4's Socioeconomic Environment, fewer flight operations are expected in Alternative E than in other Alternatives, so Soundscape would also benefit from less noise from fewer operations. Because Alternative E includes quiet-technology incentives and conversion requirements, noise impacts would decrease resulting in negligible to moderate beneficial changes in impacts Base Year to Ten-Year Forecast in the park as a whole.

Base Year would achieve Substantial Restoration of Natural Quiet in 75% of the park Peak Season, and 78% Off-Peak Season. These represent moderate beneficial changes in impacts compared to Alternative A with a 20% increase in park area restored Peak Season, and a 23% increase Off-Peak Season.

Ten-Year Forecast, Substantial Restoration of Natural Quiet would be achieved in 84% of the park Peak Season, and 86% of the park Off-Peak Season. These represent major beneficial changes in impacts compared to Alternative A with a 31% increase in park area restored Peak Season, and a 33% increase Off-Peak Season.

Conclusion by Zone **Alternative E** **Soundscape**

Ten-Year Forecast Peak Season

Wilderness Zone (about 94% of GCNP; area of moderate to major adverse impacts would be 11 to 24% of the Zone, a major beneficial change in impacts (32 to 37% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impacts would be 15 to 39% of the Zone, a major beneficial change in impacts (47 to 74% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Developed Zone (about 2% of GCNP); area of moderate to major adverse impacts would be 12 to 58% of the Zone, a major beneficial change in impacts (37 to 86% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Conclusion by Area **Alternative E** **Soundscape**

Base Year and Ten-Year Forecast

In Marble Canyon, Central, and West End (southern portions), localized long- and short-term adverse impacts would generally be negligible to minor adverse with negligible to moderate beneficial changes in impacts compared to Alternative A. Greatest noise exposure would occur in East End where long- and short-term impacts would generally be moderate to major adverse in areas under and near air-tour routes in the seasonally active Corridor, with negligible change in impacts compared to Alternative A. However, in East End areas near seasonally inactive air-tour routes and amid Flight-free Zones, there would be negligible to minor adverse impacts with moderate to major beneficial change in impacts compared to Alternative A. In West End's northern portion with air-tour routes, there would be moderate to major adverse impacts with minor beneficial changes in impacts compared to Alternative A.

Cumulative Impacts Summary **Alternative E** **Soundscape**

Cumulative impacts from all actions would be long-term moderate to major adverse, due primarily to high levels of aircraft audibility.

ALTERNATIVE F **MODIFIED CURRENT CONDITIONS** **SOUNDSCAPE**

Base Year Peak and Off-Peak Season, Alternative F modifies West End tour routes to alleviate noise at Eagle and Guano Point Location Points, and seasonally shifts Dragon Corridor routes. Alternative F would achieve Substantial Restoration of Natural Quiet in 51% of the park Peak Season, and 59% of the park Off-Peak Season, as shown in Table 4.23. These represent negligible changes in impacts from Alternative A with a 4% decrease in park area restored Peak Season, and a 4% increase Off-Peak Season.

Ten-Year Forecast Peak and Off-Peak Season Substantial Restoration of Natural Quiet would be achieved in 66% of the park Peak Season, and 75% of the park Off-Peak Season as shown in Table 4.24. These represent moderate beneficial changes in impacts from Alternative A with a 13% increase in park area restored Peak Season, and a 22% increase Off-Peak Season.

Mapped results of Alternative F noise modeling for Percent Time Audible and Average Sound Level are shown in Figures 4.18 to 4.25. Tables 4.11 to 4.16 present Contour Analysis and Location Point results computed for Alternative F Peak and Off-Peak Seasons, respectively, and include comparisons with Alternative A.

FIGURE 4.18 ALTERNATIVE F PERCENT TIME AUDIBLE BASE YEAR PEAK SEASON

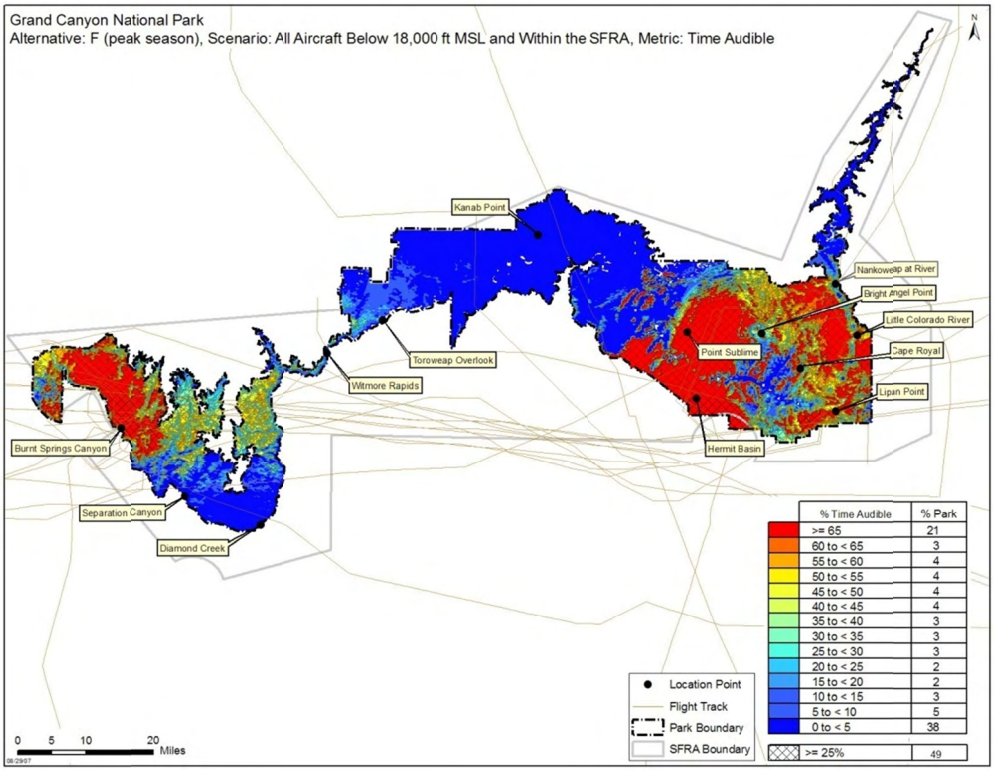


FIGURE 4.19 ALTERNATIVE F PERCENT TIME AUDIBLE TEN-YEAR FORECAST PEAK SEASON

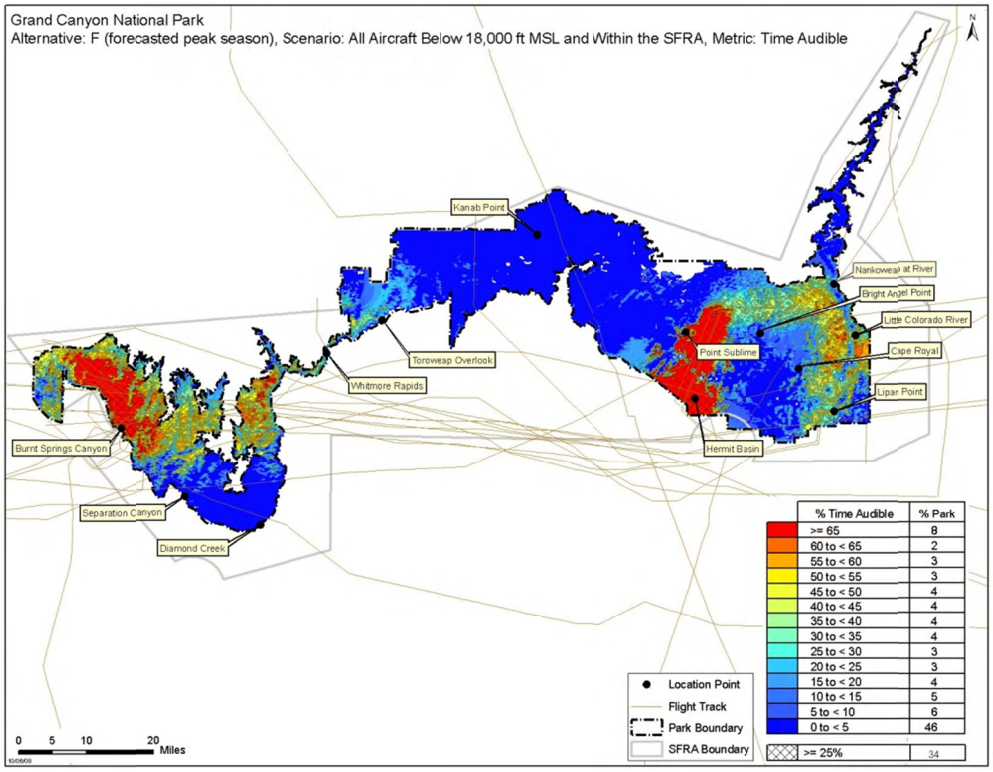


FIGURE 4.20 ALTERNATIVE F PERCENT TIME AUDIBLE BASE YEAR OFF-PEAK SEASON

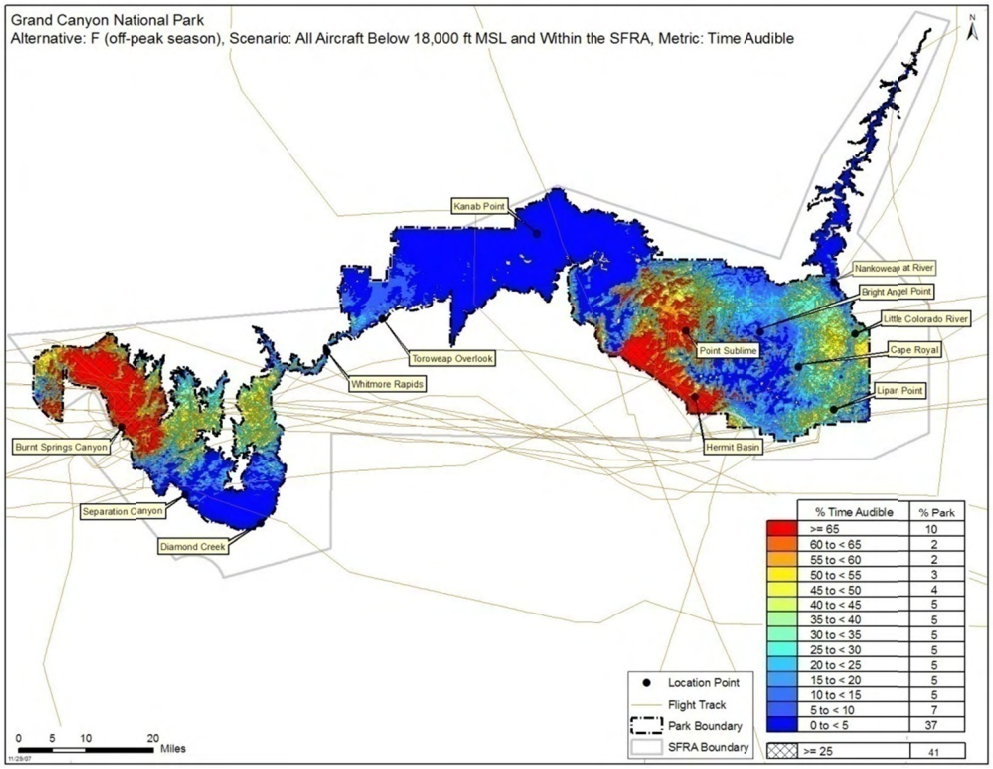
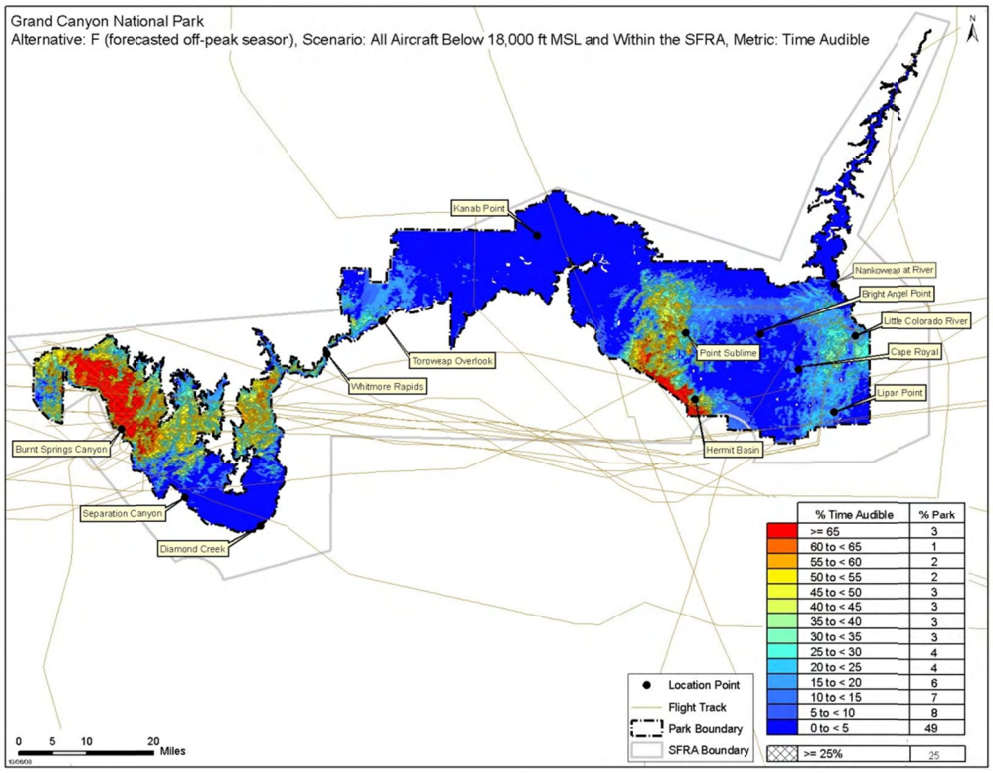


FIGURE 4.21 ALTERNATIVE F PERCENT TIME AUDIBLE TEN-YEAR FORECAST OFF-PEAK SEASON



1

FIGURE 4.22 ALTERNATIVE F AVERAGE SOUND LEVEL BASE YEAR PEAK SEASON

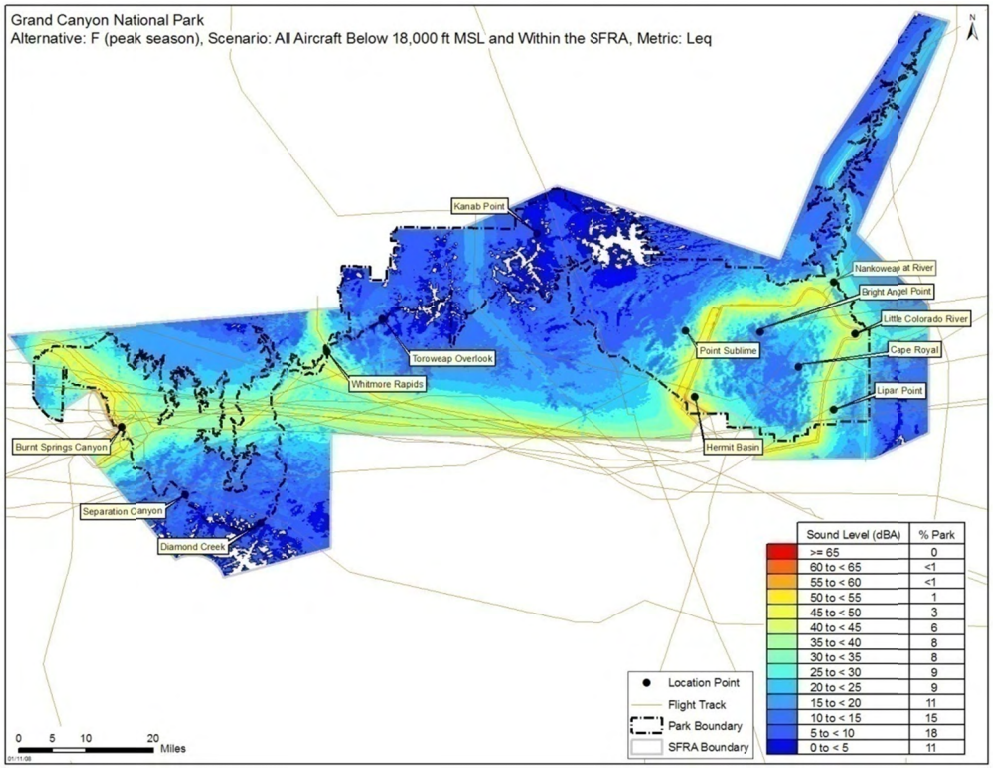
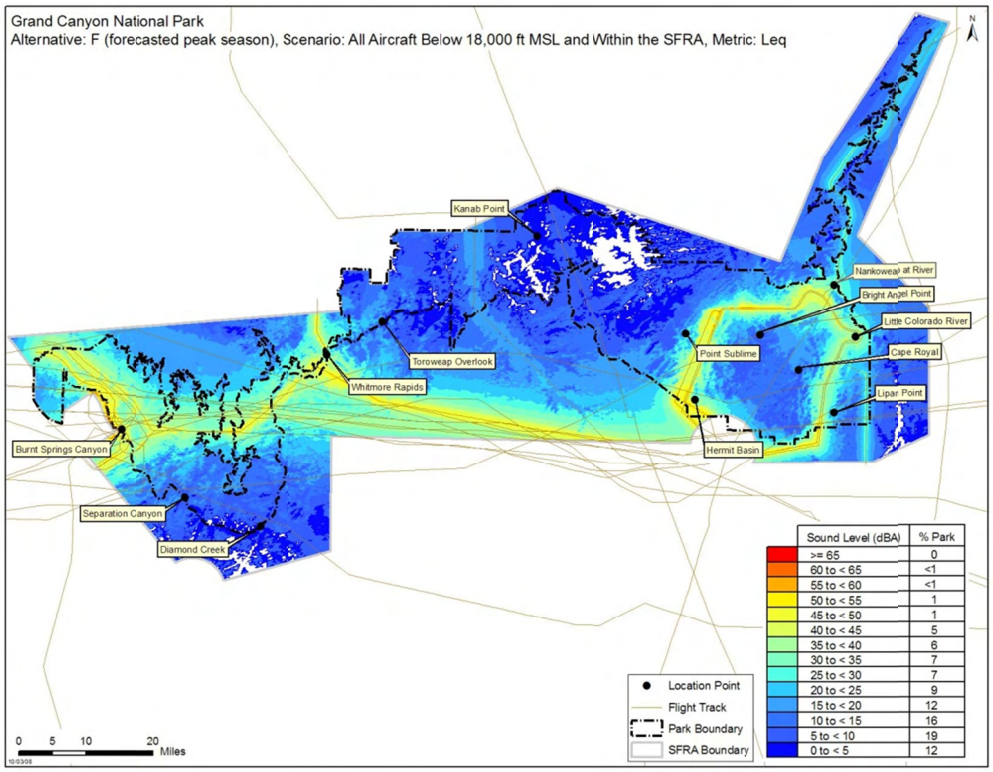


FIGURE 4.23 ALTERNATIVE F AVERAGE SOUND LEVEL TEN-YEAR FORECAST PEAK SEASON



2

FIGURE 4.24 ALTERNATIVE F AVERAGE SOUND LEVEL BASE YEAR OFF-PEAK SEASON

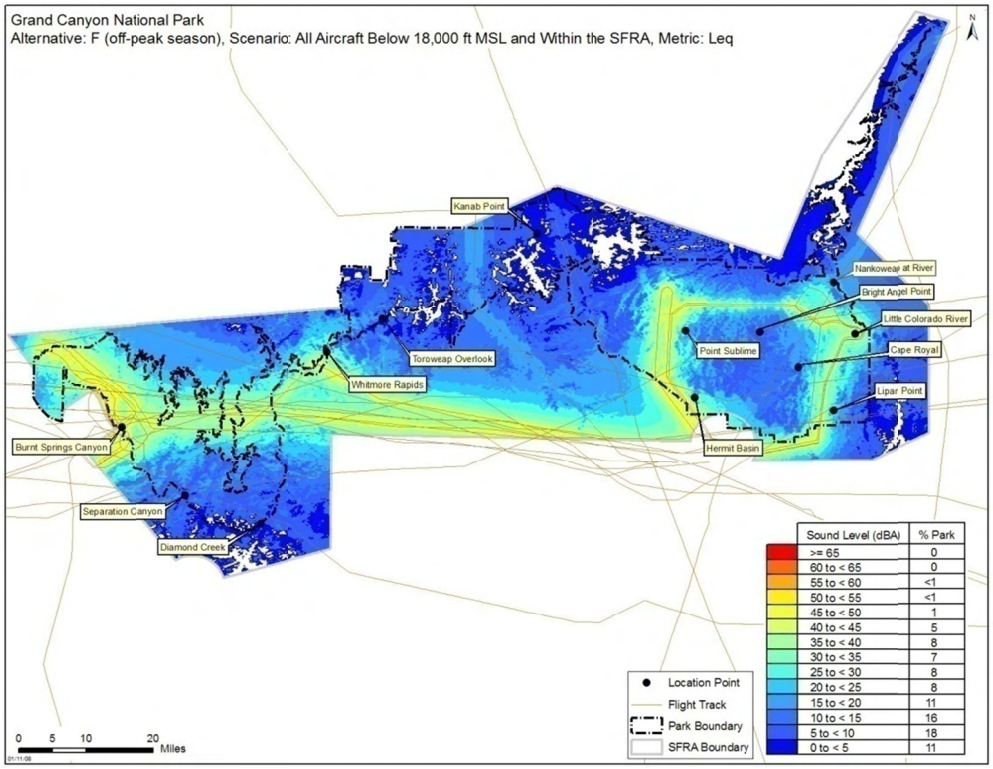


FIGURE 4.25 ALTERNATIVE F AVERAGE SOUND LEVEL TEN-YEAR FORECAST OFF-PEAK SEASON

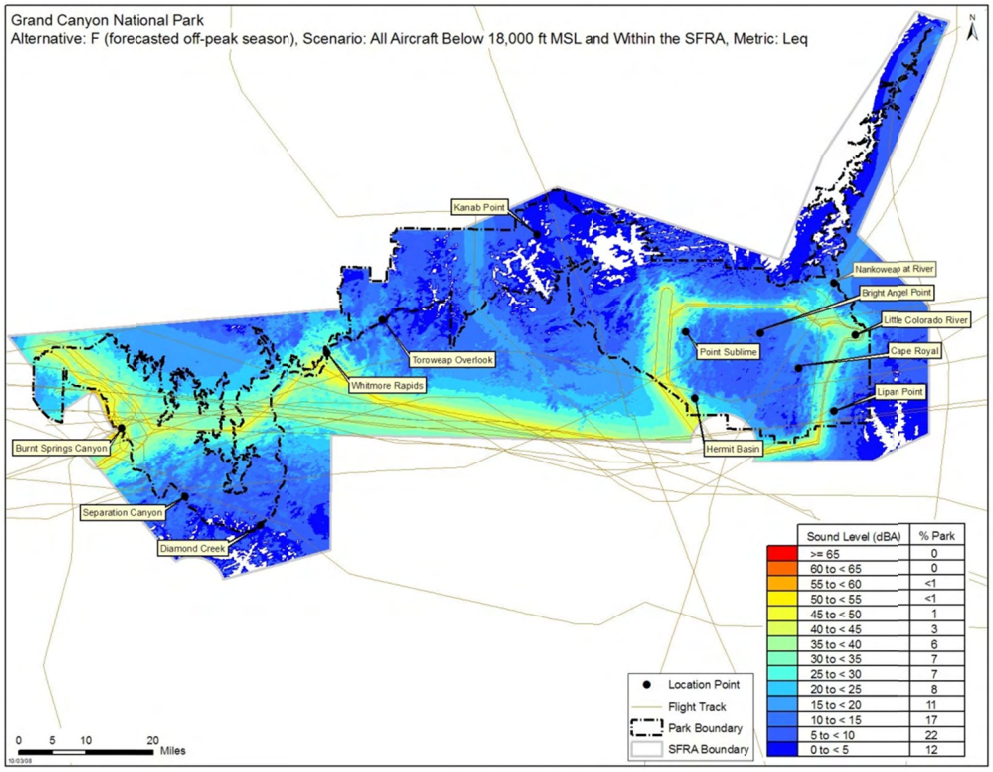


TABLE 4.11 ALTERNATIVE F PEAK SEASON[abc] PERCENT TIME AUDIBLE CONTOUR ANALYSIS RESULTS

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
Percent Park Restored				**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%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%
[b]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
[c]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

TABLE 4.12 ALTERNATIVE F PEAK SEASON[ab] AVERAGE SOUND LEVEL CONTOUR ANALYSIS RESULTS

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%

[a]Due to rounding differences, totals shown in this table may differ from Appendix D by up to 2%.
[b]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

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%

[a]Max 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

[b]TAUD = Percent Time Audible

[c]L_{Aeq12} = Average Sound Level

[d]TALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively

TABLE 4.14 ALTERNATIVE F PERCENT TIME AUDIBLE CONTOUR ANALYSIS RESULTS OFF-PEAK SEASON[ab]

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 Restored				**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%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%

[b]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

TABLE 4.15 ALTERNATIVE F AVERAGE SOUND LEVEL CONTOUR ANALYSIS RESULTS OFF-PEAK SEASON[a]

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%	23%	15%	15%	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%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%

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	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	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%	6%	1%	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	32%	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%

[a]The 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
[b]TAUD = Percent Time Audible
[c]L_{Aeq12} = Average Sound Level
[d]TALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively

Developed Zone (about 2% of GCNP) Alternative F Soundscape

With exception of a very small Developed Zone area at Tuweep, all 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 *Alternative F* *Soundscape*
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 68% of the Developed Zone; that is, Average Sound Level would be 25 to 35 dBA in 58% of the Zone (moderate adverse impact), and greater than 35 dBA in 10% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 95% of the Zone; that is, 10 to 25% in 6% of the Zone (moderate adverse impact), and greater than 25% in 89% of the Zone (major adverse impact). This would represent a negligible change of 4% in area with Average Sound Level of 25 dBA or more and a negligible change of one percent in area of 10% or more Percent Time Audible compared to Alternative A (a negligible change in areas of moderate to major adverse impact), resulting in a negligible change in impacts compared to Alternative A.

Developed Zone *Alternative F* *Soundscape*
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 34% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 37% of the Zone (moderate adverse impact), and greater than 35 dBA in 7% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 79% of the Zone; that is, 10 to 25% in 28% of the Zone (moderate adverse impact), and greater than 25% in 51% of the Zone (major adverse impact). This would represent a reduction of 44% in area with Average Sound Level of 25 dBA or more and a reduction of 15% in area of 10% or more Percent Time Audible compared to Alternative A (a 15 to 44% reduction in areas of moderate to major adverse impacts), resulting in a moderate to major beneficial change in impacts compared to Alternative A.

Developed Zone *Alternative F* *Soundscape*
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 24% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 19% of the Zone (moderate adverse impact), and greater than 35 dBA in 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 55% of the Zone; that is, 10 to 25% in 26% of the Zone (moderate adverse impact), and greater than 25% in 29% of the Zone (major adverse impact). This would represent a reduction of 75% in area with Average Sound Level of 25 dBA or more, and a reduction of 40% in area of 10% or more Percent Time Audible compared to Alternative A (a 40 to 75% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Developed Zone *Alternative F* *Soundscape*
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 9% 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 35 dBA in 2% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 39% of the Zone; that is, between 10 and 25% in 35% of the Zone (moderate adverse impact), and greater than 25% in 4% of the Zone (major adverse impact). This would represent a reduction of 90% in area with Average Sound Level of 25 dBA or more, and a reduction of 56% in area of 10% or more Percent Time Audible compared to Alternative A (a 56 to 90% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone (6% of GCNP) **Alternative F** **Soundscape**

Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone System area where 10 dBA is added to natural ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The majority of the Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis for audibility calculations, consistent with Non-Wilderness Zone management objectives that call for mostly natural conditions to prevail in the Zone.

Non-Wilderness Zone *Alternative F* *Soundscape*
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 59% 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 35 dBA in 21% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 87% of the Zone; that is, 10% to 25% in 7% of the Zone (moderate adverse impact), and greater than 25% in 80% of the Zone (major adverse impact). This would represent a negligible change of one percent in area with Average Sound Level of 25 dBA or more and in area of 10% or more Percent Time Audible compared to Alternative A (a negligible change in areas of moderate to major adverse impact), resulting in a negligible change in impacts compared to Alternative A.

Non-Wilderness Zone *Alternative F* *Soundscape*
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 30% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 23% of the Zone (moderate adverse impact) and greater than 35 dBA in 7% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 78% of the Zone; that is, 10 to 25% in 35% of the Zone (moderate adverse impact) and greater than 25% in 43% of the Zone (major adverse impact). This would represent a reduction of 28% in area with Average Sound Level of 25 dBA or more and a reduction of 9% in area of 10% or more Percent Time Audible compared to Alternative A (a 9 to 28% reduction in areas of moderate to major adverse impact), resulting in a minor to moderate beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone *Alternative F* *Soundscape*
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 36% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 23% of the Zone (moderate adverse impact) and greater than 35 dBA in 13% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 49% of the Zone; that is, 10 to 25% in 19% of the Zone (moderate adverse impact) and greater than 25% in 30% of the Zone (major adverse impact). This would represent a reduction of 54% in area with Average Sound Level of 25 dBA or more and a reduction of 37% in area of 10% or more Percent Time Audible compared to Alternative A (a 37 to 54% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone *Alternative F* *Soundscape*
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 18% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 13% of the Zone (moderate adverse impact) and greater than 35 dBA in 5% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 28% of the Zone; that is, 10 to 25% in 18% of the Zone (moderate adverse impact) and greater than 25% in 10% of the Zone (major adverse impact). This would represent a reduction of 72% in area with Average Sound Level of 25 dBA or more and a reduction of 58% in area of 10% or more Percent Time Audible compared to Alternative A (a 58 to 72% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Wilderness Zone (about 94% of GCNP) Alternative F Soundscape

In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the Wilderness Zone's increased size and geographic extent as compared to the others. Most of the Wilderness Zone is in the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

Wilderness Zone *Alternative F* *Soundscape*
Base Year Peak Season

Average Sound Level would generally be greater than 25 dBA in 32% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 15% of the Zone (moderate adverse impact) and greater than 35 dBA in 17% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 55% of the Zone; that

is, 10 to 25% in 8% of the Zone (moderate adverse impact) and greater than 25% in 47% of the Zone (major adverse impact). This would represent an increase of 5% in area with Average Sound Level of 25 dBA or more and an increase of one percent in area of 10% or more Percent Time Audible compared to Alternative A (a one to 5% increase in areas of moderate to major adverse impact), resulting in a negligible to minor adverse change in impacts compared to Alternative A.

Wilderness Zone *Alternative F* *Soundscape*
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 30% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 15% of the Zone (moderate adverse impact) and greater than 35 dBA in 15% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 54% of the Zone; that is, 10 to 25% in 13% of the Zone (moderate adverse impact) and greater than 25% in 41% of the Zone (major adverse impact). This would represent a negligible change (2 dBA and 3%) in area with Average Sound Level of 25 dBA or more and in area of 10% or more Percent Time Audible compared to Alternative A (a negligible change in areas of moderate to major adverse impact), resulting in a negligible change in impacts compared to Alternative A.

Wilderness Zone *Alternative F* *Soundscape*
Ten-Year Forecast Peak Season

Average Sound Level would generally be 25 dBA or more in 28% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 14% of the Zone (moderate adverse impact) and greater than 35 dBA in 14% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 46% of the Zone; that is, 10 to 25% in 12% of the Zone (moderate adverse impact) and greater than 25% in 34% of the Zone (major adverse impact). This would represent a 20% reduction in area with Average Sound Level of 25 dBA or more and a reduction of 9% in area of 10% or more Percent Time Audible compared to Alternative A (a 9 to 20% reduction in areas of moderate to major adverse impact), resulting in a minor beneficial change in impacts compared to Alternative A.

Wilderness Zone *Alternative F* *Soundscape*
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 25% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 14% of the Zone (moderate adverse impact) and greater than 35 dBA in 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 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.

East End *Alternative F* *Soundscape*
Base Year Off-Peak Season

East End Location Points Percent Time Audible would range zero to 95% (median 28%), and 3 to 49 dBA (median 21 dBA). At some locations, aircraft events would exceed 35 dBA for 37% of the day, 45 dBA for 14% of the day, and 55 dBA for 5% of the day. Because this represents a reduction of 36% in median Percent Time Audible, and a 5% reduction in maximum Percent Time Audible due to Dragon Corridor's western shift Off-Peak Season, this would be a minor to major beneficial change in East End impacts compared to Alternative A. Localized long- and short-term impacts would be major adverse in areas near the shifted Dragon Corridor, Zuni Point Corridor, and routes across 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 75%), and negligible to minor adverse amid Bright Angel Flight-free Zone. Bright Angel Flight-free Zone's eastern portion would experience markedly reduced air-tour sounds Off-Peak Season, while locations closer to Dragon Corridor (near **Point Sublime and Pasture Wash** Location Points) would see only modest reductions.

East End *Alternative F* *Soundscape*
Ten-Year Forecast Peak Season

East End Location Points Percent Time Audible would range zero to 98% (median 25%); Average Sound Level would range 2 dBA to 46 dBA (median 24 dBA). This represents a reduction of 39% in median Percent Time Audible from Base Year to Ten-Year Forecast, and a reduction of 42% in median Percent Time Audible compared to Alternative A, due in large part to Alternative F quiet-technology conversion requirements. There would be moderate to major adverse impacts under and near Dragon and Zuni Point Corridors and across North Rim (a moderate to major beneficial change from Alternative A), and negligible to minor adverse impacts away

from active routes and amid Bright Angel Flight-free Zone (a negligible to minor beneficial change from Alternative A).

East End *Alternative F* *Soundscape*
Ten-Year Forecast Off-Peak Season

East End Location Point Percent Time Audible would range zero to 83% (median 11%), and Average Sound Level zero to 47 dBA (median 17 dBA); compared to Base Year Off-Peak Season, an 11% reduction in median Percent Time Audible, and a 12% reduction in maximum Percent Time Audible, but only a 4 dBA reduction in median Average Sound Level. Compared to Alternative A, this represents a 56% reduction in median Percent Time Audible, a 17% reduction in maximum Percent Time Audible, and an 11% reduction in median Average Sound Level, due in large part to Alternative F quiet-technology conversion requirements. There would be moderate to major adverse impacts under and near Dragon and Zuni Point Corridors and across North Rim, moderate to major beneficial change in impacts from Alternative A in areas where Dragon Corridor is shifted from, but moderate to major adverse change in areas the Corridor is shifted to). There would also be negligible to minor adverse impacts away from active routes and amid Bright Angel Flight-free Zone (negligible to moderate beneficial change in impacts from Alternative A).

Central **Alternative F** **Soundscape**

The Central area is located in the Wilderness Zone, with exception of a few Non-Wilderness Zone dirt road corridors, and a very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System audibility area in which natural ambient sound levels are used directly in audibility calculations. This area comprises most of the Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.

In Central areas, as shown in Figures 4.18 to 4.25, aircraft Average Sound Level would be less than 10 dBA, and Percent Time Audible would be less than 5%).

Central *Alternative F* *Soundscape*
Base Year Peak Season

Central area Location Points would range zero to 12% Percent Time Audible (median one percent), and zero to 25 dBA (median 8 dBA). At some locations, aircraft events would exceed 35 dBA for 2% of the day. Compared to Alternative A, Alternative F values represent a 10% reduction in maximum Percent Time Audible (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).

West End *Alternative F* *Soundscape*

Ten-Year Forecast Peak Season

West End Location Points Percent Time Audible would range zero to 85% Percent Time Audible (median 14%), and Average Sound Level zero to 46 dBA (median 18 dBA). At some locations, aircraft events would exceed 35 dBA 60% of the day, 45 dBA 23% of the day, and 55 dBA 3% of the day. Similar levels and differences between **West End's northern and southern portions** would be as described for Base Year Peak Season. These values are generally slightly less than Base Year Peak Season. Compared to Alternative A, they represent a 7% reduction in median Percent Time Audible, and a 10% reduction in maximum Percent Time Audible, as well as a 4 dBA reduction in median Average Sound Level, due to quiet-technology conversion requirements in Alternative F. There would be moderate to major adverse impacts in the **northern area** near air-tour routes (minor beneficial change in impacts from Alternative A), and negligible to minor adverse impacts in the **southern area** away from routes (negligible to minor beneficial change from Alternative A).

West End *Alternative F* *Soundscape*

Ten-Year Forecast Off-Peak Season

West End Location Points Ten-Year Forecast Off-Peak Season results are slightly lower than Ten-Year Forecast Peak Season (3 to 4% less Percent Time Audible, one dBA lower Average Sound Level). Similar levels and differences between **West End's northern and southern portions** would be as described for Base Year Peak Season. Compared to Alternative A, they represent an 11% reduction in median Percent Time Audible, and a 14% reduction in maximum Percent Time Audible, as well as a 5 dBA reduction in median Average Sound Level. There would be moderate to major adverse impacts in the **northern area** near air-tour routes (minor beneficial change in impacts from Alternative A), and negligible to minor adverse impacts in the **southern area** away from routes (negligible to moderate beneficial change from Alternative A).

NPS Units in the SFRA Outside Grand Canyon National Park **Alternative F** **Soundscape**

Blue Direct South's southern shift to avoid Eagle and Guano Point Location Points provides localized long- and short-term moderate beneficial impacts for **lands directly under and within five miles of Blue Direct routes** (Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument); specifically, Percent Time Audible would decrease approximately 20%. Alternative F quiet-technology incentives and conversion requirements would provide some mitigation by decreasing affected area size; however, those areas still affected would see an increase in localized impacts due to growth in operations. The **remainder of the SFRA outside GCNP boundaries** would experience Average Sound Level less than 25 dBA. Localized long- and short-term impacts would generally be considered minor adverse overall to these lands. As with GCNP**, the SFRA as a whole** would benefit from quiet-technology incentives and conversion requirements Ten-Year Forecast.

Cumulative Impacts **Alternative F** **Soundscape**

Noise from aircraft flying over 18,000 feet and/or outside the SFRA from aircraft under Alternative F as discussed above, would continue to have long-term moderate to major adverse cumulative impacts on Soundscape throughout all four park areas (Marble Canyon, East End, Central, and West End), and SFRA similar to cumulative impacts described for Alternative A. Quiet-technology incentives and conversion requirements under Alternative F would mitigate a small amount of those impacts Ten-Year Forecast.

Conclusion **Alternative F** **Soundscape**

Because Alternative F includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast in the park as a whole. Beneficial impacts would occur in both Percent Time Audible and Average Sound Level.

Base Year Alternative F would achieve Substantial Restoration of Natural Quiet in 51% of the park Peak Season, and 59% of the park Off-Peak Season. These represent negligible changes in impacts from Alternative A with a 4% decrease in park area restored Peak Season, and a 4% increase Off-Peak Season.

Ten-Year Forecast Substantial Restoration of Natural Quiet would be achieved in 66% of the park Peak Season, and 75% of the park Off-Peak Season. These represent moderate beneficial changes in impacts from Alternative A with a 13% increase in park area restored Peak Season, and a 22% increase Off-Peak Season.

Conclusion **Alternative F** **Soundscape**

Conclusion by Zone *Alternative F* *Soundscape*

Ten-Year Forecast Peak Season

Wilderness Zone (about 94% of GCNP); area of moderate to major adverse impact would be 28 to 46% of the Zone, a minor beneficial change in impacts (9 to 20% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impact would be 36 to 49% of the Zone, a major beneficial change in impacts (37 to 54% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Developed Zone (about 2% of GCNP); area of moderate to major adverse impact would be 24 to 55% of the Zone, a major beneficial change in impacts (40 to 75% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Conclusion by Area *Alternative F* *Soundscape*

Base Year and Ten-Year Forecast

In Marble Canyon, Central areas, West End (southern portions), localized long- and short-term impacts would be negligible to minor adverse (aircraft Average Sound Level would generally be less than 15 dBA, and Percent Time Audible would be less than 5%) with negligible to moderate beneficial changes in impacts compared to

Alternative A depending on specific location. Greatest exposure to noise and visual impacts occur in East End and West End's northern portion where long- and short-term moderate to major adverse impacts would occur (aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%), with moderate to major beneficial changes in impacts compared to Alternative A East End, and minor beneficial changes in impacts compared to Alternative A West End. Negligible to minor adverse impacts would occur away from active routes and amid Flight-free Zones with negligible to moderate beneficial change in impacts compared to alternative A East End. Beneficial impacts to Soundscape East End due to Dragon Corridor's seven-mile western shift Off-Peak Season are clearly seen in modeled results.

Cumulative Impacts **Alternative F** **Soundscape**

Cumulative impacts from all actions would be long-term moderate to major adverse, due primarily to high levels of aircraft audibility.

NPS PREFERRED ALTERNATIVE **SOUNDSCAPE**

The NPS Preferred Alternative includes quiet-technology incentives, a modified allocation system, modified tour routes to avoid sensitive resources, and curfews.

Base Year, the NPS Preferred Alternative would achieve Substantial Restoration of Natural Quiet in 53% of the park Peak Season, and in 63% 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% decrease in park area restored, and a moderate beneficial change in impacts compared to Alternative A Off-Peak Season with an 8% increase.

Ten-Year Forecast Substantial Restoration of Natural Quiet would be achieved in 67% of the park Peak Season, and 77% of the park Off-Peak Season, as shown in Table 4.24. These represent moderate beneficial changes in impacts compared to Alternative A with a 14% increase in park area restored Peak Season, and a 24% increase Off-Peak Season.

Mapped results of noise modeling for the NPS Preferred Alternative for Percent Time Audible and Average Sound Level are shown on Figure 4.26 to 4.33. Table 4.17 to 4.22 present Contour Analysis and Location Point results computed for the NPS Preferred Alternative Peak and Off-Peak Seasons, respectively, and include comparisons with Alternative A.

FIGURE 4.26 NPS PREFERRED PERCENT TIME AUDIBLE BASE YEAR PEAK SEASON

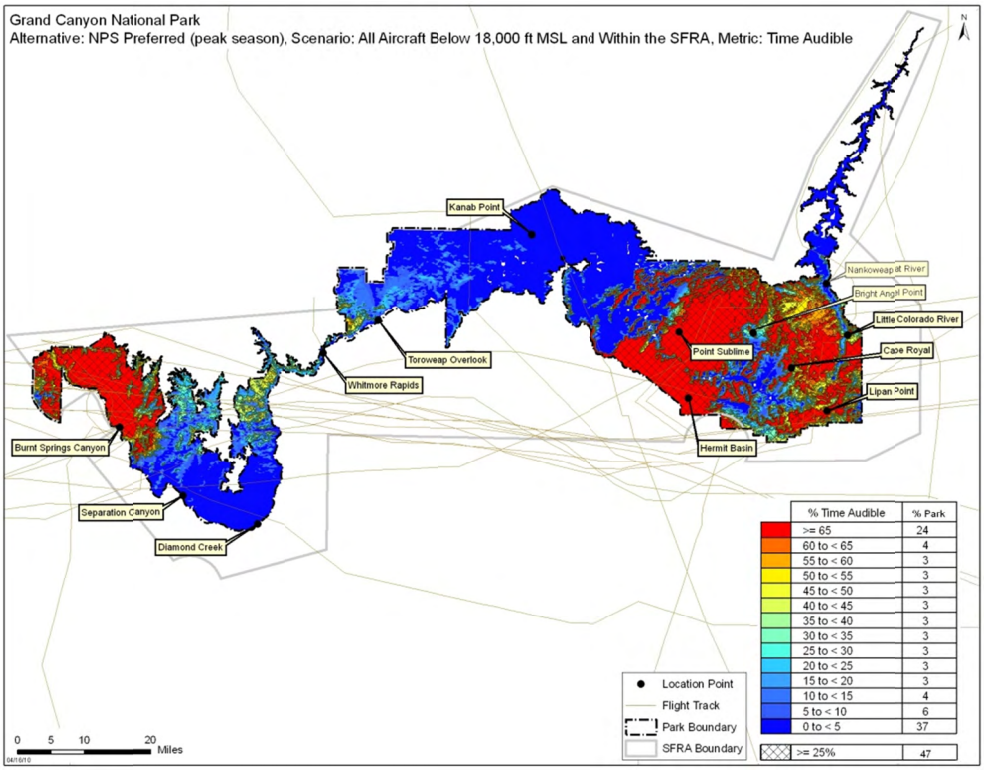


FIGURE 4.27 NPS PREFERRED PERCENT TIME AUDIBLE TEN-YEAR FORECAST PEAK SEASON

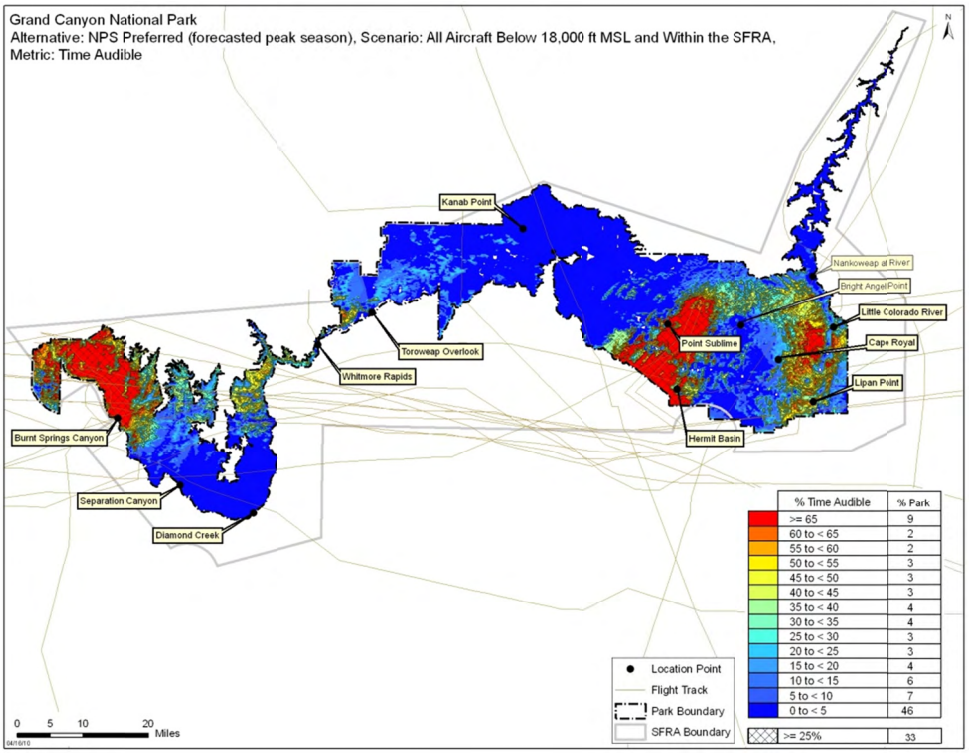


FIGURE 4.28 NPS PREFERRED PERCENT TIME AUDIBLE BASE YEAR OFF-PEAK SEASON

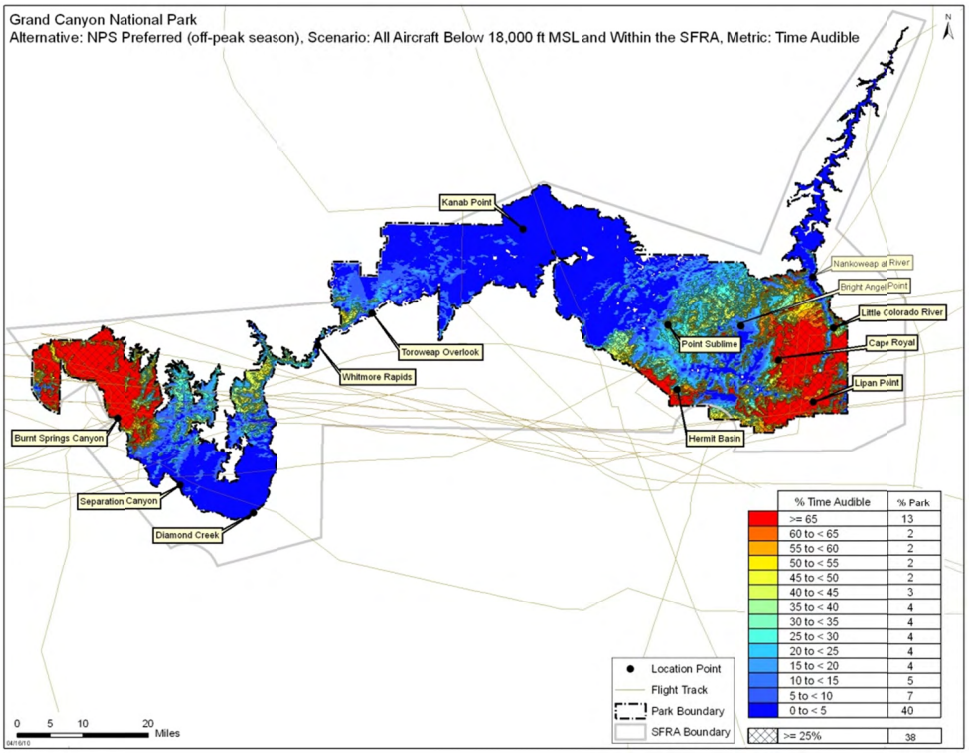


FIGURE 4.29 NPS PREFERRED PERCENT TIME AUDIBLE TEN-YEAR FORECAST OFF-PEAK SEASON

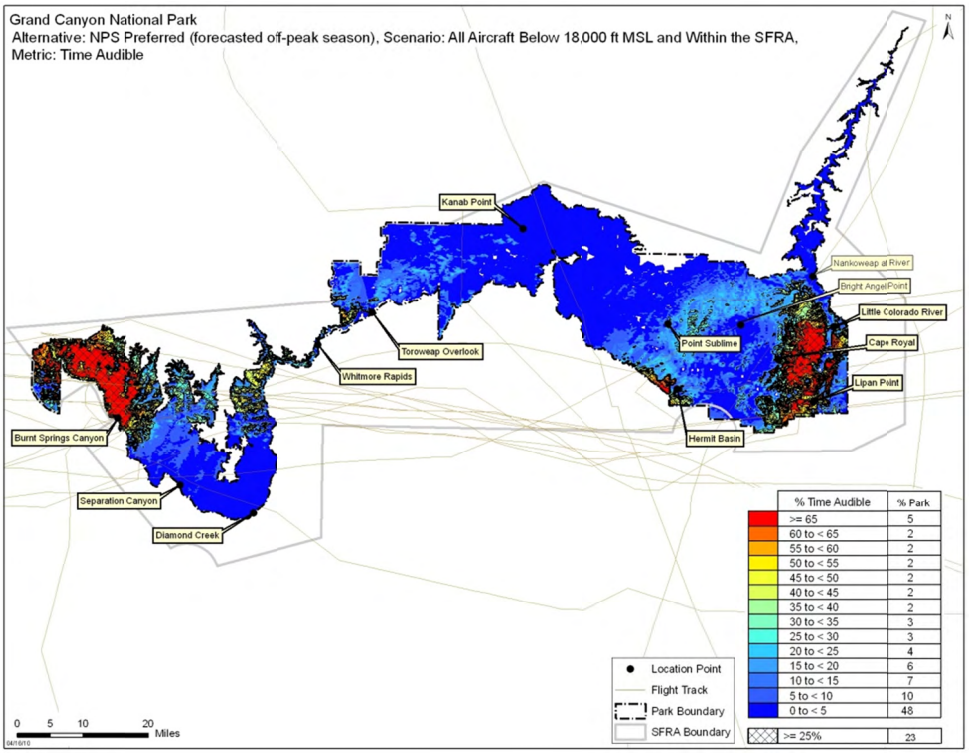


FIGURE 4.30 NPS PREFERRED AVERAGE SOUND LEVEL BASE YEAR PEAK SEASON

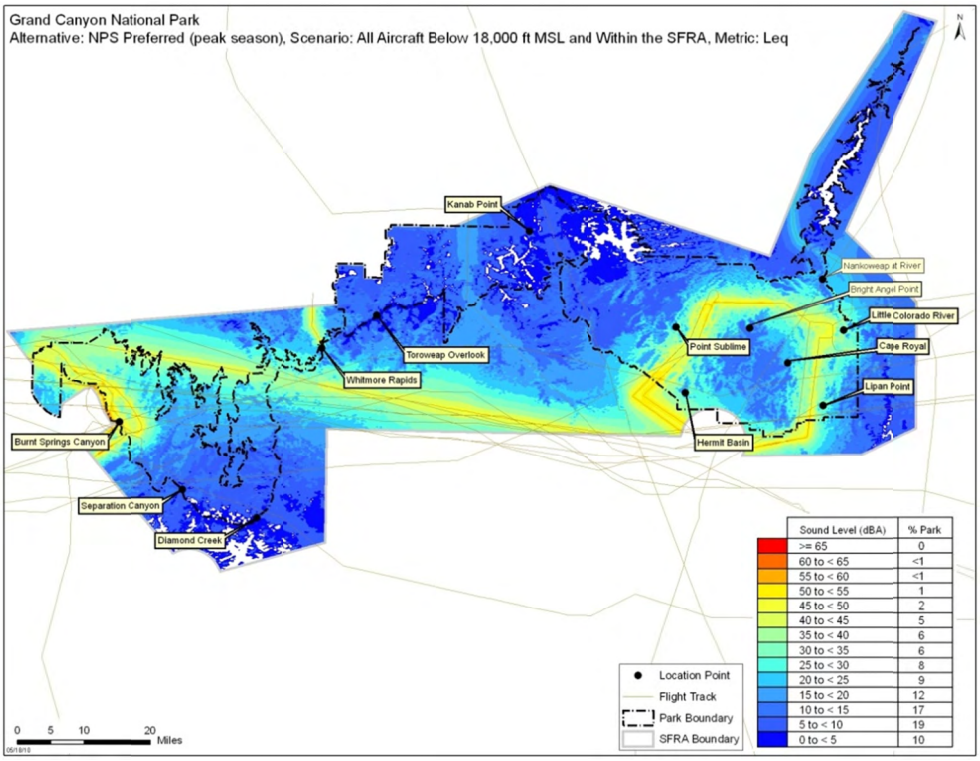


FIGURE 4.31 NPS PREFERRED AVERAGE SOUND LEVEL TEN-YEAR FORECAST PEAK SEASON

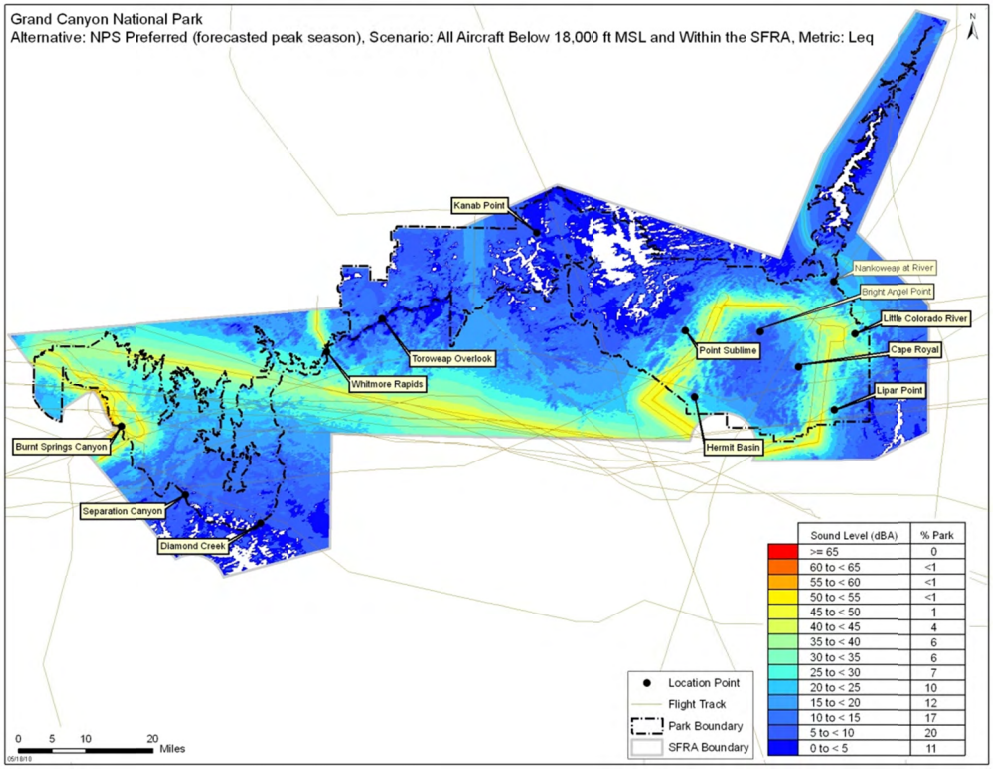


FIGURE 4.32 NPS PREFERRED AVERAGE SOUND LEVEL BASE YEAR OFF-PEAK SEASON

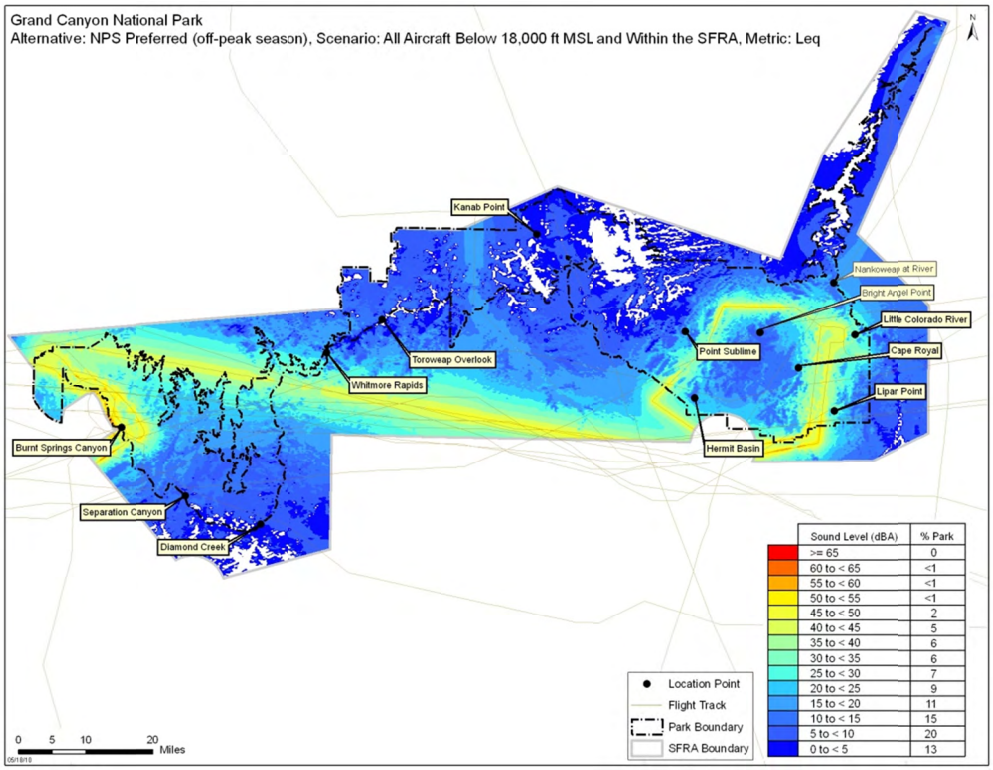


FIGURE 4.33 NPS PREFERRED AVERAGE SOUND LEVEL TEN-YEAR FORECAST OFF-PEAK SEASON

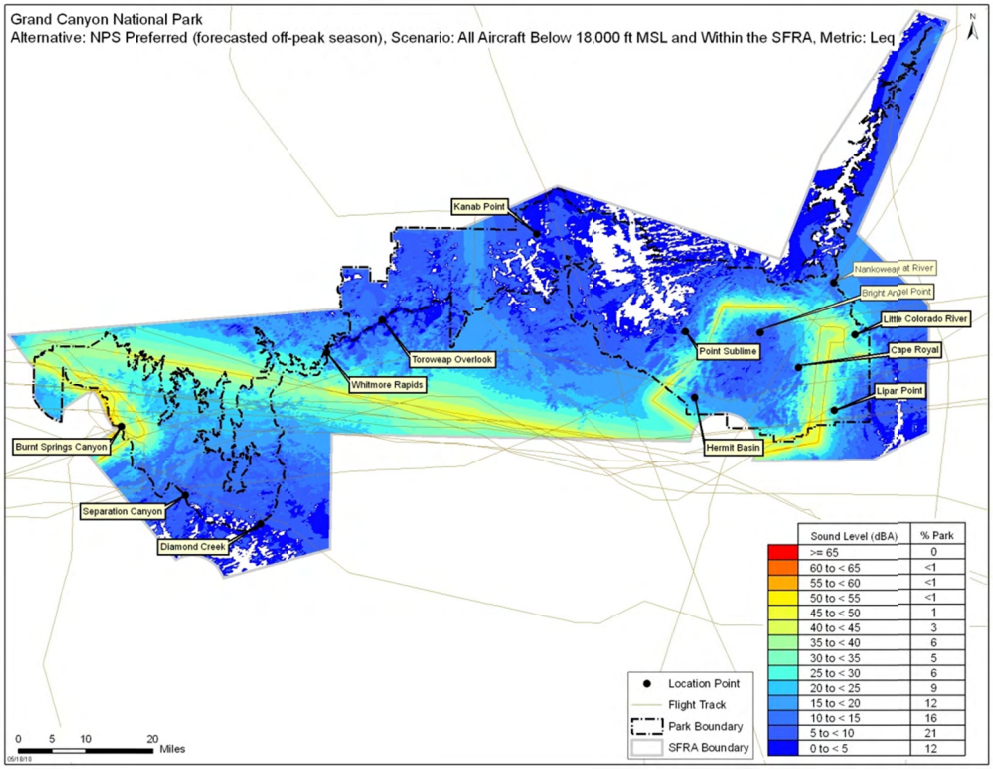


TABLE 4.17 NPS PREFERRED PERCENT TIME AUDIBLE CONTOUR ANALYSIS RESULTS PEAK SEASON[abc]

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 Restored				**53%**				**67%**
≥ 25	72%	76%	45%	47%	28%	31%	33%	33%
10 to < 25	9%	9%	10%	10%	16%	19%	13%	13%
5 to < 10	3%	3%	6%	6%	15%	11%	7%	7%
> 0 to < 5	17%	11%	38%	37%	41%	39%	46%	46%
Percent of Zone Difference in Percent Time Audible Contour Results with Alternative A								
≥ 25	17%	3%	-1%	-2%	62%	49%	12%	14%
10 to < 25	-2%	-2%	0%	1%	-12%	-12%	-3%	-3%
5 to < 10	-2%	-1%	0%	0%	-14%	-8%	-2%	-2%
> 0 to < 5	-12%	0%	1%	1%	-36%	-28%	-8%	-9%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%
[b]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
[c]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

TABLE 4.18 NPS PREFERRED 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	10%	15%	15%	14%	15%	10%	11%	12%	12%	13%
25 to < 35	28%	33%	14%	15%	15%	9%	13%	12%	12%	14%
15 to < 25	59%	33%	21%	22%	24%	70%	43%	20%	21%	24%
> 0 to < 15	3%	19%	48%	46%	44%	12%	33%	49%	48%	45%
% of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	-1%	6%	1%	1%	0%	15%	21%	10%	11%	1%
25 to < 35	27%	4%	-1%	-1%	1%	66%	44%	14%	16%	6%
15 to < 25	-26%	-5%	1%	0%	3%	-68%	-33%	18%	15%	17%
> 0 to < 15	0%	-5%	0%	0%	-4%	-12%	-32%	-36%	-36%	-21%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%
[b]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

TABLE 4.19 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%	18 dBA	0%	0%	0%	1%	18 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%
East End	Max	100%	52 dBA	100%	42%	11%	98%	51 dBA	100%	33%	8%
	Median	60%	27 dBA	0%	0%	0%	28%	22 dBA	0%	0%	0%
	Min	0%	7 dBA	0%	0%	0%	0%	3 dBA	0%	0%	0%
Central	Max	21%	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	94%	49 dBA	77%	31%	9%	88%	48 dBA	77%	29%	6%
	Median	19%	21 dBA	0%	0%	0%	13%	21 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	9%	15 dBA	0%	0%	0%	5%	14 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%	6 dBA	1%	0%	0%	2%	7 dBA	1%	0%	0%
	Median	1%	7 dBA	0%	0%	0%	1%	8 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%	-2 dBA	0%	24%	-3%
	Median	4%	2 dBA	5%	0%	0%	39%	7 dBA	6%	0%	0%
	Min	0%	-1 dBA	0%	0%	0%	0%	4 dBA	0%	0%	0%
Central	Max	1%	0 dBA	0%	0%	0%	0%	1 dBA	0%	0%	0%
	Median	0%	0 dBA	0%	0%	0%	1%	0 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
West End	Max	-1%	-2 dBA	-6%	-2%	-4%	7%	0 dBA	5%	4%	-1%
	Median	0%	1 dBA	0%	0%	0%	8%	2 dBA	0%	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%	-2 dBA	0%	24%	-3%
	Median	0%	1 dBA	0%	0%	0%	5%	4 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

[a]Max 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

[b]TAUD = Percent Time Audible

[c]L_{Aeq12} = Average Sound Level

[d]TALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively

TABLE 4.20 NPS PREFERRED OFF-PEAK[abc] PERCENT TIME AUDIBLE CONTOUR ANALYSIS RESULTS

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
Percent Park Restored				**63%**				**77%**
≥ 25	64%	66%	36%	37%	21%	19%	23%	23%
10 to < 25	12%	14%	14%	14%	18%	27%	17%	17%
5 to < 10	3%	5%	8%	7%	16%	14%	10%	10%
> 0 to < 5	21%	15%	42%	40%	45%	40%	48%	48%
Percent of Zone Difference in Percent Time Audible Contour Results with Alternative A								
≥ 25	24%	13%	8%	8%	69%	61%	22%	24%
10 to < 25	-5%	-6%	-3%	-3%	-13%	-20%	-7%	-7%
5 to < 10	-3%	-2%	-2%	-2%	-15%	-11%	-4%	-5%
> 0 to < 5	-16%	-4%	-2%	-2%	-41%	-29%	-10%	-11%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%
[b]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
[c]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

TABLE 4.21 NPS PREFERRED OFF-PEAK[ab] AVERAGE SOUND LEVEL CONTOUR ANALYSIS RESULTS

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	11%	13%	12%	12%	13%	10%	11%	10%	10%	11%
25 to < 35	12%	19%	12%	12%	13%	6%	10%	12%	11%	14%
15 to < 25	71%	39%	19%	20%	21%	59%	43%	19%	21%	22%
> 0 to < 15	6%	29%	49%	47%	46%	25%	36%	50%	49%	46%
Percent of Zone Difference in Average Sound Level Contour Results with Alternative A										
≥ 35	-2%	8%	3%	3%	1%	14%	21%	12%	13%	3%
25 to < 35	43%	18%	0%	2%	2%	68%	47%	15%	17%	7%
15 to < 25	-38%	-11%	3%	2%	6%	-57%	-34%	19%	16%	19%
> 0 to < 15	-4%	-15%	-1%	-2%	-6%	-25%	-35%	-37%	-37%	-22%

[a]Due to rounding differences, totals in this table may differ from Appendix D by up to 2%
[b]Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or was below 0 dBA

TABLE 4.22 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	87%	53 dBA	46%	14%	5%	68%	52 dBA	43%	15%	6%
	Median	36%	21 dBA	0%	0%	0%	12%	18 dBA	0%	0%	0%
	Min	0%	1 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
Central	Max	22%	28 dBA	4%	0%	0%	23%	26 dBA	4%	0%	0%
	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%
West End	Max	93%	49 dBA	78%	31%	8%	86%	48 dBA	75%	27%	6%
	Median	19%	20 dBA	0%	0%	0%	11%	19 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	93%	53 dBA	78%	31%	8%	86%	52 dBA	75%	27%	6%
	Median	7%	13 dBA	0%	0%	0%	4%	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%	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	13%	-4 dBA	55%	37%	0%	32%	-3 dBA	57%	41%	0%
	Median	28%	7 dBA	5%	0%	0%	55%	11 dBA	6%	0%	0%
	Min	0%	5 dBA	0%	0%	0%	0%	7 dBA	0%	0%	0%
Central	Max	1%	-1 dBA	0%	0%	0%	2%	1 dBA	0%	0%	0%
	Median	0%	1 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	1%	-2 dBA	-6%	-2%	-4%	9%	0 dBA	6%	6%	-1%
	Median	-1%	2 dBA	0%	0%	0%	10%	4 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%
All Location Points	Max	7%	-4 dBA	22%	21%	-3%	14%	-3 dBA	25%	30%	0%
	Median	2%	4 dBA	0%	0%	0%	6%	5 dBA	0%	0%	0%
	Min	0%	0 dBA	0%	0%	0%	0%	0 dBA	0%	0%	0%

[a]Max 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

[b]TAUD = Percent Time Audible

[c]L_{Aeq12} = Average Sound Level

[d]TALA35 dBA, TALA45 dBA, and TALA55 dBA = Percent of time during the 12-hour day used in this analysis that aircraft sounds exceed 35, 45, and 55 dBA, respectively

Developed Zone (about 2% of GCNP) 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 NPS Preferred Alternative Soundscape
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 38% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 28% of the Zone (moderate adverse impact) and greater than 35 dBA in 10% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 81% of the Zone; that is 10 to 25% in 9% of the Zone (moderate adverse impact) and greater than 25% in 72% of the Zone (major adverse impact). This would represent a reduction of 26% in area with aircraft Average Sound Level of 25 dBA or more and a reduction of 15% in area of 10% or more Percent Time Audible compared to Alternative A (a 15% to 26% reduction in areas of moderate to major adverse impact), resulting in a moderate beneficial change in impacts compared to Alternative A, primarily due to closure of Zuni Point Corridor to short-loop tours Peak Season, even though Zuni Point/Dragon Corridor long-loop tour routes would remain open.

For areas near active Dragon Corridor routes, impacts are mixed and mostly similar to Alternative A with a few notable exceptions. Specifically 1) implementation of a Dragon Corridor dogleg would negligibly increase Percent Time Audible for areas closest to it as tours would be flying a slightly longer route; however, it would also have negligible benefits in Average Sound Level reductions to other Developed Zone areas further away; and 2) Dragon Corridor short-loop route would also result in a minor adverse increase in Percent Time Audible for areas near Dragon Corridor (approximately 12% of the time at Bright Angel Point Location Point).

Developed Zone NPS Preferred Alternative Soundscape
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 23% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 12% of the Zone (moderate adverse impact) and greater than 35 dBA in 11% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 76% of the Zone; that is 10 to 25% in 12% of the Zone (moderate adverse impact) and greater than 25% in 64% of the Zone (major adverse impact). This would represent a reduction of 41% in area with Average Sound Level of 25 dBA or more and a reduction of 19% in area of 10% or more Percent Time Audible compared to Alternative A (a 19 to 41% reduction in areas of moderate to major adverse impact), resulting in a moderate to major beneficial change in impacts compared to Alternative A, primarily due to fewer air-tour operations Off-Peak Season, and Dragon Corridor closure to short-loop air-tours Off-Peak Season, even though the long-loop Zuni-Dragon tour would remain open.

For areas near active Zuni Point Corridor routes, there would be negligible to moderate increases in Percent Time Audible (approximately 12% of the time at Bright Angel Point).

Developed Zone NPS Preferred Alternative Soundscape
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 19% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 9% of the Zone (moderate adverse impact) and greater than 35 dBA in 10% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 44% of the Zone; that is 10 to 25% in 16% of the Zone (moderate adverse impact) and greater than 25% in 28% of the Zone (major adverse impact). This would represent a reduction of 81% in area with Average Sound Level of 25 dBA or more and a reduction of 50% in area of 10% or more Percent Time Audible compared to Alternative A (a 50 to 81% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Developed Zone *NPS Preferred Alternative* *Soundscape*
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 16% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 6% of the Zone (moderate adverse impact) and greater than 35 dBA in 10% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 39% of the Zone; that is 10 to 25% in 18% of the Zone (moderate adverse impact) and greater than 25% in 21% of the Zone (major adverse impact). This would represent a reduction of 82% in area with Average Sound Level of 25 dBA or more and a reduction of 56% in area of 10% or more Percent Time Audible compared to Alternative A (a 56 to 82% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A.

Non-Wilderness Zone (6% of GCNP) ***NPS Preferred Alternative*** ***Soundscape***

Almost all Non-Wilderness Zone areas are located in East End (exceptions are a few Central area dirt road corridors). A portion of the Non-Wilderness Zone is in the Dual-Zone System area where 10 dBA is added to natural ambient sound levels for audibility calculations; this portion is generally close to Developed Zone areas with motorized noise sources, although there is a strip of Non-Wilderness Zone on Marble Canyon's east side. The majority of Non-Wilderness Zone is in the area where natural ambient sound levels are used directly as the basis for audibility calculations, consistent with Non-Wilderness Zone management objectives that call for mostly natural conditions to prevail.

Non-Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 48% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 33% of the Zone (moderate adverse impact) and greater than 35 dBA in 15% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 85% of the Zone; that is 10 to 25% in 9% of the Zone (moderate adverse impact) and greater than 25% in 76% of the Zone (major adverse impact). This would represent a 10% reduction in area with Average Sound Level of 25 dBA or more and no change in area of 10% or more Percent Time Audible compared to Alternative A (a zero to 10% reduction in areas of moderate to major adverse impact), resulting in a negligible change in impacts compared to Alternative A.

For areas near active Dragon Corridor routes, implementation of a Dragon Corridor dogleg would result in negligible to minor increases in Percent Time Audible for areas closest to it as tours would be flying a slightly longer route; however, it would also have negligible benefits in sound level reductions to other areas further away.

Non-Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 32% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 19% of the Zone (moderate adverse impact) and greater than 35 dBA in 13% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 80% of the Zone; that is 10 to 25% in 14% of the Zone (moderate adverse impact) and greater than 25% in 66% of the Zone (major adverse impact). This would represent a reduction of 3% in area with Average Sound Level of 25 dBA or more and a reduction of 7% in area of 10% or more Percent Time Audible compared to Alternative A (a 3 to 7% reduction in areas of moderate to major adverse impact), resulting in a negligible to minor beneficial change in impacts compared to Alternative A.

For areas close to active Zuni Point Corridor routes, impacts are mixed. Specifically, negligible to moderate increases in Percent Time Audible for areas closest to it as tours would be flying a short loop, whereas no tours coincidentally flew a loop tour in Zuni Point Corridor on the Peak Day Alternative A (approximately 5% of the time at Lipan Point).

Non-Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 24% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 13% of the Zone (moderate adverse impact) and greater than 35 dBA in 11% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 50% of the Zone; that is 10 to 25% in 19% of the Zone (moderate adverse impact) and greater than 25% in 31% of the Zone (major adverse impact). This would represent a 65% reduction in area with Average Sound Level of 25 dBA or more and a 37% reduction in area of 10% or more Percent Time Audible compared to Alternative A (a 37 to 65% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A, primarily because the NPS Preferred Alternative includes quiet-technology incentives and conversion requirements.

Non-Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 21% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 10% of the Zone (moderate adverse impact) and greater than 35 dBA in 11% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 46% of the Zone; that is 10 to 25% in 27% of the Zone (moderate adverse impact) and greater than 25% in 19% of the Zone (major adverse impact). This represents a 68% reduction in area with Average Sound Level of 25 dBA or more and a 41% reduction in area of 10% or more Percent Time Audible compared to Alternative A (a 41 to 65% reduction in areas of moderate to major adverse impact), resulting in a major beneficial change in impacts compared to Alternative A, primarily because the NPS Preferred Alternative includes quiet-technology incentives and conversion requirements.

Wilderness Zone (94% of GCNP) **NPS Preferred Alternative** **Soundscape**

In the Wilderness Zone, results vary to a greater degree than in Developed and Non-Wilderness Zones due to the Wilderness Zone's increased size and geographic extent as compared to the others. Most of the Wilderness Zone is in the area where natural ambient sound levels are used directly in audibility calculations in the Dual-Zone System acoustic approach to noise modeling. Exceptions are West End and Marble Canyon.

Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Base Year Peak Season

Average Sound Level would generally be 25 dBA or more in 29% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 15% of the Zone (moderate adverse impact) and greater than 35 dBA in 14% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 55% of the Zone; that is 10 to 25% in 10% of the Zone (moderate adverse impact) and greater than 25% in 45% of the Zone (major adverse impact). This would represent essentially no change in areas of moderate to major adverse impact, or essentially no change in impacts compared to Alternative A.

Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Base Year Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 24% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 12% of the Zone (moderate adverse impact) and greater than 35 dBA in 12% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more of the day in 50% of the Zone; that is 10 to 25% in 14% of the Zone (moderate adverse impact) and greater than 25% in 36% of the Zone (major adverse impact). This would represent a 5% reduction in area with Average Sound Level of 25 dBA or more and a 5% reduction in area of 10% or more Percent Time Audible compared to Alternative A (a 5% reduction in areas of moderate to major adverse impact), resulting in a negligible to minor beneficial change in impacts compared to Alternative A.

Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Ten-Year Forecast Peak Season

Average Sound Level would generally be greater than 25 dBA in 24% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 12% of the Zone (moderate adverse impact) and greater than 35 dBA in 12% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 46% of the Zone; that is

10 to 25% in 13% of the Zone (moderate adverse impact) and greater than 25% in 33% of the Zone (major adverse impact). This would represent a reduction of 24% in area with Average Sound Level of 25 dBA or more and a reduction of 9% in area of 10% or more Percent Time Audible compared to Alternative A (a 9 to 24% reduction in areas of moderate to major adverse impact), resulting in a minor to moderate beneficial change in impacts compared to Alternative A, primarily because the NPS Preferred Alternative includes quiet-technology incentives and conversion requirements.

Wilderness Zone *NPS Preferred Alternative* *Soundscape*
Ten-Year Forecast Off-Peak Season

Average Sound Level would generally be greater than 25 dBA in 22% of the Zone; that is, Average Sound Level would be 25 to 35 dBA in 12% of the Zone (moderate adverse impact) and greater than 35 dBA in 10% of the Zone (major adverse impact). Percent Time Audible would generally be 10% or more in 40% of the Zone; that is 10 to 25% in 17% of the Zone (moderate adverse impact) and greater than 25% in 23% of the Zone (major adverse impact). This would represent a reduction of 27% in area with Average Sound Level of 25 dBA or more and a reduction of 15% in area of 10% or more Percent Time Audible compared to Alternative A (a 15 to 27% reduction in areas of moderate to major adverse impact), resulting in a moderate beneficial change in impacts compared to Alternative A, primarily because the NPS Preferred Alternative includes quiet-technology incentives and conversion requirements.

Marble Canyon **NPS Preferred Alternative** **Soundscape**

Marble Canyon's west side is located in the Wilderness Zone; the east side in 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 audibility (Chapter 4, Methodology). Seasonal use of Zuni Point and Dragon Corridors would not affect this area. In Marble Canyon, based on Figures 4.26 to 4.33, air-tour aircraft Average Sound Level would be less than 15 dBA, and barely audible.

Marble Canyon *NPS Preferred Alternative* *Soundscape*
Base Year and Ten-Year Forecast Peak Season

Marble Canyon Location Points Percent Time Audible range zero to one percent, and Average Sound Level zero to 18 dBA. These values represent negligible impacts with negligible to minor beneficial changes in impacts compared to Alternative A.

Marble Canyon *NPS Preferred Alternative* *Soundscape*
Base and Ten-Year Forecast Off-Peak Season

Marble Canyon Location Points Base Year Off-Peak Season, Percent Time Audible is the same as Peak Season, but Average Sound Level would range zero to 13 dBA. Ten-Year Forecast results would be nearly identical (within one percent and one dBA). These values represent negligible impacts with negligible to minor beneficial changes in impacts compared to Alternative A.

East End **NPS Preferred Alternative** **Soundscape**

Under the NPS Preferred Alternative, greatest exposure to noise and visual impacts would continue in East End. However, air-tour sounds would be reduced due to seasonal use of Zuni Point and Dragon Corridors. East End includes all three Management Zones: Developed, Non-Wilderness, and Wilderness. The one-hour extended curfew would benefit Soundscape in all East End Management Zones. Localized long- and short-term impacts would generally be major adverse under and near Zuni Point and Dragon Corridors and North Rim routes, and negligible to minor adverse amid Bright Angel Flight-free Zone. Additionally, creation of a Dragon Corridor dogleg would increase Percent Time Audible, but reduce Average Sound Level in the dogleg localized area. Impacts would be reduced compared to Alternative A in Nankoweap, Little Colorado River confluence, and Hermit Basin Location Point areas.

East End *NPS Preferred Alternative* *Soundscape*
Base Year Peak Season

East End Location Points would range zero to 100% Percent Time Audible (median 60%), and Average Sound Level 7 dBA to 52 dBA (median 27 dBA). At some locations, aircraft events would exceed 35 dBA 100% of the

day, 45 dBA 42% of the day, and 55 dBA 11% of the day. This would result in a negligible to minor beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Soundscape*
Base Year Off-Peak Season

East End Location Points would range zero to 87% Percent Time Audible (median 36%), and one to 53 dBA (median 21 dBA). At some locations, aircraft events would exceed 35 dBA 46% of the day, 45 dBA 14% of the day, and 55 dBA 5% of the day. Because this represents a 28% reduction in median Percent Time Audible and a 13% reduction in maximum Percent Time Audible, this would be a moderate to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Soundscape*
Ten-Year Forecast Peak Season

East End Location Points Percent Time Audible would have a similar range as Base Year, but median Percent Time Audible would be reduced to 28%, a reduction of 32% compared to Base Year, and a 39% reduction in median Percent Time Audible compared to Alternative A. Average Sound Level would be slightly reduced compared to Base Year, with a negligible change compared to Alternative A. There would be a moderate to major adverse impact under and near Zuni Point and Dragon Corridors and across North Rim (a major beneficial change in impacts from Alternative A), and a negligible to minor adverse impact away from routes and amid Bright Angel Flight-free Zone (a negligible to moderate beneficial change in impacts from Alternative A).

East End *NPS Preferred Alternative* *Soundscape*
Ten-Year Forecast Off-Peak Season

East End Location Points Percent Time Audible would range zero to 68% (median 12%), and Average Sound Level zero to 52 dBA (median 18 dBA). Compared to Base Year Off-Peak Season, this represents a 24% reduction in median Percent Time Audible and a 3 dBA reduction in median Average Sound Level. This represents a 55% reduction in median Percent Time Audible and a 32% reduction in maximum Percent Time Audible. There would be a moderate adverse impact under and near Zuni Point and Dragon Corridors and across North Rim (a major beneficial change in impacts from Alternative A, and a negligible to minor adverse impact away from routes and amid Bright Angel Flight-free Zone (a negligible to moderate beneficial change from Alternative A).

Central **NPS Preferred Alternative** **Soundscape**

The Central area is located in the Wilderness Zone, excepting a few Non-Wilderness Zone dirt road corridors, and a very small Developed Zone area at Tuweep. The Central area is entirely in the Dual-Zone System audibility area in which natural ambient sound levels are used directly in audibility calculations. This area comprises most of the Toroweap/Shinumo Flight-free Zone, and is transected by two general-aviation corridors.

Central *NPS Preferred Alternative* *Soundscape*
Base Year and Ten-Year Forecast Peak Season

Central area Location Points range zero to 21% Percent Time Audible (median one percent), and Average Sound Level zero to 27 dBA (median 10 dBA). Impacts would generally be negligible, with negligible change from Alternative A (within 5% Percent Time Audible at one dBA).

Central *NPS Preferred Alternative* *Soundscape*
Base Year and Ten-Year Forecast Off-Peak Season

Central area Location Points range zero to 22% Percent Time Audible (median one percent), and Average Sound Level zero to 28 dBA (median 9 dBA). Impacts would generally be negligible, with negligible change from Alternative A (within 2% Percent Time Audible at one dBA).

West End NPS Preferred Alternative Soundscape

The 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, depending on proximity to Blue Direct and Blue-2/Green-4 routes.

West End NPS Preferred Alternative Soundscape
Base Year and Ten-Year Forecast Peak Season

Overall impacts would be very similar to Alternative A. **West End Location Points** range zero to 94% Percent Time Audible (median 19%), and Average Sound Level zero to 49 dBA (median 21 dBA). At some locations, aircraft events would exceed 35 dBA for 77% of the day, 45 dBA 31% of the day, and 55 dBA 9% of the day. Peak Season Ten-Year Forecast, Average Sound Level would be essentially unchanged from Base Year, but Percent Time Audible would be reduced by 6% for both maximum and median values due to NPS Preferred Alternative quiet-technology conversion requirements. These values represent negligible to minor beneficial changes in impacts compared to Alternative A.

For areas near Blue Direct North and Blue-2/Green-4 routes (**West End's northern portion**), localized long- and short-term impacts would be moderate to major adverse (from Figures 4.26 to 4.33, Average Sound Level would be 40 to 50 dBA, aircraft 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 4.26 to 4.33, Average Sound Level would be 10 to 20 dBA, aircraft Percent Time Audible would be less than 20 percent). These values represent negligible to minor beneficial changes in impacts compared to Alternative A.

West End NPS Preferred Alternative Soundscape
Base Year and Ten-Year Forecast Off-Peak Season

Results are very similar to Peak Season. Thus, there would be moderate to major adverse impacts in **West End's northern portion** near air tour routes and negligible to minor adverse impacts in **West End's southern portion** away from air tour routes, with negligible to minor beneficial changes in impacts from Base Year to Ten-Year Forecast in both Percent Time Audible (5 to 10%) and Average Sound Level (2 to 4 dBA) Peak and Off-Peak Seasons, and negligible to minor beneficial changes in impacts compared to Alternative A.

NPS Units in the SFRA Outside Grand Canyon National Park NPS Preferred Alternative Soundscape

For NPS lands directly **under and within five miles of Blue Direct Blue-2 and Green-4 routes** (Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument) and other busy air-tour corridors in GCNP, impacts would be major adverse (from Figures 4.26 to 4.33, Average Sound Level would range 40 to 50 dBA). NPS Preferred Alternative quiet-technology incentives and conversion requirements would provide some mitigation to these adverse impacts by decreasing affected area size; however, those areas still affected would experience additional localized impacts if operations increase. The **remainder of the SFRA outside GCNP** would experience Average Sound Level less than 25 dBA, with localized long- and short-term minor adverse impacts. As with GCNP, **the SFRA as a whole** would benefit from NPS Preferred Alternative quiet-technology incentives and conversion requirements.

Cumulative Impacts NPS Preferred Alternative Soundscape

Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed in Alternative A, and 2) noise generated from aircraft under NPS Preferred Alternative as discussed above, would continue to have long-term moderate to major adverse cumulative impacts on Soundscape throughout all four park areas (Marble Canyon, East End, Central, and West End), and SFRA similar to cumulative impacts described for Alternative A. Quiet-technology incentives and conversion requirements under NPS Preferred Alternative would mitigate a small amount of those impacts over the Ten-Year Forecast period.

Conclusion NPS Preferred Alternative Soundscape

Under the NPS Preferred Alternative, a range of aircraft noise intensities and audibility would affect GCNP Soundscapes. Beneficial impacts on East End due to quiet-technology incentives and seasonal use of Dragon Corridor Peak Season and, conversely, Zuni Point Corridor Off-Peak Season, are clearly seen in modeled results. All East End Management Zones and Marble Canyon benefit from the additional one-hour curfew. Because the NPS Preferred Alternative includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast in the park as a whole. Beneficial impacts would be seen in both Percent Time Audible and Average Sound Level.

Base Year Substantial Restoration of Natural Quiet would be achieved in 53% of the park Peak Season, and in 63% of the park Off-Peak Season. These represent a negligible change in impacts compared to Alternative A Peak Season with a 2% decrease in park area restored, and a minor beneficial change in impacts compared to Alternative A Off-Peak Season with an 8% increase.

Ten-Year Forecast, Substantial Restoration of Natural Quiet would be achieved in 67% of the park Peak Season, and 77% of the park Off-Peak Season. These represent moderate beneficial changes in impacts compared to Alternative A with a 14% increase in park area restored Peak Season, and a 24% increase Off-Peak Season.

Conclusion by Zone NPS Preferred Alternative Soundscape

Ten-Year Forecast Peak Season

Wilderness Zone (about 94% of GCNP); area of moderate to major adverse impact would be 24 to 46% of the Zone, a minor to moderate beneficial change in impacts (9 to 24% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Non-Wilderness Zone (about 4% of GCNP); area of moderate to major adverse impact would be 24 to 50% of the Zone, a major beneficial change in impacts (37 to 65% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Developed Zone (about 2% of GCNP); area of moderate to major adverse impact would be 19 to 44% of the Zone, a minor to major beneficial change in impacts (10 to 81% reduction in area of moderate to major adverse impacts) compared to Alternative A.

Conclusion by Area NPS Preferred Alternative Soundscape

In Marble Canyon, Central areas, and West End (southern portions), localized long- and short-term impacts would generally be negligible to minor adverse (Average Sound Level less than 15 dBA, aircraft Percent Time Audible less than 5%) with negligible to minor beneficial change compared to Alternative A. Greatest exposure to noise and visual impacts would occur under and near air tour routes in East End and West End's northern portion where long- and short-term moderate to major adverse impacts would occur (Average Sound Level 40 to 50 dBA, aircraft Percent Time Audible greater than 65%) with negligible to minor beneficial change in impacts compared to Alternative A West End, and major beneficial change compared to Alternative A East End. In East End areas away from routes and amid Flight-free Zones, impacts would be negligible to minor adverse with negligible to moderate beneficial change from Alternative A.

Cumulative Impacts NPS Preferred Alternative Soundscape

Cumulative impacts from all actions would be long-term moderate to major adverse, due primarily to high levels of aircraft audibility.

Summary of Impacts All Alternatives Soundscape

Substantial Restoration of Natural Quiet at Grand Canyon National Park will be achieved when reduction of noise from aircraft operations below 18,000 feet MSL results in at least 50% or more of the park achieving restoration of natural quiet (no aircraft audible) 75 to 100% of the day, each and every day. The four Alternatives analyzed in this EIS provide different ways of meeting agency goals and/or objectives.

Tables 4.23 through 4.26 provide summary comparisons for different metrics modeled. Comparing Alternatives for all metrics, those with the lowest overall Soundscape impacts are Alternatives E and the NPS Preferred. The Alternative with greatest overall Soundscape impact is Alternative A.

Common to all Alternatives, a range of aircraft noise intensities and audibility would affect GCNP Soundscapes and areas outside the park in the SFRA. In Developed and Non-Wilderness Zones, aircraft audibility can be masked by sounds of visitor activity where non-natural sound sources predominate.

In the Wilderness Zone, results vary to a greater degree than in the Developed and Non-Wilderness Zones due to the Wilderness Zone's increased size and geographic extent as compared to the others. In Marble Canyon, Central areas, and West End's southern portion, localized long- and short-term adverse impacts would be negligible (Average Sound Level less than 15 dBA, Percent Time Audible less than 5%) under all Alternatives.

Although each Alternative provides different elements to manage air-tours and air-tour-related activity, greatest exposure to noise and visual impacts remain East and West Ends where long- and short-term impacts would be major adverse (Average Sound Level 40 to 50 dBA, Percent Time Audible greater than 75%). A range of beneficial impacts are evident in modeled results. Comparing elements among Alternatives for all metrics, Alternatives with greatest benefits include seasonal closures or changes to air-tour routes, extended curfew hours, and quiet-technology incentives or conversion requirements.

TABLE 4.23 CONTOUR ANALYSIS COMPARISON ALL ALTERNATIVES PERCENT TIME AUDIBLE[36,37] BASE YEAR

Percent Time Audible	Percent of Park by Alternative						
	A	E		F		NPS Preferred	
		Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
≥ 25	45	25	22	49	41	47	37
10 to < 25	10	7	8	8	14	10	14
5 to < 10	5	6	6	5	7	6	7
> 0 to < 5	38	61	63	38	37	37	40
% Park Restored	**55**	**75**	**78**	**51**	**59**	**53**	**63**

TABLE 4.24 CONTOUR ANALYSIS COMPARISON ALL ALTERNATIVES PERCENT TIME AUDIBLE TEN-YEAR FORECAST

Percent Time Audible	Percent of Park by Alternative						
	A	E		F		NPS Preferred	
		Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
≥ 25	47	16	14	34	25	33	23
10 to < 25	10	8	7	13	17	13	17
5 to < 10	5	6	6	5	8	7	10
> 0 to < 5	37	69	71	47	49	46	48
% Park Restored	**53**	**84**	**86**	**66**	**75**	**67**	**77**

[36] 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

[37] Columns do not always sum to 100% because contours include blank areas to indicate where aircraft noise was not audible or below 0 dBA

TABLE 4.25 CONTOUR ANALYSIS COMPARISON ALL ALTERNATIVES AVERAGE SOUND LEVEL BASE YEAR

Average Sound Level (dBA)	Percent of Park by Alternative						
	A	E		F		NPS Preferred	
		Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
≥ 35	16	8	7	17	14	14	12
25 to < 35	14	6	5	16	15	15	12
15 to < 25	22	18	15	20	19	22	20
> 0 to < 15	46	59	63	44	46	46	47

TABLE 4.26 CONTOUR ANALYSIS COMPARISON ALL ALTERNATIVES AVERAGE SOUND LEVEL TEN-YEAR FORECAST

Average Sound Level (dBA)	Percent of Park by Alternative						
	A	E		F		NPS Preferred	
		Peak	Off-Peak	Peak	Off-Peak	Peak	Off-Peak
≥ 35	23	6	5	14	11	12	10
25 to < 35	28	5	5	14	14	12	11
15 to < 25	37	19	17	21	19	21	21
> 0 to < 15	13	61	64	48	51	48	49

WILDERNESS CHARACTER

General Assumptions — Wilderness Character

In the thresholds below, all aspects of aircraft noise intensity and duration, including but not limited to aircraft audibility, Average Sound Level (sound energy metrics), and timing are considered in the phrase *impacts due to the event*. Audibility is the ability of animals and humans with normal hearing to hear a given sound. Audibility is affected by hearing ability of individual animals and humans, other simultaneous interfering sounds or stimuli, and by sound frequency content and amplitude. Sound energy metrics include Average Sound Level and Percent Time Above decibel levels. Aircraft noise intensity and duration is an important component of Wilderness Character related to Wildlife, Special Status Species, Soundscape, and Visitor Use and Experience.

A measure of Distance between points of interest to wilderness visitors and aircraft routes is used as an indicator related to effects of aircraft being in close proximity to sensitive Wilderness sites, including visibility and presence of aircraft to people on the ground (issues related to privacy and solitude), and of people on the ground to people in aircraft. While there is usually a close correlation between Distance and sound intensity, this Distance measure is included primarily to address effects other than aircraft sound.

NPS-Specific Methodology — Wilderness Character

Analysis of impacts to Wilderness Character considers the impact analyses for all other impact topics. Analysis relies to a large extent on noise modeling results at Location Points in the park and those that fall in designated or proposed Wilderness areas on other Federal lands in the SFRA, but all relevant information including other available noise modeling data was also considered. Noise data is presented typically as a range between Location Points in an area of the park or SFRA to provide an understanding of the level of effect for specific areas influenced by air-tour operations. Distribution of these points in relation to Wilderness and current flight routes is depicted on Map 3.3. For this impacts analysis, Wilderness Character includes consideration of qualities or characteristics (based on Wilderness Act suitability criteria) as described in Chapter 3, Wilderness Character.

SFRA overflights would not result in physical development or landscape trammeling. Therefore analysis of impacts to Wilderness Character focus on effects to natural conditions (Special Status Species and Wildlife) and

opportunities for solitude or a primitive and unconfined type of recreation (Visitor Use and Experience, Soundscape).

Wilderness Character impact analysis applies to Wilderness lands in the SFRA, which includes proposed Wilderness in the park and other NPS lands, and designated Wilderness on outside the park (see Chapter 3). The park's Non-Wilderness and Developed Zones, as well as Non-Wilderness lands outside the park but in the SFRA, are not assessed for impacts to Wilderness Character.

Impact Intensity Threshold Descriptions **Wilderness Character**

As described in General Methodology, NPS applied noise modeling and other data to threshold descriptions to determine levels of impact in Alternative A, No Action/Current Condition, and then used a similar approach to evaluate changes in impacts in the Action Alternatives compared to the No Action Alternative. Threshold descriptions for Wilderness are

Threshold Levels **Wilderness Character**

Negligible Impacts due to the event have little or no discernible effect on Wilderness Character

Natural conditions prevail. Forces of nature primarily affect Wilderness lands

Outstanding opportunities exist for solitude or a primitive and unconfined type of recreation

Aircraft audible less than or equal to 5% of the 12-hour day used in this analysis

Distance from points of interest to aircraft routes is greater than or equal to 2,000 meters

Aircraft noise intensity in a specific area is less than or equal to 15 dBA

Minor

Impacts due to the event are slightly detectable to Wilderness Character in limited areas

Natural conditions predominate. Wilderness lands generally appear affected primarily by forces of nature

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

Aircraft audible greater than 5% and less than or equal to 10% of the 12-hour day
Distance from points of interest to aircraft routes is greater than or equal to 1,000 and less than 2,000 meters

Aircraft noise intensity in a specific area is greater than 15 dBA and less than or equal to 25 dBA

Moderate Impacts due to the action are readily apparent to Wilderness Character in limited areas

It is apparent that natural conditions are altered by the event

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

Aircraft audible greater than 10% and less than or equal to 25% of the 12-hour day

Distance from points of interest to aircraft routes is greater than or equal to 500 and less than 1,000 meters

	Aircraft noise intensity in a specific area is greater than 25 dBA and less than or equal to 35 dBA
Major	Impacts of the action substantially alter Wilderness Character throughout a large portion of Wilderness lands
	Natural conditions are substantially altered by the action
	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
	Aircraft audible greater than 25% of the 12-hour day
	Distance from points of interest to aircraft routes is less than 500 meters
	Aircraft noise intensity in a specific area is greater than 35 dBA

Type of Impact	**Wilderness Character**
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 degrade public purposes of Wilderness (recreation, scenic, scientific, education, conservation, and historical use)
Beneficial	Impacts of the event contribute to or maintain the preservation of Wilderness Character components (natural conditions and outstanding opportunities for solitude or a primitive and unconfined type of recreation) or support public purposes of Wilderness (recreation, scenic, scientific, education, conservation, and historical use)

Context	**Wilderness Character**
Regional	Impacts affect majority of lands proposed for or designated as Wilderness within the Study Area
Localized	Impacts confined to specific areas in proposed or designated Wilderness in the Study Area
Park Management Zone	Not applicable. Wilderness Character is only assessed 1) for NPS lands designated, proposed, or recommended as Wilderness in the NPS Wilderness Zone and 2) for non- NPS lands designated as Wilderness or determined eligible for Wilderness designation depending on policies of the applicable land manager

Duration	**Wilderness Character**
Short Term	Impacts associated with individual, infrequent, and/or non-repetitive events affecting Wilderness Character no more than the day the events occur
Long Term	Impacts continue after completion of individual events and persist longer than the day events occur. Related events that are frequent or repetitive over more than a few days would also be considered long-term
Timing	Frequency of occurrence is an important timing consideration in assessing impacts to Wilderness Character. A subset of that issue is whether impacts would occur year-round or seasonally. Time of day, especially morning and evening, can also be important in visitor opportunities to experience solitude and Wilderness resources affected primarily by forces of nature

IMPACTS OF ALTERNATIVE A NO ACTION WILDERNESS CHARACTER

Under Alternative A, a range of aircraft noise intensities and audibility would affect Wilderness Character, especially East End. At all locations, impacts would be about the same Base Year and Ten-Year Forecast.

Nearly 50% of Wilderness[38] in the Study Area would have air-tour aircraft Percent Time Audible greater than 25% of the day predominantly East and West Ends under and near air-tour routes. Air-tour Average Sound Level would generally be low, less than 25 dBA, in about 69% of proposed Wilderness Base Year. From Base Year to Ten-Year Forecast, Average Sound Level would increase as air-tour operations increase with 45% of the area experiencing noise at less than 25 dBA, and 22% of the area exposed to Average Sound Level greater than 35 dBA. Greatest exposure to noise and visual impacts would occur under and near heavily used air-tour routes in East End and portions of the West End where Average Sound Level would be 40 to 50 dBA, and where aircraft Percent Time Audible would be greater than 75%.

Marble Canyon Alternative A Wilderness Character

Near Marble Canyon and in Paria Canyon-Vermilion Cliffs Wilderness Area, natural character and outstanding opportunities for solitude or primitive and unconfined types of recreation would be affected to a small degree by air-tour aircraft sights or sounds.

Marble Canyon Wilderness area Location Points would be quiet with air-tour aircraft Percent Time Audible zero to approximately 3% of the day, and Average Sound Level 3 to 24 dBA. Aircraft visibility would be low, and aircraft would generally be more than 2,000 meters away from points on the ground. The natural sound condition would be infrequently interrupted by air-tour aircraft noise, and there would be little visual evidence of aircraft under Alternative A. In Marble Canyon there would be little effect on elements of the natural environment such as opportunities for solitude. In few locations (e.g. North and South Canyon Location Points), aircraft would be 800 to 1,000 meters from points on the ground, which would decrease opportunities for solitude. In Marble Canyon, aircraft sights and sounds would have a negligible to minor long-term adverse effect on Wilderness Character.

In Marble Canyon, routes near Saddle Mountain Wilderness aircraft Percent Time Audible would be up to 50% of the day at greater than 35 dBA, representing minor to major adverse impact levels. In Paria Canyon-Vermilion Cliffs Wilderness Area, Average Sound Level would be much lower, generally at negligible impact levels audible less than 5% of the day at less than 15 dBA both Base Year and Ten-Year Forecast.

[38] 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

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)		
	Base Year	Ten-Year Forecast	Base Year	Ten-Year Forecast	Slant Distance (m)
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	12	2,335
Marble Canyon Dam Site	0%	0%	3	4	3,845

East End **Alternative A** **Wilderness Character**

In areas near **Little Colorado River, Nankoweap Mesa,** and **Nankoweap River** Location Points, there would be localized long-term impacts on Wilderness Character that would vary depending on proximity to air-tour routes and the river. Air-tour aircraft would be audible in locations away from the river 34 to 87% of the day with aircraft Average Sound Level of 43 dBA. Aircraft would be approximately 1,000 to 1,600 meters away from points on the ground. In these areas, natural conditions would be altered, and opportunities for solitude frequently interrupted with aircraft visible and high levels of noise throughout the day. Impacts from aircraft on Wilderness Character would be long-term moderate to major adverse.

Close to the river, as represented by the **Nankoweap River** Location Point, these effects would be less with aircraft Average Sound Level of 34 dBA and Percent Time Audible approximately 7%. Aircraft visibility would be low, and aircraft would be approximately 1,500 meters away from points on the ground. Higher natural ambient sound levels near the river (25 to 65 dBA) would reduce the frequency at which air-tour aircraft would be audible allowing natural conditions to predominate and ample opportunity for solitude. Impacts from aircraft on Wilderness Character would be long-term negligible to minor adverse.

Outside park boundaries, **Saddle Mountain Wilderness Area** Location Point would have an aircraft Average Sound Level of 37 dBA. Aircraft Percent Time Audible would be 51%, and 1,716 meters away from points on the ground. Due to air-tour routes Black-4, Black-1, and Green-1 in the area, impacts on Wilderness Character would be long-term moderate to major adverse.

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)		
	Base Year	Ten-Year Forecast	Base Year	Ten-Year Forecast	Slant Distance (m)
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	14	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	35	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	92	92	25	25	2,931
Outside the Park					
Saddle Mountain	51	53	37	37	1,716

Aircraft noise **beneath Zuni Point and Dragon Corridor** routes and **Black-1A/Green-1A routes over North Rim** would result in areas of nearly continuous noise at 62% to almost 100% Percent Time Audible (as represented by Location Points **Hermit Basin, 96-mile Camp, Point Sublime, Tower of Ra, Temple Butte, Grid Location Points 15 and 16**). Aircraft Average Sound Level would be 28 to 49 dBA. In these areas, air-tour noise would alter natural conditions and reduce opportunities for solitude a large part of the day. Aircraft would not be closer than 1,000 meters. Impacts to Wilderness Character would be long-term moderate to major adverse. Location Points represented by **The Basin** and **Grid Location Point 14** would have aircraft closer than 1,000 meters and impacts to Wilderness Character would be long term major adverse.

Beneath **Bright Angel Flight-Free Zone**, air-tour aircraft noise would vary widely. Wilderness locations near air-tour routes would experience almost continuous noise, while those amid Bright Angel Flight-free Zone would experience less noise. Amid Bright Angel Flight-free Zone, represented by **Grid Location Points 12 and 13**, air-tour operations would have very little effect on natural conditions or opportunities for solitude with Percent Time Audible of less than one percent, and Average Sound Level 12 to 13 dBA. Air-tour aircraft sounds would likely not be audible. Aircraft would be at Distances greater than 2,000 meters. Impacts to Wilderness Character would be long term negligible adverse.

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				
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Ten-Year Forecast	Base Year	Ten-Year Forecast	Slant Distance (m)
The Dome	1	1	16	16	13,109
Tuweep	12	14	15	16	8,688
Tuweep	15	17	11	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
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
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				
	Percent Time Audible (%)		Average Sound Level(dBA)		
	Base Year	Ten-Year Forecast	Base Year	Ten-Year Forecast	Slant Distance (m)
Burnt Springs Canyon	70	75	46	47	1,215
Bat Cave	93	95	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	16	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

NPS Units in SFRA Outside GCNP Alternative A Wilderness Character

Based on modeled noise results for Wilderness **directly under and within five miles of Blue Direct routes** (proposed wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument), impacts would be moderate to major adverse with aircraft Average Sound Level 40 to 50 dBA and Percent Time Audible greater than 50% Base Year and Ten-Year Forecast.

Cumulative Impacts Alternative A Wilderness Character

Other than air-tour aircraft sounds, impacts on Wilderness Character result from sounds of high-altitude aircraft above 18,000 feet MSL and aircraft below 18,000 feet MSL and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative A contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on Wilderness Character in the park and Special Flight Rules Area.

Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative A as discussed above would have long-term moderate to major adverse cumulative impacts on Wilderness Character throughout all four areas (Marble Canyon, East End, Central, and West End), due primarily to the combined Percent Time Audible of greater than 50% of the day over large areas.

Cumulative Impact Marble Canyon *Alternative A* *Wilderness Character*
At Marble Canyon Location Points and in Wilderness outside and adjacent to the park, noise from aircraft above and outside the SFRA is audible 16 to 36% of the day. When adverse impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA plus noise impacts from other sources, cumulative effect would be long term moderate to major adverse.

Cumulative Impacts East End *Alternative A* *Wilderness Character*
At all Location Points in Wilderness, except those close to the river (e.g., Nankoweap River), aircraft above and outside the SFRA are audible 27 to 71% of the day. When adverse impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA plus noise impacts from other sources, the cumulative effect would be long term moderate to major adverse.

Cumulative Impacts Central *Alternative A* *Wilderness Character*
At Central area Location Points and in Wilderness outside and adjacent to the park, noise from aircraft above and outside the SFRA is audible 16 to 65% of the day. When impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA plus noise impacts from other sources, cumulative effect would be long term moderate to major adverse.

Cumulative Impacts West End *Alternative A* *Wilderness Character*
At West End Location Points, noise from aircraft above and outside the SFRA is audible 12 to 51% of the day. When impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA plus noise impacts from other sources, cumulative effect would be long term moderate to major adverse.

Conclusion **Alternative A** **Wilderness Character**

Overall, 48% of park proposed Wilderness area would have air-tour aircraft audible more than 25% of the day, but, with a few exceptions, most of the proposed Wilderness area would have air-tour aircraft Average Sound Level less than 25 dBA. In Marble Canyon, Central areas, and West End's southern portions, aircraft Average Sound Level would generally be less than 15 dBA with Percent Time Audible less than 5%. In these areas, when air-tour aircraft would be audible it would usually be very infrequent and at low sound levels allowing for natural conditions to persist and ample opportunities for solitude. Greatest exposure to noise and visual impacts would occur under and near air-tour routes in East End and West End's northern portions where aircraft Average Sound Level would be 40 to 50 dBA and Percent Time Audible would be audible greater than 75% of the day. Natural conditions and opportunities for solitude would be reduced and disrupted frequently. Although impacts at all locations would increase slightly, level of impact would be about the same Base Year and Ten-Year Forecast.

Conclusion Marble Canyon *Alternative A* *Wilderness Character*
Alternative A would result in long-term negligible to minor adverse impacts to Wilderness Character in GCNP and the Paria Canyon-Vermilion Cliffs Wilderness Area, but minor to major adverse impacts in the Saddle Mountain Wilderness Area. Cumulative impacts from all actions would be long term moderate to major adverse.

Conclusion East End *Alternative A* *Wilderness Character*
Alternative A would result in long-term moderate to major adverse impacts to Wilderness Character in areas under and near air-tour routes in Dragon and Zuni Point Corridors and across North Rim, but negligible to minor adverse impacts in areas away from tour routes and amid Bright Angel Flight-free Zone. Cumulative impacts from all actions would be moderate to major adverse.

Conclusion Central *Alternative A* *Wilderness Character*
Alternative A would result in negligible impacts to Wilderness Character at most Central area Location Points, but up to moderate adverse impacts at a few locations. Cumulative impacts from all actions would be long term moderate to major adverse.

Conclusion West End *Alternative A* *Wilderness Character*
Alternative A would result in long-term moderate to major adverse impacts to Wilderness Character at Location Points under Green-4, Blue-2, and Blue Direct South routes. Long-term moderate adverse impacts would result at Location Points near Whitmore Rapids under Brown routes. Long-term moderate adverse impacts would result at

Blue Direct North and Blue Direct South routes. There would be long-term negligible to minor adverse impacts in areas away from routes in West End's southern portion including Sanup Flight-free Zone. Cumulative impacts from all actions would be long term moderate to major adverse.

IMPACTS OF ALTERNATIVE E ALTERNATING SEASONAL USE WILDERNESS CHARACTER

Alternative E would result in beneficial change in impacts compared to Alternative A due to reduced amount of area exposed to high Average Sound Level for long periods of the day. Natural conditions would be improved and opportunities for solitude and primitive recreation increased in the majority of the proposed Wilderness. The majority of proposed Wilderness (63% in Base Year Peak Season; 72% Ten-Year Forecast Off-Peak Season) would have air-tour aircraft Percent Time Audible less than 5% of the day. Ten-Year Forecast the amount of proposed Wilderness that experiences air-tours Percent Time Audible greater than 25% of the day would be reduced to 21% and 14%, Peak and Off-Peak Season respectively. Peak and Off-Peak Season, 60% or more of proposed Wilderness would have average air-tour aircraft Average Sound Level less than 15 dBA Base Year and Ten-Year Forecast.

Marble Canyon Alternative E Wilderness Character

In Marble Canyon, there would be a slight improvement in Wilderness Character both inside and outside the park compared to Alternative A as Average Sound Level due to air-tour aircraft would be low (generally less than 5 dBA, and aircraft Percent Time Audible would be less than 15% of the day. This is due to Bright Angel Flight-free Zone being substantially enlarged by extending its boundary north to include all of Marble Canyon.

Tables 4.31 and 4.32 present Slant Distances and Average Sound Level for Marble Canyon Location Points. Proposed Wilderness in Marble Canyon (represented by Location Points North Canyon, South Canyon, Grid Location Point 3, and Marble Canyon Dam Site) and adjacent Wilderness outside the park (represented by Location Points Cliff Dwellers Lodge and Grid Location Points 2 and 5) would be quiet, similar to Alternative A.

Marble Canyon Alternative E Wilderness Character

All Scenarios

Air-tour aircraft Percent Time Audible would be zero to one percent of the day, approximately 2 to 3% less than Alternative A. Aircraft Average Sound Level would be zero to 13 dBA, a 3 to 24 dBA decrease from Alternative A. There would be no air-tour aircraft visible from points on the ground. Improvements over Alternative A would occur at all Location Points, and most at **North** and **South Canyon** Location Points where Average Sound Level would decrease to 21 to 24 dBA. The naturalness of Wilderness and opportunities for solitude or primitive and unconfined recreation would be improved to a small degree.

Because there would be no air-tour routes in Marble Canyon under Alternative E, impacts on **Saddle Mountain Wilderness, Paria Canyon-Vermilion Cliffs Wilderness,** and **proposed GCNP Wilderness** would be negligible. In GCNP, this represents a negligible to minor long-term beneficial change in impacts from Alternative A, but in Saddle Mountain and Paria Canyon-Vermilion Cliffs Wildernesses it is a moderate to major 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 A				Alternative E															
					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	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
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 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 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

East End **Alternative E** **Wilderness Character**

Beneficial change in effects on East End Wilderness due to Dragon Corridor closure Peak Season, and conversely, Zuni Point Corridor closure Off-Peak Season is clearly seen in modeled noise results. Localized long-term adverse impacts would be major in areas near the open Corridor and comparable to Alternative A (Average Sound Level 40 to 50 dBA, and Percent Time Audible greater than 75%). Impacts would be negligible in areas near the closed Corridor, a substantial benefit as compared to Alternative A. East End as a whole would benefit from extended curfew hours. Tables 4.33 and 4.34 present Slant Distances and Average Sound Level for East End Location Points.

East End *Alternative E* *Wilderness Character*

Base Year Peak Season

Near areas represented by **Little Colorado River** and **Nankoweap Mesa** Location Points, air-tour aircraft Percent Time Audible would be 36 to 78%, an increase of 2% at the Little Colorado River Location Point and a decrease of 9% at Nankoweap Mesa Location Point. There would be somewhat lower Average Sound Level of 23 to 39 dBA, a decrease of 4 to 20 dBA. Aircraft would be more Distant than in Alternative A, and greater than 2,000 meters away from points on the ground. Although moderate to major adverse impacts would occur, there would be a long-term negligible to minor beneficial change in impacts from Alternative A.

At locations close to the river, represented by **Nankoweap River** Location Point, aircraft Average Sound Level would be approximately 12 dBA and, due to close proximity to relatively loud river sounds, Percent Time Audible would be less than one percent. This represents a 23 dBA decline in Average Sound Level and a 7% decline in Percent Time Audible from Alternative A. Aircraft would be more than 9,000 meters away from the ground. There would be negligible impacts, a long-term minor beneficial change in impacts from Alternative A.

Outside park boundaries, Saddle Mountain Location Point would have aircraft Average Sound Level of 13 dBA, a decline of 24 dBA compared to Alternative A. Percent Time Audible would be one percent, a decrease of 50% compared to Alternative A. Aircraft would be very Distant from points on the ground (approximately 15,000 meters). Natural conditions would be improved, and there would be much greater opportunity to enjoy natural sights and sounds and experience solitude and unconfined recreation. There would be negligible impacts, a long-term moderate to major beneficial change in impacts from Alternative A due to reduction in air-tour aircraft Percent Time Audible, and lack of visibility of aircraft from the ground.

When Dragon Corridor routes would not be in use, aircraft Percent Time Audible would be less than one to 13% of the day, a decrease of 71 to 96% compared to Alternative A at **Hermit Basin, Tower of Ra,** and **96-mile Camp** Location Points. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from Alternative A. **Eremita Mesa** Percent Time Audible would be 67% of the day, a 33% reduction compared to Alternative A at Average Sound Level of 21 dBA, a decline of 29 dBA. The area near Eremita Mesa Location Point would continue to experience air-tour noise from aircraft on Blue Direct and Brown routes as they approach and depart Grand Canyon Airport. As Dragon Corridor routes would be inactive, aircraft would not be visible or far less visible than in Alternative A at locations on the ground. Due to the substantial reduction in time and level of audible aircraft sound and reduced visual impact, there would be large improvement in natural conditions and increase in opportunities for solitude in Wilderness. Negligible to minor adverse impacts would occur, a long-term moderate to major beneficial change in impacts from Alternative A.

When **Zuni Point Corridor would be in use**, Percent Time Audible in areas represented by **Grid Location Point 14** and **Temple Butte** Location Points would be 75 to 81%, an approximate 12% increase compared to Alternative A. Aircraft Average Sound Level would be 38 to 39 dBA, a 5 dBA increase from Alternative A. At Grid Location Point 14, aircraft visibility from points on the ground would decrease as air-tour aircraft would be 900 meters farther away compared to Alternative A. At Temple Butte Location Point air-tours would be approximately 400 meters closer to points on the ground compared to Alternative A. In areas under Zuni Point Corridor, natural conditions in Wilderness would be disturbed, and opportunities for solitude and unconfined primitive recreation would be frequently disrupted. Major adverse impacts would in occur, but there would be a long-term minor adverse change in impacts from Alternative A due to increased air-tour Percent Time Audible.

Beneath Bright Angel Flight-free Zone, which includes **areas along North Rim** in this Alternative, air-tour aircraft noise would vary somewhat due to alternating seasonal use patterns in Zuni Point and Dragon Corridors.

Near Dragon Corridor, in Location Points such as **The Basin** and **Grid Location Point 11**, audible aircraft noise would be generally less than in Alternative A. Aircraft Percent Time Audible would be one to 6% of the day, a 49% to 72% decline compared to Alternative A, and Average Sound Level would be 5 to 9 dBA, a decrease of 9 dBA at Grid Location Point 11, and a 42 dBA decrease along North Rim near The Basin Location Point. There would be a large increase (3,446 meters) in aircraft Distance from locations on the ground from Alternative A, along North Rim near The Basin Location Point. Natural conditions and opportunities for solitude and unconfined recreation in Wilderness in Bright Angel Flight-free Zone and along North Rim, near Dragon Corridor, would be substantially improved. There would be negligible impacts across North Rim, and negligible to minor adverse impacts in areas near Dragon Corridor Base Year Peak Season, a long-term moderate to major beneficial change in impacts from Alternative A in Wilderness Character.

In areas **amid Bright Angel Flight-free Zone**, represented by **Grid Location Points 12 and 13**, there would be little change in impacts from Alternative A Peak and Off-Peak Season. Aircraft Percent Time Audible Base Year Peak Season would be similar to Alternative A, one percent or less, with Average Sound Level 10 to 12 dBA. Aircraft noise would be at low levels. Air-tour aircraft would be greater than 9,000 meters away. Negligible impacts would occur with negligible change in impacts from Alternative A at these points.

When routes in Dragon Corridor would be inactive, at **Toroweap/Shinumo Flight-free Zone's eastern edge**, at **Grid Location Point 18** and **Pasture Wash** Location Points, aircraft Percent Time Audible would be one percent and 28% of the day, a decrease of 59 to 70% from Alternative A. Aircraft Average Sound Level of 6 and 16 dBA would occur, a 5 to 10 dBA decrease compared to Alternative A. Air-tour aircraft would be greater than 6,000 meters away. Reduction in aircraft sounds and large reduction in Percent Time Audible would improve natural conditions and provide increased opportunity for solitude and primitive recreation. Negligible to minor adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A at these points due to high reduction in Percent Time Audible.

East End *Alternative E* *Wilderness Character*

Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible at **Nankoweap Mesa** Location Point would decline by 45%, and Average Sound Level would decline by 24 dBA compared to Alternative A. Although moderate adverse impacts would occur, there would be a long-term moderate to major beneficial change in impacts to Wilderness Character due to high reduction in aircraft Percent Time Audible near Nankoweap Mesa with lesser benefits at **Little Colorado River** Location Point compared to Alternative A.

At locations close to the river (**Nankoweap River** Location Point), change in aircraft Percent Time Audible, Average Sound Level, and visibility would not be appreciably different from conditions described Base Year Peak Season. Negligible to minor adverse impacts would occur, a negligible to minor beneficial change in impacts compared to Alternative A.

Percent Time Audible and Average Sound Level at **Saddle Mountain** Location Point would not be appreciably different from Base Year Peak Season. Air-tour aircraft Percent Time Audible would be one percent of the day, a 53% decline from Alternative A, at an Average Sound Level of 10 dBA, a 27 dBA decrease compared to Alternative A. Negligible impacts would occur, a long-term moderate to major beneficial change in impacts from Alternative A.

Decline in aircraft Percent Time Audible and Average Sound Level would be similar to Base Year Peak Season at **Hermit Basin, Tower of Ra,** and **96-mile Camp** Location Points. Percent Time Audible would range less than one percent to 16% of the day; a decrease of 74 to 97% from Alternative A. Average Sound Level would range 8 to 10 dBA, a decline from Alternative A of 32 to 37 dBA. Ten-Year Forecast, near **Eremita Mesa** Location Point, there would be a 50% decrease in air-tour aircraft Percent Time Audible compared to Alternative A. Air-tour aircraft Percent Time Audible would be 49% of the day at Average Sound Level of 22 dBA, a 28 dBA decrease from Alternative A. There would be negligible to minor adverse impacts with long-term moderate to major beneficial change in impacts from Alternative A at these points.

Near Zuni Point Corridor at **Grid Location Point 14** and **Temple Butte** Location Points, Percent Time Audible would be 57 to 66%, a decline of 8 to 10% compared to Alternative A with little change in air-tour

Average Sound Level. Air-tour aircraft visibility of from points on the ground would be the same as Base Year (1,038 and 1,591 meters). Moderate to major adverse impacts would occur; however, there would be a minor beneficial change in impacts at these points compared to Alternative A.

At **The Basin** and **Grid Location Point 11** Location Points, impacts and level of beneficial change would be similar to Base Year Peak Season at Bright Angel Flight-free Zone Location Points. There would be negligible impacts in Bright Angel Flight-free Zone and in areas near Dragon Corridor, a long-term moderate to major beneficial change in impacts from Alternative A at these points.

At **Grid Location Points 12 and 13**, change in aircraft Percent Time Audible, Average Sound Level, and visibility would be similar to Base Year Peak Season. Negligible impacts would occur with negligible change in impacts from Alternative A at these points.

At **Toroweap/Shinumo Flight-free Zone, Grid Location Point 18** and **Pasture Wash** Location Points, Percent Time Audible would be one percent and 31% of the day, a decrease of 60 to 67% from Alternative A. Aircraft Average Sound Level would be 6 to 17 dBA, a 4 to 10 dBA decrease compared to Alternative A. Aircraft would be long Distances from points on the ground as in Base Year. There would be negligible to minor adverse impacts, a long-term moderate to major beneficial change in impacts compared to Alternative A at these points due to high reduction in Percent Time Audible.

East End *Alternative E* *Wilderness Character*

Base Year Off-Peak Season

At areas near **Little Colorado River confluence** and **Nankoweap Mesa** Location Points, air-tour aircraft Percent Time Audible would be one percent or less, a decrease of 34 and 86% compared to Alternative A. Aircraft Average Sound Level would be 7 to 14 dBA, a decline of 29 to 36 dBA. When routes in Zuni Point Corridor are inactive Off-Peak Season, aircraft would not be visible from these areas. Air-tour aircraft would generally not be audible along the river in this area or at Nankoweap Mesa. Natural conditions in this area would be improved, and there would be greater opportunity to enjoy natural sights and sounds and experience solitude and unconfined recreation. Negligible impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

At locations close to the river, represented by **Nankoweap River** Location Point, aircraft Average Sound Level would not be appreciably different from Base Year Peak Season. Air-tour aircraft would not be audible, and air-tour Average Sound Level would be 11 dBA, a 23 dBA decrease compared to Alternative A. Negligible impacts would occur, a long-term minor beneficial change in impact from Alternative A.

When Dragon Corridor would be in use, in areas represented by **Hermit Basin, 96-mile Camp, Point Sublime, Eremita Mesa,** and **Tower of Ra** Location Points, aircraft Percent Time Audible would be 26 to 93% of the day, a decrease of 7 to 46% from Alternative A. Aircraft Average Sound Level would be 23 to 46 dBA, 9 to 19 dBA less than Alternative A, except at Tower of Ra where Average Sound Level would increase by 2 dBA. Aircraft would be more Distant and less visible than in Alternative A at locations on the ground except at Tower of Ra. Natural conditions in Wilderness would be altered frequently by sights and sounds of air-tour aircraft, negatively affecting opportunities for solitude and primitive recreation. There would be moderate to major adverse impacts, with long-term minor to major beneficial change in impact from Alternative A at these points.

When Zuni Point Corridor routes would not be in use, Percent Time Audible at **Grid Location Point 14** and **Temple Butte** Location Points would be one percent, substantially less (62 to 69%) than Alternative A. Aircraft Average Sound Level would be 6 to 7 dBA, a decrease of 27 to 32 dBA from Alternative A. Aircraft would be far less visible than in Alternative A at locations on the ground. Air-tour sounds would be rarely audible and at very low levels. Natural conditions and opportunities for solitude and unconfined recreation in Wilderness under Zuni Point Corridor routes Off-Peak Season would be substantially improved. Negligible impacts would occur, a long-term moderate to major beneficial change in impact from Alternative A.

When air-tour routes would be active in Dragon Corridor, air-tour aircraft Percent Time Audible in areas **along North Rim** represented by **The Basin** Location Point, and along **Bright Angel Flight-free Zone western edge,** represented by **Grid Location Point 11**, would be 14 and 23% of the day; a 32 to 59% reduction compared to

Alternative A. Average Sound Level would be 7 to 12 dBA, a decrease of 6 to 41 dBA. Compared to Alternative A, there would be a substantial improvement in natural conditions and opportunities for solitude and unconfined recreation in Wilderness in Bright Angel Flight-free Zone and particularly along North Rim. Although minor to moderate adverse impacts would occur, there would be a long-term moderate to major beneficial change in impacts from Alternative A at these points.

When Dragon Corridor routes would be in use, Percent Time Audible at **Grid Location Points 12 and 13** would be the same as Alternative A, one percent with aircraft Average Sound Level of 8 to 11 dBA, similar to Alternative A. When audible, aircraft sound would be at low levels. Air-tour aircraft would not be visible from locations on the ground. Adverse impacts would occur with negligible change in impacts from Alternative A at these points.

When routes would be active in Dragon Corridor, aircraft Percent Time Audible at **Toroweap/Shinumo Flight-free Zone Grid Location Point 18** and **Pasture Wash** Location Points, would be 34 and 80%, a 19 to 26% decrease from Alternative A. Aircraft Average Sound Level of 11 to 20 dBA would be similar to Alternative A. Aircraft visibility would be similar to Alternative A when Dragon Corridor is in use, greater than 5,000 meters from locations on the ground. Reduction in aircraft sound would improve natural conditions and provide increased opportunity for solitude and primitive recreation. Although moderate to major adverse impacts would occur, there would be a long-term moderate beneficial change in impacts compared to Alternative A at these points due to high reduction in Percent Time Audible.

East End *Alternative E* *Wilderness Character*

Ten-Year Forecast Off-Peak Season

For **Little Colorado River** and **Nankoweap Mesa** Location Points, change in aircraft Percent Time Audible, Average Sound Level, and visibility would not be appreciably different from conditions Base Year Off-Peak Season. There would be negligible impacts, with long-term moderate to major beneficial change in impact compared to Alternative A.

At locations close to the river, represented by **Nankoweap River** Location Point, change in aircraft Percent Time Audible, Average Sound Level, and visibility would not be appreciably different from Base Year Off-Peak Season. Negligible impacts would occur, a minor beneficial change in impacts compared to Alternative A.

At **Hermit Basin, 96-mile Camp, Point Sublime, Eremita Mesa,** and **Tower of Ra** Location Points, Percent Time Audible would be 17 to 78%; a decline of 21 to 67% from Alternative A. Aircraft Average Sound Level would range 18 to 44 dBA, a one to 24 dBA decrease. Although air-tour noise would still be present, reductions in noise compared to Alternative A would result in improvements to natural conditions in Wilderness and would increase opportunities for solitude with less frequent interruptions. These improvements would be substantial in areas where Percent Time Audible is greatly reduced, such as near Hermit Basin Location Point. Although moderate to major adverse impacts would continue, this would be a long-term minor to major beneficial change in impacts from Alternative A at these points.

Impacts and level of beneficial change at **Grid Location 14** and **Temple Butte** Location Points would be similar to Base Year Off-Peak Season for Zuni Point Corridor points. Negligible impacts would occur, a long-term moderate to major beneficial change in impacts at these points from Alternative A.

Change in aircraft Percent Time Audible, Average Sound Level, and visibility would be the same in **The Basin** and **Grid Location Point 11** as described Base Year Off-Peak Season for Bright Angel Flight-free Zone Location Points. Although minor to moderate adverse impacts would occur in Bright Angel Flight-free Zone and areas near Dragon Corridor, there would be a long-term moderate to major beneficial change in impacts from Alternative A at these points.

Change in aircraft Percent Time Audible at **Grid Location Points 12 and 13**, Average Sound Level, and visibility would be similar to Base Year Off-Peak Season. Negligible impacts would occur with negligible change in impacts from Alternative A at these points.

Percent Time Audible at Toroweap/Shinumo Flight-free Zone **Grid Location Point 18** and **Pasture Wash** Location Points would be 5 and 31% of the day, a decrease of 55 to 67% from Alternative A due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would be 9 to 18 dBA; a 3 to 7 dBA decrease compared to Alternative A. Aircraft would not be visible from points on the ground. The large reduction in air-tour aircraft Percent Time Audible would provide a high level of improvement to natural conditions in Toroweap/Shinumo Flight-free Zone, and more opportunities for solitude with much less frequent interruptions from aircraft sound. Negligible to moderate adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due to high reduction in Percent Time Audible.

TABLE 4.33 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			
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

TABLE 4.34 ALTERNATIVE E AVERAGE SOUND LEVEL EAST END

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	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	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	-28	93	-7	78	-21	41	-9	38	-12
North Rim																				
Grid Location Point 16	80	84	33	34	17	-63	23	-61	12	-21	13	-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	-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
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

Central Alternative E Wilderness Character

Based on modeled noise results there would be little change in impacts from Alternative A as the Central area would remain relatively quiet with Average Sound Level generally less than 10 dBA and aircraft Percent Time Audible less than 5%.

Tables 4.35 and 4.36 present Slant Distances and Average Sound Level for Central area Location Points. Similar to Alternative A, Wilderness Character throughout most of the Central area and adjacent to the park would be least affected by aircraft noise.

Central Alternative E Wilderness Character
Base Year Peak Season

When Dragon Corridor air-tour routes would not be in use, **Central Area** aircraft Percent Time Audible would be zero to 13%, a decrease of zero to 17% from Alternative A. Aircraft Average Sound Level would range zero to 15 dBA, similar to Alternative A. Wilderness natural conditions and primitive solitude would be improved slightly compared to Alternative A. Air-tour aircraft Percent Time Audible would be infrequent at low levels. Air-tour aircraft would be greater than 7,000 meters from locations on the ground. Negligible to minor adverse impacts would occur, a long-term negligible to moderate beneficial change in impacts due to modest reduction in air-tour aircraft Percent Time Audible from Alternative A.

Central Alternative E Wilderness Character
Ten-Year Forecast Peak Season

Central Area impacts and level of beneficial change would generally be similar to Base Year Peak Season, except for **Tuweep** Location Point where Percent Time Audible decreases 5 to 13% Base Year to Ten-Year Forecast. Negligible to minor adverse impacts would occur, a long-term negligible to moderate beneficial change in impacts due to modest reduction in Percent Time Audible from Alternative A at these points.

Central Alternative E Wilderness Character
Base Year Off-Peak Season

When air-tour routes in Dragon Corridor would be in use, **Central Area** Percent Time Audible would range zero to 25%, with highest level of increase compared to Alternative A (13%) occurring at **Tuweep** Location Point due to an increase in operations on Brown-6. In most of the Central area however, air-tour aircraft Percent Time Audible would be reduced up to 17%. Aircraft Average Sound Level of zero to 16 dBA would occur similar to Alternative A. Air-tour aircraft would be very far away from locations on the ground. In most of the Central area there would be little disruption from natural conditions or opportunities for solitude, although toward Toroweap/Shinumo Flight-free Zone's western edge, Wilderness opportunities would be more frequently interrupted with low-level aircraft sounds. Negligible to moderate impacts would occur in most of the Central area, a long-term minor to moderate beneficial change in impacts from Alternative A. At Tuweep, there would be a long-term moderate adverse impact with a minor to moderate adverse change in impacts compared to Alternative A.

Central Alternative E Wilderness Character
Ten-Year Forecast Off-Peak Season

Central Area, air-tour aircraft Percent Time Audible would range less than one to 2%, a decrease of up to 17% compared to Alternative A. Aircraft Average Sound Level of zero to 17 dBA would occur similar to Alternative A. Air-tour aircraft would be very far from locations on the ground. Natural conditions and opportunities for solitude would rarely be interrupted due to sounds of air-tour aircraft. Negligible impacts would occur, a long-term minor to moderate beneficial change in impacts from Alternative A due to modest reduction in aircraft Percent Time Audible.

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

TABLE 4.36 ALTERNATIVE E AVERAGE SOUND LEVEL CENTRAL

Location Name	Alternative A				Alternative E															
					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
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	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
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	7	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	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

WEST END **ALTERNATIVE E** **WILDERNESS CHARACTER**

West End air-tour routes near Blue-2 and Green-4 would have localized, long-term major adverse impacts as aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%, similar to Alternative A. For areas near Blue Direct routes, area of audibility would be reduced by approximately 50% due to the short distance the route travels over the park resulting in substantial beneficial effects on proposed Wilderness West End.

Tables 4.37 and 4.38 present Distances and Average Sound Level for specific West End locations. Location Points represented by **Burnt Springs Canyon, Bat Cave,** and **Grid Location Point 33** would continue to be under Green-4 and Blue-2 routes, as in Alternative A.

West End *Alternative E* *Wilderness Character*

Base Year Peak Season

At points **under Green-4 and Blue-2**, Percent Time Audible would range 70 to 92%, representing a one to 7% decrease from Alternative A. Air-tour aircraft Average Sound Level would be the same as Alternative A and range 42 to 47 dBA. Distance would be the same as Alternative A with aircraft 1,100 to 1,200 meters away. Sights and sounds of air-tour aircraft would alter Wilderness Characteristics large portions of the day, affecting natural conditions and opportunities for solitude. Major adverse conditions would occur with negligible to minor beneficial change in impacts from Alternative A.

At **Whitmore Rapids** and **Parashant Wash** Location Points air-tour aircraft Percent Time Audible would be 20% of the day and Average Sound Level of 28 dBA. Percent Time Audible would be 8% higher compared to Alternative A, and Average Sound Level would be 7 dBA higher. Air-tour aircraft would be at Distances greater than 2,000 meters from points on the ground. Wilderness impacts would be slightly greater than Alternative A due to the Blue Direct North route shift. Moderate adverse impacts would occur with minor adverse change in impacts from Alternative A.

Blue Direct North would be shifted away from the most noise sensitive West End Wilderness lands. Therefore, noise impacts would decrease compared to Alternative A. With elimination of Blue Direct South, some flights would move outside the SFRA and some may shift to Blue Direct North**. Areas under and near relocated Blue Direct North** would experience air-tour aircraft noise with Average Sound Level 40 to 50 dBA, similar to Alternative A levels. Areas further from routes would experience Average Sound Level less than 25 dBA. Long-term minor to major impacts would occur with negligible change in impacts from Alternative A.

Grid Location Point 28 was closer to Blue Direct North and South routes under Alternative A. Since those routes are moved away from Sanup Flight-free Zone, Percent Time Audible would be 5%, a 9% decrease from Alternative A and Average Sound Level 16 dBA, similar to Alternative A. Distances from aircraft to points on the ground would be more than 2,000 meters. Air-tour aircraft would be rarely audible in areas closer to the river. Wilderness would continue minimally altered by air-tour aircraft sights and sounds with minimal improvement in natural conditions and opportunities for solitude compared to Alternative A. Although minor adverse impacts would occur, there would be long-term minor beneficial change in impacts from Alternative A due to reduction in aircraft Percent Time Audible.

West End *Alternative E* *Wilderness Character*

Ten-Year Forecast Peak Season

At points under Green-4 and Blue-2, Percent Time Audible would decline to 53 to 84%, a 12 to 13% decrease from Alternative A at **Bat Cave** and **Burnt Springs Canyon** Location Points, and a 37% decrease from Alternative A at **Grid Location Point 33**. Average Sound Level would be similar to Alternative A. Although moderate to major adverse impacts would occur, there would be moderate beneficial change in impacts from Alternative A due to greater reduction in Percent Time Audible.

Impacts would not notably change at **Whitmore Rapids** and **Parashant Wash** Location Points. Change in Percent Time Audible, Average Sound Level, and Distance would be similar to Base Year Peak Season. Moderate adverse impacts would occur with minor adverse change in impacts from Alternative A.

At **Grid Location Point 28**, Percent Time Audible would decline to 3% of the day, a 13% decrease compared to Alternative A. Average Sound Level and aircraft Distance would be similar to Alternative A. Negligible to minor adverse impacts would occur, a minor to moderate long-term beneficial change in impacts from Alternative A due to higher level reduction in aircraft Percent Time Audible.

West End *Alternative E* *Wilderness Character*
Base Year Off-Peak Season

At points **under Green-4 and Blue-2**, Percent Time Audible would be 76 to 96%, a 2 to 6% increase from Alternative A. Air-tour aircraft Average Sound Level would be similar to Alternative A, ranging 43 to 48 dBA. Sights and sounds of air-tour aircraft would alter Wilderness Character in the area large portions of the day, affecting natural conditions and opportunities for solitude. Major adverse impacts would occur with negligible to minor adverse change in impacts from Alternative A.

At **Whitmore Rapids** and **Parashant Wash** Location Points, air-tour aircraft Percent Time Audible would be 24% of the day and Average Sound Level 30 dBA. Aircraft Percent Time Audible would be 12% higher compared to Alternative A, and Average Sound Level would be 9 dBA higher. Air-tour aircraft would be at Distances greater than 2,000 meters from points on the ground. Wilderness impacts would be slightly greater than in Alternative A due to the Blue Direct North shift. Moderate to major adverse impacts would occur with long-term minor adverse change in impacts from Alternative A.

Impacts **near Blue Direct** would be similar to Base Year Peak Season. Minor to major adverse impacts would occur with negligible change in impacts compared to alternative A.

Change in aircraft Percent Time Audible, Average Sound Level, and Distance at **Grid Location Point 28** would be the same as Base Year Peak Season. Minor adverse impacts would occur with a long-term minor beneficial change in impacts from Alternative A.

West End *Alternative E* *Wilderness Character*
Ten-Year Forecast Off-Peak Season

Percent Time Audible would range 61 to 88%, decreasing 8 to 29% from Alternative A. Air-tour aircraft Average Sound Level would be 38 to 46 dBA, decreasing up to 5 dBA from Alternative A at **Bat Cave** and **Grid Location Point 33** Location Points. Near **Burnt Springs Canyon** Location Point air-tour Average Sound Level would increase to 44 dBA, a 3 dBA decrease from Alternative A. Visibility would continue the same as Alternative A. Minor adverse impacts would occur with negligible to moderate beneficial change in impacts from Alternative A due to reduction in Percent Time Audible.

Change in aircraft Percent Time Audible, Average Sound Level, and visibility at **Whitmore Rapids** and **Parashant Wash** Location Points would be similar to Base Year Off-Peak Season. Moderate to major adverse conditions would occur with long-term minor adverse change in impacts from Alternative A.

Change in aircraft Percent Time Audible, Average Sound Level, and visibility in **Grid Location Point 28** would be the same as Ten-Year Forecast Peak Season. Negligible to minor adverse conditions would occur with long-term minor to moderate beneficial change in impacts from Alternative A

NPS Units in SFRA Outside GCNP **Alternative E** **Wilderness Character**

Based on modeled noise results for **Wilderness directly under or within five miles of Blue Direct routes** (proposed wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument), impacts would be moderate to major adverse with negligible change in impacts compared to Alternative A. Average Sound Level would be 40 to 50 dBA with high levels of aircraft Percent Time Audible similar to current Blue Direct North and South Routes under Alternative A. Alternative E quiet-technology incentives and conversion requirements would provide some mitigation to these long-term adverse impacts with a decrease in size of affected areas Base Year to Ten-Year Forecast.

Also, with Alternative E's changes to Blue Direct route locations, most aircraft on current Blue Direct North and South routes are expected to travel in the National Airspace System north of the SFRA's northern boundary in the

West End before/after crossing the SFRA on relocated Blue Direct North at Andrus Canyon. This would result in moving flights and associated noise and visual impacts from more sensitive **proposed wilderness lands in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument** under Alternative A, to less sensitive areas in those management units under Alternative E, areas where management objectives include fewer expectations of natural quiet and solitude.

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	11,493	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	2,852	6,359	3,507
Pumpkin Springs	12,630	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

TABLE 4.38 ALTERNATIVE E AVERAGE SOUND LEVEL WEST END

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	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	-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	1	0	0	7	7	1	1
Separation Canyon	0	1	9	9	0	0	1	0	9	0	9	0	1	0	1	0	9	0	9	0
Granite Gorge	58	63	34	35	57	-1	48	-14	34	0	32	-3	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	23	-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	25	-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	3	-11	4	-13	20	-2	21	-2	3	-11	4	-13	20	-2	21	-2
Three Springs	1	2	8	9	1	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

Cumulative Impacts Alternative E Wilderness Character

In all areas, noise from aircraft flying above and outside the SFRA would continue to have long-term moderate to major adverse effect on Wilderness Character (the sense of naturalness and opportunities for solitude) as described in Alternative A. Noise from other non-aircraft sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative E contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under Alternatives.

Noise from aircraft flying above and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative E as discussed above, would generally have long-term moderate to major adverse cumulative impacts on Wilderness Character throughout all four areas (Marble Canyon, East End, Central, and West End), due primarily to combined Percent Time Audible from all sources of greater than 50% of the day over large areas.

Conclusion Alternative E Wilderness Character

Alternative E would result in beneficial changes in impacts to Wilderness Character compared with Alternative A due to reduced amount of area exposed to high Percent Time Audible and high Average Sound Level for long periods of the day. Natural conditions would be improved and opportunities for solitude and primitive recreation would increase. The majority of Wilderness would have air-tour aircraft noise audible less than 5% of the day and Average Sound Level less than 15 dBA Base Year and Ten-Year Forecast. Because Alternative E includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast. Beneficial change in impacts from Alternative A would be seen in both Percent Time Audible and Average Sound Level.

Conclusion Marble Canyon Alternative E Wilderness Character
All Scenarios, Alternative E would result in sights and sounds of air-tour aircraft that would have negligible impacts on Marble Canyon Wilderness Character, with negligible to minor long-term beneficial change in impacts in GCNP compared with Alternative A, and moderate to major beneficial change in impacts in Saddle Mountain and Paria Canyon-Vermilion Cliffs Wilderness Areas compared to Alternative A. Cumulative impacts from all actions would be moderate to major adverse.

Conclusion East End Alternative E Wilderness Character
Base Year and Ten-Year Forecast, when air-tour routes would be inactive under Dragon and Zuni Point Corridors, and across North Rim, there would be long-term negligible to minor adverse impacts with moderate to major beneficial change in impacts compared to Alternative A. At locations under Dragon Corridor Off-Peak Season when air-tour routes would be active, there would be moderate to major adverse impacts from high Percent Time Audible; however, there would be long-term minor to major beneficial change in impacts compared to Alternative A. At locations under Zuni Point Corridor Peak Season when routes would be active, there would be moderate to major adverse impacts with a minor adverse change in impacts compared to Alternative A Base Year, but Ten-Year Forecast impacts would be reduced resulting in minor beneficial change in impacts compared to Alternative A. At Location Points away from tour routes in Bright Angel Flight-free Zone and Toroweap/Shinumo Flight-Free Zone's eastern portion, there would be negligible to minor adverse impacts with moderate to major beneficial change in impacts compared to Alternative A both Peak and Off-Peak Season. Cumulative impacts from all actions would be long-term moderate to major adverse.

Conclusion Central Alternative E Wilderness Character
Alternative E would result in negligible to minor adverse impacts to Wilderness Character Peak and Off-Peak Season; however, there would be a long-term negligible to moderate beneficial change in impacts compared to Alternative A at most Central area Location Points. Cumulative impacts from all actions would be long-term moderate to major adverse.

Conclusion West End *Alternative E* *Wilderness Character*
In West End's northern area under Green-4, Blue-2, and Blue Direct North, Alternative E would result in moderate 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 from all actions would be long-term moderate to major adverse.

IMPACTS OF 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.

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

TABLE 4.40 ALTERNATIVE F AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				Alternative F															
					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	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	14	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

East End **Alternative F** **Wilderness Character**

Modifications to East End air-tour routes would be small, resulting in impacts similar to Alternative A. Near air-tour routes, aircraft Average Sound Level would be 40 to 50 dBA and Percent Time Audible would be greater than 75%. The seven-mile Dragon Corridor Off-Peak Season shift would essentially shift impacts west seven miles. Beneficial effects to East End's middle and east side would be a 20 to 40% reduction in Percent Time Audible from Alternative A. Due to quiet-technology incentives and conversion requirements in Alternative F, additional beneficial impacts would be expected in both Percent Time Audible and Average Sound Level. Tables 4.41 and 4.42 present Percent Time Audible, Distance, and Average Sound Level for East End Location Points.

East End *Alternative F* *Wilderness Character*

Base Year Peak Season

As represented by **Little Colorado River** confluence and **Nankoweap Mesa** Location Points effects of aircraft noise would be the same as Alternative A. Air-tour sounds would continue to be experienced frequently throughout the day resulting in adverse impacts. Long-term moderate to major adverse impacts would occur and conditions would not be appreciably different from Alternative A.

Close to the river, as represented by the **Nankoweap River** Location Point, Peak Season conditions would continue the same as in Alternative A, with air-tour aircraft Percent Time Audible 7% of the day and Average Sound Level 34 dBA, minor to moderate adverse impacts with negligible change from Alternative A.

Impacts would occur at **Saddle Mountain Wilderness Area** the same as Alternative A. Air-tour aircraft Percent Time Audible would be 51% of the day at intermediate Average Sound Level of 37 dBA. Major adverse impacts would occur with no appreciable change in sound conditions or Slant Distance compared to Alternative A.

Impacts **along North Rim** as represented by **Grid Location Point 16** would be similar to Alternative A with air-tour aircraft Percent Time Audible 84% of the day at Average Sound Level of 33 dBA. Aircraft would be approximately 2,500 meters from locations on the ground. Natural conditions of Wilderness would frequently be altered at intermediate levels of noise, and opportunities for solitude reduced. Major adverse impacts would occur with negligible change in impacts from Alternative A.

Beneath Zuni Point Corridor effects of air-tour aircraft would not be appreciably different from Alternative A. Air-tour aircraft Percent Time Audible would be 62 to 70%, Average Sound Level would be 28 to 37 dBA, and aircraft would be 687 meters to about 1,600 meters from locations on the ground. Air-tour aircraft sights and sounds would frequently alter Wilderness naturalness and opportunities for solitude under these routes. Moderate to major adverse impacts would occur with negligible change in impacts from Alternative A.

Beneath Dragon Corridor effects of air-tour aircraft would be similar to Alternative A. As shown by Location Points **Eremita Mesa, Hermit Basin, 96-mile Camp,** and **Tower of Ra**, air-tour aircraft Percent Time Audible would be 72 to 100% of the day, and Average Sound Level would be 42 to 49 dBA. Natural Wilderness conditions would be frequently altered with very limited opportunities for solitude or primitive recreation. Aircraft would be visible similar to Alternative A except at Tower of Ra and Eremita Mesa where they would be 293 and 677 meters closer to points on the ground compared to Alternative A. Moderate to major adverse effects would occur with a negligible to minor change in adverse impacts compared to Alternative A.

Beneath Bright Angel Flight-free Zone effects of air-tour aircraft would be similar to Alternative A. **Grid Location Points 12 and 13** would have air-tour aircraft Percent Time Audible one percent of the day, with Average Sound Level 12 to 13 dBA. Aircraft would be at Distances greater than 2,000 meters. Air-tour aircraft would be rarely audible at relatively low sound levels in Bright Angel Flight-free Zone. There would be negligible impacts with negligible change in impacts compared to Alternative A.

Grid Location Point 11 would have aircraft Percent Time Audible about 60% of the day at Average Sound Level of 18 dBA Peak Season similar to Alternative A. Aircraft would be visible at Distances much greater than 2,000 meters. Moderate to major adverse impacts would occur with negligible change in impacts from Alternative A.

At the eastern edge of **Toroweap/Shinumo Flight-Free Zone**, at **Grid Location Points 7 and 18, Rainbow Plateau, Bass Camp,** and **Pasture Wash** Location Points effects of aircraft would be similar or slightly greater than Alternative A. Air-tour aircraft Percent Time Audible would be one percent or less of the day at locations further west of routes with Average Sound Level of 7 to 8 dBA. Closer to routes, air-tour aircraft Percent Time Audible would be 60 to 100% of the day, with Average Sound Level 16 to 35 dBA. Air-tour aircraft would be much closer to locations on the ground compared to Alternative A (except Pasture Wash). Moderate to major adverse impacts would occur with negligible change in impacts compared to Alternative A.

East End *Alternative F* *Wilderness Character*

Ten-Year Forecast Peak Season

Percent Time Audible at **Little Colorado River** confluence and **Nankoweap Mesa** Location Points would decline to 25% and 68%, respectively, a 12% and 20% decrease from Alternative A. Air-tour aircraft Average Sound Level would range 37 to 39 dBA, slightly decreased from Alternative A. Moderate to major adverse impacts would occur with long-term moderate beneficial change in impacts from Alternative A at these points due to reduction in air-tour aircraft Percent Time Audible.

At **Nankoweap River** Location Point, there would be little change from Base Year Peak Season. Natural conditions would be slightly improved, and opportunities for solitude and primitive recreation would slightly increase. There would be minor to moderate adverse impacts with negligible change from Alternative A.

At **Saddle Mountain** Location Point, Percent Time Audible would decline to 20%, a 33% decrease from Alternative A. Air-tour Average Sound Level would be similar to Alternative A. Moderate to major adverse impacts would occur with moderate to major beneficial change in impacts compared to Alternative A due to high reduction in Percent Time Audible.

Air-tour aircraft along **North Rim** at **Grid Location Point 16** Percent Time Audible would be 42% of the day, a decrease of 42% from Alternative A. Aircraft Average Sound Level would be 24 dBA, a 9 dBA decrease compared to Alternative A. Aircraft would continue to be approximately 2,500 meters from areas on the ground. Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

Percent Time Audible in **Zuni Point Corridor** area would decline to 41 to 53%, a decrease of 21 to 28% from Alternative A. Aircraft Average Sound Level would be 24 to 31 dBA, declining 4 to 7 dBA from Alternative A. Aircraft would be visible the same as described Base Year. There would be modest improvement in natural conditions and opportunities for solitude as a result of decline in aircraft Percent Time Audible. Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

Percent Time Audible in **Dragon Corridor** would range 47 to 98%, a decrease of 2 to 27% compared to Alternative A. Air-tour Average Sound Level would continue similar to Alternative A, ranging 37 to 46 dBA, a decrease of 3 to 5% compared to Alternative A. Aircraft would be visible as for Base Year. Major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due to decrease in Percent Time Audible.

Impacts at **Grid Location Points 12 and 13** would not be appreciably different from Alternative A for **Bright Angel Flight-free Zone** points. Negligible impacts would occur with negligible change in impacts from Alternative A.

Percent Time Audible at **Grid Location Point 11** would decline to 10%, a 45% decrease from Alternative A, with Average Sound Level at 12 dBA, a 7 dBA decrease from Alternative A. Natural conditions and opportunities for solitude would be greatly improved in this area. Minor adverse impacts would occur, a moderate to major beneficial change in impacts compared to Alternative A due the high level of reduction in Percent Time Audible.

Percent Time Audible at **Grid Location Point 18** and **Pasture Wash** Location Points would decline to 14 to 20%, a 46 to 78% decrease from Alternative A. There would be little change in aircraft Average Sound Level or

Distance of aircraft to Pasture Wash, but distance at Grid Location Point 18 would greatly decrease compared to Alternative A. Natural conditions and opportunities for solitude would be greatly improved due to the large decline in air-tour Percent Time Audible. Moderate adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due to the large decrease in Percent Time Audible.

East End *Alternative F* *Wilderness Character*

Base Year Off-Peak Season

Effects of aircraft near **Little Colorado River** and **Nankoweap Mesa** Location Points would be less than Peak Season and Alternative A. Aircraft Percent Time Audible would be 17 to 53% of the day, a 17 to 34% decrease from Alternative A. Aircraft Average Sound Level would be 29 to 38 dBA, a 5 to 14 dBA decrease from Alternative A. Natural conditions would be improved, and opportunities for solitude and primitive recreation would be increased with less frequent interruptions by aircraft. Moderate to major adverse impacts would occur, a moderate to major beneficial change in impacts from Alternative A due to a large reduction in air-tour aircraft Percent Time Audible.

At **Saddle Mountain** Location Point, aircraft Average Sound Level declines to 19 dBA, a decrease of 18 dBA compared to Alternative A, and Percent Time Audible would be 12% of the day, a 39% decrease from Alternative A. Minor to moderate adverse impacts from aircraft on Wilderness Character would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

When Dragon Corridor shifts Off-Peak Season, Percent Time Audible **along North Rim** at **Grid Location Point 16** would decline to 37%, a 43% decrease from Alternative A. Aircraft Average Sound Level would decline to 15 dBA, an 18 dBA decrease from Alternative A. Aircraft would no longer be visible from locations on the ground. Natural conditions would be improved and opportunities for solitude increased with less frequent interruptions of aircraft noise. Moderate to major adverse impacts would occur, a moderate to major beneficial change in impacts compared to Alternative A.

Air-tour aircraft would be audible in **Zuni Point Corridor** area 33 to 43%, a 26 to 33% decrease from Alternative A. Aircraft Average Sound Level would range 30 to 38 dBA, a 6 dBA decrease and a 10 dBA increase respectively compared to Alternative A. Aircraft would be visible at Distances similar to Alternative A. There would be a substantial improvement in natural conditions and opportunities for solitude as a result of large decline in aircraft Percent Time Audible. Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

When Dragon Corridor shifts seven miles west, **at the three Dragon Corridor** Location Points except **Eremita Mesa,** air-tour aircraft would be audible less of the day in most locations ranging one percent to 60%, a decrease of 39 to 80% compared to Alternative A. Average Sound Level would be 13 to 23 dBA, a 19 to 31 dBA decline. Noise conditions at Eremita Mesa would continue at high levels and for the majority of the day (95% Percent Time Audible at 49 dBA). Natural conditions would be greatly improved in Off-Peak Season at locations under Dragon Corridor, and opportunities for solitude would increase substantially. Negligible to major adverse impacts would occur, a moderate to major beneficial change in impacts compared to Alternative A.

Bright Angel Flight-free Zone would not be appreciably different for **Grid Location Points 12 and 13** from Base Year Peak Season. Negligible impacts would occur with negligible change in impacts from Alternative A.

Grid Location Point 11 would have air-tour aircraft Percent Time Audible less than Alternative A and about 16% of the day, a 39% decrease from Alternative A. Average air-tour aircraft Average Sound Level would be 11 dBA, 7 dBA less than Alternative A. Natural conditions would be greatly improved and there would be a large increase in opportunities for solitude. Minor to moderate adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

When Dragon Corridor moves west Off-Peak Season, aircraft Percent Time Audible at **Grid Location Point 18** and **Pasture Wash** Location Points would decline slightly in areas that are under routes Peak Season. Percent Time Audible would still remain relatively high at 57 to 90% of the day, a 3 to 8% decrease respectively in impacts from Alternative A. Aircraft Average Sound Level would range 25 to 39 dBA, a 5 to 23 dBA increase

compared to Alternative A. Moderate to major adverse impacts would occur, a long-term negligible to minor beneficial change in impacts compared to Alternative A.

In areas represented by **Grid Location Point 7, Bass Camp,** and **Rainbow Plateau** Location Points, there would be a 17 to 36% increase in Percent Time Audible and 7 to 26 dBA increase in Average Sound Level compared to Alternative A. Distances from aircraft to points on the ground would be more than 2,000 meters. Increase in aircraft Percent Time Audible and higher Average Sound Level would alter natural conditions and opportunities for solitude and primitive recreation more frequently. Moderate to major adverse impacts would occur with long-term moderate to major adverse change in impacts compared to Alternative A.

East End *Alternative F* *Wilderness Character*

Ten-Year Forecast Off-Peak Season

Percent Time Audible at **Nankoweap Mesa** Location Point would decline to 33%, a 57% decrease from Alternative A. Aircraft Average Sound Level would be 25 dBA, a 18 dBA decrease from Alternative A. Aircraft would continue to be visible at approximately 900 to 1,600 meters. Natural conditions in Wilderness would be improved, and there would be a large increase in opportunities for solitude and primitive recreation. Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts from Alternative A due to reduction in Percent Time Audible.

Percent Time Audible at **Saddle Mountain** Location Point would decline further to 2%, a 51% reduction compared to Alternative A. Air-tour aircraft Average Sound Level would decline to 15 dBA, a 22 dBA decrease from Alternative A. Distance of aircraft from points on the ground would be the same as Alternative A (1,716 meters). With a substantial reduction in air-tour aircraft Percent Time Audible and Average Sound Level, negligible impacts from aircraft on Wilderness Character would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

Percent Time Audible along North Rim at **Grid Location Point 16** would decline to 21%, a 63% decrease from Alternative A, and air-tour aircraft Average Sound Level would decline to 13 dBA, a 21 dBA decrease compared to Alternative A. Aircraft would be at Distances greater than 2,000 meters. Natural conditions would improve and opportunities for solitude would increase with decreased aircraft Percent Time Audible. Moderate adverse impacts would occur, a moderate to major beneficial change in impacts compared to Alternative A.

Sounds of air-tour aircraft would continue to decline in **Zuni Point Corridor**. Air-tour aircraft Percent Time Audible would be 17 to 27% of the day, a decrease of 43 to 52% compared to Alternative A. Average Sound Level would range 24 to 35 dBA, an 11 dBA decrease to a 6 dBA increase compared to Alternative A. Aircraft would be visible at Distances similar to Alternative A. Natural conditions would be improved with increased opportunities for solitude with much less frequent interruption from aircraft noise. Moderate adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due to the large reduction in Percent Time Audible.

Aircraft Percent Time Audible at **Dragon Corridor** Location Points would further decline to less than one percent at **96-mile Camp** Location Point, and 6 to 32% at **Tower of Ra** and **Hermit Basin** Location Points respectively. Percent Time Audible would be 68% to 92% less than Alternative A. Aircraft Average Sound Level would decline to 10 to 19 dBA, a decrease of 23 to 35 dBA from Alternative A. Noise conditions at **Eremita Mesa** Location Point would continue at high levels (47 dBA) for the majority of the day (83%, a decrease of 17% from Alternative A). Aircraft Average Sound Level would decline to 47 dBA Ten-Year Forecast, a 2 dBA decrease from Alternative A. Negligible to moderate adverse impacts would occur, a moderate to major beneficial change in impacts compared to Alternative A.

At **Grid Location Points 12 and 13,** negligible impacts would occur with negligible change in impacts from Alternative A.

At **Grid Location Point 11,** minor to moderate adverse impacts would occur, a long-term moderate to major 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

TABLE 4.42 ALTERNATIVE F AVERAGE SOUND LEVEL EAST END

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
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	-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
North Rim																				
Grid Location Point 16	80	84	33	34	84	4	42	-42	33	0	24	-10	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	-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
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	13	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

with

Central Alternative F Wilderness Character

In Central areas, there would be little change in impacts from Alternative A as the area would remain relatively quiet with aircraft Average Sound Level generally less than 10 dBA and Percent Time Audible generally less than 5%.

Tables 4.43 and 4.44 present Slant Distances and Average Sound Level for Central area Location Points. Similar to Alternative A, Wilderness Character throughout most of Central area would be the least affected by air-tour aircraft.

Central Alternative F Wilderness Character
Base Year and Ten-Year Forecast Peak Season

There would be negligible change as a result of aircraft noise compared to Alternative A for **most Central area Location Points**. However, at **Grid Location Point 22**, air-tour aircraft Percent Time Audible would be one percent of the day, a 17% decrease from Alternative A. Aircraft would be greater than 7,000 meters from locations on the ground. Central area natural conditions would persist with little interruption by air-tour aircraft sights and sounds. At most Central locations, negligible to minor adverse impacts would occur with negligible to moderate beneficial change in impacts compared to Alternative A.

Central Alternative F Wilderness Character
Base Year and Ten-Year Forecast Off-Peak Season

At **Central area Location Points** Percent Time Audible would range less than one to 8% of the day, a decrease of up to 17% from Alternative A. At **Grid Location Point 8** there would be an increase in Percent Time Audible to 25%, a 23% increase from Alternative A. Aircraft Average Sound Level would be similar to Alternative A, ranging less than one to 16 dBA. Negligible to moderate adverse impacts would occur with some Location Points up to a moderate adverse change in impacts, and some Location Points up to a moderate beneficial change in impacts compared to Alternative A.

TABLE 4.43 ALTERNATIVE F SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	Alternative F	
		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
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
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

TABLE 4.44 ALTERNATIVE F AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				Alternative F															
					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
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	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
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	10	-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	-1	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	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	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

West End Alternative F Wilderness Character

In West End's northern half, aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65% of the time. However, 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. Because Alternative F includes quiet-technology incentives and conversion requirements, impacts would be mitigated as aircraft convert to quiet technology over time. Increased operations Ten-Year Forecast would adversely affect Wilderness on West End's northeastern side. In West End's southern portion near Sanup Flight-free Zone aircraft Average Sound Level would be 10 to 20 dBA with Percent Time Audible less than 20% of the time.

Tables 4.45 and 4.46 present Percent Time Audible, Distance, and Average Sound Level for West End Location Points.

West End Alternative F Wilderness Character
Base Year Peak Season and Off-Peak Season

Burnt Springs Canyon, Bat Cave, and **Grid Location Point 33** Location Points would continue to be under Green-4 and Blue-2 routes as in Alternative A. Percent Time Audible would range 75 to 85% of the day, a 4 to 12% decrease from Alternative A at Bat Cave and Grid Location Point 33 Location Points, and a 4% increase at Burnt Springs Canyon Location Point. Average Sound Level would be 42 to 47 dBA, similar to Alternative A. Air-tour aircraft would be about 900 to 1,200 meters from locations on the ground, similar to Alternative A. Major adverse impacts would occur, a long-term minor beneficial change in impacts compared to Alternative A.

Whitmore Rapids and **Grid Location Point 28** Location Points would be affected by the shift in Blue Direct North quiet-technology route. Percent Time Audible at Whitmore Rapids would be 9%, similar to Alternative A. Aircraft Average Sound Level would increase to 33 dBA, a 12 dBA increase from Alternative A. At Grid Location Point 28, Percent Time Audible would be 41% of the day, a 28% increase compared to Alternative A, and Average Sound Level would increase slightly to 26 dBA. Natural conditions would be substantially altered particularly at higher elevation locations where air-tour aircraft noise would be audible for large portions of the day at intermediate sound levels. Minor to major adverse impacts would occur, a long-term minor to moderate adverse change in impacts compared to Alternative A in locations near the river, and moderate adverse at higher elevations.

West End Alternative F Wilderness Character
Ten-Year Forecast Peak and Off-Peak Season

At **Burnt Springs Canyon, Bat Cave,** and **Grid Location Point 33** Location Points**,** air-tour aircraft Percent Time Audible would range 65 to 83% of the day, a 6 to 25% decrease compared to Alternative A. Average Sound Level would be similar to Alternative A. Natural conditions would improve, in that air-tour aircraft although relatively loud would be audible less frequently. Moderate to major adverse impacts would occur, a long-term minor to moderate beneficial change in impacts compared to Alternative A due to reduction in Percent Time Audible.

Near **Whitmore Rapids** and **Grid Location Point 28** Location Points, Percent Time Audible would increase to 16 and 52%, an increase of 4 and 38% compared to Alternative A. Average Sound Level and aircraft visibility would not be appreciably different from Peak Season Base Year. Moderate to major adverse impacts would occur with long-term minor to moderate adverse change in impacts compared to Alternative A.

NPS Units in SFRA Outside GCNP Alternative F Wilderness Character

Alternative F changes to Blue Direct routes to avoid Eagle and Guano Points would move locations of moderate to major adverse impacts **under and within five miles of the routes** to proposed Wilderness lands in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument to the south of where those impacts occur in Alternative A. This would result in moving flights and associated noise and visual impacts to more sensitive Wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument under Alternative F, from slightly less sensitive Wilderness in those same management units under current routes in Alternative A. Average Sound Level and Percent Time Audible would be reduced in some areas and increased in others compared to Alternative A Base Year, ranging from moderate adverse changes in impacts to minor beneficial changes in impacts compared to Alternative A. However, Ten-Year Forecast, Alternative F's quiet-technology

incentives and conversion requirements would reduce affected area size, resulting in changes in impacts ranging from minor adverse to minor beneficial compared to Alternative A.

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	23,335	-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	2,852	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

TABLE 4.46 ALTERNATIVE F AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				Alternative F															
					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
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	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
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

Cumulative Impacts Alternative F Wilderness Character

Noise from aircraft flying over 18,000 feet MSL and outside the SFRA would continue to have a long-term moderate to major adverse effect on Wilderness Character (sense of naturalness and opportunities for solitude) as described in Alternative A. Noise from other non-aircraft sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative F contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under the Alternatives.

Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative F as discussed above, would generally have long-term moderate to major adverse cumulative impacts on Wilderness Character throughout all four areas (Marble Canyon, East End, Central, and West End), due primarily to combined Percent Time Audible of greater than 50% of the day over large areas.

Conclusion Alternative F Wilderness Character

Base Year Alternative F would generally result in negligible changes in impacts compared with Alternative A, but with quiet-technology incentives and conversion requirements, noise impacts would decrease Ten-Year Forecast. Alternative F would result in decreased opportunities for solitude and natural conditions altered in nearly half of the proposed Wilderness in the park, but Wilderness Character would improve over time. Base Year, nearly 50% of proposed Wilderness would have air-tour aircraft Percent Time Audible greater than 25% of the day predominantly in East and West Ends. Ten-Year Forecast Percent Time Audible would decrease, and the majority of Wilderness would experience air-tour aircraft Percent Time Audible less than 10% of the day. Average air-tour Average Sound Level would generally be low, less than 25 dBA. The greatest exposure to noise and visual impacts would occur in East and West Ends where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75% of the time. In Marble Canyon, Central areas, and West End's southern portions, Wilderness would be least impacted by air-tour operations as aircraft Average Sound Level would generally be less than 15 dBA with Percent Time Audible less than 5%.

Conclusion Marble Canyon Alternative F Wilderness Character

Alternative F would result in no notable change in impacts from Alternative A, Base Year and Ten-Year Forecast. Off-Peak Season impacts would be reduced in Marble Canyon's southern part, resulting in a long-term negligible to minor beneficial change in impacts from Alternative A. Cumulative impacts from all actions would be moderate to major adverse primarily due to aircraft over 18,000 feet and outside the SFRA.

Conclusion East End Alternative F Wilderness Character

Base Year Peak Season, there would be no appreciable change in moderate to major adverse impacts from Alternative A at Location Points near the Little Colorado River confluence, Nankoweap Mesa, Saddle Mountain, and over North Rim. However, Ten-Year Forecast, although moderate to major adverse impacts would continue, there would be a long-term moderate to major beneficial change in impacts from Alternative A, with even greater reductions in impacts Off-Peak Season when Dragon Corridor would shift west.

Impacts at Nankoweap River Location Point would continue to be minor adverse similar to Alternative A Peak and Off-Peak Season.

Under Zuni Point Corridor, Base Year Peak Season, there would be moderate to major adverse impacts with negligible change in impacts from Alternative A. However, Base Year Off-Peak Season and Ten-Year Forecast Peak Season, although moderate to major adverse impacts would continue under the routes, there would be long-term moderate to major beneficial change in impacts compared to Alternative A due to a large decline in Percent Time Audible.

Under Dragon Corridor, there would be moderate to major adverse impacts with negligible to minor change in impacts compared to Alternative A Base Year Peak Season. Off-Peak Season moderate to major adverse impacts

would shift seven miles west, and there would be long-term moderate to major beneficial change in impacts compared to Alternative A in areas where the Corridor was shifted from. Impacts would be reduced Ten-Year Forecast due to conversion to quiet-technology aircraft.

Under Bright Angel Flight-Free Zone and areas away from air-tour routes, negligible to minor adverse impacts from air-tour aircraft would continue with negligible to major beneficial change in impacts compared to Alternative A.

Cumulative impacts from all actions would be moderate to major and adverse.

Conclusion Central *Alternative F* *Wilderness Character*

Alternative F would result in negligible to minor adverse impacts with negligible to moderate beneficial change in impacts to Wilderness Character compared to Alternative A at most Central area Location Points All Scenarios. However, Off-Peak Season some points closer to the shifted Dragon Corridor would experience up to moderate adverse impacts with up to moderate adverse change in impacts compared to Alternative A. Cumulative adverse impacts from all actions would be moderate to major and adverse.

Conclusion West End *Alternative F* *Wilderness Character*

Base Year and Ten-Year Forecast, Alternative F would result in moderate to major adverse impacts at Location Points under Green-4, Blue-2, and Blue Direct South, with up to moderate adverse change in impacts to moderate beneficial change in impacts to Wilderness Character compared to Alternative A, depending on location. Near Whitmore Rapids under Brown routes, there would be minor to major adverse impacts with up to moderate adverse to moderate beneficial change in impacts compared to Alternative A as a result of changes in configuration of Blue Direct North. In West End's southern portion away from air-tour routes, there would be negligible to minor adverse impacts with moderate adverse to moderate beneficial change from Alternative A, depending on location.

Cumulative adverse impacts from all actions would be moderate to major and adverse.

NPS PREFERRED ALTERNATIVE **WILDERNESS CHARACTER**

Overall the NPS Preferred Alternative would result in a beneficial change in impacts from Alternative A in Wilderness Character due to route changes and quiet-technology incentives and requirements.

Marble Canyon **NPS Preferred Alternative** **Wilderness Character**

Marble Canyon would remain relatively quiet with air-tour aircraft Percent Time Audible generally less than 5% of the time and Average Sound Level less than 20 dBA. In Marble Canyon, there would be a slight improvement in Wilderness Character compared to Alternative A as air-tour aircraft Average Sound Level would be low and rarely audible. Tables 4.47 and 4.48 present Slant Distance and Average Sound Level for Marble Canyon Location Points.

Marble Canyon *NPS Preferred Alternative* *Wilderness Character*

All Scenarios

In the park and adjacent Wilderness outside the park, impacts at representative **Marble Canyon Location Points** would be quiet, similar to Alternative A. However, aircraft Percent Time Audible would be generally less than Alternative A, one percent or less, and Average Sound Level would generally be zero to 18 dBA, a decrease of one to 20 dBA compared to Alternative A. In most areas, aircraft would be much farther away from locations on the ground, ranging from approximately 4,000 to 9,500 meters and would not be visible from points on the ground. Improvements over Alternative A would occur at all Marble Canyon Location Points, except **Cliff Dwellers Lodge** and **Grid Location Point 5**, and most at **North** and **South Canyon** Location Points. This would result in aircraft sights and sounds that would have negligible to minor adverse impacts on natural conditions and opportunities for solitude or primitive and unconfined recreation; a negligible to minor long-term beneficial change in impacts compared with Alternative A.

In areas near Location Points **Cliff Dwellers Lodge** and **Grid Location Point 5**, aircraft would be closer compared to Alternative A, from 1,059 to 1,499 meters due to reconfiguration of Black-4 along the SFRA's western boundary at Marble Canyon. Due to route reconfiguration, aircraft Average Sound Level would increase to 15 and 18 dBA Peak Season, a 7 to 12 dBA increase compared to Alternative A (reducing to zero dBA Off-

Peak Season). Although Average Sound Level would increase it would be rarely audible. In this area, there would be negligible to minor adverse impacts with negligible to minor adverse change in impacts Peak Season, and negligible to minor beneficial change in impacts Off-Peak Season compared to Alternative A.

TABLE 4.47 NPS PREFERRED ALTERNATIVE SLANT DISTANCES MARBLE CANYON

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
North Canyon	999	5,962	4,963
South Canyon	816	4,742	3,926
Cliff Dwellers Lodge	3,695	1,059	-2,636
Grid Location Point 2	858	4,204	3,345
Grid Location Point 3	2,958	9,585	6,627
Grid Location Point 5	2,335	1,499	-836
Marble Canyon Dam Site	3,845	4,218	374

Δ indicates change in noise metric data from Alternative A

TABLE 4.48 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				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
North Canyon	3	3	24	25	1	-2	1	-2	5	-19	5	-21	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	1	-2	1	-2	0	-20	0	-23	0	-2	0	-2	0	-21	0	-23
Cliff Dwellers Lodge	1	1	6	10	1	0	1	-1	18	12	18	9	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	8	-8	1	-2	1	-2	7	-8	7	-8
Grid Location Point 5	2	2	8	12	1	-1	1	-1	15	7	15	4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	2	-1	1	-3	0	0	0	0	0	-3	0	-4

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

East End NPS Preferred Alternative Wilderness Character

Beneficial effects to East End Wilderness, due to seasonal use of Dragon and Zuni Point Corridor short-loop tour routes, are clearly seen in modeled results. Peak Season impacts would be major adverse close to active routes with aircraft Average Sound Level 40 to 50 dBA and Percent Time Audible greater than 75% of the time. For the inactive short-loop routes area, Percent Time Audible is reduced 25 to 35%. Creation of a short-loop fixed-wing route in Dragon Corridor would result in localized increases in aircraft audibility. Base Year to Ten-Year Forecast there would be substantial beneficial change in impacts particularly in areas near Dragon Corridor compared to Alternative A. East End as a whole would benefit from the additional one-hour curfew. Tables 4.49 and 4.50 present Percent Time Audible, Distances, and Average Sound Level for East End Location Points.

East End NPS Preferred Alternative Wilderness Character

Base Year Peak Season

Noise conditions and effects on Wilderness near **Little Colorado River** and **Nankoweap River** Location Points would improve compared to Alternative A, with adjustment of Black-1 and Green-1 routes away from the Little Colorado River confluence. Air-tour aircraft Percent Time Audible would be less than one to 8%, a 7 to 26% decrease from Alternative A. Aircraft Average Sound Level would be 15 to 27 dBA, a decrease of 16 to 19 dBA compared to Alternative A. Aircraft would be farther than 2,000 meters from points on the ground. Negligible to minor adverse impacts would occur, a long-term minor to major beneficial change in impacts compared to Alternative A.

Nankoweap Mesa Location Point would be farther from Black-1 and Green-1 than in Alternative A, and aircraft would be much less visible from points on the ground. Air-tour aircraft Percent Time Audible would be 78% of the day (9% less than Alternative A) at Average Sound Level of 31 dBA (12 dBA less than Alternative A). Although aircraft sights and sounds would have moderate to major adverse impacts on Wilderness Character, there would be negligible to minor beneficial change in impacts from Alternative A.

Outside park boundaries, **Saddle Mountain** Wilderness Area Location Point would be further from Black-4, and impacts on Wilderness Character would be less than Alternative A Peak and Off-Peak Season. Aircraft Percent Time Audible would be 36%, a decrease from Alternative A of 14%. Aircraft Average Sound Level would be 22 dBA, a 14 dBA decrease from Alternative A. Aircraft would be much farther from points on the ground than in Alternative A. There would be modest improvements in natural condition of Wilderness and greater opportunity for primitive recreation with fewer interruptions. Moderate to major adverse impacts would occur with long-term moderate beneficial change in impacts compared to Alternative A.

Across North Rim, represented by **Grid Location Point 16**, there would be less impact from air-tour aircraft than Alternative A. Air-tour aircraft Percent Time Audible would be 47%, a 34% decrease from Alternative A. Aircraft Average Sound Level would be similar to Alternative A at 32 dBA. Aircraft would be greater than 2,000 meters from points on the ground. Moderate to major 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.

Beneath and near Dragon Corridor routes Base Year Peak Season, represented by Location Points **Hermit Basin, Tower of Ra, 96-mile Camp, Point Sublime, The Basin, Eremita Mesa,** and **Grid Location Point 11**, air-tour aircraft Percent Time Audible would be 47 to 100%, a decrease of up to 12% compared to Alternative A. Aircraft Average Sound Level would be 20 to 44 dBA, a one to 22 dBA decrease. In most areas, aircraft would be greater than 3,000 meters from the ground except at Tower of Ra where aircraft would be at approximately 1,500 meters. Although there would be slight improvements in Wilderness Character, natural conditions would be altered due to high level of Percent Time Audible. Major adverse impacts would occur with negligible to minor beneficial change in impacts compared to Alternative A.

Beneath **Zuni Point Corridor** routes Base Year Peak Season, at areas represented by Location Points **Temple Butte** and **Grid Location Points 14 and 15** air-tour aircraft Percent Time Audible would be 58 and 67%, a 3 to 8% decrease from Alternative A. Aircraft Average Sound Level would be 37 and 39 dBA, a less than one to 11 dBA increase from Alternative A. Aircraft would be visible from 1,200 meters to greater than 2,300 meters from points on the ground. Natural Wilderness conditions and opportunities for solitude would be altered by high

levels of air-tour aircraft sound. Major adverse impacts would occur with mixed results ranging from minor beneficial to minor adverse change in impacts compared to Alternative A.

Beneath **Bright Angel Flight-free Zone**, effects of air-tour aircraft would generally be similar to Alternative A. At areas represented by **Grid Location Points 12 and 13**, air-tour aircraft Percent Time Audible would be one to 2% of the day, aircraft Average Sound Level would be 13 dBA, and aircraft would be much greater than 2,000 meters from points on the ground. Negligible impacts from air-tour aircraft on Wilderness Character would occur with negligible change in impacts compared to Alternative A.

Toroweap/Shinumo Flight-free Zone's eastern edge, represented by **Grid Location Point 18** and **Pasture Wash** Location Points, aircraft Percent Time Audible would be 91% and 99% respectively, with aircraft Average Sound Level of 19 and 27 dBA, respectively; a one to 31% increase in Percent Time Audible and a 3 to 6 dBA increase in Average Sound Level compared to Alternative A. Air-tour aircraft sounds would frequently alter natural conditions and opportunities for solitude. Major adverse impacts would occur with minor to major adverse changes in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Wilderness Character*

Ten-Year Forecast Peak Season

Areas near **Little Colorado River** and **Nankoweap River** Location Points would not be appreciably different from Base Year Peak Season. Negligible to minor adverse impacts would occur, a long-term minor to moderate beneficial change in impacts compared to Alternative A.

At **Nankoweap Mesa** Location Point air-tour aircraft Percent Time Audible would be 57%, a 33% decrease from Alternative A, and Average Sound Level would be 29 dBA, a 14 dBA decrease from Alternative A. Aircraft visibility would be similar to Base Year Peak Season. Natural ambient conditions would improve, and opportunities for solitude would increase with less interruption from aircraft sound. Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

At **Saddle Mountain** Location Point, air-tour aircraft Percent Time Audible would be 11%, a 42% decrease from Alternative A. Aircraft Average Sound Level would be 20 dBA, a 17 dBA decrease. Air-tour aircraft would be over 6,500 meters Distant. There would be large improvements in natural condition of Wilderness and greater opportunity for solitude and primitive recreation with fewer interruptions. Minor to moderate adverse impacts would occur, be a long-term moderate to major beneficial change in impacts compared to Alternative A.

Across North Rim at **Grid Location Point 16**, impacts would further decline continuing the beneficial change in impacts compared to Alternative A. Air-tour aircraft Percent Time Audible would be 24%, a 60% decline. Average Sound Level would be 24 dBA, a 9 dBA decrease. Aircraft would be visible greater than 2,000 meters from points on the ground. Moderate adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

Aircraft Percent Time Audible in **Dragon Corridor areas** would range 41 to 98% of the day, a 2 to 50% decrease compared to Alternative A. Average Sound Level would range 16 to 38 dBA, a 7 to 26 dBA decline. In most areas, aircraft would be greater than 3,000 meters from the ground except at **Tower of Ra** Location Point where aircraft would be approximately 1,500 meters. At **Hermit Basin** and **96-mile Camp** Location Points, there would be large improvements in natural conditions and increases in opportunities for solitude. Although there would be slight improvements in Wilderness Character, natural conditions would be altered due to high level of Percent Time Audible. Moderate to major adverse impacts would occur, a minor to major beneficial change in impacts compared to Alternative A.

Zuni Point Corridor Percent Time Audible would decrease 13 to 27% compared to Alternative A, reducing time air-tours would be audible to 42 to 61% of the day. Aircraft Average Sound Levels would be 37 dBA, a one dBA decrease to an 8 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, 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 68%, a 13 to 31% decrease from Alternative A. Aircraft Average Sound Level would remain similar to Alternative A. Natural conditions and opportunities for solitude would be altered much less often. Visibility of aircraft would be similar to Alternative A. Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Wilderness Character*

Base Year Off-Peak Season

Impacts near **Little Colorado River** and **Nankoweap River** Location Points would not be appreciably different from Base Year Peak Season. Negligible to minor adverse impacts would occur, a long-term minor to moderate beneficial change in impacts compared to Alternative A.

At **Nankoweap Mesa** Location Point impacts would not be appreciably different from Base Year Peak Season. Moderate to major adverse impacts would occur with negligible change in impacts from Alternative A.

At **Saddle Mountain** Location Point air-tour aircraft Percent Time Audible would be 18%, a 33% decrease from Alternative A, and Average Sound Level would be 18 dBA, a 19 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. Moderate adverse impacts would occur, a long-term moderate to 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 22%, a 59% reduction compared to Alternative A. Aircraft would be greater than 2,000 meters from points on the ground. Aircraft Average Sound Level would be 26 dBA, 7 dBA less than Alternative A. Moderate 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 10 to 84%, a 16 to 64% decrease from Alternative A. Aircraft Average Sound Level would be 13 to 34 dBA, a 5 to 29 dBA decrease from Alternative A. Aircraft would be greater than 2,000 meters from points on the ground. Major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

Beneath Zuni Point Corridor, aircraft Average Sound Level and visibility would not be appreciably different from Base Year Peak Season. Change in Percent Time Audible ranges from a one to 7% increase to a 13% decrease compared to Alternative A. Moderate to major impacts would occur with minor adverse to minor 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.

When Dragon Corridor short-loop routes would not be in use, at **Grid Location Point 18** and **Pasture Wash** Location Points aircraft Percent Time Audible would be up to half the amount of time compared to Alternative A, ranging from 21% to 48% of the day. Aircraft Average Sound Level would be 10 to 18 dBA, a 3 to 6 dBA decrease compared to Alternative A. Aircraft would be more than 5,000 meters from locations on the ground. Natural conditions and opportunities for solitude would be greatly improved. Moderate to major adverse impacts would occur, a long-term minor to major beneficial change in impacts compared to Alternative A due to high decrease in Percent Time Audible.

East End *NPS Preferred Alternative* *Wilderness Character*

Ten-Year Forecast Off-Peak Season

Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season near **Little Colorado River** and **Nankoweap River** Location Points. Negligible to minor adverse impacts would occur, a long-term minor to major beneficial change in impacts compared to Alternative A.

At **Nankoweap Mesa** Location Point, Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Ten-Year Forecast Peak Season. Moderate to major adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A.

At **Saddle Mountain** Location Point, Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Ten-Year Forecast Peak Season. Minor to moderate adverse impacts would occur, a long-term moderate to 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 12%, a 72% decrease from Alternative A. Average Sound Level would be 21 dBA, a 13 dBA decrease. Natural conditions would be greatly improved in areas along North Rim, with substantial increase in opportunity for solitude with much fewer interruptions of low-level aircraft sounds. Minor to moderate 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.

In **Dragon Corridor** areas, Average Sound Level and Distance would not appreciably differ from Base Year Off-Peak Season. Changes in Percent Time Audible represent a 33 to 86% decrease from Alternative A. Minor to major adverse impacts would occur, but there would be long-term moderate to major beneficial change in impacts compared to Alternative A.

Under **Zuni Point Corridor**, Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Ten-Year Forecast Peak Season. Moderate to major adverse impacts would occur, but there would be long-term moderate to major beneficial change in impacts compared to Alternative A.

Beneath **Bright Angel Flight-free Zone** Percent Time Audible, Average Sound Level, and Distance 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 aircraft Percent Time Audible would be 8 to 15%, a 52 to 83% decrease from Alternative A. Natural conditions would be markedly improved and there would be more opportunity for experiencing solitude and primitive recreation. Minor to moderate adverse impacts would occur, a long-term moderate to major beneficial change in impacts compared to Alternative A due to high decrease in Percent Time Audible.

TABLE 4.49 NPS PREFERRED ALTERNATIVE SLANT DISTANCES EAST END

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Little Colorado River/Nankoweap Area			
Little Colorado River	1,629	2,689	1,059
Nankoweap Mesa	973	6,096	5,123
Nankoweap River	1,449	5,705	4,256
Dragon Corridor			
Hermit Basin	1,518	6,447	4,929
96 Mile Camp	1,573	3,168	1,594
Tower of Ra	1,147	1,579	431
Eremita Mesa	1,034	4,277	3,244
North Rim			
Grid Location Point 16	2,589	2,591	2
The Basin	477	874	397
Grid Location Point 6	6,935	5,137	-1,798
Zuni Point Corridor			
Grid Location Point 14	687	1,412	726
Grid Location Point 15	1,637	2,345	708
Temple Butte	1,458	1,228	-230
Bright Angel Flight-Free Zone			
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
Toroweap /Shinumo Flight-Free Zone			
Grid Location Point 18	8,449	5,106	-3,342
Pasture Wash	5,532	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	-5
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

TABLE 4.50 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL EAST END

Location Point Name	Alternative A				NPS Preferred Alternative															
					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	8	-26	5	-33	27	-16	27	-16	7	-27	3	-34	24	-19	25	-18
Nankoweap Mesa	87	90	43	43	78	-9	57	-33	31	-12	29	-14	79	-8	54	-36	28	-15	26	-17
Nankoweap at River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	13	-22	13	-22
Dragon Corridor																				
Hermit Basin	99	100	42	42	96	-4	50	-50	20	-22	16	-26	35	-64	13	-86	13	-29	11	-31
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	10	-61	7	-68	30	-15	29	-16
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	36	-61	28	-70	34	-10	30	-14
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	84	-16	67	-33	28	-21	24	-25
North Rim																				
Grid Location Point 16	80	84	33	34	47	-34	24	-60	32	-1	24	-9	22	-59	12	-72	26	-7	21	-13
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	29	-44	19	-57	40	-8	37	-11
Grid Location Point 6	52	56	19	20	64	12	26	-30	19	0	11	-9	23	-30	12	-44	13	-6	8	-12
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	67	-3	61	-13	39	6	37	2	77	7	68	-6	41	8	39	4
Grid Location Point 15	65	69	28	29	58	-8	42	-27	39	11	37	8	52	-13	40	-29	36	8	34	6
Temple Butte	62	66	37	38	58	-5	45	-21	37	0	37	-1	63	1	45	-22	35	-3	35	-3
Bright Angel Flight Free Zone																				
Grid Location Point 11	55	56	18	18	47	-8	18	-39	20	2	13	-6	9	-46	4	-52	13	-5	9	-10
Grid Location Point 12	1	1	13	14	2	1	3	2	13	0	12	-1	2	1	2	1	12	-1	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	13	1	10	-3	5	5	1	0	12	0	11	-1
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	21	-39	8	-52	10	-6	9	-8
Pasture Wash	98	98	20	21	99	1	68	-31	27	6	21	0	48	-50	15	-83	18	-3	15	-6
Point Sublime	100	100	35	35	100	0	94	-6	35	-1	28	-7	73	-27	33	-67	24	-12	18	-17
Grid Location Point 7	1	1	7	8	3	3	1	0	8	2	6	-1	0	-1	0	-1	2	-5	2	-6
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	1	-6	0	-7
Rainbow Plateau	0	54	6	7	0	0	0	-54	9	3	5	-2	0	0	0	-54	2	-4	2	-5
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	27	-65	4	-88	17	-8	12	-13
Outside the Park																				
Saddle Mountain	51	53	37	37	36	-14	11	-42	22	-14	20	-17	18	-33	6	-47	18	-19	18	-20

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

Central NPS Preferred Alternative Wilderness Character

In the Central area, there would be little change in impacts from Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 15 dBA, and aircraft Percent Time Audible generally less than 15% of the time. Tables 4.51 and 4.52 present Percent Time Audible, Distance, and Average Sound Level for Central area Location Points. Similar to Alternative A, Wilderness Character throughout most of the Central area would be least affected by aircraft noise.

Central NPS Preferred Alternative Wilderness Character
Base Year Peak Season

In **Central area Location Points** when Dragon Corridor short-loop routes would be in use, aircraft Percent Time Audible would generally be zero to 14% with aircraft Average Sound Level zero to 15 dBA with little change in impacts compared to Alternative A, except for **Grid Location Point 8**, where Percent Time Audible would be up to 21%, an 18% increase compared to Alternative A. Natural conditions would generally persist in proposed Wilderness. Audible air-tour aircraft sound would be low, and natural conditions and opportunities for solitude would not often be disrupted. Impacts would generally be negligible to minor adverse with negligible to moderate beneficial change in impacts compared to Alternative A. However, at Grid Location Point 8, impacts would be up to moderate adverse with moderate adverse change in impacts from Alternative A.

Central NPS Preferred Alternative Wilderness Character
Ten-Year Forecast Peak Season

At **Central area Location Points** Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season, except for **Grid Location Point 8** (decrease of 20% Percent Time Audible, and 6 dBA compared to Base Year), and **Grid Location Point 22** (increase of 6 dBA compared to Base Year). Negligible to minor adverse impacts would occur with generally negligible change in impacts compared to Alternative A (except for a moderate beneficial change at Grid Location Point 8).

Central NPS Preferred Alternative Wilderness Character
Base Year Off-Peak Season

At **Central area Location Points** Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season, except for **Grid Location Point 8** and **Tuweep** Location Points where decreases compared to Base Year Peak Season would be greater. Impacts would generally be negligible to minor adverse with negligible change in impacts compared to Alternative A.

Central NPS Preferred Alternative Wilderness Character
Ten-Year Forecast Off-Peak Season

At **Central area Location Points** Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season, except Location Points **Tuweep (GC009)** and **Grid Location Point 8** which have an 11 and 20% decrease respectively in Percent Time Audible. Impacts would generally be negligible to minor adverse with negligible to minor beneficial change in impacts compared to Alternative A.

TABLE 4.51 NPS PREFERRED ALTERNATIVE SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	NPS Preferred Alternative	
		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	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

TABLE 4.52 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				NPS Preferred Alternative															
					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
The Dome	1	1	16	16	1	0	1	0	15	0	16	0	1	0	1	0	15	-1	16	0
Tuweep	12	14	15	16	12	-1	1	-13	15	0	16	0	13	1	1	-13	14	-1	15	-1
Tuweep	15	17	11	11	14	-1	14	-3	11	0	12	1	8	-7	13	-4	10	-1	11	0
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	10	1	9	0	2	0	2	0	7	-1	9	-1
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	8	-2	4	1	1	-2	8	-2	7	-3
Grid Location Point 9	1	1	5	5	1	0	1	0	6	1	3	-2	1	0	1	0	3	-2	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	17	-1	23	3	12	0	13	0	14	-5	21	1	11	-2	12	-1
Grid Location Point 23	2	2	10	10	2	0	2	0	10	0	10	0	2	0	2	0	9	-1	10	-1
Grid Location Point 24	3	4	8	8	3	0	2	-2	7	-1	8	0	2	-2	2	-2	6	-2	8	-1
Grid Location Point 25	11	12	9	10	10	-1	13	1	9	0	10	0	8	-3	11	-1	9	-1	10	0
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	9	3	6	-1	1	0	1	0	5	-1	5	-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	13	0	14	0	0	0	0	0	12	-1	13	-1
Upper Deer Creek	1	1	1	1	1	0	1	0	2	1	1	-1	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

West End **NPS Preferred Alternative** **Wilderness Character**

In West End's northern portion, which includes Blue Direct North, Blue-2, and Green-4, impacts would be major adverse under and near routes with aircraft Average Sound Level of 40 to 50 dBA and Percent Time Audible greater than 65%. NPS Preferred Alternative quiet-technology incentives and conversion requirements would provide some mitigation to these impacts with a decrease in affected area size; however, areas still affected would see increased localized impacts due to increased operations Base Year to Ten-Year Forecast. In West End's southern portion near Sanup Flight-free Zone Average Sound Level would be 10 to 20 dBA with aircraft Percent Time Audible less than 20%. Tables 4.53 and 4.54 present Percent Time Audible, Distances, and Average Sound Level for West End Location Points.

West End *NPS Preferred Alternative* *Wilderness Character*
Base Year Peak Season

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 71 to 93% with Average Sound Level ranging 42 to 49 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.

Locations near **Whitmore Rapids** Location Point under Brown routes, and further west along the river, would be affected by air-tour aircraft similar to Alternative A. Minor to moderate adverse impacts would continue with negligible change from Alternative A.

Grid Location Point 32 would be affected by air-tour aircraft on Blue Direct North similar to Alternative A. Air-tour aircraft Percent Time Audible would be 42% at Average Sound Level of 27 dBA. Air-tour aircraft would be greater than 6,000 meters away. Natural conditions would be altered in Wilderness. Moderate to major adverse impacts would continue with negligible change in impacts compared to Alternative A.

West End *NPS Preferred Alternative* *Wilderness Character*
Ten-Year Forecast Peak Season

In Location Points **Burnt Springs Canyon, Bat Cave,** and **Grid Location Point 33**, change in Percent Time Audible, Average Sound Level, and Distance would be just slightly less than Base Year Peak Season, with a 3 to 7% reduction in Percent Time Audible, and 2 to 3 dBA reduction in Average Sound Level due to quiet-technology aircraft conversion. Major adverse impacts would continue with a negligible to minor beneficial change in impacts compared to Alternative A.

For locations near **Whitmore Rapids** Location Point under Brown routes, and further west along the river, change in Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season. Minor to moderate adverse impacts would continue with negligible change in impacts compared to Alternative A.

At **Grid Location Point 32** aircraft Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season. Moderate to major adverse impacts would continue with negligible change in impacts compared to Alternative A.

West End *NPS Preferred Alternative* *Wilderness Character*
Base Year Off-Peak Season

At Location Points **Burnt Springs Canyon, Bat Cave,** and **Grid Location Point 33**, change in Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season. Moderate to major adverse impacts would occur with negligible change in impacts compared to Alternative A.

At locations near **Whitmore Rapids** Location Point under Brown routes, and further west along the river, change in Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season. Minor to moderate adverse impacts would continue with negligible change in impacts compared to Alternative A.

At **Grid Location Point 32** Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season. Minor to major adverse impacts would continue with negligible change in impacts compared to Alternative A.

West End *NPS Preferred Alternative* *Wilderness Character*

Ten-Year Forecast Off-Peak Season

At Location Points **Burnt Springs Canyon, Bat Cave,** and **Grid Location Point 33,** Percent Time Audible, Average Sound Level, and Distance would be slightly less than Base Year Peak Season, with 7 to 10% less Percent Time Audible. Moderate to major adverse impacts would continue with minor beneficial change in impacts compared to Alternative A.

At Location Points near **Whitmore Rapids** under Brown routes, and further west along the river, aircraft Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season. Minor to moderate adverse impacts would continue with negligible change in impacts compared to Alternative A.

At **Grid Location Point 32** Percent Time Audible, Average Sound Level, and Distance would not be appreciably different from Base Year Peak Season. Moderate to major adverse impacts would continue with negligible change in impacts compared to Alternative A.

TABLE 4.53 NPS PREFERRED ALTERNATIVE SLANT DISTANCES WEST END

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Burnt Springs Canyon	1,215	1,421	206
Bat Cave	1,134	827	-307
Grid Location Point 33	1,105	1,107	2
Whitmore Rapids	1,804	1,804	0
Grid Location Point 28	8,327	16,314	7,987
Grid Location Point 32	2,016	6,332	4,316
Diamond Creek	27,108	34,512	7,404
Separation Canyon	16,020	17,017	997
Granite Gorge	2,397	1,675	-722
Grid Location Point 29	9,306	12,193	2,887
Grid Location Point 30	2,008	2,810	802
Grid Location Point 34	28,206	31,096	2,889
Granite Peak	5,264	12,090	6,826
Kelly Point	20,278	23,696	3,418
Jackson Canyon	5,610	6,445	834
Parashant Wash	2,852	2,852	0
Pumpkin Springs	12,630	19,695	7,065
Peach Spring Canyon South	42,795	44,272	1,477
Sanup	1,820	1,820	0
Separation Canyon, 1 km N of Colorado River	15,819	16,959	1,140
Separation Canyon at Colorado River	16,377	17,617	1,240
Suicide Point	2,093	10,634	8,541
Three Springs	14,750	21,783	7,033
Twin Point	3,347	6,214	2,868
West End	1,688	1,754	65

Δ indicates change in noise metric data from Alternative A

TABLE 4.54 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL WEST END

Location Points	Alternative A				NPS Preferred Alternative															
					Peak Season								Off-Peak Season							
	Time Audible (%)		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	71	1	68	-8	48	2	46	-1	69	-2	64	-11	47	1	44	-3
Bat Cave	93	95	47	48	93	0	88	-7	49	2	48	0	92	-1	86	-9	49	2	48	-1
Grid Location Point 33	87	90	42	43	87	0	80	-10	42	0	39	-4	88	1	77	-13	42	0	38	-4
Whitmore Rapids	12	13	21	21	12	-1	12	-2	21	0	21	-1	9	-3	10	-4	20	-1	18	-3
Grid Location Point 28	14	16	17	18	13	-1	7	-9	17	0	18	0	13	-1	7	-9	17	0	18	0
Grid Location Point 32	44	49	27	28	42	-2	47	-1	27	0	27	0	43	-1	44	-4	27	0	27	-1
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	57	-1	52	-11	33	-1	31	-3	56	-2	48	-15	33	-1	32	-3
Grid Location Point 29	7	8	12	13	6	-1	5	-3	12	-1	13	-1	8	1	6	-2	12	0	13	0
Grid Location Point 30	39	42	28	28	54	15	32	-10	31	4	32	3	55	16	22	-20	33	5	32	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	17	0	18	0	2	0	2	0	17	0	18	0
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	18	1	11	-9	21	-3	21	-3	19	2	6	-14	22	-2	22	-3
Parashant Wash	12	14	33	33	11	-1	14	0	32	0	32	-1	12	-1	13	-1	34	1	31	-2
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	8	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	0	0	0	0
Sanup	79	83	38	38	79	1	68	-14	37	0	37	-1	80	2	63	-20	39	1	37	-2
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	16	1	12	-5	22	0	23	0	19	4	12	-5	22	0	23	0
Three Springs	1	2	8	9	1	0	2	0	8	0	9	0	1	0	2	0	8	0	9	0
Twin Point	19	22	23	23	29	10	17	-5	24	1	24	0	35	15	9	-13	24	2	24	0
West End	58	63	39	40	58	0	45	-19	41	1	38	-2	60	1	43	-20	41	2	37	-3

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year forecast

NPS Units in SFRA Outside GCNP NPS Preferred Alternative Wilderness Character
Based on modeled noise results, for **Wilderness directly under and within five miles of Blue Direct routes** (proposed wilderness in Lake Mead National Recreation Area and Grand Canyon-Parashant National Monument), impacts would continue to be moderate to major adverse. Average Sound Level would generally be 40 to 50 dBA, with high levels of aircraft Percent Time Audible similar to current Blue Direct North and South routes under Alternative A. These represent negligible changes in impacts compared to Alternative A Base Year. However, with NPS Preferred Alternative quiet-technology incentives and conversion requirements, there would be a decrease in size of affected areas resulting in minor beneficial changes in impacts compared to Alternative A Ten-Year Forecast.

Because there would be only one northbound route in Marble Canyon under the NPS Preferred Alternative, but it would be closer to Paria Canyon-Vermilion Cliffs Wilderness than current routes under Alternative A, impacts would be negligible to minor adverse on **Wilderness in the Marble Canyon area** (Saddle Mountain Wilderness and Paria Canyon-Vermilion Cliffs Wilderness) and changes in impacts compared to Alternative A would range from minor adverse to minor beneficial under the NPS Preferred Alternative Base Year and Ten-Year Forecast.

Cumulative Impacts ` NPS Preferred Alternative Wilderness Character

Noise from aircraft flying above and outside the SFRA would continue to have long-term moderate to major adverse impacts on Wilderness Character (i.e., natural conditions and opportunities for solitude) in all SFRA areas as described in Alternative A. Noise from other sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA combined with air-tour aircraft under the NPS Preferred Alternative contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under the Alternatives.

Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under the NPS Preferred Alternative as discussed above, would have long-term moderate to major adverse cumulative impacts on Wilderness Character throughout all four areas (Marble Canyon, East End, Central, and West End), due primarily to the combined Percent Time Audible of greater than 50% of the day over large areas.

Conclusion NPS Preferred Alternative Wilderness Character

Overall the NPS Preferred Alternative would result in mostly beneficial changes in impacts to Wilderness Character compared to Alternative A. In Marble Canyon, Central areas, and West End's southern portions, Wilderness would be least impacted by air-tour operations as Average Sound Level would generally be less than 15 dBA, with aircraft Percent Time Audible less than 5%. Greatest exposure to noise and visual impacts in Wilderness would occur under and near air-tour routes in East End and West End's northwestern portions where Average Sound Level would generally be 40 to 50 dBA, and aircraft Percent Time Audible would generally be greater than 75% of the time.

Because the NPS Preferred Alternative includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast in the park as a whole.

Conclusion Marble Canyon NPS Preferred Alternative Wilderness Character
Peak and Off-Peak Seasons, improvements over Alternative A would occur at most Marble Canyon Location Points, and most at North and South Canyon Location Points. Negligible to minor adverse impacts would continue with an overall negligible to minor long-term beneficial change in impacts from Alternative A Base Year and Ten-Year Forecast. Areas under reconfigured Black-4 would experience increased aircraft sights and sounds resulting in a negligible to minor adverse change in impacts from Alternative A. Cumulative impacts from all actions would be moderate to major adverse.

Conclusion East End NPS Preferred Alternative Wilderness Character
Noise conditions and effects on Wilderness at Location Points Little Colorado River confluence and Nankoweap River would improve compared to Alternative A. Negligible to minor adverse impacts would continue with a minor to moderate beneficial change in impacts from Alternative A. Impacts would be similar All Scenarios.

Peak and Off-Peak Season, Nankoweap Mesa would be farther from Black-1 and Green-1 than in Alternative A. Base Year, moderate to major adverse impacts from aircraft on Wilderness Character would occur with negligible to minor beneficial change in impacts compared to Alternative A. Ten-Year Forecast, air-tour aircraft Percent Time Audible would decline, still resulting in long-term moderate to major impacts, but moderate to major beneficial change in impacts compared to Alternative A.

In Saddle Mountain Wilderness Area, impacts on Wilderness Character would be minor to moderate adverse with moderate to major beneficial change in impacts compared to Alternative A All Scenarios.

Along North Rim moderate to major adverse impacts from aircraft Base Year would change to minor to moderate adverse impacts Ten-year Forecast with long-term moderate to major beneficial change in impacts compared to Alternative A due to high reduction in aircraft Percent Time Audible.

Beneath and near Dragon Corridor routes Peak Season, major adverse impacts from air-tour aircraft on Wilderness Character would continue Peak Season; however, there would be negligible to minor beneficial change in impacts compared to Alternative A Base Year, and moderate to major beneficial change from Alternative A Ten-Year Forecast. Off-Peak Season there would be minor to major adverse impacts with moderate to major beneficial change in impacts compared to Alternative A Base Year and Ten-Year Forecast.

Beneath Zuni Point Corridor routes Base Year Peak and Off-Peak Season there would be moderate to major adverse impacts with minor adverse to moderate beneficial change in impacts compared to Alternative A. Ten-Year Forecast Peak and Off-Peak Season there would be long-term moderate to major adverse impacts with moderate to major beneficial change in impacts compared to Alternative A.

Beneath Bright Angel Flight-Free Zone All Scenarios, effects of air-tour aircraft would be similar to Alternative A with negligible impacts from air-tour aircraft on Wilderness Character, and negligible change in impacts compared to Alternative A.

At Toroweap/Shinumo Flight-Free Zone's eastern edge Base Year Peak Season there would be major adverse impacts with minor to major adverse change in impacts compared to Alternative A. Base Year Off-Peak Season, there would be moderate to major adverse impacts with minor to major beneficial change in impacts compared to Alternative A. Ten-Year Forecast, there would be moderate to major adverse impacts Peak Season, and minor to moderate adverse impacts Off-Peak Season, and both would represent a moderate to major beneficial change in impacts compared to Alternative A. Cumulative impacts from all actions would be moderate to major adverse.

Conclusion Central *NPS Preferred Alternative* *Wilderness Character*
Peak Season there would be negligible to minor adverse impacts with negligible to moderate change in impacts compared to Alternative A Base Year and Ten-Year Forecast. Off-Peak Season, impacts to Wilderness Character would be negligible except at Tuweep (GC009) and Grid Location Point 8 Location Points where change in impacts would be negligible to minor adverse with negligible to minor beneficial change in impacts compared to Alternative A. Cumulative impacts from all actions would be moderate to major adverse.

Conclusion West End *NPS Preferred Alternative* *Wilderness Character*
For Location Points near Blue-2 and Green-4 (Burnt Springs Canyon, Bat Cave, and Grid Location Point 33), moderate to major adverse impacts would continue with negligible to minor beneficial change in impacts compared to Alternative A All Scenarios. Near Whitmore Rapids Location Point and Brown routes, there would be minor to moderate adverse impacts with negligible change in impacts from Alternative A All Scenarios. Near Blue Direct North there would be moderate to major adverse impacts with negligible change in impacts from Alternative A All Scenarios. Cumulative impacts from all actions would be moderate to major adverse.

ETHNOGRAPHIC RESOURCES

General Methodology

Impacts of proposed action to Ethnographic Resources are analyzed for effects to Traditional Cultural Properties, tribal concerns, and various intangible and tangible resources valued by American Indian people affiliated with

GCNP or land in the SFRA. For additional information about what resources may be affected and why, including the role of natural quiet in Traditional Cultural Practices and Properties, see Chapter 3, Ethnographic Resources. Impacts are described with respect to privacy (including protection of property and viewscapes information) and traditional observance, as well as policy and guidelines, in accordance with Section 106 of the National Historic Preservation Act (§106). Traditional Cultural Properties referred to below are Ethnographic Resources eligible for listing on the National Register of Historic Places.

General Assumptions **Methodology** **Ethnographic Resources**

In the thresholds below, all aspects of impacts due to aircraft noise intensity and duration including, but not limited to, audibility, aircraft Average Sound Level (sound energy metrics), and timing are considered in the phrase *impacts due to the event*. Audibility is the ability of animals, including humans, with normal hearing, to hear a given sound. Audibility is affected by the hearing ability of animals and humans, other simultaneous interfering sounds or stimuli, and sound frequency content and amplitude. Sound energy metrics include Average Sound Level and Time Above decibel levels.

A measure of distance from points of ethnographic interest (Traditional Cultural Properties) to aircraft routes is used as an indicator related to effects of aircraft in close proximity to cultural practitioners or sites, including visibility and presence of aircraft to people on the ground, and of people on the ground to people in aircraft (issues related to privacy and traditional observance). While there is usually close correlation between distance and sound intensity, this measure of distance is included primarily to address effects other than aircraft sound.

Because each of the 11 tribes discussed in Chapter 3's Affected Environment has different religious and traditional practices conducted largely in private at different times in different places, an accurate evaluation of benefits and/or adverse effects of curfews on Ethnographic Resources would be impossible. Thus, possible effects of curfews will be discussed only in the most general terms.

Methodology **Ethnographic Resources**

Impact Intensity Threshold Descriptions

Threshold Levels

Negligible Impacts due to the event at lowest levels of detection and barely perceptible. Aircraft audible less than or equal to 5% of the 12-hour day used in this analysis

Distance from points of interest to aircraft routes greater than or equal to 2000 meters

Aircraft noise intensity in a specific area (Average Sound Level) less than or equal to 15 dBA

Impacts neither alter resource conditions, such as traditional access and site preservation, nor the relationship between the resource and the affiliated group's body of practices and beliefs

Minor Impacts due to the event slight but noticeable. Aircraft audible greater than 5% and less than or equal to 10% of the 12-hour day

Distance from points of interest to aircraft routes is greater than or equal to 1000 meters and less than 2000 meters

Aircraft noise intensity in a specific area (Average Sound Level) greater than 15 dBA and less than or equal to 25 dBA

Impacts neither appreciably alter resource conditions, such as traditional access and site preservation, nor the relationship between the resource and the affiliated group's body of practices and beliefs

Moderate	Impacts due to the event apparent. Aircraft audible greater than 10% and less than or equal to 25% of the 12-hour day Distance from points of interest to aircraft routes greater than or equal to 500 meters and less than 1,000 meters Aircraft noise intensity in a specific area (Average Sound Level) greater than 25 dBA and less than or equal to 35 dBA Impacts appreciably alter resource conditions, such as traditional access and site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs, but the group's body of practices and beliefs survive
Major	Impacts due to the event substantially alter resource conditions, such as traditional access and site preservation, or the relationship between the resource and the affiliated group's body of practices and beliefs, to the extent survival of a group's body of practices and/or beliefs is jeopardized Aircraft audible greater than 25% of the 12-hour day Distance from points of interest to aircraft routes less than 500 meters Aircraft noise intensity in a specific area (Average Sound Level) is greater than 35 dBA Impacts could result in substantial changes or destabilization to defining elements and resource condition and an increase in exposure or vulnerability to natural elements

Type of Impact	**Ethnographic Resources**
Adverse	Impacts adversely alter resource conditions, or interfere with traditional access, site preservation, or relationship between resource and affiliated group's body of practices and beliefs
Beneficial	Impacts positively alter resource conditions, or facilitate or improve traditional access, site preservation, or relationship between resource and affiliated group's body of practices and beliefs
Context	
Localized	Impacts restricted to specific sites
Regional	Impacts occur to several specific resource sites or to one or more sites with cultural significance to a large area or the general vicinity, or a single site with significance extending well beyond the vicinity
Park Management Zone	Where appropriate, impacts on Ethnographic Resources analyzed consistent with park Management Zones

Duration Ethnographic Resources

Short term Impacts that, in five years, no longer detectable as resource, access, site preservation, or relationship returns to pre-disturbance condition or appearance

Long term Impacts do not allow resource, access, site preservation, or relationship to return to pre-disturbance condition or appearance for more than five years, and/or for all practical purposes would be considered permanent

Timing Some traditional practices must be performed during specific times of year or season. Some Ethnographic Resources might be more vulnerable during spring growing season or at other times of year depending on tribal traditions.

ALTERNATIVE A NO ACTION ETHNOGRAPHIC RESOURCES

Under Alternative A, a range of aircraft noise intensities and audibility would affect Ethnographic Resources across the park and SFRA. Although Percent Time Audible and Average Sound Level would generally decrease Base Year to Ten-Year Forecast at all locations, impact intensity levels would be the same Base Year and Ten-Year Forecast.

Traditional access and site preservation, prayers, ceremonies, and other cultural practices could be altered in nearly half the park and SFRA, Base Year and Ten-Year Forecast. As shown in Figure 4.6, 45% of the park would have air-tour aircraft Percent Time Audible greater than 25% of the day predominantly in East and West Ends under and near air-tour routes. Air-tour Average Sound Level would generally be low, less than 25 dBA, in about 67% of the SFRA Base Year. Ten-Year Forecast aircraft noise would increase slightly in the park and SFRA. Greatest exposure to noise and visual impacts would occur East and West Ends under and adjacent to air-tour routes.

Marble Canyon ***Alternative A*** ***Ethnographic Resources***

Base and Ten-Year Forecast

Based on noise modeling results including those shown in Tables 4.55 and 4.56, Marble Canyon would remain relatively quiet. The area on average would not be exposed to audible aircraft noise, and Average Sound Level would be less than 5 dBA. Steep canyon walls would reduce aircraft visibility, and aircraft would generally be more than 3,000 meters away from points on the ground. There would be negligible adverse visual and auditory impacts on Ethnographic Resources.

Near **South Canyon** Location Point, aircraft Percent Time Audible would be 2 to 3% of the day with Average Sound Level 21 to 23 dBA. Near where fixed-wing Black routes intersect; aircraft would be closer than 1,000 meters from points on the ground. This would result in noticeable aircraft sights and sounds that could intrude on traditional practices. However, these effects would be localized and intermittent, and would have negligible to minor long-term adverse impacts on Ethnographic Resources.

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

TABLE 4.56 ALTERNATIVE A SLANT DISTANCES MARBLE CANYON

Location Point Name	Slant Distance (m)
South Canyon	816

East End ***Alternative A*** ***Ethnographic Resources***

Base and Ten-Year Forecast

As shown in Figures 4.6 and 4.7, greatest noise and visual impact exposure would occur East End where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75%.

Effects of air-tour aircraft on near **Little Colorado River** and **Nankoweap Mesa** Location Points would vary depending on proximity to Green-1 and Black-1. As shown in Tables 4.57 and 4.58, at Little Colorado River and **Temple Butte** Location Points air-tour aircraft Percent Time Audible would be 34 to 66% of the day at 37 to 43 dBA. Aircraft would be greater than 1,400 meters away from points on the ground.

The area near the Little Colorado River confluence is especially significant to the majority of tribes with Grand Canyon cultural ties. Numerous historic and prehistoric routes (many still used by contemporary peoples) lead into the canyon from this general area, and numerous special sites are in or adjacent to the canyon such as the Zuni place of origin, Hopi Salt Mines, Zuni Pilgrimage Trail, and others. Quiet is needed for proper performance of traditional activities such as singing, praying, contemplation, or healing ceremonies. Native people feel interruptions may cause traditional ceremonies to be unsuccessful, and prayers may not have the desired effect. Hualapai religious and ceremonial activities at Traditional Cultural Properties depend on an uninterrupted viewshed so prayers can travel uninterrupted from one site to another (low aircraft flights should not block prayers).

Some on-the-ground traditional activities may be visible from aircraft. As an example, native peoples or individuals participating in pilgrimages to special places like the Hopi Salt Mines and Hopi place of origin, Navajo worshipers engaging in traditional activities, or Hualapai who consider the canyon a physical and spiritual landmark could be visible from aircraft. Onlookers from above may be highly distracting to traditional practitioners, greatly reducing their sense of privacy and sanctity of worship. American Indians are also concerned that curious onlookers may return later to a site, possibly damaging physical remains seen from the air, increasing potential for unauthorized collecting or site damage. Fixed-wing aircraft and helicopters that make a loop around the confluence area would be visible from the ground, and activities being conducted below would be open to view from aircraft. Clarity of view and Average Sound Level would be reduced somewhat due to aircraft elevation.

Traditionally, native people gather plants and minerals for religious and medicinal purposes. Obviously time of year/seasonality is crucial in obtaining correct plant parts at optimum growth stage/maturity. Many vegetative materials such as seeds, cactus fruit, bark, sage, agave, etc., may be available (and culturally appropriate for gathering) only in certain seasons and specific areas. If plant materials are not gathered at the optimum time, their efficacy (in both a physical and spiritual sense) may be reduced. Due to the tightly interwoven relationship between native peoples' natural and cultural worlds, prayers and other actions often accompany resource gathering. These activities could be interrupted by the presence of air-tours.

Existing curfews as described in Table 2.6 would have very slight benefits to Ethnographic Resources by allowing practitioners to enter the canyon for traditional practices early in the morning while it is still cool and quiet. However, timing and location of traditional practices may or may not correspond to arbitrary curfew times. In addition, due to difficult terrain and time necessary to access areas in or adjacent to canyons, curfews would generally not allow sufficient time to complete necessary religious activities during a quiet period.

At the confluence, as shown by the **Little Colorado River** Location Point in Tables 4.57 and 4.58, aircraft Percent Time Audible would be 34 to 37% of the day at Average Sound Level of 43 dBA. Although air-tour noise would be audible a high percent of the day at a noticeable level, this would not be expected to inhibit survival of a group's practices and beliefs. This effect would be somewhat moderated by aircraft flying more than 1,600 meters away from points on the ground, and by noise masking from ambient river sounds which would tend to reduce these effects. Thus long-term adverse impacts on Ethnographic Resources in the confluence area would be moderate.

Little Colorado and Nankoweap River Location Points would be farther away from air-tour routes, and air-tour aircraft Percent Time Audible would be one to 8% of the day where natural ambient Average Sound Level near the river is 25 to 65 dBA. Aircraft Average Sound Level would be 25 to 35 dBA. Aircraft would be more

than 1,400 meters away from points on the ground. Ambient river noise would mask much aircraft noise, but the human ear can distinguish among different sounds, allowing aircraft to be heard. Adverse impacts from aircraft on Ethnographic Resources would be long term minor. This is because river noise would mask some aircraft noise, noise would be infrequent and sporadic, and there would be increased distance from aircraft.

Although the **Desert View** area is in Desert View Flight-free Zone, it contains developed areas and is near Zuni Point Corridor. The area provides many opportunities for overlooking the canyon, and contains Tusayan Museum, which houses cultural resources. Impacts to Ethnographic Resources in the vicinity could result from aircraft Percent Time Audible of 76 to 79% of the day at Average Sound Level of 29 to 30 dBA. Aircraft would be more than 5,000 meters away from points on the ground. The Bright Angel Point area is valued by visitors for its spectacular viewsheds and trails affording canyon access. **Bright Angel Point** Location Point also represents an area of ethnographic sites of special importance to American Indians; Bright Angel Trail was originally an American Indian trail that afforded native people canyon access. Bright Angel Point Location Point would have aircraft Percent Time Audible 47 to 48% of the day at Average Sound Level of 24 dBA. Aircraft would be visible at distances greater than 6,000 meters. While some noise would be audible for nearly half the 12-hour day, aircraft Average Sound Level and Distance would be less than other locations described above. Thus 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	1,629
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.

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

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

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.

A number of Hualapai Traditional Cultural Properties are located near heavily visited West End areas including Burnt Springs Canyon. 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.

Aircraft noise could seriously disrupt prayers, ceremonies, or other cultural practices. Since many cultural practices are site specific, there could be times when practitioners could not be assured of either visual privacy or freedom from aircraft noise. It is possible traditional practitioners might need to begin prayers or ceremonies repeatedly until they can complete the prayer or ceremony without interruption. Or, they might consider moving to another location; a particular burden on more elderly practitioners. When traditional ceremonies or recitation of prayer cannot be conducted in appropriate places at appropriate times, centuries-old traditional practices could be altered. Although Ethnographic Resources in areas under routes would be appreciably altered, the group's practices and beliefs would be expected to survive. Impacts to Ethnographic Resources would be long term moderate adverse.

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

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

Cumulative Impacts Alternative A Ethnographic Resources

Area of Potential Effect for this EIS is located in the Study Area as defined in Chapter 1, and the time period for Ethnographic Resources extends back two centuries. Over this period, American Indians have occupied what is now the American Southwest, and in particular the Grand Canyon and its environs. Human culture, that is, a shared set of attitudes, values, goals, practices, and learned behaviors that characterizes a group, has shaped the human response to this special environment. Area cultures have not been static, but have evolved over time to meet human needs and changing environments. Long-held religious beliefs and traditional cultural practices have also changed, but for many, that change has come slowly.

Many past changes in American Indian culture have come from incursion of Euroamericans and Euroamerican ideas into their midst, changing the way cultures operate. Despite these changes, most religious beliefs and practices have survived, but may have been altered. For example, when tribes were moved to reservations, some traditionally used shrines may have been destroyed or left behind, or words of special prayers lost. Access to important resources may now be more difficult because these resources are now in a national park or on privately owned land.

Over the past century, development, ever-increasing park visitor numbers, new interpretive programs, and air-tours have come to Grand Canyon. Tribes now use computers to track business, and motorized vehicles to access points

on the land that would have taken many hours or days to reach a century ago. Traditions have changed as well. For example, it is rare to see young American Indians in traditional dress (outside special events). Some of these changes have enriched American Indian culture, but other changes have had adverse effects on traditional religious activities. No doubt, traditional practitioners and tribal members alike have found access to cultural sites in the Grand Canyon region much more difficult after Euroamerican occupation of northern Arizona, and subsequent changes in land status to Federal or private land ownership. This has resulted in long-term minor to moderate adverse effects on Ethnographic Resources.

Human-caused noises from machinery, trains, visitors, and motor vehicles are present and audible throughout portions of GCNP and the SFRA. Quieter, less-used areas may be revered by native people, and can be disturbed by those hiking into them. All these noises and visual intrusions combine to create distractions for traditional practitioners. This has resulted in short- and long-term minor to moderate adverse effects on Ethnographic Resources.

Other than air-tour aircraft sounds, impacts on Ethnographic Resources are caused by activities described above as well as by sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet outside of the SFRA. Throughout the park, these aircraft produce Average Sound Level 22 to 31 dBA, and are only minimally visible from points on the ground. These effects are not expected to diminish, and would extend into the future. Aircraft above 18,000 feet and outside the SFRA Percent Time Audible varies. Local differences are described below for each area.

The following presents, for each of the four geographic areas, effects of past, present, and reasonably foreseeable actions combined with Alternative A impacts.

Cumulative Impacts Marble Canyon Alternative A Ethnographic Resources

In locations close to the river, noise from aircraft outside the SFRA would be less noticeable, resulting in fewer impacts on practitioners and Ethnographic Resources. Sounds would be more audible and aircraft more visible (and thus more distracting) to practitioners at high-elevation points. At **Marble Canyon** Location Points, noise from aircraft outside the SFRA combined with aircraft above 18,000 feet is audible 16 to 36% of the day and, combined with Average Sound Level and Distance from points on the ground provided above, results in long-term minor to moderate adverse impacts to Ethnographic Resources. Although aircraft would be audible large portions of the day, and traditional practices frequently interrupted, a group's body of practices and beliefs would be expected to survive. 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 impacts, 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 American Indian religious practitioners. When Alternative A's negligible impacts are combined with 1) minor to moderate adverse impacts of other aircraft noise outside the SFRA, 2) minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and 3) minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts East End Alternative A Ethnographic Resources

As shown in Figures 4.6 and 4.7, at all East End Location Points, except those close to the river (e.g. Nankoweap River Location Point), aircraft outside the SFRA and above 18,000 feet are audible 27 to 71% of the day. This, combined with aircraft Average Sound Level and Distances from points on the ground, results in long-term moderate to major adverse impacts to Ethnographic Resources. If these sounds are present more than half a day, practitioners might not have time to access sites or complete prayers or other activities during a period of quiet.

Additionally, places as Bright Angel Point have relatively high-visitation levels, contributing minor to moderate adverse impacts from noise and lack of privacy.

On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft is added to all other intrusive noises and visual distractions present in and near the park, resulting effect can diminish focus and sense of introspection of American Indian religious practitioners. When Alternative A's minor to moderate adverse impacts are combined with 1) minor to moderate adverse impacts of other aircraft noise outside the SFRA, 2) minor to moderate adverse effects of restrictions on

access to sites as a result of past actions, and 3) minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts, Central *Alternative A* *Ethnographic Resources*
At Central area Location Points, as shown in Figures 4.6 and 4.7, noise from aircraft outside the SFRA is audible 16 to 65% of the day, and combined with aircraft Average Sound Level and Distances from points on the ground provided above, results in long-term minor to moderate adverse impacts to Ethnographic Resources.

Tribes have voiced concerns when sacred places are pointed out to visitors during a tour, feeling this information might increase potential for on-the-ground damage at a later time. Potential for adverse impacts from high-elevation aircraft increases at higher elevations on the ground (aircraft are more visible and more audible).

On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. 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 American Indian religious practitioners. When Alternative A's negligible impacts are combined with 1) minor to moderate adverse impacts of other aircraft noise outside the SFRA, 2) minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and 3) minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long-term moderate adverse.

Cumulative Impacts West End *Alternative A* *Ethnographic Resources*
At West End Location Points, as shown in Figures 4.6 and 4.7, noise from aircraft outside the SFRA is audible 12 to 51% of the day and, combined with aircraft Average Sound Level and Distances from points on the ground provided above, results in long-term moderate adverse impacts to Ethnographic Resources.

On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When Alternative A's negligible to moderate adverse impacts are combined with 1) minor to moderate adverse impacts of other aircraft noise outside the SFRA, 2) minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and 3) minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term adverse moderate.

Conclusion **Alternative A** **Ethnographic Resources**

Conclusion Marble Canyon *Alternative A* *Ethnographic Resources*
Alternative A would result in long-term negligible to minor adverse impacts to Ethnographic Resources. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion East End *Alternative A* *Ethnographic Resources*
Alternative A would result in long-term minor to moderate adverse impacts to Ethnographic Resources. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion Central *Alternative A* *Ethnographic Resources*
Alternative A would result in negligible adverse impacts to Ethnographic Resources at most Central area Location Points. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion West End *Alternative A* *Ethnographic Resources*
Alternative A would result in moderate adverse impacts to Ethnographic Resources at Location Points under Green-4 and Black-2. Negligible adverse impacts would result at Location Points near Meriwhitca and Granite Peak. Cumulative impacts from all actions would be moderate adverse.

IMPACTS OF ALTERNATIVE E **ALTERNATING SEASONAL USE** **ETHNOGRAPHIC RESOURCES**

Changes in impact of air-tour aircraft noise are analyzed Base Year and Ten-Year Forecast. air-tour aircraft Percent Time Audible changes at some Location Points over Ten-Year Forecast as noted below.

Alternative E would increase park area beneath Flight-free Zones by alternating seasonal use of Zuni Point and Dragon Corridors, and by extending Bright Angel Flight-free Zone north to include Marble Canyon. A range of air-tour aircraft sounds would continue to affect Ethnographic Resources throughout the park and SFRA. Seasonal route closures would decrease air-tour aircraft noise, resulting in beneficial changes to traditional practices on East End. Alternative E would also implement quiet technology and a maximum seven-hour flight time over eastern portions of the park further reducing adverse impacts Ten-Year Forecast.

Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high Average Sound Level for long periods of the day. As shown in Figures 4.11 and 4.13, Ten-Year Forecast the majority of the SFRA (68% Peak Season, 71% Off-Peak Season) would have air-tour aircraft noise Percent Time Audible less than 5% of the day. Amount of area exposed to air-tours Percent Time Audible greater than 25% of the day would be reduced to 16% and 14%, Peak and Off-Peak Seasons respectively, compared to 47% of the park in Alternative A. This would result in greatly reduced impacts on resources with greater areas of the park and SFRA protected from air-tour aircraft sights and sounds. Traditional access, site preservation, and the relationship between Ethnographic Resources and a group's body of practices and beliefs would be substantially improved.

Marble Canyon ***Alternative E*** ***Ethnographic Resources***

Based on modeled noise results, as shown in Tables 4.63 and 4.64, in 100% of Marble Canyon, aircraft Percent Time Audible would be 5% or less. The entire area would experience Average Sound Level of 15 dBA or less.

Marble Canyon *Alternative E* *Ethnographic Resources*
All Scenarios

Marble Canyon ethnographic Location Points would be quieter than in Alternative A. Elimination of air-tour routes by extension of Bright Angel Flight-Free Zone to include Marble Canyon would reduce in-canyon noise and aircraft visibility. Air-tour aircraft Percent Time Audible would be less than Alternative A at less than one percent, and Average Sound Level would be zero. No air-tour routes would be visible from points on the ground, including Ethnographic Resources reflected by **South Canyon** Location Point. Improvements over Alternative A would result in aircraft sights and sounds that would adversely affect Ethnographic Resources less than Alternative A. Although negligible impacts would occur, there would be minor long-term beneficial changes in impacts compared with Alternative A.

TABLE 4.63 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	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

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
South Canyon	816	26,091	25,275

Δ indicates change in noise metric data from Alternative A

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 32 to 36 dBA decline from Alternative A. When audible, air-tour aircraft sounds would be low. In most cases, traditional activities could be

conducted without interference. Negligible impacts would occur with long-term minor to moderate change in beneficial impacts compared to Alternative A.

When **Dragon Corridor** routes would be active, aircraft Percent Time Audible would be 80% of the day, a 19% decrease compared to Alternative A. Aircraft Average Sound Level of 20 dBA would be similar to Alternative A. Aircraft would be visible during this time similar to Alternative A, greater than 2,000 meters from locations on the ground. A number of American Indian religious activities require a lengthy period without interruption. Thus, 80% daytime audibility would make it difficult to successfully complete prayers, singing, or other traditional activities where quiet is vital. Near continual interruption of prayers may cause practitioners to seek other, more private areas. Some religious ceremonies are site-specific so there could be times when practitioners could not be assured freedom from aircraft noise. Although these moderate adverse impacts would occur under Alternative E, there would be minor to moderate beneficial change in impacts compared to Alternative A.

At **Bright Angel Point** Location Point impacts would be similar to those described Base Year Peak Season.

East End *Alternative E* *Ethnographic Resources*
Ten-Year Forecast Peak Season

Impacts would be similar to Base Year Peak Season at **Little Colorado, Nankoweap River, Little Colorado River** and **Temple Butte** Location Points, although Percent Time Audible would decrease to 30% and 57%. At **Bright Angel Point** and **Pasture Wash** Location Points impacts would be similar to Base Year Peak Season.

East End *Alternative E* *Ethnographic Resources*
Ten-Year Forecast Off-Peak Season

At **Little Colorado, Nankoweap River, Little Colorado River** and **Temple Butte** Location Points, impacts would be similar to Base Year Off-Peak Season. Air-tour aircraft Percent Time Audible at **Pasture Wash** Location Point would decline to 31% of the day, a 67% decrease from Alternative A. Average Sound Level would decrease to 18 dBA. Although minor to moderate adverse impacts would occur under Alternative E at these location points, there would be minor to moderate beneficial change in impacts compared to Alternative A. At **Bright Angel Point** Location Point impacts would be similar to Base Year Peak Season.

TABLE 4.65 ALTERNATIVE E AVERAGE SOUND LEVEL EAST END

Location Point Name	Alternative A				Alternative E															
					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
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	-8	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	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

TABLE 4.66 ALTERNATIVE E SLANT DISTANCES EAST END

Location Point Name	Alternative A	Alternative E	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
North Rim			
Bright Angel Point	6,235	9,522	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

Central Alternative E Ethnographic Resources

Based on modeled noise results shown in Figures 4.10 to 4.13, in the Central area, there would be little change from Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 10 dBA and aircraft Percent Time Audible less than 5% of the time.

Central Alternative E Ethnographic Resources
Base Year Peak Season

Similar to Alternative A, Ethnographic Resources and values throughout most of **Central area** would be least affected by aircraft noise. As shown in Table 4.67 and Table 4.68, at Location Points **Upper Deer Creek, Surprise Valley, Mohawk Canyon,** and **Grid Location Point 08** when Dragon Corridor would not be in use, aircraft would be audible about one percent of the day, with aircraft Average Sound Level zero to 9 dBA. Aircraft would not be greatly visible from locations on the ground as they would range 3,000 to 26,000 meters away. Negligible impacts would occur with negligible change from Alternative A.

Central Alternative E Ethnographic Resources
Ten-Year Forecast Peak and Off-Peak Season
Base Year Off-Peak Season

Impact levels would be the same as Peak Season Base Year.

Central Alternative E Ethnographic Resources

TABLE 4.67 ALTERNATIVE E AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				Alternative E															
					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
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	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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

West End **Alternative E** **Ethnographic Resources**

Based on modeled noise results shown in Figures 4.10 to 4.13, West End air-tour routes near Blue-2 and Green-4 would continue to have localized long-term adverse impacts as aircraft Average Sound Level would be 40 to 50 dBA and Percent Time Audible would be greater than 65% of the time, similar to Alternative A. For areas near Blue Direct, area of audibility would be reduced by approximately 50% due to the short distance the route travels over the park resulting in substantial beneficial effects on traditional cultural practices in this portion of the park.

West End *Alternative E* *Ethnographic Resources*
Base Year Peak Season

Ethnographic Resources at **Meriwhitca** and **Granite Peak** Location Points would continue to have air-tour aircraft impacts similar to Alternative A (audible a very short period and relatively low dBA). Negligible impacts to Ethnographic Resources would occur with negligible change in impact compared to Alternative A.

Burnt Springs Canyon Location Point would be under Green-4/Black-2 routes, and adverse impacts to Ethnographic Resources would be similar to those described in Alternative A. As shown in Table 4.69 and 4.70, aircraft Percent Time Audible under these routes would be 70% at Average Sound Level 46 to 47 dBA. The closest air-tour aircraft to the ground would be near Burnt Springs Canyon Location Point at 1,215 meters. Adverse impacts would result from lack of a clear line of sight for prayers (visual effects), and from aircraft noise that would interrupt traditional practices, possibly forcing religious leaders to move to another area. If traditional practices are site-specific, and noise is too intrusive, relationship between resources and American Indian practices and beliefs could be appreciably altered in this area; however, a group's practices and beliefs would be expected to continue to survive. Moderate adverse impacts would occur with negligible change in impacts from Alternative A.

West End *Alternative E* *Ethnographic Resources*
Base Year Off-Peak Season

Impacts at **Meriwhitca, Granite Peak** and **Burnt Springs Canyon** Location Points would be similar to those described Base Year Peak Season.

West End *Alternative E* *Ethnographic Resources*
Ten-Year Forecast Peak Season

Aircraft Percent Time Audible at **Burnt Springs Canyon** Location Point would be 62%, a 13% decrease compared to Alternative A, and Average Sound Level would decrease to 43 dBA, a 4 dBA decrease. Modest levels of air-tour aircraft background noise would be present for large portions of the day, resulting in frequent interference with traditional cultural practices. Moderate adverse impacts would occur with negligible to minor beneficial change in impacts compared to Alternative A.

Impacts at **Meriwhitca and Granite Peak** Location Points would be similar to Peak Season Base Year.

West End *Alternative E* *Ethnographic Resources*
Ten-Year Forecast Off-Peak Season

Impacts at **Burnt Springs Canyon, Meriwhitca** and **Granite Peak** Location Points would be similar to Base Year Peak Season.

TABLE 4.69 ALTERNATIVE E AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				Alternative E															
					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
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

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
Burnt Springs Canyon	1,215	1,215	0
Granite Peak	5,264	16,588	11,324
Meriwhitca	15,742	5,833	-9,909
Pumpkin Springs	12,630	22,337	9,707

Δ indicates change in noise metric data from Alternative A

Cumulative Impacts Alternative E Ethnographic Resources

The time period and area considered under Alternative E cumulative impacts is the same as described under Alternative A. Noise from aircraft flying over 18,000 feet and outside the SFRA would continue to have long-term moderate adverse effect on Ethnographic Resources as described in Alternative A. Access to cultural sites has become increasingly difficult, resulting in long-term minor to moderate adverse impacts. Human-caused noise from mechanized equipment, motorized vehicles, and visitors result in visual and auditory intrusion, distracting and interrupting traditional cultural practices resulting in short- and long-term minor to moderate adverse impact.

Cumulative Impacts Marble Canyon Alternative E Ethnographic Resources
Alternative E would reduce aircraft sights and sounds resulting in long-term minor beneficial change in impacts compared with Alternative A Ten-Year Forecast. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. 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 American Indian religious practitioners. When Alternative E's negligible impacts are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts East End Alternative E Ethnographic Resources
Under Alternative E, Peak Season at Little Colorado River and Temple Butte Location Points, there would be negligible change in impacts from air-tour aircraft on Ethnographic Resources compared to Alternative A Ten-Year Forecast. At Little Colorado and Nankoweap River Location Points adverse impacts from air-tour aircraft would continue but there would be a long-term negligible to minor beneficial change in impact compared to Alternative A Ten-Year Forecast.

At all East End ethnographic locations, Off-Peak Season, adverse impacts from air-tour aircraft would continue but there would be a long-term minor to moderate beneficial change in impacts compared to Alternative A Ten-Year Forecast.

On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. 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 American Indian religious practitioners. When minor to moderate beneficial effects of Alternative E are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts Central Alternative E Ethnographic Resources
Alternative E Ten-Year Forecast would result in negligible change in impacts to Ethnographic Resources at most Central Location Points compared to Alternative A. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. 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 American Indian religious practitioners. When negligible impacts of Alternative E are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts West End Alternative E Ethnographic Resources
Alternative E Ten-Year Forecast would result in long-term negligible to minor adverse change in impacts compared to Alternative A, both visual and auditory, to Ethnographic Resources at Location Points under Green-4 and Black-2. Negligible change in impacts would result at Location Points near Meriwhitca, Granite Peak, and Pumpkin Springs, Base Year and Ten-Year Forecast compared to Alternative A. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. 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 American Indian religious practitioners. When negligible to minor

adverse impacts of Alternative E are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Conclusions Alternative E Ethnographic Resources

Overall in the park and SFRA, Base Year and Ten-Year Forecast, Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced amount of area exposed to high Average Sound Level for long periods of the day. Substantially reduced impacts of aircraft noise in both Percent Time Audible and Average Sound Level would result in the majority of the park and SFRA allowing for improved traditional access, preservation of sites, and enhanced relationships between resources and an affiliated group's body of practices and beliefs. The majority of the SFRA would have air-tour aircraft noise Percent Time Audible less than 5% of the day, and air-tour aircraft Average Sound Level less than 15 dBA. Because Alternative E includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast.

Conclusion Marble Canyon Alternative E Ethnographic Resources
All Scenarios

Alternative E would reduce aircraft sights and sounds that would adversely affect Ethnographic Resources as a result of expansion of Bright Angle Flight-free Zone to include Marble Canyon. As a result there would be negligible impacts with minor long-term beneficial change in impacts compared with Alternative A Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion East End Alternative E Ethnographic Resources
Base Year and Ten-Year Forecast Peak Season

Peak Season Base Year at Little Colorado River and Temple Butte Location Points, there would be moderate adverse impacts with negligible change in impacts from air-tour aircraft on Ethnographic Resources compared to Alternative A.

At Little Colorado and Nankoweap River Location Points negligible impacts from air-tour aircraft would continue with long-term negligible to minor beneficial change in impacts compared to Alternative A. Bright Angel Point Location Point would have negligible impacts with long-term moderate beneficial change in impacts compared to Alternative A. Pasture Wash Location Point would have minor adverse impacts with moderate beneficial change in impacts compared to Alternative A.

Conclusion East End Alternative E ` Ethnographic Resources
Base Year and Ten-Year Forecast Off-Peak Season

At all East End ethnographic Location Points, negligible to moderate adverse impacts from air-tour aircraft would continue but there would be a long-term minor to moderate beneficial change in impacts compared to Alternative A. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion Central Alternative E Ethnographic Resources
Base Year and Ten-Year Forecast Peak and Off-Peak Season

Alternative E would result in negligible impacts with negligible change in impacts to Ethnographic Resources at most Central area Location Points compared to Alternative A. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion West End Alternative E Ethnographic Resources
All Scenarios

Alternative E would result in negligible impacts with negligible changes in impacts, both visual and auditory, to Ethnographic Resources at West End Location Points away from air-tour routes. Other West End Location Points under and near Green-4/Black-2 routes would have negligible to moderate adverse impacts with negligible to minor beneficial change in impacts compared to Alternative A. Cumulative impacts from all actions would be moderate adverse.

ALTERNATIVE F MODIFIED CURRENT CONDITIONS ETHNOGRAPHIC RESOURCES

Base Year in the park and SFRA, Alternative F would result in negligible changes in impacts compared with Alternative A. With quiet-technology incentives and conversion requirements, noise impacts would decrease Ten-Year Forecast. Traditional cultural practices, site access and preservation, and the relationship between resources and a group's practices and beliefs would be interfered with or altered in nearly half the park and SFRA. Nearly 50% of the park would have air-tour aircraft Percent Time Audible greater than 25% of the day predominantly in East and West Ends under and near air-tour routes.

Ten-Year Forecast Peak Season Percent Time Audible would decrease to 34%. Off-Peak Season, it would be reduced to 25% of the park.

Peak and Off-Peak Seasons Base Year and Ten-Year Forecast, average air-tour Average Sound Level would generally be low, less than 25 dBA, in about 68 to 70% of the SFRA.

Greatest exposure to noise and visual impacts would occur in East End and West End's western portions nearest air-tour routes. In Marble Canyon, Central areas, and West End's southern portions, traditional cultural practices and cultural sites would be least impacted by air-tour operations. Because Alternative F includes quiet-technology incentives and conversion, noise impacts would decrease from Base Year to Ten-Year Forecast.

Marble Canyon Alternative F Ethnographic Resources

Based on modeled noise results shown in Figures 4.18 to 4.21, Marble Canyon would remain relatively quiet with air-tour aircraft Percent Time Audible generally less than 5% of the time and Average Sound Level less than 15 dBA. Ten-Year Forecast there would be a slight improvement in conditions compared to Alternative A. The area would remain relatively quiet, and traditional cultural practices could be conducted with few to no interruptions from air-tour aircraft.

Marble Canyon Alternative F Ethnographic Resources

All Scenarios

As shown in Table 4.71, at **Marble Canyon Location Points**, effects of air-tour aircraft noise in Alternative F would be the same as Alternative A (relatively quiet with air-tour aircraft Percent Time Audible only about 2% of the day). Overhead visibility for those in the canyon would be reduced by the steep canyon walls, and for more distant aircraft, river sounds would help mask aircraft noise. Aircraft sights and sounds would affect Ethnographic Resources in the vicinity of **South Canyon** Location Point intermittently, particularly where fixed-wing flights on Black routes cross the canyon. There would be negligible impacts with negligible change in impacts compared to Alternative A.

TABLE 4.71 ALTERNATIVE F AVERAGE SOUND LEVEL 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 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

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
South Canyon	816	822	7

Δ indicates change in noise metric data from Alternative A

East End **Alternative F** **Ethnographic Resources**

Modifications to East End air-tour routes would be small resulting in Peak Season impacts similar to Alternative A. As shown in Figures 4.18 to 4.21, Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75% of the time.

Dragon Corridor's Off-Peak Season seven-mile western shift would essentially shift impacts seven-miles west. Due to quiet-technology incentives and conversion, additional beneficial impacts would be expected from Base Year to Ten-Year Forecast in both Percent Time Audible and Average Sound Level.

East End *Alternative F* *Ethnographic Resources*

Base Year Peak Season

Location Points near **Little Colorado River and Nankoweap Mesa** would be affected much the same as described in Alternative A. Because so many of the cultural, geologic and natural features of the confluence area are significant to tribes with ties to Grand Canyon, aircraft noise and visibility can intrude on performance of traditional activities such as singing, praying, contemplation, resource gathering, or ceremonies. Native people have concerns that such interruptions can result in unsuccessful traditional activities and ceremonies, and block prayers or cause them to fail. Gathering of natural resources with accompanying traditional prayers also can be delayed or interrupted, with adverse results. Concerns also have been raised over visibility (from aircraft) of native people participating in pilgrimages or other traditional activities. Of special concern is the flight pattern over the Confluence area.

There would be moderate adverse impacts with negligible change in impacts compared to Alternative A at **Little Colorado River** and **Temple Butte** Location Points, as shown in Tables 4.73 and 4.74.

Impacts at the **Little Colorado** and **Nankoweap River** Location Points would be the same as Alternative A. Aircraft Percent Time Audible would be one to 7% of the day at Average Sound Level of 25 to 34 dBA. Adverse impacts from aircraft on Ethnographic Resources would occur with negligible change from Alternative A.

Effects of air-tour aircraft on Ethnographic Resources at **Bright Angel Point** Location Point would be similar to those described for Alternative A. Aircraft Percent Time Audible would be 47% of the day at Average Sound Level of 24 dBA. Aircraft would be visible at Distances greater than 6,000 meters. Minor to moderate adverse impacts to Ethnographic Resources would occur with negligible change in impacts compared to Alternative A.

At **Toroweap/Shinumo Flight-free Zone's eastern edge** at **Pasture Wash** Location Point, effects of aircraft would be similar or somewhat greater than Alternative A. Traditional cultural practices and access to sites would be restricted to a large degree due to nearly continuous aircraft noise. Minor adverse impacts to Ethnographic Resources would occur with negligible change from Alternative A.

East End *Alternative F* *Ethnographic Resources*

Ten-Year Forecast Peak Season

At **Little Colorado River** and **Temple Butte** Location Points air-tour aircraft Percent Time Audible would decline to 25% and 45% of the day, respectively, a 12 to 22% decrease compared to Alternative A. Average air-tour aircraft Average Sound Level would decline slightly to 37 and 31 dBA. Aircraft would continue to be approximately 1,500 meters away from points on the ground. Although minor to moderate adverse impacts would occur, there would be minor beneficial change in impacts compared to Alternative A.

There would be little change in Percent Time Audible at **Little Colorado** and **Nankoweap River** Location Points; however, at Little Colorado Location Point there would be a 22 dBA decrease in Average Sound Level. This would represent negligible impacts and long-term negligible to minor beneficial change in impacts compared to Alternative A.

Air-tour aircraft Percent Time Audible at **Bright Angel Point** Location Point would decline to 12%, a 36% decrease from Alternative A. Average Sound Level would decline to 18 dBA, a 6 dBA decrease. Traditional cultural practices could be performed with substantially less interruption by aircraft sounds that are relatively low. Although minor

adverse impacts would occur, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.

Aircraft Percent Time Audible at **Pasture Wash** Location Point would be greatly reduced at 20% of the day, a 78% decrease compared to Alternative A. Average Sound Level would be similar to Alternative A at 17 dBA. There would be large improvement in opportunities to perform traditional activities without interruption, and for site preservation due to reduction in amount of the day air-tour operations would be audible. Although minor adverse impacts would occur, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.

East End *Alternative F* *Ethnographic Resources*
Base Year Off-Peak Season

Effects of aircraft at **Little Colorado River** and **Temple Butte** Location Points would be somewhat less than Peak Season and less than Alternative A. Aircraft Percent Time Audible would be 17 to 37% of the day, a decrease of 17 to 26% from Alternative A. Aircraft Average Sound Level would be 31 to 38 dBA, similar to Alternative A. Aircraft would be approximately 1,500 meters away from points on the ground. Due to reduction in amount of time air-tour aircraft would be audible, the ability to perform traditional activities without interruption would be enhanced. Although minor to moderate adverse impacts would occur, there would be long-term minor beneficial changes in impacts compared to Alternative A.

Air-tour aircraft would have little or no effect on **Little Colorado** and **Nankoweap River** Location Points. Aircraft would rarely be audible at Average Sound Level of 3 to 20 dBA, a 14 to 22 dBA decrease compared to Alternative A. Incremental reductions in air-tour sounds would result in beneficial changes in ability to conduct traditional practices. Although adverse impacts would occur, there would be long-term negligible to minor beneficial changes in impacts compared to Alternative A.

Bright Angel Point Location Point air-tour Percent Time Audible would decline to 2% of the day, a 45% decrease from Alternative A. Average Sound Level would also be reduced to 13 dBA, an 11 dBA decrease. Although negligible impacts could occur, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.

Pasture Wash Location Point impacts would be similar to Base Year Peak Season.

East End *Alternative F* *Ethnographic Resources*
Ten-Year Forecast Off-Peak Season

Air-tour aircraft Percent Time Audible and Average Sound Level at **Little Colorado River** and **Temple Butte** Location Points would decline slightly, further enhancing Ethnographic Resources. Aircraft Percent Time Audible would be 12 to 23% of the day; a decrease of 26 to 43% from Alternative A. Average Sound Level would be 27 to 33 dBA, declining 10 to 11 dBA from Alternative A. Although minor adverse impacts would occur, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.

Bright Angel Point Location Point impacts would be similar to Base Year Off-Peak Season.

Pasture Wash Location Point impacts would be similar to Ten-Year Forecast Peak Season.

TABLE 4.73 ALTERNATIVE F AVERAGE SOUND LEVEL EAST END

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 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
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	0	-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	-2	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

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
North Rim			
Bright Angel Point	6,235	6,225	-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

Central Alternative F Ethnographic Resources

Based on modeled noise results shown in Figures 4.18 to 4.21, in Central areas, there would be little change from Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 10 dBA and aircraft Percent Time Audible less than 5%.

Central Alternative F Ethnographic Resources
Base Year Peak Season

Similar to Alternative A, Ethnographic Resources throughout most of the Central area would be least affected by aircraft noise. As shown by representative **Central area** Location Points in Table 4.75, aircraft Percent Time Audible would be less than one to 4% of the day, and Average Sound Level would be less than one to 11 dBA. Negligible impacts to Ethnographic Resources would occur with negligible change compared with Alternative A.

Central Alternative F Ethnographic Resources
Ten-Year Forecast Peak Season

Central area Location Point impacts would be similar to Peak Season Base Year.

Central Alternative F Ethnographic Resources
Base Year Off-Peak Season

Aircraft noise would increase along the **Central area's eastern boundary** due to Dragon Corridor's seven-mile shift west. As illustrated by **Grid Location Point 8**, aircraft Percent Time Audible would be 25% of the day, an increase of 22% compared to Alternative A. Average Sound Level would remain low at 10 dBA. Aircraft would be more frequently heard or experienced although at low levels. Minor adverse impacts to Ethnographic Resources would represent a minor to moderate adverse change compared Alternative A.

Central Alternative F Ethnographic Resources
Ten-Year Forecast Off-Peak Season

With implementation of quiet technology, aircraft Percent Time Audible would be at % of the day at Average Sound Level of 10 dBA. Negligible impacts would occur with negligible change compared to Alternative A.

TABLE 4.75 ALTERNATIVE F AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				Alternative F															
					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
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

TABLE 4.76 ALTERNATIVE F SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	Alternative F	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Grid Location Point 8	13,765	13,765	0
Mohawk Canyon	3,009	3,009	0
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

West End **Alternative F** **Ethnographic Resources**

Based on modeled noise results shown in Figures 4.18 to 4.21, in West End's northern half, aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65%. However, beneficial impacts to Ethnographic Resources 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. Because Alternative F includes quiet-technology incentives and conversion, adverse impacts would be mitigated as aircraft convert Ten-Year Forecast. Increased air-tour-related activity on Blue Direct would, however, adversely affect Ethnographic Resources on West End's eastern side. In West End's southern portion near Sanup Flight-free Zone, aircraft noise would intrude little on Ethnographic Resources.

West End *Alternative F* *Ethnographic Resources*
Base Year Peak Season

Burnt Springs Canyon Location Point would be located under Green-4/Black-2, as in Alternative A. At this location, as shown in Table 4.77 aircraft Percent Time Audible would be 75% of the day at Average Sound Level of 47 dBA, similar to Alternative A. Adverse impacts to Ethnographic Resources would result from lack of a clear line of sight for prayers, and from aircraft noise that would interrupt traditional practices and possibly force religions leaders to move to another area temporarily, or, in the worst case scenario, abandon use of a particular area. Moderate adverse impacts would occur with negligible change in impacts compared to Alternative A.

Ethnographic Resources at **Meriwhitca** Location Point would have air-tour aircraft impacts similar to Alternative A. Due to low frequencies of visible and audible flights, and relatively low-decibel noise, impacts to Ethnographic Resources would be negligible with negligible change in impacts compared to Alternative A.

Granite Peak Location Point would be beneath both Blue Direct North quiet-technology route and Blue Direct South. This would result in increased effects of air-tour aircraft compared with Alternative A. Air-tour aircraft Percent Time Audible would be 21%, a 19% increase from Alternative A. Average Sound Level would be 28 dBA, a 12 dBA increase. Aircraft visibility at 5,257 meters from locations on the ground would be comparable to visibility in Alternative A. Minor to moderate adverse impacts would occur with long-term minor adverse change in impacts from Alternative A.

West End *Alternative F* *Ethnographic Resources*
Base Year Off-Peak Season

At **Burnt Springs Canyon** and **Meriwhitca** Location Points impacts similar to Base Year Peak Season.

West End *Alternative F* *Ethnographic Resources*
Ten-Year Forecast Peak and Off-Peak Season

Air-tour aircraft Percent Time Audible would be similar to Alternative A. Average Sound Level at **Burnt Springs Canyon** Location Point would increase to 44 dBA, a 3 dBA decrease from Alternative A. Negligible to moderate adverse impacts would occur with negligible change in impacts compared to Alternative A.

At **Meriwhitca** Location Point impacts similar to Base Year Peak Season.

TABLE 4.77 ALTERNATIVE F AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				Alternative F															
					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
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

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
Burnt Springs Canyon	1,215	1,215	0
Granite Peak	5,264	5,257	-7
Meriwhitca	15,742	13,733	-2,009
Pumpkin Springs	12,630	12,622	-8

Δ indicates change in noise metric data from Alternative A

Cumulative Impacts Alternative F Ethnographic Resources

Time and area considered for Alternative F cumulative impacts are the same as Alternative A. Noise from aircraft flying over 18,000 feet and outside the SFRA would be continue to have long-term moderate adverse effect on Ethnographic Resources as described in Alternative A. Access to cultural sites has become increasingly difficult since Euroamerican occupation of northern Arizona resulting in long-term minor to moderate adverse impacts. Human-caused noise from mechanized equipment, motorized vehicles, and visitors result in visual and auditory intrusion, distracting and interrupting traditional cultural practices resulting in short- and long-term minor to moderate adverse impact.

Cumulative Impacts Marble Canyon Alternative F Ethnographic Resources
Alternative F would result in aircraft sights and sounds that would adversely affect Ethnographic Resources, and there would be minor beneficial changes in impacts compared to Alternative A, Ten-Year Forecast. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When minor beneficial effects of Alternative F are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts East End Alternative F Ethnographic Resources
Ten-Year Forecast there would be long-term negligible to moderate beneficial changes in impacts on Ethnographic Resources at Little Colorado River, Temple Butte, Little Colorado, and Nankoweap River Location Points compared to Alternative A. Minor to moderate beneficial changes in impacts would also occur Ten-Year Forecast at Bright Angel Point and Toroweap/Shinumo Flight-free Zone's eastern portion due to implementation of quiet-technology incentives and conversion requirements.

On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When negligible impacts of Alternative F are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor to moderate noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts Central Alternative F Ethnographic Resources
Alternative F would result in a negligible change in impacts to Ethnographic Resources at most Central area Location Points compared to Alternative A. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When negligible impacts of Alternative F are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts West End Alternative F Ethnographic Resources
Alternative F would result in a negligible change in impacts to Ethnographic Resources at most West End Location Points compared to Alternative A. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When negligible impacts of Alternative F are combined with the minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor to moderate noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Conclusion Alternative F Ethnographic Resources

Base Year Alternative F would result in negligible changes in impacts compared with Alternative A. Traditional cultural practices, site access and preservation, and the relationship between resources and a group's practices and beliefs would be interfered with or altered in nearly half park and SFRA. Ten-Year Forecast these impacts would decline as result of quiet-technology incentives and conversion requirements. Greatest exposure to noise and visual impacts would occur in East End and West End's western portions nearest air-tour routes. In Marble Canyon, Central area, and West End's southern portions, traditional cultural practices and cultural sites would be least impacted by air-tour operations.

Conclusion Marble Canyon Alternative F Ethnographic Resources
All Scenarios

Marble Canyon Location Points would be little affected by aircraft sights and sounds, and there would be negligible impacts with negligible change in impacts on Ethnographic Resources compared to Alternative A. Cumulative impacts from all actions would be long-term moderate adverse.

Conclusion East End Alternative F Ethnographic Resources
Base Year Peak Season

There would be minor to moderate adverse impacts with negligible changes in impacts from air-tour aircraft noise on Ethnographic Resources at Little Colorado River and Temple Butte Location Points compared to Alternative A. At Little Colorado and Nankoweap River Location Points there would be negligible change in impacts.

Conclusion East End Alternative F Ethnographic Resources
All Scenarios

Impacts on Ethnographic Resources at Bright Angel Point and Pasture Wash Location Points would be minor to moderate adverse similar to Alternative A. Ten-Year Forecast due to a large reduction in Percent Time Audible there would be long-term minor to moderate beneficial change in impacts compared to Alternative A. Cumulative impacts from all actions would be long-term moderate adverse.

Conclusion East End Alternative F Ethnographic Resources
Ten-Year Forecast Off-Peak Season

At Little Colorado River and Temple Butte Location Points, reduction in aircraft Percent Time Audible and Average Sound Level would result in minor adverse impacts with long-term minor to moderate beneficial change in impacts compared to Alternative A. However, impacts at Little Colorado and Nankoweap River Location Points would be negligible with negligible to minor beneficial changes in impacts compared to Alternative A.

Conclusion Central Alternative F Ethnographic Resources
All Scenarios

Alternative F would result in negligible impacts with negligible changes in impacts to Ethnographic Resources at most Central area Location Points compared to Alternative A. There would be up to moderate adverse impacts with minor to moderate adverse changes in impacts at areas along the Central area's eastern edge due to Dragon Corridor's westward shift Off-Peak Season. Cumulative impacts from all actions would be moderate adverse.

Conclusion West End Alternative F Ethnographic Resources
All Scenarios

Alternative F would result in negligible to moderate adverse impacts on Ethnographic Resources with greatest level of impacts under and near Green-4 and Black-2 routes, and negligible to minor adverse changes in impacts compared to Alternative A. Cumulative impacts from all actions would be moderate adverse.

NPS PREFERRED ALTERNATIVE ETHNOGRAPHIC RESOURCES

Overall the NPS Preferred Alternative would result in beneficial changes from Alternative A due to differences in route location, route altitude, and quiet-technology conversion.

Base Year Peak Season area in which air-tour aircraft Percent Time Audible would be greater than 25% would increase slightly from 45% in Alternative A to 47%, but would decline to 37% Off-Peak Season.

Ten-Year Forecast Peak Season Percent Time Audible would decline further to 33 and 23% Off-Peak Season. Average Sound Level would remain relatively low with 68% of the SFRA exposed to sound levels of 25 dBA or less. Base Year, disturbances to Ethnographic Resources would occur, but Ten-Year Forecast there would be improvement as aircraft noise would be reduced allowing enhanced opportunities for traditional cultural practices and site preservation.

Marble Canyon NPS Preferred Alternative Ethnographic Resources

Based on modeled noise results shown in Figures 4.26 to 4.29, Marble Canyon would remain relatively quiet with air-tour aircraft Percent Time Audible generally less than 5%, and Average Sound Level less than zero dBA.

Marble Canyon NPS Preferred Alternative Ethnographic Resources
All Scenarios

Ethnographic Resources represented by **South Canyon** Location Point would be quiet, similar to Alternative A, as shown in Table 4.79. However, due to route changes, air-tour aircraft Percent Time Audible would be less than Alternative A, at about one percent, and aircraft Average Sound Level would be less than one dBA, a decrease of 21 dBA from current conditions. Air-tour aircraft would be far less visible from points on the ground. Thus there would be fewer distractions (visually or auditory) for American Indian practitioners than in Alternative A. Improvements over Alternative A, including increased curfews, would result in aircraft sights and sounds that would adversely affect Ethnographic Resources less than Alternative A. Although negligible impacts would occur, there would be long-term minor beneficial changes in impacts compared to Alternative A.

TABLE 4.79 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				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
South Canyon	2	3	21	23	1	-1	1	-2	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 4.80 NPS PREFERRED ALTERNATIVE SLANT DISTANCES MARBLE CANYON

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
South Canyon	816	4,742	3,926

Δ indicates change in noise metric data from Alternative A

East End NPS Preferred Alternative Ethnographic Resources

Changes due to the NPS Preferred Alternative, including curfews and seasonal closure of short-loop tour routes alternating between Dragon and Zuni Point Corridors, would provide more quiet time for East End Ethnographic Resources. Religious practitioners would have more time to complete prayers and other traditional cultural practices in privacy and quiet. There would be fewer distractions from overhead aircraft.

East End NPS Preferred Alternative Ethnographic Resources
Base Year Peak Season

At **Little Colorado River** Location Point, changes in Green-1/Black-1 routes would move air-tour aircraft away from Ethnographic Resources. Air-tour aircraft Percent Time Audible would be 8%, a 26% decrease from Alternative A. Average Sound Level would be 27 dBA, a 16 dBA decrease from Alternative A, with air-tour aircraft visible at Distances greater than 2,000 meters from points on the ground. Although minor adverse impacts would occur, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.

Impacts at **Temple Butte** Location Point would be similar to Alternative A. Air-tour aircraft on Green-1/Black-1 would result in aircraft Percent Time Audible 58% of the day with Average Sound Level of 37 dBA. Aircraft would be visible between 1,000 and 1,500 meters from points on the ground. Moderate adverse impacts from air-tour aircraft noise on Ethnographic Resources would occur with negligible change from Alternative A.

Bright Angel Point Location Point would be exposed to aircraft noise slightly greater than in Alternative A. Air-tour aircraft Percent Time Audible would be 58%, a 12% increase. Average Sound Level would be 24 dBA, the same as Alternative A. Aircraft would be visible greater than 6,000 meters from points on the ground. Minor to moderate adverse impacts from air-tour aircraft noise on Ethnographic Resources would be long-term negligible to minor adverse compared to Alternative A.

Pasture Wash Location Point would be similar to Alternative A with aircraft Percent Time Audible 99% of the day with Average Sound Level of 27 dBA. Air-tour aircraft visibility would decrease by 3,000 meters from Alternative A. Ability of groups or individuals to practice beliefs and perform traditional activities would be severely inhibited by the near constant sound of aircraft. There would be moderate adverse impacts with negligible to minor adverse change in impacts compared to Alternative A.

East End NPS Preferred Alternative Ethnographic Resources
Base Year Peak and Off-Peak Season

Changes to Green-1/Black-1 routes would move air-tour aircraft away from **Little Colorado** and **Nankoweap River** Location Points, and impacts of air-tour aircraft on Ethnographic Resources would be reduced compared with Alternative A. As shown in Table 4.81 air-tour aircraft Percent Time Audible would be less than one percent of the day with Average Sound Level 7 to 15 dBA, which would be less than natural ambient Average Sound Level. Air-tour aircraft would be visible at Distances greater than 5,000 meters from points on the ground. Impacts to Ethnographic Resources would be negligible with long-term negligible to minor beneficial change in impacts compared with Alternative A.

East End NPS Preferred Alternative Ethnographic Resources
Base Year Off-Peak Season

Minor to moderate adverse impacts at **Little Colorado River, Temple Butte,** and **Bright Angel Point** Location Points similar to Base Year Peak Season.

East End NPS Preferred Alternative Ethnographic Resources
Ten-Year Forecast Peak Season

Negligible to minor adverse impacts at **Little Colorado, Little Colorado River** and **Nankoweap River** Location Points similar to those described Base Year Peak Season.

Phasing-in of quiet technology on the long-loop tour over North Rim would reduce impacts at **Bright Angel Point** Location Point. Percent Time Audible would decline to 18%, a 30% decrease from Alternative A. Average Sound Level of 17 dBA, a 7 dBA decrease from Alternative A. Although minor adverse impacts would continue, there would be long-term minor to moderate beneficial changes in impacts compared to Alternative A.

Air-tour aircraft Average Sound Level at **Pasture Wash** Location Point would be similar to Alternative A, but Percent Time Audible would decline to 68%, a 31% decrease. Average Sound Level would remain at 21 dBA. Overall this would provide some improvement in conditions in which to perform traditional cultural practices. Although minor to moderate adverse impacts would occur, there would be long-term minor beneficial changes in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Ethnographic Resources*
Ten-Year Forecast Peak and Off-Peak Season

There would be a modest reduction in aircraft Percent Time Audible at **Temple Butte** Location Point. Aircraft Percent Time Audible would be 45%, a 21% decrease from Alternative A. Average Sound Level would be 35 and 37 dBA Peak and Off-Peak respectively, similar to Alternative A. This would result in a slight improvement to conditions in which traditional cultural practices would take place. Moderate adverse impacts would occur with long-term minor beneficial changes in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Ethnographic Resources*
Ten-Year Forecast Off-Peak Season

Impacts at **Little Colorado River** and **Bright Angel Point** Location Points similar to Base Year Peak Season.

Conditions at **Pasture Wash** Location Point improve greatly. Aircraft Percent Time Audible would be 15%, an 83% decrease compared to Alternative A. Average Sound Level would be 15 dBA, a 6 dBA decrease from Alternative A. Large reduction in daytime aircraft audibility would greatly improve potential to successfully complete prayers, singing, or other traditional activities where quiet is vital. Prayers would be infrequently interrupted by aircraft at low sound levels. Minor adverse impacts would occur with long-term moderate to major beneficial changes in impacts compared to Alternative A.

TABLE 4.81 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL EAST END

Location Point Name	Alternative A				NPS Preferred Alternative															
					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
North Rim																				
Bright Angel Point	47	48	24	24	58	12	18	-30	24	0	17	-7	59	12	9	-39	19	-4	15	-9
Zuni Point Corridor																				
Temple Butte	62	66	37	38	58	-5	45	-21	37	0	37	-1	63	1	45	-22	35	-3	35	-3
Little Colorado River/Nankoweap Area																				
Little Colorado	1	1	25	25	0	-1	0	-1	7	-18	6	-19	0	-1	0	-1	4	-20	3	-22
Little Colorado River	34	37	43	43	8	-26	5	-33	27	-16	27	-16	7	-27	3	-34	24	-19	25	-18
Nankoweap River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	13	-22	13	-22
Toroweap/Shinumo Flight Free Zone																				
Pasture Wash	98	98	20	21	99	1	68	-31	27	6	21	0	48	-50	15	-83	18	-3	15	-6

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.82 NPS PREFERRED ALTERNATIVE SLANT DISTANCES EAST END

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
North Rim			
Bright Angel Point	6,235	6,236	2
Zuni Point Corridor			
Temple Butte	1,458	1,228	-230
Little Colorado River/Nankoweap Area			
Little Colorado	1,637	5,891	4,253
Little Colorado River	1,629	2,689	1,059
Nankoweap River	1,449	5,705	4,256
Toroweap/Shinumo Flight Free Zone			
Pasture Wash	5,532	8,967	3,435

Δ indicates change in noise metric data from Alternative A

Central NPS Preferred Alternative Ethnographic Resources

Based on modeled noise results shown in Figures 4.26 to 4.29, in the Central area, there would be little change from Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 10 dBA, and aircraft Percent Time Audible less than 5%.

Central NPS Preferred Alternative Ethnographic Resources
Base Year Peak Season

Areas in the Central area's eastern portion, represented by **Grid Location Point 8**, would be exposed to higher levels of aircraft noise due to active Dragon Corridor routes. At Grid Location Point 8, aircraft Percent Time Audible would be 21%; an increase of 18% compared to Alternative A. Average Sound Level would also increase, but remain low at 14 dBA. Aircraft would be more frequently heard or experienced although at relatively low levels. Minor adverse impacts to Ethnographic Resources would represent a minor adverse change in impact compared Alternative A.

Central NPS Preferred Alternative Ethnographic Resources
Base Year Peak and Off-Peak Season

Similar to Alternative A, Ethnographic Resources throughout most of the Central area would be least affected by aircraft noise. As shown in Table 4.83, at **Upper Deer Creek**, **Surprise Valley**, and **Mohawk Canyon** Location Points, aircraft Percent Time Audible would be about one percent of the day, with Average Sound Level zero to 11 dBA. Negligible impacts would occur with negligible change from Alternative A.

Central NPS Preferred Alternative Ethnographic Resources
Base Year Off-Peak Season

At **Central area** Location Points, when air-tour routes in Zuni Corridor would be active, there would be a slight decrease in noise impacts on Ethnographic Resources. Aircraft Percent Time Audible would be 4% of the day at 8 dBA, similar to Alternative A. Traditional cultural practices would rarely be disturbed or interrupted. Although negligible impacts would occur, there would be negligible change in impacts compared to Alternative A.

Central NPS Preferred Alternative Ethnographic Resources
Ten-Year Forecast Peak Season

With quiet-technology implementation incentives and conversion requirements, aircraft Percent Time Audible at **Grid Location Point 8** would be one percent at Average Sound Level of 8 dBA. Negligible impacts would occur with negligible change in impacts compared to Alternative A.

Central NPS Preferred Alternative Ethnographic Resources
Ten-Year Forecast Off-Peak Season

Negligible impacts similar to Base Year Off-Peak Season.

TABLE 4.83 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				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
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	8	-2	4	1	1	-2	8	-2	7	-3
Mohawk Canyon	1	1	11	12	1	0	0	-1	11	0	12	0	1	0	0	-1	11	-1	12	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	0	1	1	1	0	1	1	2	1	1	0	1	0	1	1	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

TABLE 4.84 NPS PREFERRED ALTERNATIVE SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Grid Location Point 8	13,765	14,620	855
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

West End **NPS Preferred Alternative** **Ethnographic Resources**

Modeled noise results indicate impacts associated with West End air-tour routes would be similar to Alternative A, with exception of Blue Direct South. In West End's northern portion Average Sound Level of 40 to 50 dBA, and aircraft Percent Time Audible greater than 65% would occur. NPS Preferred Alternative quiet-technology incentives and conversion requirements would provide some mitigation to these adverse effects. In West End's southern portion near Sanup Flight-free Zone aircraft noise would intrude little on Ethnographic Resources.

West End *NPS Preferred Alternative* *Ethnographic Resources*
Base Year Peak and Off-Peak Season

Burnt Springs Canyon Location Point would continue to be under Green-4/Black-2 routes as in Alternative A. At this location, as shown in Table 4.85, aircraft Percent Time Audible would be 71% of the day at Average Sound Level of 48 dBA, similar to Alternative A. Adverse impacts to Ethnographic Resources would result from lack of a clear line of sight for prayers, and from continuing aircraft noise that would interrupt traditional practices and possibly force religions leaders to move to another area temporarily, or, in the worst case scenario, abandon use of a particular area. Moderate adverse impacts would occur with negligible change in impacts compared to Alternative A.

Ethnographic Resources at **Meriwhitca** and **Granite Peak** Location Points would have air-tour aircraft impacts similar to Alternative A. Due to low numbers of visible and audible flights, and relatively low decibel levels, adverse impacts to Ethnographic Resources would be negligible with negligible change in impacts compared to Alternative A.

West End *NPS Preferred Alternative* *Ethnographic Resources*
Ten-Year Forecast Peak and Off-Peak Seasons

Air-tour aircraft Percent Time Audible and Average Sound Level at **Burnt Springs Canyon** Location Point would be similar to Alternative A. Moderate adverse impacts would occur with negligible change in impacts compared to Alternative A.

West End *NPS Preferred Alternative* *Ethnographic Resources*
Ten-Year Forecast Peak Season
Base Year and Ten-Year Forecast Off-Peak Season

Impacts at **Meriwhitca** and **Granite Peak** Location Points would be negligible similar to Base Year Peak Season.

TABLE 4.85 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				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
Burnt Springs Canyon	70	75	46	47	71	1	68	-7	48	2	46	-1	69	-1	64	-11	47	1	44	-3
Granite Peak	2	2	17	18	2	0	2	0	17	0	18	0	2	0	2	0	17	0	18	0
Meriwhitca	0	1	7	8	0	0	1	0	7	0	7	0	0	0	1	0	7	0	7	0
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	8	0	0	0	0	0	7	0	8	0

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.86 NPS PREFERRED ALTERNATIVE SLANT DISTANCES WEST END

Location Point Name	Alternative A	NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,421	206
Granite Peak	5,264	12,090	6,826
Meriwhitca	15,742	15,550	-192
Pumpkin Springs	12,630	19,695	7,065

Δ indicates change in noise metric data from Alternative A

Cumulative Impacts NPS Preferred Alternative Ethnographic Resources

Time and area considered under NPS Preferred Alternative cumulative impacts is the same as Alternative A. Noise from aircraft flying over 18,000 feet and outside the SFRA would continue to have long-term moderate adverse effect on Ethnographic Resources as described in Alternative A. Access to cultural sites has become increasingly difficult since Euroamerican occupation of northern Arizona resulting in long-term minor to moderate adverse impacts. Human-caused noise from mechanized equipment, motorized vehicles, and visitors result in visual and auditory intrusion, distracting and interrupting traditional cultural practices resulting in short- and long-term minor to moderate adverse impact.

Cumulative Impacts Marble Canyon NPS Preferred Alternative Ethnographic Resources
The NPS Preferred Alternative would result in long-term minor beneficial change in impacts compared to Alternative A. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When minor beneficial change in impacts of the NPS preferred Alternative are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts East End NPS Preferred Alternative Ethnographic Resources
Ten-Year Forecast, East End there would be long-term minor to moderate beneficial changes in impacts on Ethnographic Resources Peak and Off-Peak Season compared to Alternative A. This would result from implementation of NPS Preferred Alternative quiet-technology incentives and conversion requirements. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When minor beneficial change in impacts of the NPS Preferred Alternative are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor to moderate noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts Central NPS Preferred Alternative Ethnographic Resources
At Upper Deer Creek, Surprise Valley, and Mohawk Canyon, Peak and Off-Peak Season, adverse impacts to Ethnographic Resources would be slightly less than Alternative A and would result in long-term negligible change in impacts compared with Alternative A. Along the Central area's eastern edge, there would be a reduction in noise effects of aircraft using Dragon Corridor, and there would be negligible change in impacts compared to Alternative A. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When minor beneficial change in impacts of the NPS Preferred Alternative are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Cumulative Impacts West End NPS Preferred Alternative Ethnographic Resources
Ten-Year Forecast, the Burnt Springs Canyon Location Point area would be exposed to high levels of aircraft sounds that would result in a negligible change in impacts compared to Alternative A. At Meriwhitca, Granite Peak, and Pumpkin Springs Location Points, adverse impacts to Ethnographic Resources would also change negligibly from Alternative A, and would remain relatively quiet. On-the-ground human reactions to high-altitude aircraft (noise and visuals) can vary greatly person to person. However, when noise from high-altitude aircraft 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 American Indian religious practitioners. When minor

beneficial change in impacts of the NPS Preferred Alternative are combined with minor to moderate adverse impacts of other aircraft noise outside the SFRA, minor to moderate adverse effects of restrictions on access to sites as a result of past actions, and minor to moderate noise impacts and lack of privacy as a result of other human-caused intrusions, cumulative effect would be long term moderate adverse.

Conclusions	**NPS Preferred Alternative**	**Ethnographic Resources**

Conclusions Marble Canyon *NPS Preferred Alternative* *Ethnographic Resources*
All Scenarios

Marble Canyon would be little affected by aircraft sights and sounds, and there would be negligible impacts with a minor beneficial change in impacts on Ethnographic Resources compared to Alternative A. Cumulative impacts from all actions would be long term moderate adverse.

Conclusions East End *NPS Preferred Alternative* *Ethnographic Resources*
All Scenarios

At Little Colorado and Nankoweap River Location Points, effects of air-tour aircraft on Ethnographic Resources would be negligible with negligible to minor beneficial change in impacts compared with Alternative A. At Little Colorado River Location Point, minor adverse impacts to Ethnographic Resources would be less than Alternative A, and would result in a long-term minor to moderate beneficial change in impacts compared with Alternative A. Impacts would not change Ten-Year Forecast. At Temple Butte and Bright Angel Point Location Points, Base Year, minor to moderate adverse impacts from air-tour aircraft noise on Ethnographic Resources represent negligible to minor adverse changes in impacts. Ten-Year Forecast there would be a reduction in aircraft noise resulting in minor to moderate beneficial changes in impacts compared to Alternative A. Pasture Wash Location Point would be similar to Alternative A. Ten-Year Forecast Peak and Off-Peak Season a reduction in aircraft noise would result in minor to moderate adverse impacts with long-term minor to major beneficial change in impacts compared to Alternative A. Cumulative impacts from all actions would be moderate adverse.

Conclusions Central *NPS Preferred Alternative* *Ethnographic Resources*
All Scenarios

At Upper Deer Creek, Surprise Valley, and Mohawk Canyon Location Points, negligible impacts to Ethnographic Resources would be slightly less than Alternative A, and would result in long-term negligible change in impacts compared with Alternative A. Minor adverse impacts at Grid Location Point 8 in Base Year would decrease to negligible Ten-Year Forecast. Cumulative impacts from all actions would be moderate adverse.

Conclusions West End *NPS Preferred Alternative* *Ethnographic Resources*
All Scenarios

At Burnt Springs Canyon Location Point impacts to Ethnographic Resources would be moderate adverse Base Year, decreasing slightly Ten-Year Forecast, with negligible change in impact compared to Alternative A. At Meriwhitca, Granite Peak, and Pumpkin Springs Location Points, negligible impacts represent a negligible change in impacts from Alternative A. Cumulative impacts from all actions would be moderate adverse.

VISITOR USE AND EXPERIENCE

General Assumptions and Methodology

The phrase *applicable policies and/or objectives* in Threshold Descriptions for Visitor Use and Experience refers to 1) Chapter 1's objectives, 2) applicable NPS management policies, objectives, and zoning for visitors to NPS lands in the Study Area, and 3) applicable policies and management objectives for visitors to non-NPS lands in the Study Area (Map 1.2).

In the Thresholds below, all aspects of aircraft noise intensity and duration including, but not limited to aircraft Percent Time Audible, Average Sound Level, and timing are included in the term *aircraft noise intensity*.

Audibility is the ability of animals and humans with normal hearing to hear a given sound. Audibility is affected by an individual's hearing ability, other simultaneous interfering sounds or stimuli, and by sound frequency content and amplitude. Sound energy metrics include Average Sound Level and Time Above decibel levels. When discussing areas in the SFRA outside the park boundary only Average Sound Level is evaluated to determine level of effect because no ambient data was available to calculate Percent Time Audible. Analysis of Average Sound Level includes evaluation of data in the park and SFRA.

A measure of Distance between visitor locations and aircraft routes is used as an indicator related to effects of aircraft being in close proximity to visitors, including aircraft visibility and presence to visitors on the ground, and of visitors on the ground to people in aircraft. This can affect perceptions of privacy, and conflicts between visitors. While there is usually a close correlation between Distance and sound intensity, this measure of Distance is included primarily to address effects other than aircraft sound (see Ground-Based Visitors discussion).

Visitor Use and Experience is evaluated from two perspectives 1) ground-based visitors and 2) air-tour visitors. Definitions for impact type, context, duration, and timing apply to both visitor types; however, assessing impact intensity varies for the two visitor types. Separate conclusions are presented for effects of Alternatives on ground-based visitors and air-tour visitors. It also should be noted that this impact topic only considers Visitor Use and Experience, not number of visitors affected by Alternatives.

In general, impact analyses take into consideration that more noise sources are present, and more noise impacts from all sources, including air-tour aircraft, are accepted in Developed Zone (2% of the park) than in other zones, based on each Zone's management objectives. Impacts are presented and compared to Alternative A for Base Year and Ten-Year Forecast Peak and Off-Peak Season.

GROUND-BASED VISITORS — VISITOR USE AND EXPERIENCE

Impacts to ground-based visitors depend primarily on opportunities to experience areas consistent with applicable policies and/or objectives. This includes considering how Alternatives affect desired conditions and setting of relevant park Management Zones or objectives of non-NPS lands. Level of detection and perceptibility of aircraft noise resulting from noise frequency and intensity levels contribute to this assessment. Further, intensity of impacts from Alternatives would be greater in areas where desired conditions/objectives provide more natural and contemplative settings (Wilderness Zone) versus more developed and social settings (Developed Zone). As shown in Figure 1, Appendix D, Dual-Zone Noise Standard, 10 dB were added to natural ambient sound levels in Developed Zones and some other areas to account for increased visitor activity and accepted presence of non-natural sound sources.

AIR-TOUR VISITORS — VISITOR USE AND EXPERIENCE

Impacts to air-tour visitors are not related to sound produced by aircraft; thus, thresholds defined for ground-based visitors do not apply to air-tour visitors. In terms of impacts, air-tour Visitor Use and Experience depends primarily on access to opportunities for, and perceptions of, aerial viewing experiences. Access to opportunities for aerial viewing experiences varies due to Alternative actions in terms of geography, time of day and duration, plus consistency with applicable policies and/or objectives.

Access to opportunities for aerial viewing experiences does not lend itself to defining impact intensity thresholds, so thresholds are not defined for air-tour Visitor Use and Experience in this analysis. Instead, differences between Alternatives in impacts on air-tour Visitor Use and Experience are described on a comparative basis in terms of factors for intensity such as available flight hours, time of day considerations, number and variety of air-tour options, and geographic areas along tour routes. Impacts to air-tour Visitor Use and Experience are also described in terms of context, duration, and timing as defined below. In this way, Alternative impacts are evaluated and can be compared without impacts being described in terms of impact intensity thresholds.

Perceptions of aerial viewing experiences include 1) aspects like weather and turbulence not under control of air-tour operators, and 2) aspects mostly under control of individual air-tour operators such as aircraft type (including windows and seating), tour narration quality, cost, customer service, comfort, neatness/cleanliness, and safety perceptions. These aspects affecting perceptions of aerial viewing experiences vary primarily by individual air-tour operators and their business decisions, not directly due to Alternative actions. Thus, they are not included in detailed analysis for Visitor Use and Experience, but a few are evaluated in Chapter 4, Socioeconomic Environment if operators are expected to adjust business decisions due to the Alternatives.

Impact Intensity Threshold Descriptions **Visitor Use and Experience**

Threshold Levels

Negligible Impacts due to the event at lowest levels of detection and barely perceptible on ground-based visitors, including access to opportunities for visitors to experience desired conditions or setting in accordance with applicable policies and/or objectives

Distance from points of interest to aircraft routes is greater than or equal to 2,000 meters

Aircraft noise intensity (Average Sound Level) in a specific area less than or equal to 15 dBA

Aircraft noise rarely audible, i.e., aircraft are audible less than or equal to 5% of the 12-hour day used in this analysis

Minor 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

Distance from points of interest to aircraft routes greater than or equal to 1,000 meters and less than 2,000 meters

Aircraft noise intensity (Average Sound Level) in a specific area greater than 15 dBA and less than or equal to 25 dBA

Aircraft noise audible for a small portion of applicable times, i.e., aircraft audible greater than 5% and less than or equal to 10% of the 12-hour day

Moderate 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

Distance from points of interest to aircraft routes greater than or equal to 500 meters and less than 1,000 meters

Aircraft noise intensity (Average Sound Level) in a specific area greater than 25 dBA and less than or equal to 35 dBA

Aircraft noise audible for an intermediate portion of applicable time periods, i.e., aircraft audible greater than 10% and less than or equal to 25% of the 12-hour day

Major 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

Distance from points of interest to aircraft routes less than 500 meters

	Aircraft noise intensity (Average Sound Level) in a specific area greater than 35 dBA
	Aircraft noise audible for a large portion of applicable times, i.e., aircraft audible greater than 25% of the 12-hour day

Type of Impact	**Visitor Use and Experience**
Adverse	Impacts detract from Visitor Use and Experience, including opportunities to experience desired conditions or setting in accordance with applicable management objectives
Beneficial	Impacts enhance Visitor Use and Experience, including opportunities to experience desired conditions or setting in accordance with applicable management objectives
Context	
Regional	Impacts affect visitors over a widespread area, such as the majority of the park or Special Flight Rules Area, or multiple backcountry use areas, attraction sites, trails or flight routes
Localized	Impacts affect visitors over a small area (e.g., a single backcountry use area) or a specific site, such as an overlook or attraction site, or a specific trail or flight route
Park Management Zone	A given noise generally has greatest intensity impact in NPS areas in the Wilderness Zone, then Non-Wilderness Zone, and least in the Developed Zone. 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, and minor-to-moderate in the Non-Wilderness Zone considered, depending on other factors including duration and timing
Duration	
Short Term	Impacts associated with individual, infrequent, and/or non-repetitive actions impact a minor portion of an average visit, affecting Visitor Use and Experience only during and shortly after specified actions
Long Term	Impacts persist well beyond completion of individual actions, affecting majority of an average visit. Impacts considered long-term if actions are frequent or repetitive over more than a few days, or if they affect visitation patterns
Timing	Time of day, frequency of occurrence, seasonality (coinciding with different visitation periods), and sensitive times (quiet times near sunrise and sunset) can be important in assessing impacts to Visitor Use and Experience, and are discussed in the analysis when relevant

ALTERNATIVE A, NO ACTION/CURRENT CONDITIONS — VISITOR USE AND EXPERIENCE

Under Alternative A, a range of aircraft noise intensities and audibility would affect visitor opportunities to appreciate natural sounds. Backcountry visitors in and around Marble Canyon would be little affected by air-tour sounds. Aircraft sounds would be concentrated over East End visitors where Zuni Point and Dragon Corridors are heavily used. East End air-tour aircraft sounds have potential to affect the greatest percentage of visitors, as this includes the most accessible, most visited, and most developed park areas. Visitors in Wilderness or hiking Central area trail corridors would have most of the day to appreciate natural sounds. West End visitors would be exposed to a mixture of air-tour and natural sounds.

Marble Canyon Alternative A Visitor Use and Experience
Ground-Based Visitors

As shown Figures 4.8 to 4.9, modeled noise results indicate Marble Canyon would generally experience aircraft Average Sound Level less than 10 dBA and Percent Time Audible less than 5% of the day. **Marble Canyon Dam Site** and **South Canyon** Location Points represent Marble Canyon Visitor Use and Experience. Both sites are located in areas where visitors expect opportunities to experience solitude and primitive and unconfined recreation. Visitors would generally be pursuing river and backcountry activities in challenging terrain with relatively high expectations for connecting to natural sights and sounds. Under continued current management, there would be long-term negligible to minor adverse impacts on Visitor Use and Experience at these locations.

As shown in Table 4.87, near **Marble Canyon Dam Site** Location Point, air-tour noise would rarely be perceptible. Air-tour aircraft sound levels would be low at 3 to 21 dBA. The opportunity to experience natural quiet and solitude would be maintained for visitors at this location. Aircraft would be at Distances in excess of nearly 4,000 meters. Thus, there would be limited impacts to natural sounds appreciation, and no interference with visitor conversations on the ground under continued current conditions. Because air-tour aircraft would rarely be audible, and aircraft would be visible occasionally at Distances over 2,000 meters, impacts on Visitor Use and Experience and appreciation of park resources would be negligible.

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 sounds 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 sounds 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				
	Percent Time Audible (%)		Average Sound Level (dBA)		Slant Distance (m)
	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 sounds (Table 4.3). 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 sounds because aircraft sounds 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 majority of the day during summer season. The locations also have similar air-tour sound levels due to their proximity to Zuni Point Corridor routes. Under Alternative A, air-tour sound Percent Time Audible would be approximately 64 to 75% of the day, with daily air-tour Average Sound Level 29 to 35 dBA. Visitors may frequently hear aircraft noise, and aircraft would be visible for short period, at Distances in excess of 2,000 meters. In these developed areas, visitors tend to be somewhat less sensitive to such intrusions. The combination of aircraft being audible for a high percentage of the day, noticeable at a modest sound level and visible beyond 2,000 meters would result in localized moderate adverse impacts on Visitor Use and Experience.

Grand Canyon Village is developed with roads, hotels, restaurants, and parking areas. Near **El Tovar** Location Point, aircraft Percent Time Audible would be 95% of the day, with Average Sound Level of 19 dBA. However, this busy frontcountry area has combined natural and human-caused sound level of 37 to 47 dBA. Thus, air-tour sound would mix with existing background noise, and could occasionally be intrusive, reducing visitor opportunities to appreciate natural conditions portions of the day. Aircraft would be visible for short periods at Distances in excess of 5,000 meters. Combination of long periods of aircraft audibility at low sound levels in a developed setting, with low aircraft visibility would result in moderate adverse impacts on Visitor Use and Experience.

East End Ground-Based Visitors
Developed Zone Phantom Ranch Alternative A Visitor Use and Experience
Phantom Ranch lies along North Kaibab Trail, near the Colorado River. This location provides a range of visitor amenities, including food service, camping, and a lodge. Phantom Ranch area is not generally affected by air-tour sound, being beneath Bright Angel Flight-free Zone and near Bright Angel Creek and the Colorado River. As shown in Table 4.88, air-tour sounds Percent Time Audible would be less than 4% of the day, with Average Sound Level of 12 dBA. Opportunities to appreciate natural conditions would be present most of the day. Air-tour aircraft visibility would be quite low, with aircraft seen infrequently and in excess of 10,000 meters. The low percentage of time aircraft would be audible, relatively low sound level, and low aircraft visibility would result in long-term negligible impacts on Visitor Use and Experience near Phantom Ranch.

East End Ground-Based Visitors
Developed Zone North Rim Alternative A Visitor Use and Experience
Bright Angel Point, Cape Royal, and Point Imperial Location Points represent effects on North Rim frontcountry Visitor Use and Experience. Bright Angel Point is a popular canyon overlook, accessed via paved

trail from North Rim Lodge. Cape Royal and Point Imperial offer majestic views, and are located east of the main North Rim developed area, accessible via paved roads. As shown in Table 4.88, at these Cape Royal and Point Imperial Location Points, air-tour sound Percent Time Audible would be 47 and 66% of the day, with sound levels 24 and 38 dBA. Air-tour aircraft would be visible at Distances of 2,000 meters. In these ponderosa pine and juniper habitats, sound levels would be 37 to 58 dBA. The mixing of air-tour noise with background sounds would result in aircraft being audible the majority of the day. The combination of aircraft being audible for a high percentage of the day, at a noticeable level, and visible beyond 2,000 meters would result in short- and long-term localized moderate adverse impacts on Visitor Use and Experience.

East End Ground-Based Visitors
Non-Wilderness Zone *Alternative A* *Visitor Use and Experience*
Human-caused sounds are less prevalent in the Non-Wilderness Zone than in the Developed Zone (Ambrose 2008). Noise-free intervals, ranging up to 26 minutes, did occur in these areas. Visitors to Non-Wilderness Zones have over half the day to appreciate natural sounds associated with a variety of habitat types, including intervals free of human-caused noise. Thus, expectations for opportunities to experience natural sounds and sights would be higher here than in the Developed Zone.

South Rim Non-Wilderness visitor use is represented by **Cedar Ridge** Location Point near the top of the South Kaibab Trail and accessible from the developed South Rim. As shown in Table 4.88, visitors near this location would experience air-tour noise Percent Time Audible 81% of the day Base Year, with an Average Sound Level of 19 dBA. Modest levels of air-tour aircraft noise would be present most of the day, resulting in lost opportunities to appreciate natural quiet at these sites. Air-tour aircraft would be at Distances in excess of 9,000 meters. Impacts from air-tour aircraft on Visitor Use and Experience would be long term moderate to major adverse.

East End Ground-Based Visitors
Wilderness Zone *Alternative A* *Visitor Use and Experience*
As shown in Figures 4.8 and 4.9, East End Wilderness Zone visitors could expect a wide range of exposure to air-tour noise. Percent Time Audible would range zero to virtually 100% of the day. Air-tour aircraft Average Sound Level would range zero to 45 dBA. As described above, these visitors are seeking access to solitude and primitive recreation conditions, and expect to encounter limited human-caused sounds and sights in the backcountry.

As shown in Table 4.88, visitors near **Little Colorado River** and **Nankoweap Mesa** Location Points would have air-tour aircraft Percent Time Audible 34% and 87% of the day, and Average Sound Level of 43 dBA. Aircraft would be visible 1,000 to 2,000 meters from the ground. This level of human-caused sights and sounds may interfere with opportunities to appreciate natural sounds and park resources near these locations. In particular, sensitive visitors and those with high expectations for solitary and primitive recreation experiences may be impacted. Impacts from aircraft on Visitor Use and Experience would be long term moderate to major adverse.

As shown in Table 4.88, close to the river, such as **Nankoweap River** Location Point, aircraft Average Sound Level would be 34 dBA, with Percent Time Audible approximately 7% of the day where natural sound levels near the river are 25 to 65 dBA. Here, the high sound level caused by the river and low periods of aircraft audibility would result in a low level of interference with appreciation of park resources. Visibility of aircraft in this vicinity would be low with aircraft nearly 1,500 meters away from points on the ground. Impacts from aircraft on Visitor Use and Experience would be long term minor adverse.

Visitor Use and Experience beneath Dragon Corridor are represented by conditions at **Hermit Basin, 96-mile Camp, Point Sublime,** and **Pasture Wash** Location Points. These Location Points are all affected by air-tour aircraft sound from under and near air-tour routes. Visitors pursue a range of activities in this area, from viewing at promontories (both North and South Rims), use of four-wheel drive roads, and accessing remote sites by long hikes and river trips into the canyon. As shown in Table 4.88, these sites receive air-tour noise Percent Time Audible 72 to virtually 100% of the day, with Average Sound Level 20 to 45 dBA. Aircraft would be visible for much of the day at Distances of 1,500 meters or more. Air-tour aircraft would interfere with Wilderness visitors'

ability to appreciate natural sounds and experience solitude for much of the day. Backcountry visitors may find this level of air-tour aircraft sound disruptive, and it may interfere with the opportunity to experience primitive recreation and appreciate park resources. The combination of nearly continuous aircraft sound at 20 dBA and above with high aircraft visibility would result in localized long-term moderate to major adverse impacts on Visitor Use and Experience.

TABLE 4.88 ALTERNATIVE A SOUND LEVELS AND SLANT DISTANCES EAST END

Location Point Name	Alternative A				
	Percent Time Audible (%)		Average Sound Level (dBA)		Slant Distance (m)
	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

East End Alternative A Visitor Use and Experience
Ground-Based Visitors Outside the Park within the SFRA

The **Navajo Nation** and **Kaibab National Forest** bound East End. Within Navajo lands, visitors would be pursuing backcountry activities in a remote area. As shown in Figures 4.8 and 4.9, air-tour aircraft Average Sound Level would range zero to 30 dBA. Air-tour sounds would mix with, and occasionally be audible, and could interfere with, opportunities to appreciate natural sounds. Visitors in this area would experience short-term minor to moderate adverse impacts from air-tour sounds.

In the **Kaibab National Forest** at GCNP's southeast corner, air-tour aircraft Average Sound Level would range 35 to 50 dBA. Most visitors are using motorized transportation, and many are near Grand Canyon Airport. The vegetative community is old conifer forest, which has a background sound level of approximately 31 dBA. Thus, air-tour sounds would be audible portions of each day, and may occasionally compete with other human-generated sounds associated with development and visitor services. Air-tour aircraft fly directly over the USFS Ten-X Campground area when using Grand Canyon Airport. The result would be short-term minor to moderate adverse impacts on Visitor Use and Experience.

Central Ground-Based Visitors Alternative A Visitor Use and Experience

As shown in Figures 4.8 and 4.9, 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% of the time. Under Blue Direct routes in the SFRA, air-tour sights and sounds would be greater with Average Sound Level ranging 40 to 50 dBA. Wilderness and Non-Wilderness Zone visitors near Upper Deer Creek and Toroweap Overlook in the Central area would be largely unaffected by air-tour aircraft sounds under Alternative A because this part of the park is largely under Flight-free Zones and away from air-tour routes. Low levels of sound and aircraft visibility would result in few impacts on 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 sounds 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 sounds, 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				
	Percent Time Audible (%)		Average Sound Level (dBA)		Slant Distance (m)
	Base Year	Forecast	Base Year	Forecast	
Upper Deer Creek	1	0	1	1	23,683
Toroweap Overlook	0	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 sound. 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 sounds 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 sound 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				
	Percent Time Audible (%)		Average Sound Level (dBA)		Slant Distance (m)
	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).

Black routes in Marble Canyon would cross the canyon multiple times to provide river views for passengers on both sides of the plane. An entry and exit route would be available near South Canyon.

East End, air-tour visitors would have access to long- and short-loop tours year-round. Zuni Point Corridor routes would include overflights of Little Colorado River confluence and Nankoweap Basin. Long-loop tour routes that encircle Bright Angel Flight-free Zone would include views of geologic highlights. Tours of longer duration provide high levels of visitor satisfaction by providing increased time over the canyon for viewing.

West End, Blue Direct routes between Las Vegas and Grand Canyon Airport would provide canyon viewing with limited opportunities to view the Colorado River. Loop routes would continue to provide canyon and river views for those visiting from the Las Vegas area. Visitors to Hualapai Tribal Lands may participate in air tours to and from Grand Canyon West as well as helicopter tours to the river near Quartermaster Canyon (Over the Edge Flights).

Cumulative Impacts Alternative A Visitor Use and Experience
Ground-Based Visitors

Other than air-tour aircraft sounds, impacts on Visitor Use and Experience result from sounds of high-altitude aircraft above 18,000 feet MSL, and aircraft below 18,000 feet MSL and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under the Alternative contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on Visitor Use and Experience in the park and SFRA.

Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative A as discussed above, would have long-term moderate to major adverse cumulative impacts on Visitor Use and Experience throughout all four areas (Marble Canyon, East End, Central, and West End), due primarily to combined Percent Time Audible of greater than 50% of the day over large areas.

Cumulative Impacts Marble Canyon Alternative A Visitor Use and Experience
Ground-Based Visitors
At Marble Canyon Location Points, noise from aircraft above and outside the SFRA Percent Time Audible is 16 to 36% of the day. When adverse impacts of Alternative A are combined with impacts of other aircraft noise

outside and above the SFRA plus noise impacts from other sources, the cumulative effect would be long term moderate adverse.

Cumulative Impacts East End Alternative A Visitor Use and Experience
Ground-Based Visitors
Developed Zone (South Rim, Phantom Ranch, North Rim)
North and South Rim Developed areas, visitors would be exposed to sounds of other high-altitude aircraft as well as vehicular traffic, facility operations, and other visitors. Near Grand Canyon Airport, aircraft noise Percent Time Audible is 48 to 69% of the day at Average Sound Level of 28 dBA. Thus, other aircraft and sounds of passing vehicles, other visitors, and noise associated with highly developed areas may reduce opportunities to appreciate natural conditions. Impacts of other activities, in combination with impacts of Alternative A would result in cumulative long term minor to moderate adverse impacts on Visitor Use and Experience.

Cumulative Impacts East End Alternative A Visitor Use and Experience
Ground-Based Visitors
Non-Wilderness Zone
Visitors in areas represented by Cedar Ridge Location Point would be exposed to sounds of other aircraft from 52 to 69% of the day, at an Average Sound Level of 29 dBA. This would result in loss of opportunity to experience natural conditions. Impacts of other activities, in combination with impacts of Alternative A, would result in be long term moderate to major adverse cumulative impacts on Visitor Use and Experience.

Cumulative Impacts East End Alternative A Visitor Use and Experience
Ground-Based Visitors
Wilderness Zone
East End (e.g., Nankoweap River), aircraft above and outside the SFRA Percent Time Audible would be 27 to 71% of the day. When adverse impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA plus noise impacts from other sources, cumulative effect would be long term moderate to major adverse.

Cumulative Impacts Alternative A Visitor Use and Experience
Central Ground-Based Visitors
At Central area Location Points, noise from aircraft above and outside the SFRA Percent Time Audible is 16 to 65% of the day. When impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA plus noise impacts from other sources including river passenger exchanges at Whitmore Wash, cumulative effect would be long term moderate adverse.

Cumulative Impacts Alternative A Visitor Use and Experience
West End Ground-Based Visitors
At West End Location Points, noise from aircraft above and outside the SFRA Percent Time Audible is 12 to 51% of the day at Average Sound Level 17 to 26 dBA. When impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA plus noise impacts from other sources including flights associated with Grand Canyon West, cumulative effect would be long term moderate to major adverse.

Conclusion Ground-Based Visitors Alternative A Visitor Use and Experience

Conclusion Marble Canyon Alternative A Visitor Use and Experience
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.

Conclusion East End *Alternative A* *Visitor Use and Experience*
Developed Zone
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.

Conclusion East End *Alternative A* *Visitor Use and Experience*
Non-Wilderness Zone
The No Action Alternative would result in long-term moderate to major adverse impacts on Non-Wilderness Visitor Use and Experience. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion East End *Alternative A* *Visitor Use and Experience*
Wilderness Zone
The No Action Alternative would result in long-term minor to major adverse impacts on East End Wilderness Visitor Use and Experience. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion Central *Alternative A* *Visitor Use and Experience*
The No Action Alternative would result in negligible impacts on Visitor Use and Experience. Cumulative impacts on Visitor Use and Experience would be long term moderate adverse.

Conclusion West End *Alternative A* *Visitor Use and Experience*
The No Action Alternative would result in minor to major adverse impacts on West End Visitor Use and Experience. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion **Alternative A** **Visitor Use and Experience**
Air-tour Visitors

Alternative A provides a wide range of opportunities for air-tour visitors year-round, and scenic views would be available for aerial viewing from a variety of routes.

ALTERNATIVE E ALTERNATING SEASONAL USE VISITOR USE AND EXPERIENCE

Alternative E would increase park area beneath Flight-free Zones by alternating seasonal use of Zuni Point and Dragon Corridors, and by extending Bright Angel Flight-free Zone north to include Marble Canyon. A range of air-tour aircraft sounds would continue to affect Visitor Use and Experience throughout the park. Seasonal route closures would decrease air-tour aircraft noise, resulting in beneficial changes to ground-based East End Visitor Use and Experience. Alternative E would also fully implement quiet-technology aircraft with a maximum seven hours daily flight time in East End flight corridors.

Marble Canyon Ground-Based Visitors **Alternative E** **Visitor Use and Experience**

As shown in Figures 4.14 to 4.17, Marble Canyon would remain relatively quiet with aircraft Average Sound Level less than 10 dBA and Percent Time Audible less than 5%. In the park, Marble Canyon Location Points would experience beneficial changes compared to Alternative A, and would generally be free of air-tour aircraft sounds and sights.

Marble Canyon Ground-Based Visitors *Alternative E* *Visitor Use and Experience*
All Scenarios

Bright Angel Flight-free Zone would be extended north to Lees Ferry, thereby eliminating air-tours and related flights from Marble Canyon. Consequently, aircraft Average Sound Level would be reduced throughout the year. In Base Year Peak Season, at **Marble Canyon Dam Site** Location Point, as shown in Tables 4.91 and 4.92, Percent Time Audible would remain zero percent, with Average Sound Level falling 3 dBA to zero. At **South Canyon** Location Point, Percent Time Audible would decrease from 2% of the day to

zero, and Average Sound Level would decrease from 21 dBA to zero. Aircraft would be over 17,000 meters distant from these locations. The small increment of reduced Percent Time Audible, compared to Alternative A, would result in air-tour aircraft rarely being heard. Opportunities to experience natural conditions and solitude would improve over Alternative A. Negligible impacts would occur with long term negligible to minor beneficial change in impacts compared to Alternative A.

Marble Canyon *Alternative E* *Visitor Use and Experience*
Ground-Based Visitors Outside the Park within the SFRA
All Scenarios

With extension of Bright Angel Flight-free Zone northward to include all of Marble Canyon, Average Sound Level in areas of **Saddle Mountain** and **Paria Canyon-Vermilion Cliffs Wilderness Areas** and the **Navajo Nation** adjacent to the park would be unaffected by air-tour overflight sounds. As shown in Figure 4.14, Base Year Peak Season, Average Sound Level in these areas ranges zero to 5 dBA. For All Scenarios, mixing of aircraft sounds with low level natural sounds would likely result in air-tours rarely being audible, resulting in negligible impacts with a negligible change in impacts compared to Alternative A.

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	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	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

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

East End **Alternative E** **Visitor Use and Experience**

Under Alternative E, greatest exposure to noise and visual impacts would continue East End. Modeled noise results shown in Figures 4.14 to 4.17 indicate under and adjacent to active air-tour routes there would be high Average Sound Level of air-tour sounds (40 to 50 dBA) frequently throughout the day (Percent Time Audible greater than 75% of the time). However, air-tour sounds would be reduced beneath Dragon Corridor due to closure during Peak Season and conversely, beneath Zuni Point Corridor due to closure during Off-Peak Season. This would result in substantial beneficial effects compared to Alternative A. Alternative E curfews would benefit ground-based visitors in all East End Management Zones by reducing daily operating times. Because Alternative E includes quiet-technology incentives and conversion requirements, opportunities to appreciate natural sounds would increase Base Year to Ten-Year Forecast. Although adverse impacts on Visitor Use and Experience would continue, beneficial changes would be seen in both Percent Time Audible and Average Sound Level.

East End Ground-Based Visitors *Alternative E* *Visitor Use and Experience*
Developed Zone South Rim
Base Year Peak Season

At **Desert View, Lipan Point,** and **Tusayan Museum** Location Points air-tour aircraft sound would increase modestly Base Year Peak Season when Zuni Point Corridor is in use and air-tour flights are concentrated in this route. At these sites, as shown in Tables 4.93 and 4.94, air-tour Percent Time Audible would rise from 64 to 76%, to 84 to 88% of the day. Average Sound Level would rise by a modest 3 to 7 dBA. These increases in Percent Time Audible and Average Sound Level would reduce already limited opportunities to appreciate natural quiet at these Developed Zone sites. However, aircraft visibility would increase at the various visitor locations, with Distance to aircraft exceeding 2,000 meters at Desert View Location Point, nearly 1,000 meters at Lipan Point Location Point, and less than 500 meters at Tusayan Museum Location Point. Although Developed Zone Visitor Use and Experience is affected by a combination of natural and human-caused sounds, Alternative E Peak Season would introduce additional air-tour aircraft sound. Impacts would be moderate adverse. Compared to Alternative A, this would further limit opportunities for visitors to experience natural sounds and appreciate park resources, resulting in long-term minor to moderate adverse changes to Visitor Use and Experience at these sites.

Visitors near **El Tovar** Location Point would see dramatic reductions in air-tour aircraft sounds because Dragon Corridor is not in use Peak Season. Air-tour Percent Time Audible would fall from 95% of the day to 8%. Average Sound Level would be reduced from 19 to 7 dBA. This would provide additional opportunities to experience natural sounds in this Developed Zone. Aircraft visibility would increase by 3,500 meters. Although negligible impacts to Visitor Use and Experience from air-tour aircraft would occur, these changes would be long-term minor to moderate beneficial compared to Alternative A.

East End Ground-Based Visitors *Alternative E* *Visitor Use and Experience*
Developed Zone *South Rim*
Ten-Year Forecast Peak Season

Compared to Alternative A at **Desert View, Lipan Point,** and **Tusayan Museum** Location Points, Percent Time Audible would fall from 64 to 76%, to 50 to 62%. Average Sound Level would vary somewhat, but would be similar to Alternative A at 26 to 40 dBA. Although moderate to major adverse impacts would continue, this would result in negligible to minor beneficial changes to Visitor Use and Experience compared to Alternative A.

At **El Tovar** Location Point, Percent Time Audible would decrease from 96 to 9% and Average Sound Levels would decrease from 20 to 12 dBA, negligible impacts with long-term moderate to major beneficial changes in impacts from Alternative A.

East End Ground-Based Visitors *Alternative E* *Visitor Use and Experience*
Developed Zone *South Rim*
Base Year Off-Peak Season

Air-tour sounds at **Desert View** and **Tusayan Museum** Location Points would be reduced as air-tour operations move to Dragon Corridor. Visitors in this area would experience large reductions in air-tour aircraft Percent Time Audible and Average Sound Level. Percent Time Audible would decrease to zero to 6% of the day from Alternative A levels of 64 to 76%. Average Sound Level would also decrease 23 to 33 dBA, resulting in Average Sound Level of 3 to 6 dBA. Although negligible impacts would occur, these conditions would increase opportunities for visitors to experience natural sounds at these sites, producing long-term moderate beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

At **El Tovar** Location Point, Dragon Corridor dogleg would be in use and air-tour aircraft would move west. Only quiet-technology aircraft would be in use early and late in the operating day. This would dramatically reduce air-tour Percent Time Audible in this area. Aircraft Percent Time Audible would be 34% of the day at 11 dBA, down from 95% of the day at 19 dBA under Alternative A. Visitors in this area would have additional opportunities to experience natural sounds Off-Peak Season. Although some minor adverse effects to Visitor Use and Experience would persist, Alternative E Off-Peak Season would result in long-term moderate beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

East End Ground-Based Visitors *Alternative E* *Visitor Use and Experience*
Developed Zone *South Rim*
Ten-Year Forecast Off-Peak Season

El Tovar Location Point would experience further decreases in air-tour aircraft noise. Air-tour Percent Time Audible would be 11% of the day at 10 dBA, down from 96% of the day at 20 dBA under Alternative A. Air-tour sounds would mix with natural and human-caused sounds, resulting in low audibility, and increased opportunities to experience natural sounds. Although minor adverse impacts would continue, conditions at **El Tovar, Desert View, Lipan Point,** and **Tusayan Museum** Location Points would represent long term moderate beneficial changes in impacts compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Developed Zone Phantom Ranch
All Scenarios

Under Alternative E, air-tour aircraft sounds at **Phantom Ranch** would be reduced from their already low levels. As shown in Tables 4.93 and 4.94, Percent Time Audible and Average Sound Level would decrease to approximately one percent of the day at 6 to 7 dBA, compared to 3 to 4% and 12 dBA under Alternative A. Aircraft would be at Distances of 10,000 meters. It is unlikely visitors would perceive these small beneficial changes (2% and 5 dBA). However, opportunities to experience combined natural and human-made sound conditions would be largely uninterrupted. If aircraft were audible, it would be for brief, infrequent periods. These represent negligible impacts with negligible changes in impacts compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Developed Zone North Rim
Base Year Peak Season

Extension of Bright Angel Flight-free Zone northward would reduce air-tour aircraft noise, and **Bright Angel Point** and **Point Imperial** Location Points would see marked decreases in both Percent Time Audible and air-tour Average Sound Level. As shown in Tables 4.93 and 4.94 aircraft Percent Time Audible would be 5 to 31% of the day, at Average Sound Level 11 to 13 dBA. This is a reduction of 34 to 42% Percent Time Audible and 24 to 38 dBA from Alternative A. Visitors in this vicinity would experience reduced impacts from air-tour aircraft. Although minor adverse impacts would occur, Alternative E would result in long-term minor to moderate beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

At **Cape Royal** Location Point, Zuni Point Corridor use would increase aircraft sounds compared to Alternative A. Air-tour Percent Time Audible would be 77% of the day at an Average Sound Level of 26 dBA, compared to 59% of the day at 25 dBA under Alternative A. Aircraft would be at Distances of 6,000 meters. The increased portion of the day flights are audible would reduce visitor opportunities to appreciate

natural sounds, but the increase in sound level would not likely be noticeable. This would result in moderate adverse impacts with long-term negligible to minor adverse changes to Visitor Use and Experience compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Developed Zone *North Rim*
Ten-Year Forecast Peak and Off-Peak Season

At **Bright Angel Point** and **Point Imperial** Location Points, air-tour aircraft Percent Time Audible would be reduced to one percent at 8 to 11 dBA. These values are decreased 47 to 66% Percent Time Audible at 24 to 38 dBA from Alternative A. Visitors would have increased opportunities to appreciate natural sounds throughout the day in these areas, with negligible impacts and long-term moderate beneficial changes in impacts to Visitor Use and Experience compared to Alternative A. Similar levels of aircraft sound and Percent Time Audible of one percent would also occur at this location Ten-Year Forecast Off-Peak Season.

Conditions at **Cape Royal** Location Point Ten-Year Forecast Peak Season show reduced air-tour sounds with Percent Time Audible 25% of the day at Average Sound Level 20 dBA, a reduction from Alternative A of 36% and 6 dBA. Reduction in Percent Time Audible would produce minor to moderate adverse impacts with long-term minor beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Developed Zone *North Rim*
Base Year and Ten-Year Forecast Off-Peak Season

Cape Royal Location Point would receive reduced levels of air-tour aircraft sounds as operators move to Dragon Corridor. Sound levels would decrease to Percent Time Audible one percent of the day at an Average Sound Level of 11 dBA, down from 59% and 25 dBA under Alternative A (a 58% and 14 dBA reduction). Visitors would have opportunities to appreciate natural sounds at this developed site throughout the day. Negligible impacts would occur with long-term moderate beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

East End **Alternative E** **Visitor Use and Experience**
Non-Wilderness Zone
Base Year Peak Season

Alternative E would reduce air-tour aircraft sounds due to Zuni Point Corridor use and Dragon Corridor dogleg implementation. At **Cedar Ridge** Location Point, as shown in Tables 4.93 and 4.94, aircraft Percent Time Audible would be 40% of the day at an Average Sound Level of 14 dBA. This compares to 81% of the day at 19 dBA under Alternative A, a reduction of 41% and 5 dBA. Aircraft would be at Distances of approximately 13,000 meters. Although minor to moderate adverse impacts would occur, increased opportunity to appreciate natural sounds would result in long-term moderate to major beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Non-Wilderness Zone
Base Year Off-Peak Season

At **Cedar Ridge** Location Point, aircraft Percent Time Audible would be reduced by 56% and Average Sound Level 7 dBA from Alternative A. Visibility of aircraft from the ground would be the same as Base Year Peak Season. Although minor adverse impacts would occur, increased opportunity to appreciate natural sounds would result in long-term minor to major beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Non-Wilderness Zone
Ten-Year Forecast Peak and Off-Peak Season

Air-tour aircraft sounds at **Cedar Ridge** Location Point would decrease. Due to quiet-technology conversion, Percent Time Audible would fall to 4% of the day with Average Sound Level of 11 dBA. This represents a reduction of 77% and 8 dBA compared to Alternative A. Although negligible impacts would occur, changes

in impacts to Visitor Use and Experience would be long-term minor to major beneficial changes in impacts compared to Alternative A.

East End Wilderness Zone **Alternative E** **Visitor Use and Experience**

East End Wilderness visitors could expect a wide range of exposure to air-tour noise. Percent Time Audible would range zero to virtually 100% of the day. Air-tour Average Sound Level would range zero to 45 dBA.

East End Wilderness Zone *Alternative E* *Visitor Use and Experience*
Base Year Peak Season

As shown in Tables 4.93 and 4.94, visitors near the **Little Colorado River** and **Nankoweap Mesa** Location Points would be exposed to air-tour sound levels similar to Alternative A. Aircraft Percent Time Audible would be 36 to 78%, at Average Sound Level of 23 to 39 dBA. This represents a decrease of 7 to 9% Percent Time Audible, and 4 to 20 dBA in Average Sound Level. Aircraft would be more Distant than in Alternative A and greater than 2,000 meters away from points on the ground. These modest changes would provide a small increment of increased opportunities to appreciate natural sounds and experience solitude in these areas. Although moderate to major adverse effects would continue, compared to Alternative A this would result in long-term minor beneficial changes in impacts to Visitor Use and Experience.

Under Alternative E, visitors near **Nankoweap River** Location Point would experience reduced air-tour sounds compared to Alternative A. Percent Time Audible would drop from 7% to zero, and Average Sound Level would decrease from 34 dBA to 12 dBA. Because this area is close to the river, aircraft would be less audible. Aircraft would be distant, at more than 7,000 meters. Negligible impacts with long-term minor beneficial changes in impacts compared to Alternative A.

Base Year Peak Season under Alternative E, Wilderness visitors near **Hermit Basin, 96-mile Camp, Point Sublime,** and **Pasture Wash** Location Points would have increased opportunities to appreciate natural sounds of the river and desert scrub habitats, solitude, and primitive recreation. This would provide an experience more consistent with expectations of backcountry visitors. Dragon Corridor would not be in use, resulting in reduced air-tour aircraft sounds at locations beneath or near this route. Percent Time Audible would decrease 54 to 87% from Alternative A. Average Sound Level would decrease 5 to 37 dBA from Alternative A. Aircraft would be visible 1,700 to 11,000 meters in the Distance. Impacts would be negligible to moderate adverse. Peak Season, at Pasture Wash Location Point, long-term beneficial change in Average Sound Level compared to Alternative A would be negligible; otherwise backcountry visitors at these locations would experience long-term major beneficial changes compared to Alternative A.

East End Wilderness Zone *Alternative E* *Visitor Use and Experience*
Ten-Year Forecast Peak Season

Nankoweap Mesa Location Point Percent Time Audible would decline 45% with a decrease in Average Sound Level of 24 dBA. Aircraft would be at Distances beyond 6,000 meters. There would be increased opportunities for Visitor Use and Experience more consistent with Wilderness expectations, including solitude and primitive recreation. Alternative E would produce negligible impacts with long-term moderate to major beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

Ten-Year Forecast Peak Season conditions for visitors **Hermit Basin, 96-mile Camp,** and **Point Sublime** Location Points beneath or near Dragon Corridor would be improved compared to Alternative A. Percent Time Audible would range zero to 31%, a 67 to 83% reduction. Average Sound Level would range 8 to 17 dBA, a 4 to 37 dBA reduction. Backcountry visitors would have marked improvement in opportunities to appreciate natural sounds and solitude. Impacts would be negligible to moderate adverse. Changes in impacts compared to Alternative A would be long term major beneficial, except at **Pasture Wash** where change in Average Sound Level would be negligible compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Wilderness Zone
Base Year Off-Peak Season

Operations would move to Dragon Corridor with only quiet-technology aircraft early and late in the operating day, and visitors would be less affected by air-tour aircraft sounds. At locations near the **Little Colorado River** and **Nankoweap Mesa** Location Points, air-tour aircraft Percent Time Audible would be one percent of the day or less with aircraft Average Sound Level of 14 dBA. This represents an 86% reduction in Percent Time Audible, and a 29 dBA reduction in Average Sound Level. Backcountry visitors could appreciate natural sounds of desert scrub and river virtually all day. When audible, air-tour aircraft sound levels would be low. Although negligible impacts would occur, there would be long-term moderate to major beneficial changes in impacts compared to Alternative A.

At 96-mile Camp Location Point, air-tour aircraft Percent Time Audible would be 26% with an Average Sound Level of 37 dBA, a reduction of 46% and 7 dBA. At Hermit Basin, Pasture Wash, and Point Sublime Location Points, air-tour aircraft Percent Time Audible would be 71 to 89% of the day, with Average Sound Level 20 to 29 dBA. This represents a reduction in Percent Time Audible of 11 to 28%, and in Average Sound Level of one to 19 dBA. Backcountry visitors would have increased opportunities to experience natural sounds and solitude in this area. Moderate to major adverse impacts would occur with long-term minor to major beneficial changes in impacts compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Wilderness Zone
Ten-Year Forecast Off-Peak Season

Change in Percent Time Audible, Average Sound Level, and aircraft visibility from the ground at **Little Colorado River** and **Nankoweap Mesa** Location Points would be similar to Base Year Off-Peak Season. Although moderate to major adverse impacts would occur, long-term there would be moderate to major beneficial changes in impacts to Visitor Use and Experience compared to Alternative A.

Conditions **at Hermit Basin, Pasture Wash, Point Sublime,** and **96-mile Camp** Location Points would also result in improved conditions for backcountry visitors. Percent Time Audible would range 17 to 63%, a 37 to 67% decrease from Alternative A. Average Sound Level would range 18 to 34 dBA, a 3 to 24 dBA decrease from Alternative A. This would result in minor to major adverse impacts with long-term minor to major beneficial changes in impacts for visitors in this area compared to Alternative A.

East End *Alternative E* *Visitor Use and Experience*
Wilderness Zone
Base Year Off-Peak Season and Ten-Year Forecast Peak and Off-Peak Season

Near **Nankoweap River** Location Point, change in aircraft Percent Time Audible, Average Sound Level, and visibility would be nearly the same as Base Year Peak Season. Although negligible impacts would occur, long-term there would be minor beneficial changes in impacts compared to Alternative A.

East End **Alternative E** **Visitor Use and Experience**
Ground-Based Visitors Outside the Park within the SFRA
Base Year and Ten-Year Forecast Peak Season

Areas of the **Navajo Nation** and **Kaibab National Forest** beneath and near Zuni Point Corridor would continue to be affected by air-tour sounds. As shown in Figures 4.14 and 4.15, aircraft Average Sound Level would range 35 to 50 dBA. Air-tour sounds would be audible. Visitors in these areas would experience moderate adverse impacts with long-term minor to moderate adverse changes in impacts compared to Alternative A.

East End Ground-Based Visitors *Alternative E* *Visitor Use and Experience*
Visitors Outside the Park within the SFRA
Base Year and Ten-Year Forecast Off-Peak Season

With operations only in Dragon Corridor, air-tour sounds would be virtually eliminated from **Navajo lands** and **areas east of Grand Canyon Village** resulting in negligible impacts with long-term moderate beneficial changes in impacts compared to Alternative A.

Use of Dragon Corridor would generate air-tour aircraft sounds **west of Grand Canyon Village outside the park.** Air-tour sounds between Grand Canyon Airport and the park would average 30 to 50 dBA. Air-tour sounds would be audible above natural sounds for some or much of the day. Moderate adverse impacts would occur with visitors in this area experiencing negligible change in impacts compared to Alternative A.

TABLE 4.93 ALTERNATIVE E SOUND LEVELS EAST END

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	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 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	25	-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	12	-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	-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
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

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

Central Ground-Based Visitors Alternative E Visitor Use and Experience

Based on modeled noise results shown in Figures 4.14 to 4.17, in the Central area there would be little change from Alternative A as conditions would remain relatively quiet with Average Sound Level generally less than 10 dBA and aircraft Percent Time Audible less than 5% of the time.

Central Alternative E Visitor Use and Experience
Wilderness Zone
Base Year Peak and Off-Peak Season and Ten-Year Forecast Peak Season

Conditions at **Upper Deer Creek** Location Point would remain largely unchanged from Alternative A as shown in Tables 4.95 and 4.96. Percent Time Audible under All Scenarios would be zero to one percent, and Average Sound Level would be zero to one dBA. Air-tour aircraft would be at Distances in excess of 20,000 meters. Low audibility and sound level in this scrub habitat would virtually eliminate effects of air-tours on visitors, resulting in negligible impacts with negligible change in impacts compared to Alternative A.

Central Alternative E Visitor Use and Experience
Wilderness Zone
Ten-Year Forecast Off-Peak Season

At **Upper Deer Creek** Location Point, change in Percent Time Audible would be one percent, Average Sound Level would decrease by 14 dBA, and aircraft visibility from the ground would be the same as Base Year Peak Season. Negligible impacts would continue with negligible change in impacts compared to Alternative A.

Central Alternative E Visitor Use and Experience
Non-Wilderness Zone
All Scenarios

Conditions at **Toroweap Overlook** Location Point would vary little. As shown in Tables 4.95 and 4.96, Base Year Peak Season, Percent Time Audible would remain zero. Air-tour aircraft would be over 9,000 meters. Visitors would have uninterrupted opportunities to experience and appreciate natural sounds and park resources. Negligible impacts would occur with negligible change in impacts compared to Alternative A.

Central Alternative E Visitor Use and Experience
Ground Based Visitors Outside the Park within the SFRA
All Scenarios

As shown in Figure 4.14, in **Kaibab National Forest**, north of the park, there would be negligible impacts and negligible change in impacts compared to Alternative A.

South of the park, air-tour sounds over **Havasupai** and **Hualapai Reservation lands** would be reduced Peak and Off-Peak Season compared to Alternative A. Blue Direct South would be eliminated, and non-air-tour flights would be required to fly outside the SFRA. Near the SFRA southern boundary, air-tour sounds would average 25 to 45 dBA. Thus, along the SFRA southern boundary, natural sounds would occasionally be dominated by aircraft sounds. This would result in long-term minor to moderate adverse impacts with negligible changes in impacts outside the park compared to Alternative A.

TABLE 4.95 ALTERNATIVE E SOUND LEVELS CENTRAL

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	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	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

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

West End Ground-Based Visitors Alternative E Visitor Use and Experience

Based on modeled noise results shown in Figures 4.14 to 4.17, West End, adverse impacts would result from aircraft Average Sound Level 40 to 50 dBA and Percent Time Audible greater than 65% in areas under Blue-2 and Green-4. For areas near Alternative A's Blue Direct routes, area of audibility would be reduced by approximately 50% due to the route's short travel Distance over the park. In West End's southern portion under and near Sanup Flight-free Zone, aircraft Average Sound Level would be 10 to 20 dBA with Percent Time Audible less than 20%. For lands outside the park directly under and within five miles of Alternative E's Blue Direct North and other busy air-tour corridors, adverse impacts would result from Average Sound Level ranging 40 to 50 dBA. The remainder of the SFRA outside park boundaries would experience Average Sound Level less than 25 dBA.

West End Ground-Based Visitors Alternative E Visitor Use and Experience
Base Year Peak Season

As shown in Tables 4.97 and 4.98, under Alternative E, Blue-2 and Green-4 air-tour routes would be unchanged from Alternative A, and impacts would also be the same. Based on Location Point data, Percent Time Audible would range zero to 92%. Average Sound Level would range zero to 47 dBA at **Whitmore Rapids** and **Bat Cave** Location Points. At Whitmore Rapids and Bat Cave Location Points, impacts would be moderate adverse with negligible change from Alternative A. At **Parashant Wash** Location Point, minor adverse impacts would occur with negligible change compared to Alternative A. There would be negligible impacts with negligible change in impacts at **Separation Canyon** Location Point compared to Alternative A.

West End Ground-Based Visitors Alternative E Visitor Use and Experience
Base Year Off-Peak Season and Ten-Year Forecast Peak and Off-Peak Season

Degree of change in aircraft Percent Time Audible, Average Sound Level, and Distance at **Whitmore Rapids, Bat Cave, Parashant Wash,** and **Separation Canyon** Location Points would be similar to Base Year Peak Season. Minor to moderate adverse impacts would continue with negligible change compared to Alternative A.

West End Alternative E Visitor Use and Experience
Ground-Based Visitors Outside the Park within the SFRA
All Scenarios

Air-tour operations using Blue Direct North would be expected to travel north of the SFRA boundary in less remote areas of **Lake Mead National Recreation Area** and **Grand Canyon-Parashant National Monument**, where management objectives include fewer expectations of natural quiet. Sounds from Blue Direct North would be Average Sound Level 25 to 50 dBA as shown in Figures 4.14 and 4.16. Thus, impacts Base Year Peak and Off-Peak Season would be minor to moderate adverse with negligible change in impacts compared to Alternative A.

Outside the park's southwest corner and far western boundary, air-tour sound conditions would continue to have negligible to moderate adverse impacts with negligible change from Alternative A.

TABLE 4.97 ALTERNATIVE E SOUND LEVELS WEST END

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	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

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	16,377	16,329	-49
Bat Cave	1,134	1,134	0

Δ indicates change in noise metric data from Alternative A

Air-tour Visitors Alternative E Visitor Use and Experience

Alternative E would provide the least variety of air-tour choices of proposed Alternatives. Many options currently available would be eliminated, no long-loop air-tours would be available, and viewing a variety of scenic landscapes would be reduced. Bright Angel Flight-free Zone would extend northward to include Marble Canyon, effectively eliminating air-tours from that area.

East End routes would be limited to one of two seasonal choices of short-loop tours in either Zuni Point or Dragon Corridor depending on month of visit. Routes in Zuni Point Corridor (Peak Season) would include viewing of the Little Colorado River confluence, but would eliminate Nankoweap Basin. Routes in Dragon Corridor (Off-Peak Season) would include North Rim views. However, no route connecting Zuni Point Corridor to Dragon Corridor would be available. Thus, opportunities for longer routes some visitors prefer would be eliminated.

On Blue Direct North between Las Vegas and Grand Canyon, the canyon would be visible as the route passes over the Colorado River near Parashant Wash and Andrus Canyon, and as it continues west toward Lake Mead. Blue Direct South would be eliminated, and transportation and repositioning flights would travel outside the SFRA.

West End Blue-2 and Green-4 routes would continue unchanged from Alternative A with no change in impacts on air-tour Visitor Use and Experience in this part of the park.

Cumulative Impacts Alternative E Visitor Use and Experience
Ground-Based Visitors

In all areas, noise from aircraft flying above and outside the SFRA would continue to have long-term moderate to major adverse effect on Visitor Use and Experience as described in Alternative A. Noise from other sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under Alternatives.

Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative E as discussed above, would have long-term moderate to major adverse cumulative impacts on Visitor Use and Experience throughout all four areas (Marble Canyon, East End, Central, and West End), due primarily to combined Percent Time Audible from all sources of greater than 50% of the day over large areas.

Cumulative Impacts Marble Canyon Alternative E Visitor Use and Experience
Alternative E would generally have negligible change in impacts compared with Alternative A. When impacts of Alternative E are combined with adverse impacts of aircraft noise outside and above the SFRA, cumulative effect would be long-term moderate to major adverse.

Cumulative Impacts East End Alternative E Visitor Use and Experience
Under Alternative E Peak and Off-Peak Season, adverse impacts from air-tour aircraft on Visitor Use and Experience would continue; however, there would be long-term negligible to major beneficial changes in impacts from Alternative A. When impacts of Alternative E are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would continue to be long-term moderate to major adverse.

Cumulative Impacts Central Alternative E Visitor Use and Experience
Alternative E would result in negligible to moderate beneficial changes in impacts to Visitor Use and Experience in most of Central area and adjacent to the park compared to Alternative A. When impacts of Alternative E are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would be long-term negligible to moderate adverse.

Cumulative Impacts West End *Alternative E* *Visitor Use and Experience*
Alternative E would result in negligible changes in impacts in most of West End compared to Alternative A. When impacts of Alternative E are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would be long-term negligible to moderate adverse.

Conclusion Ground-Based Visitors **Alternative E** **Visitor Use and Experience**

Conclusion Marble Canyon *Alternative E* *Visitor Use and Experience*
Alternative E would result in long-term negligible to minor beneficial change in impacts compared to Alternative A for Marble Canyon visitors. Cumulative impacts on Visitor Use and Experience would be long term moderate adverse.

Conclusion East End Developed Zone *Alternative E* *Visitor Use and Experience*
Ten-Year Forecast Alternative E would result in long-term minor to moderate beneficial change in impacts compared to Alternative A to Developed Zone Visitor Use and Experience as air-tour sounds are reduced by seasonal route use and quiet-technology implementation. Cumulative impacts on Visitor Use and Experience would be long term minor adverse.

Conclusion East End Non-Wilderness Zone *Alternative E* *Visitor Use and Experience*
Ten-Year Forecast Alternative E would result in long-term negligible to major beneficial change in impacts compared to Alternative A to Non-Wilderness Zone Visitor Use and Experience as air-tour sounds are reduced by seasonal route use and quiet-technology implementation. Cumulative impacts on Visitor Use and Experience would be long term minor adverse.

Conclusion East End Wilderness Zone *Alternative E* *Visitor Use and Experience*
Ten-Year Forecast Alternative E would result in long-term negligible to major beneficial change in impacts compared to Alternative A to Wilderness Visitor Use and Experience as air-tour sounds are reduced by seasonal route use and quiet-technology implementation. Cumulative impacts on Visitor Use and Experience would be long term minor adverse.

Conclusion Central *Alternative E* *Visitor Use and Experience*
Under Alternative E, impacts to Central area Visitor Use and Experience would not be appreciably different from Alternative A. Cumulative impacts on Visitor Use and Experience would be long term minor to moderate adverse.

Conclusion West End *Alternative E* *Visitor Use and Experience*
Under Alternative E, impacts to West End Visitor Use and Experience would change negligibly compared to Alternative A. Cumulative impacts on Visitor Use and Experience would be long term minor to moderate adverse.

Conclusion Air-tour Visitors **Alternative E** **Visitor Use and Experience**

Alternative E would provide the least variety of opportunities for air-tour visitors of proposed Alternatives. Seasonal route closures and elimination of long-loop tours would make Alternative E least desirable of the Alternatives for some air-tour visitors.

ALTERNATIVE F **MODIFIED CURRENT CONDITION** **VISITOR USE AND EXPERIENCE**

Under Alternative F, a range of aircraft noise intensities and audibility would continue to affect park visitors. As shown in Figures 4.22 to 4.25, greatest exposure to noise and visual impacts would occur in East End and West End's western portions where Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75%. Dragon Corridor's Off-Peak Season western shift would provide some limited

seasonal benefits. Marble Canyon, Central area, and West End's southern portions would be least impacted by air-tour operations as Average Sound Level would be less than 15 dBA, and aircraft Percent Time Audible would be less than 5%. Alternative F would also include quiet-technology conversion that would provide reduction in Percent Time Audible and Average Sound Level.

Marble Canyon Ground-Based Visitors Alternative F Visitor Use and Experience

Based on modeled noise results shown in Figures 4.22 to 4.25, Marble Canyon would remain relatively quiet with air-tour aircraft Percent Time Audible generally less than 5% and Average Sound Level less than 15 dBA. Modifications to East End air-tour routes would have little effect in Marble Canyon Peak Season compared to Alternative A. The greatest degree of change would be a 21 to 23 dBA decrease in Average Sound Level during Peak and Off-Peak Seasons at South Canyon Location Point.

Marble Canyon Ground-Based Visitors Alternative F Visitor Use and Experience
Base Year and Ten-Year Forecast Peak Season

Under Alternative F, air-tour operations over Marble Canyon impacts on Visitor Use and Experience would be similar to those described for Alternative A. Throughout the year, **Marble Canyon Location Points** would generally be free of air-tour aircraft sights and sounds. As shown in Tables 4.99 and 4.100, **Marble Canyon Dam Site** Location Point would have zero Percent Time Audible at Average Sound Level of 3 dBA. At **South Canyon** Location Point, Percent Time Audible would be 2% at an Average Sound Level of 21 dBA. Impacts on Visitor Use and Experience at these locations would be negligible with negligible change in impacts compared to Alternative A.

Marble Canyon Ground-Based Visitors Alternative F Visitor Use and Experience
Base Year and Ten-Year Forecast Off-Peak Season

Air-tour aircraft would no longer be audible at **South Canyon**, with Percent Time Audible falling from 2% to zero, and Average Sound Level falling from 21 dBA to zero. Adverse impacts would not continue at either location as air-tour noise would not interrupt visitor opportunities to appreciate natural sounds. Visitors would experience negligible impacts with long-term minor beneficial changes compared to Alternative A.

Marble Canyon Alternative F Visitor Use and Experience
Ground-Based Visitors Outside the Park within the SFRA
All Scenarios

Outside the park in the Marble Canyon area, air-tour sound conditions would remain generally unchanged from Alternative A. As shown Figures 4.22 to 4.25, there would be negligible impacts with negligible change in impacts compared to Alternative A.

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

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

East End Ground-Based Visitors Alternative F Visitor Use and Experience

As shown Figures 4.22 to 4.25, under Alternative F greatest exposure to noise and visual impacts occur East End. Based on modeled noise results, Peak Season modifications to East End air-tour routes would be small, resulting in impacts similar to Alternative A. Average Sound Level would be 40 to 50 dBA and aircraft Percent Time Audible would be greater than 75%. The seven-mile Dragon Corridor western shift Off-Peak Season moves impacts, but does not diminish impact levels. Beneficial effects to East End's middle and east side include a 20 to 40% reduction in Percent Time Audible from Alternative A. Because Alternative F would implement quiet technology, air-tour sounds would decrease Base Year to Ten-Year Forecast.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone South Rim
Base Year Peak Season

Under Alternative F, there would be little change in air-tour sounds for visitors at **Desert View, Tusayan,** and **Lipan Point** Location Points. Interference with opportunities to appreciate natural sound would result in moderate adverse impacts with negligible change in impacts to compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone South Rim
Ten-Year Forecast Peak Season

There would be reductions in air-tour noise as shown in Tables 4.101 and 4.102 at **Desert View** and **Tusayan Museum** Location Points where Percent Time Audible would decrease by 36%, and Average Sound Level would fall by 8 dBA. At **Lipan Point** Location Point, Percent Time Audible would decrease by 28 to 49%, and Average Sound Level would fall from 34 to 27 dBA. Conditions at **El Tovar** Location Point would include a dramatic decline in Percent Time Audible from 95 to 12% of the day, with a modest reduction in Average Sound Level from 19 to 13 dBA. Visitors would have increased opportunities to experience combined natural and human-caused sounds, but given the background sound level of 39 to 49 dBA, improvements may not be as dramatic as the decrease in Percent Time Audible alone would imply. Although minor to major adverse conditions would occur, compared to Alternative A, these changes in impacts would be long term negligible to major beneficial.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone South Rim
Base Year Off-Peak Season

Visitors on eastern South Rim would experience varying decreases in air-tour sounds compared to Alternative A. At **Desert View** Location Point, Percent Time Audible would decline 76% to 46%, and Average Sound Level would fall 29 to 24 dBA. At **Lipan Point** Location Point, Percent Time Audible would decline 74% to 45%, and Average Sound Level would fall 34 to 29 dBA. At **Tusayan Museum** Location Point, Percent Time Audible would decline 64% to 36%, and Average Sound Level would fall 35 to 29 dBA. Although Percent Time Audible declines notably for these locations, decibel levels remain similar to Alternative A. Thus, although Percent Time Audible would decrease, visitors may not notice the change. Although moderate to major adverse impacts would continue, changes in impacts would be long term minor beneficial compared to Alternative A.

Near **El Tovar** Location Point, Percent Time Audible would decline by 76% from 95 to 19%, and Average Sound Level would fall 19 to 8 dBA. Drastic reduction in Percent Time Audible may be appreciated by visitors. Although minor adverse impacts would continue, changes in impacts would be long term moderate beneficial compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone South Rim
Ten-Year Forecast Off-Peak Season

At **Desert View** Location Point, Percent Time Audible would decline from 76% to 19%, and Average Sound Level would fall from 29 to 18 dBA. At **Lipan Point** Location Point, Percent Time Audible would decline from 74% to 22%, and Average Sound Level would fall from 34 to 24 dBA. At **Tusayan Museum** Location

Point, Percent Time Audible would decline from 64% to 15%, and Average Sound Level fall from 35 to 24 dBA. Although moderate adverse impacts would persist, changes in impacts would be long term moderate beneficial compared to Alternative A.

At **El Tovar** Location Point, aircraft Percent Time Audible would be 8% of the day at an Average Sound Level of 8 dBA, compared to 95% of the day at 19 dBA under Alternative A. As described above, visitors would have opportunities to experience the area without aircraft sounds most of the day, leading to negligible impacts. Compared to Alternative A, changes in impacts would be long term moderate beneficial.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone Phantom Ranch
Base Year Peak Season

Under Alternative F, as shown in Tables 4.101 and 4.102, air-tour aircraft sounds at Phantom Ranch Location Point would remain unchanged from Alternative A. Aircraft Percent Time Audible would be less than 4% of the day at Average Sound Level of 12 dBA, and would be 10,000 meters Distant. Thus, negligible impacts would occur with no change in impacts from Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone Phantom Ranch
Ten-Year Forecast Peak Season

Percent Time Audible would decrease from less than 4% to zero and Average Sound Level from 12 to 7 dBA. Air-tour aircraft would rarely be audible, leading to negligible impacts with negligible change in impacts compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone Phantom Ranch
Base Year and Ten-Year Forecast Off-Peak Season

Phantom Ranch Location Point would have slightly reduced air-tour noise compared to Alternative A. Percent Time Audible would decrease from less than 4% to one percent; Average Sound Level would fall from 12 to 6 dBA. Visitors would have opportunities to experience the area without aircraft sound most of the day. Aircraft would be audible for brief, infrequent periods. Negligible impacts would occur with negligible change in impacts compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone North Rim
Base Year Peak Season

Air-tour aircraft sound level and audibility would remain unchanged from Alternative A at **Point Imperial, Bright Angel Point,** and **Cape Royal** Location Points. As shown in Tables 4.101 and 4.102 aircraft Percent Time Audible would be 47 to 66% of the day, at Average Sound Level of 24 to 38 dBA. Combination of aircraft audible for a high percentage of the day, at levels less than background sounds would lead to moderate adverse impact with negligible change in impacts from Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone *North Rim*
Ten-Year Forecast Peak Season

Air-tour aircraft at **Point Imperial** Location Point Percent Time Audible would decrease from 68% to 25% but Average Sound Level would decrease by only 2 dBA to 37 dBA. At **Bright Angel Point** Location Point, Percent Time Audible would decrease from 48% to 12%, with Average Sound Level falling from 24 to 18 dBA. Percent Time Audible at **Cape Royal** Location Point would decrease from 61% to 17%, and Average Sound Level would fall from 26 to 19 dBA. This results from shifting helicopter routes west of Dragon Corridor. Although ambient conditions may mask air-tour aircraft sounds, these large reductions in Percent Time Audible could improve visitor experience. Although moderate adverse impacts would occur, changes in impacts would be long term minor beneficial compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone *North Rim*
Base Year Off-Peak Season

Air-tour sounds at **Point Imperial** Location Point would decrease from 66% to 28% and Average Sound Level would fall from 38 to 18 dBA. At **Bright Angel Point** Location Point, Percent Time Audible would decrease from 47 to 2%, with Average Sound Level falling from 24 to 13 dBA. At **Cape Royal** Location Point, Percent Time Audible would decrease from 59 to 31%, and Average Sound Level would fall from 25 to 21 dBA. Although ambient conditions may mask air-tour aircraft sounds, large reductions in Percent Time Audible could improve visitor experience. Negligible to moderate adverse impacts would occur with long-term minor beneficial changes in impacts compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Developed Zone *North Rim*
Ten-Year Forecast Off-Peak Season

Point Imperial, Cape Royal, and **Bright Angel Point** Location Points would have reduced aircraft sounds compared to Alternative A. At Bright Angel Point Location Point, Percent Time Audible would decrease from 47 to 2%, with Average Sound Level fall from 24 to 11 dBA. At Cape Royal Location Point, Percent Time Audible would decrease from 59 to 7%, and Average Sound Level would fall from 25 to 16 dBA. At Point Imperial Location Point, Percent Time Audible would decrease from 68 to 2%, with Average Sound Level falling from 39 to 14 dBA. Visitors would have opportunities to appreciate ambient sound conditions throughout much the day, with occasional aircraft sounds at low volumes. Negligible to minor adverse impacts would occur with long term minor to moderate beneficial changes in impacts compared to Alternative A.

East End **Alternative F** **Visitor Use and Experience**
Non-Wilderness Zone
Base Year Peak Season

Air-tour operations would have the same impacts on Visitor Use and Experience near **Cedar Ridge** Location Point as Alternative A. As shown in Tables 4.101 and 4.102, aircraft Percent Time Audible would be 81% of the day at Average Sound Level of 19 dBA. Aircraft would be visible at Distances in excess of 2,000 meters. Moderate to major adverse impacts would occur with no change in impacts compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Non-Wilderness Zone
Ten-Year Forecast Peak and Off-Peak Season

Cedar Ridge Location Point shows great reduction in air-tour sounds Percent Time Audible, and a modest reduction in Average Sound Level. Aircraft Percent Time Audible would be 5% at 13 dBA, down from 82% and 19 dBA. Visitors would have opportunities to experience ambient sounds most of the day, with occasional aircraft sounds at low volumes. Negligible impacts would occur, but increased opportunity to appreciate natural sounds would result in long-term moderate to major beneficial changes in impacts compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Non-Wilderness Zone
Base Year Off-Peak Season

Air-tour sounds would decrease from Peak Season near **Cedar Ridge** Location Point because air-tour operations move to Dragon Corridor. Air-tour aircraft Percent Time Audible would be 20% of the day at 14 dBA, down from 81% and 19 dBA. Visitors would have opportunities to appreciate natural sounds most of the day, with occasional aircraft sounds at low volumes. Although minor adverse impacts would occur, , this would result in long-term moderate to major beneficial changes in impacts compared to Alternative A.

East End Alternative F Visitor Use and Experience
Wilderness Zone

Visitors could expect a wide range of exposure to air-tour noise. Percent Time Audible would range from less than one percent to over 90% of the day. Air-tour Average Sound Level would range 10 to 43 dBA.

East End Alternative F Visitor Use and Experience
Wilderness Zone
Base Year Peak Season

All East End Wilderness Location Points (shown in Tables 4.101 and 4.102 as **Nankoweap River, Nankoweap Mesa, Little Colorado River, Hermit Basin, 96-mile Camp, Point Sublime,** and **Pasture Wash**) would have air-tour aircraft sounds and sights unchanged from Alternative A (minor to major adverse impacts) because air-tour routes the same as those currently in place would be used ten months of the year.

East End Alternative F Visitor Use and Experience
Wilderness Zone
Ten-Year Forecast Peak Season

Generally modest reductions in Percent Time Audible and Average Sound Level would occur, and opportunities to experience natural sounds and solitude would improve. At **Nankoweap River** Location Point, Ten-Year Forecast would result in minimal change from Base Year. Compared to Alternative A, Percent Time Audible would decrease from 8 to 5%, and Average Sound Level would remain relatively unchanged at 33 dBA compared to 35 dBA under Alternative A. At **Nankoweap Mesa, Little Colorado River, Hermit Basin, 96-mile Camp, Point Sublime,** and **Pasture Wash** Location Points, modest reductions in air-tour noise would occur. At Nankoweap Mesa Location Point, Percent Time Audible would decrease from 90 to 68%, and Average Sound Level would fall from 43 to 39 dBA. At Little Colorado River Location Point, Percent Time Audible would decrease from 37 to 25%, and Average Sound Level would fall from 43 to 37 dBA. At Hermit Basin Location Point, Percent Time Audible would decrease from 100 to 89%, and Average Sound Level would fall from 42 to 37 dBA. At 96-mile Camp Location Point, Percent Time Audible would decrease from 74 to 47%, and Average Sound Level would fall from 45 to 41 dBA. At Point Sublime Location Point, Percent Time Audible would decrease from 100 to 94%, and Average Sound Level would fall from 35 to 30 dBA. At Pasture Wash Location Point, Percent Time Audible would decrease from 98 to 20%, and Average Sound Level would fall from 21 to 17 dBA. Reductions in air-tour sounds would result in minor to major adverse impacts with minor beneficial changes in impacts compared to Alternative A, as reduced noise would be less dominant.

East End Alternative F Visitor Use and Experience
Wilderness Zone
Base Year Off-Peak Season

Dragon Corridor would be shifted west Off-Peak Season. East End backcountry visitors would experience markedly reduced air-tour sounds, while visitors closer to Zuni Point Corridor would see only modest reductions. At **Nankoweap Mesa** Location Point, Percent Time Audible would decrease from 87 to 53%, and Average Sound Level would fall from 43 to 29 dBA. At **Little Colorado River** Location Point, Percent Time Audible would decrease from 34 to 17%, and Average Sound Level would fall from 43 to 38 dBA. At **Hermit Basin** Location Point, Percent Time Audible would decrease from 99 to 60%, and Average Sound Level would fall from 42 to 23 dBA. Changes at **96-mile Camp** Location Point would include a Percent Time Audible decrease from 72 to one percent, and Average Sound Level would fall from 45 to 13 dBA. At **Point Sublime** Location Point, Percent Time Audible would decrease from 100 to 89%, and Average Sound Level would fall from 35 to 19 dBA. At **Pasture Wash** Location Point, Percent Time Audible would decrease from 98 to 90%, and Average Sound Level would rise modestly from 20 to 25 dBA. These overall reductions in air-tour sounds would result in moderate to major adverse impacts (except at **96-mile Camp** Location Point where impacts would be negligible), with long-term minor beneficial changes in impacts compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Wilderness Zone
Ten-Year Forecast Off-Peak Season

There would be reduced air-tour sounds compared to Alternative A. At **Nankoweap Mesa** Location Point, Percent Time Audible would decrease from 90 to 33%, and Average Sound Level would fall from 43 to 25 dBA. At **Little Colorado River** Location Point, Percent Time Audible would decrease from 37 to 12%, and Average Sound Level would fall from 43 to 33 dBA. At **Hermit Basin** Location Point, Percent Time Audible would decrease from 100 to 32%, and Average Sound Level would fall from 42 to 19 dBA. At **96-mile Camp** Location Point, Percent Time Audible would decrease from 74% to zero, and Average Sound Level would fall from 45 to 10 dBA. At **Point Sublime** Location Point, Percent Time Audible would decrease from 100 to 24%, and Average Sound Level would fall from 35 to 17 dBA. At **Pasture Wash** Location Point, Percent Time Audible would decrease from 98 to 58%, and Average Sound Level would fall from 21 to 20 dBA. Although negligible and moderate adverse impacts would occur, these changes in impacts would be long term moderate to major beneficial compared to Alternative A.

East End **Alternative F** **Visitor Use and Experience**
Ground-Based Visitors Outside the Park within the SFRA
Base Year Peak Season
Ten-Year Forecast Peak and Off-Peak Season

As shown in Figure 4.22, impacts would be minor to moderate adverse with negligible change in impacts on visitors to **Navajo lands** east of the park and in **Kaibab National Forest** at GCNP's southeast corner compared to Alternative A.

East End *Alternative F* *Visitor Use and Experience*
Ground-Based Visitors Outside the Park within the SFRA
Base Year Off-Peak Season

As operations move to Dragon Corridor, effects to visitor use on **Navajo lands** east of the park and in **Kaibab National Forest** at GCNP's southeast corner would be reduced, with Average Sound Level ranging zero to 25 dBA; approximately 5 dBA less than under current management. This would produce long-term minor to moderate adverse impacts with negligible change in impacts compared to Alternative A for visitors in this area.

TABLE 4.101 ALTERNATIVE F SOUND LEVELS EAST END

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
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	-6	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	-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	-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

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

Central Ground-Based Visitors Alternative F Visitor Use and Experience

Based on modeled noise results shown in Figures 4.22 to 4.25, there would be little change from Alternative A as the area would remain relatively quiet with Average Sound Level generally less than 10 dBA and aircraft Percent Time Audible less than 5%. Under Alternative F, All Scenarios Central area visitors would be largely unaffected by air-tour sounds. This condition would be unchanged from Alternative A.

Central Alternative F Visitor Use and Experience
Wilderness Zone
All Scenarios

As shown in Tables 4.103 and 4.104, conditions at **Upper Deer Creek** Location Point would remain unchanged from Alternative A. Percent Time Audible All Scenarios would be zero to one percent and Average Sound Level would be zero to one dBA. Air-tour aircraft would be at Distances in excess of 20,000 meters. Low Percent Time Audible and Average Sound Level would produce negligible impacts with negligible change in impacts compared to Alternative A.

Central Alternative F Visitor Use and Experience
Non-Wilderness Zone Visitors
All Scenarios

Conditions at **Toroweap Overlook** Location Point would vary little. As shown in Tables 4.103 and 4.104, Percent Time Audible would remain approximately zero, while Average Sound Level would increase from 13 to 17 dBA. Air-tour aircraft would be over 9,000 meters distant. Because Percent Time Audible is zero, visitors would not hear air-tour aircraft, and visibility would be low. Visitors would have uninterrupted opportunities to experience and appreciate natural sounds and park resources. Negligible impacts would occur with negligible changes in impacts compared to Alternative A.

Central Alternative F Visitor Use and Experience

Ground-Based Visitors Outside the Park within the SFRA

All Scenarios

As shown in Figures 4.22 and 4.23, north of the park in **Kaibab National Forest** and **other adjacent lands**, there would be negligible impacts with negligible change in impacts to visitors compared to Alternative A.

South of the park, in **Havasupai** and **Hualapai lands**, because Blue Direct routes are further south than Alternative A, aircraft sounds would spread to a larger area outside the park. Sound levels would be the same as described for Alternative A with a larger area near the Study Area's southern boundary receiving high sound levels. Opportunity to appreciate natural sounds would be reduced in the area, producing minor to moderate adverse impacts with a long-term minor adverse change in impacts compared to Alternative A.

TABLE 4.103 ALTERNATIVE F SOUND LEVELS CENTRAL

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
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

TABLE 4.104 ALTERNATIVE F SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	Alternative F	
		Slant Distance (m)	
	Slant Distance (m)	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

West End Ground-Based Visitors Alternative F Visitor Use and Experience

Based on modeled noise results, West End near Blue-2, Green-4 and Blue Direct routes, aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 65% of the time. Quiet-technology conversion would reduce some impacts over time. In West End's southern portion near Sanup Flight-free Zone, Average Sound Level would be 10 to 20 dBA with aircraft Percent Time Audible less than 20%.

West End Ground-Based Visitors Alternative F Visitor Use and Experience
Base Year Peak Season

West End visitors would see small increments of change in air-tour sounds. As shown in Tables 4.105 and 4.106, **Whitmore Rapids** Location Point Percent Time Audible would decrease from 12 to 9%, and Average Sound Level would rise from 21 to 33 dBA. At **Parashant Wash** Location Point, Percent Time Audible would decrease from 12 to 7%, and Average Sound Level would fall from 33 to 23 dBA. At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average Sound Level would rise from 7 to 8 dBA. At **Bat Cave** Location Point, Percent Time Audible would fall from 93 to 88%, and Average Sound Level would remain unchanged at 47 dBA. This would result in negligible to minor adverse impacts, except at Bat Cave where impacts would be major adverse, with long-term negligible to minor beneficial changes in impacts compared to Alternative A.

West End Ground-Based Visitors Alternative F Visitor Use and Experience
Ten-Year Forecast Peak Season

At **Whitmore Rapids** Location Point, Percent Time Audible would increase from 13 to 16%, and Average Sound Level would rise from 21 to 37 dBA compared to Alternative A. At **Parashant Wash** Location Point**,** Percent Time Audible would decrease from 14 to 11%, and Average Sound Level would fall from 33 to 26 dBA. At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average Sound Level would rise from 7 to 8 dBA. At **Bat Cave** Location Point, Percent Time Audible would fall from 95 to 83%, and Average Sound Level would fall from 47 to 46 dBA. This would result in negligible to moderate adverse impacts, except at Bat Cave where impacts would be major adverse, with negligible change in impacts compared to Alternative A.

West End Ground-Based Visitors Alternative F Visitor Use and Experience
Base Year Off-Peak Season

At **Whitmore Rapids** Location Point, Percent Time Audible would decrease from 12 to 5%, and Average Sound Level would rise from 21 to 32 dBA compared to Alternative A. At **Parashant Wash** Location Point, Percent Time Audible would decrease from 12 to 8%, and Average Sound Level would fall from 33 to 23 dBA. At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average Sound Level would rise from 7 to 8 dBA. At **Bat Cave**, Percent Time Audible would fall from 93 to 88%, and Average Sound Level would fall from 47 to 46 dBA. This would result in negligible to minor adverse impacts, except at Bat Cave where impacts would be major adverse, with negligible change in impacts compared to Alternative A.

West End Ground-Based Visitors Alternative F Visitor Use and Experience
Ten-Year Forecast Off-Peak

At **Whitmore Rapids** Location Point, Percent Time Audible would decrease from 13 to 12%, and Average Sound Level would rise from 21 to 36 dBA compared to Alternative A. At **Parashant Wash** Location Point, Percent Time Audible would decrease from 14 to 9%, and Average Sound Level would fall from 33 to 25 dBA. At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average Sound Level would rise from 7 to 8 dBA. At **Bat Cave** Location Point, Percent Time Audible would fall from 95 to 81%, and Average Sound Level would fall from 47 to 45 dBA. This would result in negligible to major adverse impacts with negligible change in impacts compared to Alternative A.

West End Alternative F Visitor Use and Experience
Ground-Based Visitors outside the Park within the SFRA

Alterations to Blue Direct routes that carry visitors to and from Las Vegas would shift air-tour noise impacts to more noise-sensitive areas of **Lake Mead National Recreation Area** and **Grand Canyon-Parashant National Monument** for ground-based visitors.

West End Alternative F Visitor Use and Experience
Ground-Based Visitors outside the Park within the SFRA
All Scenarios

As shown in Figures 4.22 to 4.25, negligible to moderate adverse impacts on Visitor Use and Experience **outside West End** would continue with negligible change in impacts compared to Alternative A.

TABLE 4.105 ALTERNATIVE F SOUND LEVELS WEST END

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
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

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

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

In all areas, noise from aircraft flying above and outside the SFRA would continue to have long-term moderate to major adverse effect on Visitor Use and Experience as described in Alternative A. Noise from other sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under Alternatives.

Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative F as discussed above, would have long-term moderate to major adverse cumulative impacts on Visitor Use and Experience throughout all four areas (Marble Canyon, East End, Central, and West End), due primarily to combined Percent Time Audible from all sources of greater than 50% of the day over large areas.

Cumulative Impacts Marble Canyon Alternative F Visitor Use and Experience
Alternative F would generally have negligible to minor beneficial change in impacts compared with Alternative A. When impacts of Alternative F are combined with adverse impacts of aircraft noise outside and above the SFRA, cumulative effect would be long-term moderate to major adverse.

Cumulative Impacts East End Alternative F Visitor Use and Experience
Under Alternative F Peak and Off-Peak Season, adverse impacts from air-tour aircraft on Visitor Use and Experience would continue; however, there would be long-term negligible to major beneficial changes compared with Alternative A. When impacts of Alternative F are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would continue to be long-term moderate to major adverse.

Cumulative Impacts Central Alternative F Visitor Use and Experience
Alternative F would result in negligible to minor beneficial changes in impacts to Visitor Use and Experience in most of Central area and adjacent to the park compared to Alternative A. When impacts of Alternative F are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would be long-term minor to moderate adverse.

Cumulative Impacts West End *Alternative F* *Visitor Use and Experience*
Alternative F would result in negligible to minor beneficial changes in impacts in most of West End compared to Alternative A. When impacts of Alternative F are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would be long-term moderate to major adverse.

Conclusion **Alternative F** **Visitor Use and Experience**

Conclusion *Marble Canyon* ***Alternative F*** ***Visitor Use and Experience***
Ten-Year Forecast, Alternative F would result in long-term negligible to minor beneficial change in impacts on Visitor Use and Experience in Marble Canyon compared to Alternative A. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion East End Developed Zone *Alternative F* *Visitor Use and Experience*
Ten-Year Forecast, Alternative F would result in long-term negligible to moderate beneficial changes in impacts compared to Alternative A for Visitor Use and Experience as air-tour sounds would be reduced by seasonal Dragon Corridor route use and quiet-technology conversion. Cumulative impacts on Visitor Use and Experience would continue to be long-term moderate to major adverse.

Conclusion East End Non-Wilderness Zone *Alternative F* *Visitor Use and Experience*
Ten-Year Forecast, Alternative F would result in long-term moderate to major beneficial changes in impacts to Visitor Use and Experience as air-tour sounds are reduced by seasonal route use and quiet-technology implementation. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion East End Wilderness Zone *Alternative F* *Visitor Use and Experience*
Ten-Year Forecast, Alternative F would result in long-term minor to major beneficial changes in impacts to Wilderness Visitor Use and Experience as air-tour sounds would be reduced by seasonal route use and quiet-technology implementation. Cumulative impacts on Visitor Use and Experience would be long-term moderate to major adverse.

Conclusion Central *Alternative F* *Visitor Use and Experience*
Under Alternative F, there would be negligible change in impacts to Wilderness Visitor Use and Experience compared to Alternative A near Central area Location Points. Cumulative impacts on Visitor Use and Experience would be long-term minor to moderate adverse.

Conclusion West End *Alternative F* *Visitor Use and Experience*
Ten-Year Forecast Alternative F, there would be negligible change in impacts to West End Wilderness Visitor Use and Experience from Alternative A. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion Air-tour Visitors **Alternative F** **Visitor Use and Experience**

Alternative F would provide air-tour opportunities similar to Alternative A for East End visitors. Blue Direct routes would differ from other Alternatives. A range of tours would be available year-round, and scenic views would be available for aerial viewing on a variety of routes.

NPS PREFERRED ALTERNATIVE **VISITOR USE AND EXPERIENCE**

Under the NPS Preferred Alternative, a range of air-tour aircraft Average Sound Level and Percent Time Audible would affect Visitor Use and Experience. Beneficial impacts would occur East End as quiet technology is introduced, along with Zuni Point and Dragon Corridors' seasonal changes in short-loop tour routes. This

Alternative would also establish longer curfews, with visitors in all Management Zones benefitting from the additional hour without air-tour noise.

As shown in Figures 4.30 to 4.33, air-tour sound impacts on visitors would vary. As with other Alternatives, Marble Canyon would remain relatively quiet, and areas of concentrated air-tour aircraft sound would be limited mainly to East and West Ends. Peak Season, when Zuni Point Corridor air-tour routes would be active, Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75%. Off-Peak Season, Percent Time Audible would be reduced 25 to 35%.

Marble Canyon NPS Preferred Alternative Visitor Use and Experience Ground-Based Visitors

All Scenarios

Based on modeled noise results, **Marble Canyon** Location Points would remain relatively quiet with air-tour aircraft Percent Time Audible generally less than 5% and Average Sound Level less than zero dBA. In Marble Canyon, there would be a slight improvement in Visitor Use and Experience compared to Alternative A, as Average Sound Level from air-tour aircraft would be low, and aircraft would be infrequently audible.

As shown in Tables 4.107 and 4.108, Average Sound Level would decrease from Alternative A, and air-tour aircraft would not be audible Base Year or Ten-Year Forecast Peak or Off-Peak Season at **Marble Canyon Dam Site** and **South Canyon** Location Points. Aircraft could be at 4,200 meters; a Distance slightly greater than in Alternative A. Impacts to Visitor Use and Experience at these locations would be negligible with a negligible to minor beneficial change in impacts from Alternative A.

Marble Canyon NPS Preferred Alternative Visitor Use and Experience Ground-Based Visitors Outside the Park within the SFRA

All Scenarios

As described for Alternative A and shown in Figures 4.30 to 4.33, backcountry visitors in **lands adjacent to Marble Canyon** would be little affected by air-tour overflight sounds. Base Year Peak Season, Average Sound Level would be zero dBA. Impacts would be negligible with negligible change in impacts from Alternative A on ground-based visitors outside the park.

TABLE 4.107 NPS PREFERRED ALTERNATIVE SOUND LEVELS MARBLE CANYON

Location Point Name	Alternative A				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
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	2	-1	1	-3	0	0	0	0	0	-3	0	-4
South Canyon	2	3	21	23	1	-1	1	-2	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 NPS PREFERRED ALTERNATIVE SLANT DISTANCES MARBLE CANYON

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Marble Canyon Dam Site	3,845	4,218	374
South Canyon	816	4,742	3,926

Δ indicates change in noise metric data from Alternative A

East End Ground-Based Visitors NPS Preferred Alternative Visitor Use and Experience

Under the NPS Preferred Alternative, long-term beneficial effects on East End Visitor Use and Experience would result from quiet-technology implementation, alternating seasonal use of Zuni Point and Dragon Corridors, and extended curfew hours.

East End NPS Preferred Alternative Visitor Use and Experience
Developed Zone South Rim
Base Year Peak Season

There would be no perceptible changes in air-tour sounds for South Rim East End visitors. As shown in Tables 4.109 and 4.110, at **Desert View** Location Point, Percent Time Audible would decrease from 76 to 74%, and Average Sound Level would remain unchanged at 29 dBA. At **Lipan Point** Location Point, Percent Time Audible would increase slightly from 74 to 78%, and Average Sound Level would rise from 34 to 35 dBA. At **Tusayan Museum** Location Point, Percent Time Audible would increase slightly from 64 to 67%, and Average Sound Level would rise from 35 to 36 dBA. At **El Tovar** Location Point, Percent Time Audible would fall from 95 to 93%, and Average Sound Level would increase from 19 to 20 dBA. Visitors would not likely notice these minimal changes. Aircraft would be visible at Distances in excess of 2,000 meters. Impacts would be moderate adverse with negligible change in impacts compared to Alternative A.

East End NPS Preferred Alternative Visitor Use and Experience
Developed Zone South Rim
Ten-Year Forecast Peak Season

Reductions in air-tour noise would occur along South Rim's East End. At **Desert View** Location Point, Percent Time Audible would decrease from 79 to 46%, and Average Sound Level would fall from 29 to 24 dBA. At **Lipan Point** Location Point, Percent Time Audible would decrease from 77 to 57%, and Average Sound Level would fall from 35 to 30 dBA. At **Tusayan Museum** Location Point, Percent Time Audible would decrease from 67 to 47%, and Average Sound Level would remain 36 dBA. Visitors would experience a modest increase in amount of day they could experience ambient conditions. Although moderate adverse impacts would occur, there would be long term minor to moderate beneficial change in impacts compared to Alternative A.

Conditions at **El Tovar** Location Point show a dramatic decline in Percent Time Audible from 96 to 16%, with a modest reduction in Average Sound Level from 20 to 14 dBA. Visitors would have increased opportunities to experience natural sounds, but, improvements may not be as dramatic as decrease in Percent Time Audible alone would imply. Negligible impacts would occur with long-term moderate beneficial change in impacts compared to Alternative A.

East End NPS Preferred Alternative Visitor Use and Experience
Developed Zone South Rim
Base Year Peak and Off-Peak Season

Visitors on South Rim's East End would experience varying changes in air-tour sounds compared to Alternative A. At **Desert View** Location Point, Percent Time Audible would increase from 76 to 84%, and Average Sound Level would remain unchanged at 29 dBA. At **Lipan Point** Location Point, Percent Time Audible would increase from 74 to 87%, and Average Sound Level would remain unchanged at 34 dBA. At **Tusayan Museum** Location Point, Percent Time Audible would increase from 64 to 79%, and Average Sound Level would fall from 35 to 34 dBA. Although there are increases in Percent Time Audible for these locations, decibel levels would remain very similar to Alternative A. Thus, although Percent Time Audible would increase, visitors may not notice the change. There would be moderate to major impacts with long-term negligible to minor adverse change in impacts compared to Alternative A.

East End NPS Preferred Alternative Visitor Use and Experience
Developed Zone South Rim
Ten-Year Forecast Off-Peak Season

Percent Time Audible at **El Tovar** Location Point would decline by 87% from 96 to 8%, and Average Sound Level would fall from 20 to 9 dBA. As described above, ambient conditions include natural and human-caused sounds at higher sound levels than air-tour aircraft. However, visitors could appreciate drastic reduction in

Percent Time Audible, although change in Average Sound Level would be modest. There would be negligible impacts with long-term moderate beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Developed Zone Phantom Ranch
Base Year Peak Season

At **Phantom Ranch** Location Point, air-tour aircraft Percent Time Audible would be further reduced from low levels occurring under Alternative A. Phantom Ranch is located near Bright Angel Creek and the Colorado River where background sound levels can be high. Visibility of air-tour aircraft would be quite low, with aircraft in excess of 11,000 meters All Scenarios. As shown in Tables 4.109 and 4.110 air-tour aircraft Percent Time Audible would be 2% with Average Sound Level 10 dBA, down from 3% and 12 dBA in Alternative A. There would be negligible impacts with negligible change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Developed Zone Phantom Ranch
Ten-Year Forecast Peak and Off-Peak Season

Aircraft Percent Time Audible, Average Sound Level, and Distance would be similar to Base Year Peak Season. There would be negligible impacts with negligible change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Developed Zone Phantom Ranch
Base Year Off-Peak Season

Modeling results show Percent Time Audible of one percent and Average Sound Level of 7 dBA, both slightly reduced from Alternative A. Phantom Ranch visitors would have largely uninterrupted opportunities to appreciate sounds and sights similar to Alternative A conditions. This would result in negligible impacts with negligible change in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Developed Zone North Rim
Base Year Peak Season

North Rim overlook areas (**Bright Angel Point, Point Imperial,** and **Cape Royal** Location Points) would have mixed exposures to air-tour aircraft sounds under the NPS Preferred Alternative. As shown in Tables 4.109 and 4.110, compared to Alternative A, Bright Angel Point Location Point would have increased Percent Time Audible at 58%, and slightly reduced Average Sound Level at 24 dBA. Aircraft would be at Distances in excess of 6,000 meters (unchanged from Alternative A). At Bright Angel Point Location Point**,** small increases in air-tour aircraft sounds may be perceptible to some visitors, resulting in moderate adverse impacts with long-term minor adverse change in impacts compared to Alternative A.

For visitors near **Point Imperial** Location Point, Percent Time Audible would decrease from Alternative A from 66 to 48%, with reduced Average Sound Level from 38 to 18 dBA. Although moderate adverse impacts would occur, this would result in minor to moderate beneficial change in impacts compared to Alternative A.

At **Cape Royal** Location Point, a variety of changes would take place under the NPS Preferred Alternative. In general, air-tour aircraft sounds would increase due to proximity of proposed fixed-wing and helicopter routes. Percent Time Audible would increase from Alternative A's 59% to 72%, with Average Sound Level rising modestly from 25 to 27 dBA. Aircraft would continue at Distances beyond 4,000 meters. The small loss of opportunities to experience combined natural and human-caused sounds would result in moderate to major adverse impacts with long-term minor adverse change in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Developed Zone *North Rim*
Ten-Year Forecast Peak Season

Sound conditions at **Bright Angel Point** Location Point would improve relative to Alternative A as a result of quiet-technology conversion. Percent Time Audible would be 18%, at Average Sound Level of 17 dBA, down from 48% Percent Time Audible and Average Sound Level of 24 dBA under Alternative A. This reduction would improve opportunities for visitors to appreciate natural sounds approximately one-third of the day.

Although minor adverse impacts would occur, this would result in long-term minor to moderate beneficial changes in impacts at this location compared to Alternative A.

Further reduction in air-tour sounds would occur near **Point Imperial** Location Point with Percent Time Audible falling from Alternative A's 68% to 11%, and Average Sound Level decreasing from 39 to 16 dBA. Although minor adverse impacts would occur, changes in impacts in this area would be long-term moderate beneficial compared to Alternative A.

At **Cape Royal** Location Point, air-tour sounds would decrease, with Percent Time Audible falling from Alternative A's 61% to 40%, and Average Sound Level reduced modestly from 26 to 23 dBA. Although moderate adverse impacts would occur, this would result in minor beneficial change in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Developed Zone *North Rim*
Base Year Off-Peak Season

Visitors near **Bright Angel Point** Location Point would experience an increase in Percent Time Audible from 47 to 59% from Alternative A to NPS Preferred, respectively. Average Sound Level would decrease slightly from 24 to 19 dBA. This loss of opportunities to appreciate ambient sound conditions would result in moderate adverse impacts with long-term minor adverse change in impacts compared to Alternative A.

For visitors near **Point Imperial** Location Point, Percent Time Audible would decrease from Alternative A's 66% to 33%, with reduced Average Sound Level from 38 to 14 dBA. Although moderate adverse impacts would occur, this would result in minor to moderate beneficial change in impacts compared to Alternative A.

Visitors near **Cape Royal** Location Point would experience increases in air-tour sounds. Aircraft Percent Time Audible would be 81%, up from 59%. Average Sound Level would also increase modestly from 25 to 29 dBA. Visitors near this location would experience air-tour sounds most of the day, although changes in sound level may not be noticeable due to ambient sounds. This would result in moderate to major adverse impacts with long-term moderate adverse changes in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Developed Zone *North Rim*
Ten-Year Forecast Off-Peak Season

Conditions at **Bright Angel Point** Location Point would improve relative to Alternative A. Percent Time Audible would decrease relative to Alternative A from 48 to 9%; Average Sound Level would fall from 24 to 15 dBA. This would provide modest improvement in visitor opportunities to appreciate ambient sound conditions. Aircraft would continue to be at Distances greater than 6,000 meters. Although minor adverse impacts would occur, long-term minor to moderate beneficial changes in impacts would occur compared to Alternative A.

Point Imperial Location Point Percent Time Audible would decrease by 62% to 6%, and Average Sound Level would fall from Alternative A's 39 to 14 dBA. Although negligible to minor adverse impacts would occur, changes in impacts to in this area would be long term moderate beneficial compared to Alternative A.

Conditions at **Cape Royal** Location Point would improve slightly. Percent Time Audible would decrease from 61% in Alternative A to 54%, and Average Sound Level would remain almost unchanged at 25 dBA. These small increments of change would not likely be noticed by visitors, resulting in moderate adverse impacts with negligible change in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Non-Wilderness Zone
Base Year Peak Season

Cedar Ridge Location Point would generally see mixed changes in air-tour sounds under the NPS Preferred Alternative. As shown in Tables 4.109 and 4.110, locations near Cedar Ridge Location Point would experience small increases in air-tour Percent Time Audible, up from 81 to 89% of the day, with Average Sound Level

remaining unchanged at 19 dBA. These moderate to major impacts represent a negligible change in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Non-Wilderness Zone
Ten-Year Forecast Peak Season

A dramatic decline in air-tour sounds near **Cedar Ridge** Location Point would occur with quiet-technology conversion. Percent Time Audible would decrease from 81 to 6% of the day, and Average Sound Level would fall from 19 to 14 dBA. Aircraft would be at Distances of nearly 10,000 meters. Although negligible to minor adverse impacts would occur, this would result in long-term major beneficial changes in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Non-Wilderness Zone
Base Year Off-Peak Season

Percent Time Audible at **Cedar Ridge** Location Point would decrease from 81% in Alternative A to 60%, and Average Sound Level would fall modestly from 19 to 16 dBA. Aircraft would be at Distances in excess of 12,000 meters. Air-tour sounds would remain audible over half the day, with sound levels remaining relatively unchanged. Although moderate adverse impacts would occur, this would result in minor to moderate beneficial changes in impacts compared to Alternative A.

East End Ground-Based Visitors *NPS Preferred Alternative* *Visitor Use and Experience*
Non-Wilderness Zone
Ten-Year Forecast Off-Peak Season

Conditions at **Cedar Ridge** Location Point would improve markedly with quiet-technology conversion. Percent Time Audible would decrease from 82% in Alternative A to 9%, and Average Sound Level would fall from 19 to 13 dBA. Although minor adverse impacts would occur, this would result in long-term major beneficial changes in impacts compared to Alternative A.

East End **NPS Preferred Alternative** **Visitor Use and Experience**
Wilderness Zone

As shown in Figures 4.30 to 4.33, East End Wilderness Zone could expect a wide range of exposure to air-tour noise. Percent Time Audible sound would range up to virtually 100% of the day. Air-tour aircraft sound levels would range up to 39 dBA.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Wilderness Zone
Base Year Peak Season

Locations along the river represented by **Nankoweap River** and **Little Colorado River** Location Points shown in Tables 4.109 and 4.110, would see decreases in aircraft sounds as air-tours move west of the Little Colorado Confluence. Near Nankoweap River Location Point, Percent Time Audible would decrease from 7% to zero, and Average Sound Level would fall from 34 to 15 dBA. At Little Colorado River Location Point, Percent Time Audible would decrease from 34 to 8%, and Average Sound Level would fall from 43 to 27 dBA. Aircraft would be over 2,600 meters Distant. Thus, opportunities to appreciate the area without air-tour aircraft sounds would increase compared to Alternative A. Although minor adverse impacts would occur, changes in impacts would be long-term minor to moderate beneficial compared to Alternative A.

Visitors near **Hermit Basin, Point Sublime,** and **Pasture Wash** Location Points would experience a variety of changes in air-tour sounds. Operations would use Dragon Corridor, and air-tour sounds would be similar to those described for Alternative A. At Hermit Basin Location Point, Percent Time Audible would be 96% compared to 99% under Alternative A. However, Average Sound Level would fall from 42 to 20 dBA. At Point Sublime Location Point, conditions would remain unchanged at 100% Percent Time Audible with Average Sound Level remaining at 35 dBA. At Pasture Wash Location Point, air-tour sounds would increase slightly from 98% to 99% Percent Time Audible with Average Sound Level rising from 20 to 27 dBA. Dominance of air-tour aircraft noise would continue, virtually eliminating opportunities to experience the area without air-tour aircraft sound, and

resulting in an experience inconsistent with expectations for Wilderness Zone visitors. Impacts would be major adverse, similar to Alternative A, resulting in negligible changes in impacts.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Wilderness Zone
Base Year Off-Peak Season

At **Nankoweap River** Location Point, Percent Time Audible would fall from 7% to zero, and Average Sound Level would decrease from 34 to 13 dBA compared to Alternative A. At **Little Colorado River** Location Point, Percent Time Audible would fall from 34% to 7 compared to Alternative A, a decrease of 27% compared to Alternative A. Average Sound Level would fall from 43 to 24 dBA. Aircraft would occasionally be at Distances in excess of 4,000 meters. Visitors would have opportunities to experience the area without air-tour aircraft sounds most of the day. Although negligible to minor adverse impacts would occur, changes in impacts would be long-term minor to moderate beneficial compared to Alternative A.

High levels of air-tour sounds at **Nankoweap Mesa** Location Point would be reduced somewhat under the NPS Preferred Alternative. Air-tour Percent Time Audible would be 78 to 79%, down from 87% under Alternative A. Average Sound Level would range 28 to 31 dBA, down from 43 dBA under Alternative A. Air-tour aircraft would be at Distances in excess of 6,000 meters. Reduction in air-tour sounds would provide additional opportunities to appreciate the area without air-tour aircraft sound along one of the park's most challenging and rugged visitor trails. Although moderate to major adverse impacts would occur, this would result in long-term minor beneficial change in impacts compared to Alternative A.

Near **Hermit Basin** Location Point, Percent Time Audible would decrease from 99% in Alternative A to 35%, a 64% reduction; Average Sound Level would fall from 42 to 13 dBA, a 29-dBA reduction compared to Alternative A. Near **Pasture Wash** Location Point, Percent Time Audible would decrease from 98% to 48, and Average Sound Level would fall from 20 to 18 dBA. These changes would reduce air-tour noise from daylong predominant sound to being audible less than half the day, a notable improvement resulting in conditions more consistent with Wilderness Zone expectations. Although moderate adverse impacts would occur, changes in impacts would be long term moderate to major beneficial compared to Alternative A.

At **Point Sublime** Location Point, a 27% reduction in Percent Time Audible would occur from 100% in Alternative A to 73% under the NPS Preferred, and a decrease in Average Sound Level from 35 to 24 dBA. Aircraft sounds would be reduced, and opportunities for visitors to experience the area without air-tour aircraft sound would increase, but air-tours would remain audible nearly three-quarters of the day. Although moderate to major adverse impacts would occur, changes in impacts would be long term moderate beneficial compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Wilderness Zone
Ten-Year Forecast Peak and Off-Peak Season

Impact levels resulting from Percent Time Audible, Average Sound Level, and Distance would be similar at **Nankoweap River** and **Little Colorado River** Location Points to Base Year Peak Off-Peak Season. Although negligible to minor adverse impacts would occur, changes in impacts would be long-term minor to moderate beneficial compared to Alternative A.

Further reductions in air-tour noise near **Nankoweap Mesa** Location Point would occur with Percent Time Audible reduced more than 30% compared to Alternative A. Average Sound Level fall from 43 dBA in Alternative A to 26 to 29 dBA. Thus, aircraft would be audible about half the day. Although moderate to major adverse impacts would occur, changes in impacts would be long term minor to moderate beneficial compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Wilderness Zone
Ten-Year Forecast Peak Season

Visitors in areas near **Hermit Basin, Point Sublime,** and **Pasture Wash** Location Points would experience a variety of changes in air-tour sounds. Operations would use Dragon Corridor, and air-tour sounds would be

similar to those for Alternative A. At **Hermit Basin** Location Point, aircraft Percent Time Audible would be 50%, compared to 100% under Alternative A, and Average Sound Level would fall from 42 to 16 dBA, a notable improvement resulting in conditions more consistent with Wilderness Zone visitor expectations. Although moderate adverse impacts would occur, changes in impacts would be long term moderate to major beneficial compared to Alternative A.

Near **Point Sublime** Location Point Percent Time Audible would fall from 100 to 94%, and Average Sound Level would decrease from 35 to 28 dBA. Air-tour aircraft noise dominance would continue, virtually eliminating opportunities to experience the area without air-tour aircraft sound, and resulting in an experience inconsistent with expectations for Wilderness Zone visitors. Although major adverse impacts would occur, changes in impacts would be long term negligible to minor beneficial compared to Alternative A.

Air-tour Percent Time Audible at **Pasture Wash** Location Point would decrease from 98 to 68% with Average Sound Level remaining at 21 dBA. Visitors would experience increased opportunities to experience the area without air-tour aircraft sound. Although moderate to major adverse impacts would occur, impacts would be long term moderate beneficial compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Wilderness Zone
Ten-Year Forecast Off-Peak Season

Near **Hermit Basin** Location Point, Percent Time Audible would decrease from 100% in Alternative A to 13%, with a corresponding reduction of Average Sound Level from 42 to 11 dBA. Visitors near **Pasture Wash** Location Point would experience similar improvements, with air-tour Percent Time Audible reduced from 98 to 15%, and a reduction in Average Sound Level from 21 to 15 dBA. At **Point Sublime** Location Point, Percent Time Audible would be reduced from 100 to 33% of the day, and Average Sound Level would fall from 35 to 18 dBA. There would be a marked increase in opportunities to experience the area without air-tour aircraft sound, more consistent with expectations for solitude and primitive recreation in Wilderness. Although minor to moderate adverse impacts would occur, changes in impacts would be long term major beneficial compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Wilderness Zone
Base Year and Ten-Year Forecast Peak Season

Visitors near **96-mile Camp** Location Point would experience a drop in air-tour Percent Time Audible from 72% in Alternative A to 59%, with Average Sound Level declining from 45 to 39 dBA. Ten-Year Forecast Peak Season, greater reductions would occur with Percent Time Audible falling from 74 to 41% and Average Sound Level decreasing from 45 to 37 dBA. Average Sound Level would remain relatively high, but decrease in Percent Time Audible would improve opportunities to experience the area without air-tour aircraft sound. Although major adverse impacts would occur, changes in impacts would be long term minor to moderate beneficial compared to Alternative A.

East End *NPS Preferred Alternative* *Visitor Use and Experience*
Wilderness Zone
Base Year and Ten-Year Forecast Off-Peak Season

Opportunities for visitors to experience the area without air-tour aircraft sound would increase noticeably at **96-mile Camp** Location Point. Compared to Alternative A, Percent Time Audible would decrease from 72 to 74%, to 7 to 10%. Average Sound Level would diminish from 45 dBA, to 29 to 30 dBA. This represents a marked improvement in conditions, and would lead to an experience more consistent with expectations for this Wilderness Zone location. Although minor adverse impacts would occur, there would be long-term major beneficial change in impacts compared to Alternative A.

East End NPS Preferred Alternative Visitor Use and Experience

Ground-Based Visitors Outside the Park within the SFRA

All Scenarios

Modest, localized reductions in air-tour aircraft sounds would result from elimination of some fixed-wing (Black) routes. As shown in Figures 4.30 to 4.33, air-tour aircraft Average Sound Level would range zero to 25 dBA in adjacent **Navajo lands** where limited visitor numbers would be pursuing backcountry activities in a remote area. If the Navajo Nation develops air-tour opportunities, taking advantage of entry and exit routes off Green-1 in this Alternative, interest in ground-based visitor activities on Navajo lands could increase. Air-tour sounds would mix with natural sounds, and could interfere with opportunities to experience the area without air-tour aircraft sound. There would be minor to moderate adverse impacts with negligible change in impact from air-tour sounds compared to Alternative A.

In **Kaibab National Forest** at the park's southeast corner, air-tour aircraft Average Sound Level would range 35 to 50 dBA. Many visitors are in developed areas using motorized transportation, and near Grand Canyon Airport. Thus, air-tour sounds and other human-generated sounds associated with development and visitor services would be audible portions of each day. There would be minor to moderate adverse impacts with negligible change in impacts from air-tour sounds compared to Alternative A.

TABLE 4.109 NPS PREFERRED ALTERNATIVE SOUND LEVELS EAST END

Location Point Name	Alternative A				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
South Rim																				
Desert View	76	79	29	30	74	-2	46	-33	29	0	24	-6	84	8	51	-27	29	-1	25	-5
Tusayan	64	67	35	36	67	3	47	-20	36	1	31	-5	79	15	54	-13	34	-1	31	-4
El Tovar	95	96	19	20	93	-2	16	-80	20	0	14	-6	44	-51	8	-87	13	-6	9	-10
Bright Angel Flight Free Zone																				
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	6	-6	1	-2	1	-3	7	-5	5	-7
Cedar Ridge	81	82	19	19	89	9	6	-76	19	1	14	-5	60	-21	9	-73	16	-2	13	-7
North Rim																				
Point Imperial	66	68	38	39	48	-17	11	-56	18	-20	16	-22	33	-33	6	-62	14	-24	14	-25
Bright Angel Point	47	48	24	24	58	12	18	-30	24	0	17	-7	59	12	9	-39	19	-4	15	-9
Cape Royal	59	61	25	26	72	13	40	-21	27	2	23	-3	81	22	54	-7	29	4	25	-1
Zuni Point Corridor																				
Lipan Point	74	77	34	35	78	5	57	-20	35	0	30	-5	87	14	65	-12	34	0	32	-3
Little Colorado River/Nankoweap Area																				
Nankoweap Mesa	87	90	43	43	78	-9	57	-33	31	-12	29	-14	79	-8	54	-36	28	-15	26	-17
Nankoweap at River	7	8	34	35	0	-7	0	-8	15	-19	13	-22	0	-7	0	-8	13	-22	13	-22
Little Colorado River	34	37	43	43	8	-26	5	-33	27	-16	27	-16	7	-27	3	-34	24	-19	25	-18
Dragon Corridor																				
Hermit Basin	99	100	42	42	96	-4	50	-50	20	-22	16	-26	35	-64	13	-86	13	-29	11	-31
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	10	-61	7	-68	30	-15	29	-16
Toroweap /Shinumo Flight Free Zone																				
Point Sublime	100	100	35	35	100	0	94	-6	35	0	28	-7	73	-27	33	-67	24	-12	18	-17
Pasture Wash	98	98	20	21	99	1	68	-31	27	6	21	0	48	-50	15	-83	18	-3	15	-6

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.110 NPS PREFERRED ALTERNATIVE SLANT DISTANCES EAST END

Location Point Name	Alternative A	NPS 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	5,705	4,256
Little Colorado River	1,629	2,689	1,059
Dragon Corridor			
Hermit Basin	1,518	6,447	4,929
96 Mile Camp	1,573	3,168	1,594
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.

Central Ground-Based Visitors 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 relatively quiet with aircraft Average Sound Level generally less than 10 dBA and Percent Time Audible less than 5%.

Central 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 ***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 12 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 sound. Thus, impacts would be negligible with negligible change in impacts compared to Alternative A.

Central NPS Preferred Alternative Visitor Use and Experience

Ground-Based Visitors Outside the Park within the SFRA

All Scenarios

Because air-tour routes are south of the Central area, visitors in to **Kaibab National Forest, BLM lands,** and **other adjacent lands north of the park** would experience few air-tour aircraft sounds. As shown in Figures 4.30 to 4.33, air-tour sounds would range zero to 10 dBA. There would be negligible impacts with negligible changes in impacts on visitors north of the park compared to Alternative A.

South of the park, shown in Figures 4.30 to 4.33, on **Havasupai** and **Hualapai Indian Reservation lands**, air-tour aircraft Average Sound Level would range widely, from zero to 50 dBA. Aircraft sounds would mostly be in the zero to 25 dBA range except beneath Blue Direct North. Thus, near the Central area's southern edge, natural sounds would occasionally be dominated by aircraft sounds, and opportunity to experience the area without air-tour aircraft sound would be interrupted. This would result in minor to moderate adverse impacts and negligible change in impacts compared to Alternative A.

TABLE 4.111 NPS PREFERRED ALTERNATIVE SOUND LEVELS CENTRAL

Location Point Name	Alternative A				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
Upper Deer Creek	1	0	1	14	1	0	1	1	2	1	1	-13	1	0	1	1	0	-1	0	-13
Toroweap Overlook	0	1	13	1	0	0	0	-1	13	0	14	12	0	0	0	-1	12	-1	13	12

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.112 NPS PREFERRED ALTERNATIVE SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	NPS 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

West End Ground-Based Visitors NPS Preferred Alternative Visitor Use and Experience

As shown in Figures 4.30 to 4.33, modeled noise results indicate impacts associated with West End air-tour routes would be generally be similar to Alternative A. In **West End's northwestern portion** (near Blue-2/Green-4), impacts would be major adverse with Average Sound Level 40 to 50 dBA and aircraft Percent Time Audible greater than 65%. Quiet-technology incentives and conversion requirements would provide some mitigation of these long-term adverse impacts. Near **Sanup Flight-free Zone** Average Sound Level would be 10 to 20 dBA with aircraft Percent Time Audible less than 20%.

West End Ground-Based Visitors NPS Preferred Alternative Visitor Use and Experience
Base Year Peak Season

Whitmore Rapids Location Point Percent Time Audible would remain unchanged at 12%, Average Sound Level would remain unchanged at 21 dBA, and aircraft Distance would be at approximately 1,800 meters. At **Parashant Wash** Location Point, Percent Time Audible would decrease from 12 to 11%, Average Sound Level would fall from 33 to 32 dBA, and aircraft Distance would be over 2,800 meters. At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, Average Sound Level would remain unchanged at 7 dBA, and aircraft Distance would be over 17,000 meters. At **Bat Cave** Location Point Percent Time Audible would remain at 93%, Average Sound Level would rise from 47 to 49 dBA, and aircraft Distance at 827 meters would be 300 meters closer than under Alternative A. These represent limited changes in opportunities to experience the area without air-tour aircraft sound. Negligible to minor adverse impacts would occur, except at Bat Cave where impacts would be major adverse. These represent negligible changes in impacts compared to Alternative A.

West End Ground-Based Visitors NPS Preferred Alternative Visitor Use and Experience
Ten-Year Forecast Peak Season

At **Whitmore Rapids** Location Point, Percent Time Audible would decrease by one percent, and Average Sound Level would remain at 21 dBA. At **Parashant Wash** Location Point, Percent Time Audible would remain at 14%, and Average Sound Level would fall from 33 to 32 dBA. At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average Sound Level would remain at 7 dBA. Changes would be greatest at **Bat Cave** Location Point where Percent Time Audible would fall from 95 to 88%, and Average Sound Level would increase from 47 to 48 dBA. These represent limited changes in opportunities to experience the area without air-tour aircraft sound. Negligible to minor adverse impacts would occur, except at Bat Cave where impacts would be major adverse, with negligible changes in impacts compared to Alternative A.

West End Ground-Based Visitors NPS Preferred Alternative Visitor Use and Experience
Base Year Off-Peak Season

At **Whitmore Rapids** Location Point, Percent Time Audible would decrease from 12 to 9%, and Average Sound Level would fall from 21 to 20 dBA. At **Parashant Wash** Location Point, Percent Time Audible would remain at 12%, and Average Sound Level would increase from 33 to 34 dBA. At **Separation Canyon** Location Point, Percent Time Audible would remain unchanged at zero, and Average Sound Level would remain 7 dBA. At **Bat Cave** Location Point, Percent Time Audible would fall from 93 to 92%, and Average Sound Level would rise from 47 to 49 dBA. These represent limited changes in opportunities to experience the area without air-tour aircraft sound. Negligible to minor adverse impacts would occur, except at Bat Cave where impacts would be major adverse, with negligible changes in impacts compared to Alternative A.

West End Ground-Based Visitors NPS Preferred Alternative Visitor Use and Experience
Ten-Year Forecast Off-Peak Season

At **Whitmore Rapids** Location Point, Percent Time Audible would decrease 10% from Alternative A, and Average Sound Level would decrease from 21 to 18 dBA. At **Parashant Wash** Location Point, Percent Time Audible would decrease from 14 to 13%, and Average Sound Level would fall from 33 to 31 dBA. **Separation Canyon** Location Point would see no change with Percent Time Audible remaining at zero and Average Sound Level at 7 dBA. At **Bat Cave** Location Point, Percent Time Audible would fall from 95 to 86%, and Average Sound Level would increase from 47 to 48 dBA. These are limited changes in opportunities to experience the area without air-tour aircraft sound. Negligible to minor adverse impacts would occur, except at Bat Cave where impacts would be major adverse, with negligible to minor beneficial change in impacts compared to Alternative A.

West End NPS Preferred Alternative Visitor Use and Experience

Ground-Based Visitors Outside the Park within the SFRA

All Scenarios

As described for Alternative A, and shown in Figures 4.30 to 4.33, **along the park's northern boundary** in the SFRA, sounds from Blue Direct North would be heard at Average Sound Level of 25 to 50 dBA in noise-sensitive portions of **Grand Canyon-Parashant National Monument's** proposed Wilderness areas. Aircraft would be audible portions of the day. Minor to moderate adverse impacts would occur with negligible change in impact compared to Alternative A.

On the **Hualapai Indian Reservation**, near Sanup Flight-Free Zone, air-tour sounds would be generally absent with Average Sound Level zero to 15 dBA due to elimination of Blue Direct South. Air-tour sounds would be audible a small portion of the day. Negligible impacts would occur with negligible to minor beneficial change in impact compared to Alternative A.

At the SFRA's far West End, the **Hualapai Indian Reservation** and small portions of **Lake Mead National Recreation Area** would receive air-tour aircraft Average Sound Level from 20 to over 50 dBA. Thus, air-tour sounds would be audible for some or much of the day, and opportunities to experience the area without aircraft sound would be reduced. Minor to moderate adverse impacts would occur with negligible change in impact compared to Alternative A.

TABLE 4.113 NPS PREFERRED ALTERNATIVE SOUND LEVELS WEST END

Location Point Name	Alternative A				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
Whitmore Rapids	12	13	21	21	12	-1	12	-2	21	0	21	-1	9	-3	10	-3	20	-1	18	-3
Parashant Wash	12	14	33	33	11	-1	14	0	32	0	32	-1	12	0	13	-1	34	1	31	-2
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	49	2	48	1	92	-1	86	-9	49	2	48	1

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.114 NPS PREFERRED ALTERNATIVE SLANT DISTANCES WEST END

Location Point Name	Alternative A	NPS 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	17,617	1,240
Bat Cave	1,134	827	-307

Δ indicates change in noise metric data from Alternative A

Air-tour Visitors NPS Preferred Alternative Visitor Use and Experience

The NPS Preferred Alternative would provide air-tour visitors a wide variety of highly desirable opportunities to view park resources. This Alternative retains spectacular routes, much as in Alternative A. The Marble Canyon route would be moved away from the canyon rim to protect park and tribal resources while still providing excellent canyon and river views. The route would cross the river once. East End, long- and short-tour loops would be available. Views of the Little Colorado River confluence would still be available. Point Sublime would be visible from Dragon Corridor. While Blue Direct south would be eliminated, Blue Direct North would remain as a two-way route in exactly the same location as in Alternative A providing opportunities to view the canyon and river. West End, Green and Blue routes are similar to those currently used, but some adjustments move traffic away from the river and over the canyon landscape.

Cumulative Impacts NPS Preferred Alternative Visitor Use and Experience
Ground-Based Visitors

In all areas, noise from aircraft flying above and outside the SFRA would continue to have long-term moderate to major adverse effect on Visitor Use and Experience as described in the NPS Preferred Alternative. Noise from other sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under Alternatives.

Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under the NPS Proposed Alternative as discussed above, would have long-term moderate to major adverse cumulative impacts on Visitor Use and Experience throughout all four park and SFRA areas (Marble Canyon, East End, Central, and West End), due primarily to combined Percent Time Audible from all sources of greater than 50% of the day over large areas.

Cumulative Impacts Marble Canyon NPS Preferred Alternative Visitor Use and Experience

The NPS Preferred Alternative would generally have negligible change in impacts compared with Alternative A. When impacts of the NPS Preferred Alternative are combined with adverse impacts of aircraft noise outside and above the SFRA, cumulative effect would be long-term moderate adverse.

Cumulative Impacts East End NPS Preferred Alternative Visitor Use and Experience
Under the NPS Preferred Alternative Peak and Off-Peak Season, adverse impacts from air-tour aircraft on Visitor Use and Experience would continue; however, there would be long-term negligible to major beneficial changes compared with Alternative A. When impacts of the NPS Preferred Alternative are combined with adverse impacts of aircraft noise outside and above the SFRA, cumulative effect would continue long-term moderate to major adverse.

Cumulative Impacts Central NPS Preferred Alternative Visitor Use and Experience
The NPS Preferred Alternative would result in minor to moderate adverse changes in impacts to Visitor Use and Experience in most of Central Area and adjacent to the park compared to Alternative A. When impacts of the NPS Preferred Alternative are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would be long-term minor to moderate adverse.

Cumulative Impacts West End NPS Preferred Alternative Visitor Use and Experience

The NPS Preferred Alternative would result in negligible to moderate adverse changes in impacts in most of West End compared to Alternative A. When impacts of the NPS Preferred Alternative are combined with adverse impacts of other aircraft noise outside and above the SFRA, cumulative effect would be long-term minor to major adverse.

Conclusion Ground-Based Visitors NPS Preferred Alternative Visitor Use and Experience

Conclusion Marble Canyon NPS Preferred Alternative Visitor Use and Experience
Ten-Year Forecast, the NPS Preferred Alternative would result in negligible impacts with negligible change in impacts from Alternative A on Visitor Use and Experience in Marble Canyon. Cumulative impacts on Visitor Use and Experience would be long-term moderate adverse.

Conclusion East End Developed Zone NPS Preferred Alternative Visitor Use and Experience
Ten-Year Forecast the NPS Preferred Alternative would result in negligible to moderate adverse impacts with long-term negligible to moderate beneficial changes in impacts compared to Alternative A for Developed Zone areas as air-tour sounds would be reduced by seasonal route use and quiet-technology conversion. Cumulative impacts on Visitor Use and Experience would be long-term moderate to major adverse.

Conclusion East End Non-Wilderness Zone NPS Preferred Alternative Visitor Use and Experience
Ten-Year Forecast the NPS Preferred Alternative would result in negligible to minor adverse impacts with long-term major beneficial change in impacts compared to Alternative A to Non-Wilderness Zone Visitor Use and Experience as air-tour sounds are reduced by seasonal route use and quiet-technology conversion. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion East End Wilderness Zone NPS Preferred Alternative Visitor Use and Experience
Ten-Year Forecast the NPS Preferred Alternative would result in negligible to major adverse impacts with long-term negligible to major beneficial change in impacts compared to Alternative A as air-tour sounds would be reduced by seasonal route use and quiet-technology conversion. Cumulative impacts on Visitor Use and Experience would be long term moderate to major adverse.

Conclusion Central NPS Preferred Alternative Visitor Use and Experience
Under the NPS Preferred Alternative adverse impacts to Wilderness Visitor Use and Experience would negligibly change from Alternative A near Central area Location Points. Cumulative impacts on Visitor Use and Experience would be long term minor to moderate adverse.

Conclusion West End NPS Preferred Alternative Visitor Use and Experience
Under the NPS Preferred Alternative negligible to minor (except at Bat Cave where impacts would be major) adverse impacts to West End Visitor Use and Experience would represent negligible to minor beneficial change in impacts from Alternative A. Cumulative impacts on Visitor Use and Experience would be long term minor to major adverse.

Conclusion Air-tour Visitors NPS Preferred Alternative Visitor Use and Experience

The NPS Preferred Alternative would offer a range of options for air-tour visitors, but would change aerial viewing options for Marble Canyon, Little Colorado River, and Nankoweap Basin compared to Alternative A. Blue Direct North experience would be the same as currently available, and West End tour options would be similar to Alternative A. This Alternative would retain a wide variety of highly desirable air-tour opportunities roughly similar to Alternatives A and F, and a much great variety than Alternative E.

WILDLIFE

General Methodology

As described in Chapter 3, area of analysis for wildlife includes the park, as well as the SFRA and throughout the Study Area. To the extent habitat and species occurrences correlate, impacts to Wildlife are expected to be similar in the entire Study Area. Effects of aircraft noise and proximity to Wildlife and their habitat are analyzed in the context of natural variability and ecosystem integrity, as well as effects on individuals and populations. Responses to impacts may be species-specific. A list of species that occur in specific habitats is provided in Chapter 3, Wildlife.

The analysis relies on Contour Analysis and a representative Location Point analysis for Percent Time Audible and Average Sound Level in the park and SFRA. Location Point noise data is usually presented as a range to provide an understanding of level of effect for specific areas influenced by air-tour operations. In addition, spatial analysis using noise contour data (Chapter 4, Methodology) was conducted to determine amount of wildlife habitat, represented in acres within a range of metric values (Average Sound Level and Percent Time Audible). Appendix F provides spatial analysis results for Wildlife. Results for Percent Time Audible are provided only for areas in the park as limited ambient data was available outside the park, so audibility could not be calculated there. Therefore, when discussing areas in the SFRA but outside the park boundary, only Average Sound Level is evaluated to determine level of effect. Average Sound Level analysis includes evaluation of data within the park and SFRA. Results are presented for each geographic area (Marble Canyon, East End, Central, and West End).

General Assumptions **Wildlife**

In the thresholds below, all aspects of aircraft noise intensity and duration including, but not limited to, audibility, aircraft Average Sound Level and timing are considered. Audibility is the ability of animals and humans with normal hearing to hear a given sound, and is affected by the animal's hearing ability, other simultaneous interfering sounds or stimuli, and by sound frequency content and amplitude and whether the sound contains information the animal has learned to pay attention to or ignore.

As calculated for this EIS, Percent Time Audible relates to human hearing (audibility), which is used here as a surrogate for sounds heard by wildlife, understanding different animals hear sounds at different sound frequencies and levels, and some hear sounds at frequencies humans cannot. Use of human audibility as a surrogate for impacts related to wildlife audibility is reasonable for this impact analysis because the type of noise generated by aircraft mostly falls within the human hearing range, and wildlife of interest in this analysis can also hear quite well in the human hearing range even though some can also hear in ranges humans cannot.

A measure of Distance between representative Location Points and aircraft routes is used as an indicator related to effects of aircraft being in close proximity to wildlife or habitats, including aircraft visibility and presence to wildlife on the ground. While there is usually a close correlation between Distance and sound intensity, this Distance measure is included primarily to address effects other than aircraft sound.

Although wildlife would tend to habituate[39] to frequent audible aircraft with lower Average Sound Level, habituation in natural areas in a national park is an adverse impact (Barber, Turina, and Fristrup 2009/2010).

Impact Intensity Threshold Descriptions **Wildlife**

Professional judgment and knowledge of Grand Canyon wildlife and habitat was applied in using intensity thresholds described below to make impact determinations for Wildlife where data related to specific situations fell into more than one intensity threshold (negligible, minor, moderate, major). For example, where Percent Time Audible is at levels considered major in the thresholds (greater than 25% Percent Time Audible), but Average Sound Level and Distance are at levels considered negligible (less than or equal to 15 dBA and greater than or equal to 2,000 meters), then impact level would generally be considered moderate adverse, when reasonably consistent with other portions of thresholds for moderate levels (observable and measurable impacts, no risk of extirpation, changes outside natural variability, etc.), absent any over-riding information more relevant to impact determination indicating a different level.

Similarly, where Percent Time Audible is at levels considered moderate in the thresholds (greater than 10% and less than or equal to 25% Percent Time Audible), but Average Sound Level and Distance are at levels considered negligible (less than or equal to 15 dBA and greater than or equal to 2,000 meters), then impact level would generally be considered minor adverse, when reasonably consistent with other portions of thresholds for minor levels (observable or measurable impacts, changes not outside natural variability and no effects at the population level, etc.), absent any over-riding information more relevant to impact determination indicating a different level.

[39] Habituate: become accustomed to, or tolerant of, in this case, noise

Threshold Levels	**Wildlife**
Negligible	Impacts due to the event have no observable effects to wildlife or its habitat
	Impacts outside critical periods such as breeding season
	Distance from points of interest to aircraft routes greater than or equal to 2,000 meters
	Aircraft noise rarely audible (aircraft Percent Time Audible less than or equal to 5% of the 12-hour day in this analysis)
	Aircraft noise intensity in a specific area is less than or equal to 15 dBA
Minor	Impacts due to the event observable or measurable to individuals of a wildlife or localized habitats
	Severity and timing of changes to parameter measurements not outside natural variability and have no effects on species at the population level, including distributions, behaviors, habitat or ecosystem processes
	Impacts outside critical periods such as breeding season
	Distance from points of interest to aircraft routes greater than or equal to 1,000 meters and less than 2,000 meters
	Aircraft noise audible for a small portion of applicable time periods (aircraft Percent Time Audible greater than 5% and less than or equal to 10% of the 12-hour day)
	Aircraft noise intensity in a specific area greater than 15 dBA and less than or equal to 25 dBA
Moderate	
	Impacts due to the event observable and measurable to individuals or a population of wildlife or its habitat No species at risk of being extirpated
	Severity and timing of changes to parameter measurements sometimes fall outside natural variability, and changes within natural variability might be long term
	Measurable changes occur from natural variability (which could be from displacement) on species' populations including numbers, structure, distributions, behaviors, genetic variability, or other demographic factors
	Some impacts affect critical periods, key habitat, ecosystem processes, or activities necessary for survival, but effects are temporary and populations expected to return to pre-disturbance conditions, and to remain indefinitely stable and viable
	Distance from points of interest to aircraft routes greater than or equal to 500 meters and less than 1,000 meters
	Aircraft noise audible for an intermediate portion of applicable time periods (aircraft Percent Time Audible greater than 10% and less than or equal to 25% of the 12-hour day)
	Aircraft noise intensity in a specific area greater than 25 dBA and less than or equal to 35 dBA
Major	
	Impacts due to the event are readily measurable to a population of wildlife or its habitat

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

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

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

Substantial impacts could occur during critical time periods

Distance from points of interest to aircraft routes less than 500 meters

Aircraft noise is audible for a large portion of applicable time periods (aircraft Percent Time Audible greater than 25% of the 12-hour day)

Aircraft noise intensity in a specific area greater than 35 dBA

Type of Impact	**Wildlife**
Adverse	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
Beneficial	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
Context	**Wildlife**
Regional	Impacts affect a large part of the population or a widespread area of suitable habitat or species' range within the park or SFRA
Localized	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
Park Management Zone	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
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 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)

ALTERNATIVE A NO ACTION WILDLIFE

Under Alternative A, a range of aircraft noise intensities and audibility would affect wildlife and habitat. Although there would be an increase Base Year to Ten-Year Forecast in aircraft operations and Average Sound Level, the increases would generally not change impact intensity levels (i.e., a moderate adverse impact would generally remain moderate adverse).

Wildlife would experience noise from air-tour aircraft that would disturb individuals, affect behaviors, population numbers, and species distributions in nearly half the Study Area Base Year and Ten-Year Forecast. Forty-five percent of the park would have air-tour aircraft Percent Time Audible 25% or more of the day predominantly in East and West Ends under and near air-tour routes. Average air-tour Average Sound Level would generally be low, less than 25 dBA, in about 67% of the SFRA Base Year. Aircraft noise would increase slightly with increased operations Ten-Year Forecast. Greatest exposure to noise and visual impacts would occur near heavily-used air-tour routes where aircraft Average Sound Level would be 40 to 50 dBA and Percent Time Audible greater than 75%. However, there would also be large habitat areas in Marble Canyon and the Central area relatively undisturbed by air-tours.

Marble Canyon Alternative A Wildlife

The predominant plateau habitat in the Marble Canyon area is old-desert scrub. This habitat is used by species such as mule deer, bighorn, bald eagle (winter), and peregrine falcon. Based on contour data, in 87% of old-desert scrub habitat, aircraft Percent Time Audible would be 5% or less. In 2% of the habitat, aircraft Percent Time Audible would be greater than 25%. In the entire habitat, Average Sound Level would be 25 dBA or less. The other predominant Marble Canyon habitat is river/riparian used by song birds, sparrows, warblers, ducks, skunks, foxes, and a variety of reptiles and amphibians. In the canyon along the river where background sounds from rapids can be loud, 94% of Marble Canyon habitat would experience air-tour Percent Time Audible 5% or less of the day, and Average Sound Level in 77% of river/ riparian habitat would be 15 dBA or less. These conditions are reflected in Location Point data.

Marble Canyon Alternative A Wildlife

Base Year and Ten-Year Forecast

Location Point data, as shown in Tables 4.115 and 4.116, indicates Marble Canyon would be quiet with air-tour aircraft Percent Time Audible zero to 3% of the day. Average Sound Level would be zero to 25 dBA with higher levels in Marble Canyon's southern portion. Aircraft would generally be more than 2,000 meters away from points on the ground. In few locations (**North and South Canyon** Location Points), aircraft would be 800 to 1,000 meters from points on the ground. In most Marble Canyon areas, Wildlife and habitat would be exposed to very infrequent noise at very low sound levels which would have little to no effect on species activities, behaviors, or populations. Impacts to Wildlife and habitat would be short-term negligible to minor adverse.

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

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

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 along the canyon rim, there would be potential to disrupt normal wildlife behavior patterns such as breeding, feeding, or sheltering that may result in reduced species populations. For example, falcons are known to occur in reduced densities beneath current air-tour routes which may indicate nearly continuous noise at high levels is restricting wildlife use of suitable habitat (NPS 2010c). Impacts to wildlife would be short and long term moderate to major adverse under East End tour routes.

East End Alternative A Wildlife

Base Year and Ten-Year Forecast

Close to the river, such as **Nankoweap River** Location Point, air-tour aircraft Average Sound Level would be 34 to 35 dBA, but could sometimes be masked by loud river background sound, and Percent Time Audible would be 7 to 8% of the day. Aircraft visibility would be low with aircraft generally more than 1,400 meters away from points on the ground. Individuals may be disturbed temporarily and infrequently, and would be expected to resume normal activities after an aircraft event. Impacts from aircraft on Wildlife and habitat would be generally be short term minor adverse near the river.

Beneath Bright Angel Flight-free Zone, air-tour aircraft noise would vary widely. Wildlife and habitat near air-tour corridors would experience almost continuous noise and moderate to major adverse impacts. **Grid Location Points 12 and 13** and **Phantom Ranch** Location Points amid Bright Angel Flight-free Zone would have Percent Time Audible less than 5% with aircraft Average Sound Level of 12 to 14 dBA. Aircraft would be at distances greater than 7,000 meters. Impacts to wildlife habitats amid Bright Angel Flight-free Zone would be negligible.

Similar impacts would occur in Toroweap/Shinumo Flight-free Zone's eastern portion represented by Location Points **Point Sublime** and **Grid Location Point 10**. Near Dragon Corridor, wildlife and habitat would experience aircraft Average Sound Level 25 to 35 dBA with Percent Time Audible nearly 92 to 100% of the day, and moderate to major adverse impacts would generally occur. Areas further west of Dragon Corridor and north of Brown-6, represented by **Bass Camp** and **Rainbow Plateau** Location Points, air-tour aircraft Average Sound Level decreases to approximately 6 to 7 dBA, and Percent Time Audible would be less than one percent; impacts to Wildlife and habitat would be negligible.

Based on contour data maps (Appendix D), in areas outside the park boundary along the SFRA's eastern boundary, east of Desert View Flight-free Zone, and areas south of Toroweap/Shinumo Flight-free Zone, aircraft Percent Time Audible would generally be , greater than 65% of the day with Average Sound Level 35 dBA or less. Impacts to wildlife in these areas would be long-term minor to moderate adverse.

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	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

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

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.

Base Year and Ten-Year Forecast Alternative A Wildlife

Central

In the Central area, Wildlife and habitat would be little affected by aircraft overflight noise. This area comprises Toroweap/Shinumo Flight-free Zone's middle and western portions, as well as Fossil Canyon and Tuckup General Aviation Corridors. In this remote area, Percent Time Audible would range zero to 25%, with Average Sound Level up to 27 dBA (Table 4.119). **South of the park boundary within the SFRA**, Wildlife and habitat would be most affected in areas beneath Blue Direct routes and Brown-1, Brown-4, and Brown-6. Areas near Brown-1 and Brown-6 would experience air-tour aircraft Average Sound Level 7 dBA to 27 dBA as represented by **South Supai Canyon** and **Havatagvitch Canyon** Location Points, and air-tour aircraft would be 1,480 to 3,668 meters from the ground as shown in Table 4.120. Near Brown-1, toward the west, aircraft Percent Time Audible would be 22 to 25% of the day at Average Sound Level 22 dBA based on **Prospect Canyon** Location Point. In this location, air-tour aircraft would be over 3,800 meters from the ground.

In the majority of the Central area, there would be limited presence of air-tour noise and low Average Sound Level, with air-tour aircraft far from locations on the ground. In these areas, there would be little potential for Wildlife and habitat disturbance. Some individuals may be disturbed for short-periods but would be expected to return to normal behaviors after air-tour activity with no population level changes. In areas close to air-tour routes, effect on wildlife of air-tour operations may increase with potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering. Impacts to Wildlife and habitat would generally be short term negligible to minor adverse, with impacts up to moderate adverse close to air-tour routes.

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	25	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

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

West End Alternative A Wildlife

Under Alternative A, a range of aircraft noise intensities and audibility would affect Wildlife and habitats due to heavy helicopter traffic for river access, West End air tours, and direct-flight routes between Las Vegas and Grand Canyon Airport. A large West End wildlife habitat area would be relatively quiet under Sanup Flight-free Zone.

West End is a mixture of warm- and cold-desert shrub, piñon-juniper, and riparian habitat along the river. West End Wildlife and habitat would be exposed to varying levels of aircraft noise depending on route proximity. As shown in Appendix F, aircraft Percent Time Audible would be greater than 25% of the day in 36% of piñon-juniper habitat; 44% of warm-desert; and 28% of river/riparian habitat river due to masking of sounds by the river. However in areas away from routes, a large amount of habitat would experience very infrequent aircraft noise. Aircraft Percent Time Audible would be 5% of the day or less in 36% of West End piñon-juniper habitat, in 45% of West End warm-desert scrub habitat; and 59% of West End river/riparian habitat. Average Sound Level would remain low (25 dBA or less) in 83% of West End piñon-juniper, 69% of warm desert, and 68% of river/riparian habitats.

West End Alternative A Wildlife

Base Year and Ten-Year Forecast

As shown in Tables 4.121 and 4.122, Location Points **Burnt Springs Canyon, Bat Cave,** and **Grid Location Point 33** near Green-4, Blue-2, and Blue Direct routes would have aircraft Percent Time Audible 70 to 95% of the day with Average Sound Level 42 to 48 dBA. Aircraft would be 1,100 to 1,220 meters from points on the ground. There would be potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering. Wildlife may avoid these areas for suitable adjacent habitats. Higher aircraft Average Sound Level may result in localized changes in population numbers and structure. In areas under West End tour routes, impacts to Wildlife and habitat would be short and long term moderate to major adverse.

Areas near Brown routes, represented by **Whitmore Rapids** and **Parashant Wash** Location Points, would have aircraft Percent Time Audible 12 to 14% and Average Sound Level 20 to 33 dBA. At higher elevations in shrub and ponderosa pine habitat such as **Andrus Canyon** Location Point, air-tour aircraft Percent Time Audible would be 22 to 24% of the day. Aircraft would be 1,400 to 1,800 meters from points on the ground. Wildlife and habitat may be disturbed infrequently during the day by air-tour aircraft sounds slightly above background conditions; however, normal activities would be expected to recover after disturbance with no population level impacts. Wildlife under Brown routes would experience long-term minor to moderate adverse impacts.

Areas near Blue Direct routes, including **Grid Location Points 27 and 32, Mt. Dellenbaugh,** and **Shivwits Fire Camp** Location Points would experience air-tour Average Sound Level 26 to 41 dBA with Percent Time Audible 20 to 44% of the day. Habitat is a mixture of old-desert scrub and old piñon-juniper. At higher elevation plateau locations, air-tour aircraft would be 800 to 3,300 meters from the ground. Impacts to Wildlife and habitat would be long term moderate to major adverse under Blue Direct routes.

Wildlife and habitat found below Sanup Flight-free Zone and south toward the SFRA boundary would be minimally affected by air-tour operations. Aircraft Percent Time Audible would be less than 5% of the day at Average Sound Level 8 dBA and less as represented by **Pumpkin Springs** and **Diamond Creek** Location Points. Impacts to Wildlife and habitat would be negligible at these locations.

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

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

Cumulative Impacts Alternative A Wildlife

In addition to air-tour aircraft sounds, impacts on Wildlife and habitat also result from sounds of high-altitude aircraft above 18,000 feet and aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. High-altitude aircraft audibility varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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 wildlife through habitat improvement.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative A contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on Wildlife and habitat. Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative A as discussed above, would generally have long-term moderate adverse cumulative impacts on Wildlife throughout all four areas (Marble Canyon, East End, Central, and West End).

Cumulative Impacts Alternative A Wildlife
Marble Canyon
At Marble Canyon Location Points where aircraft operate at higher altitudes, noise from aircraft outside the SFRA combined with aircraft above 18,000 feet is audible 16 to 36% of the day. When Alternative A's impacts are combined with impacts of other aircraft noise above and outside the SFRA, with localized impacts of non-aircraft noise sources, and with beneficial impacts of fire management activities, cumulative impact would generally be long term moderate adverse Base Year and Ten-Year Forecast.

Cumulative Impacts Alternative A Wildlife
East End
East End, aircraft above and outside the SFRA are audible 27 to 71% of the day. When impacts of Alternative A are combined with impacts of other aircraft noise above and outside the SFRA, with localized impacts of non-aircraft noise sources, and with beneficial impacts of fire management activities, cumulative impact would generally be long term moderate adverse, but up to major adverse impacts under air-tour routes Base Year and Ten-Year Forecast.

Cumulative Impacts Alternative A Wildlife
Central
In the Central area, noise from aircraft above and outside the SFRA is audible 16 to 65% of the day. When impacts of Alternative A are combined with impacts of other aircraft noise above and outside the SFRA, with localized impacts of non-aircraft noise sources, and with beneficial impacts of fire management activities, cumulative impact would generally be long term moderate adverse Base Year and Ten-Year Forecast.

Cumulative Impacts Alternative A Wildlife
West End
West End, noise from aircraft above and outside the SFRA is audible 12 to 51% of the day. When impacts of Alternative A are combined with impacts of other aircraft noise above and outside SFRA, with localized impacts of non-aircraft noise sources, and with beneficial impacts of fire management activities, cumulative impacts would generally be long term moderate adverse, but up to major adverse under air-tour routes Base Year and Ten-Year Forecast.

Conclusion Alternative A Wildlife

In the park and SFRA wildlife would experience noise from air-tour aircraft that would disturb individuals, affect behaviors, population numbers, and species distributions in nearly half the Study Area Base Year and Ten-Year Forecast. Greatest exposure to noise and visual impacts would occur near East and West End heavily-used air-tour routes where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75% of the time. However, there would also be large habitat portions that would go relatively undisturbed in Marble Canyon and the Central area.

Conclusion *Alternative A* *Wildlife*
Marble Canyon
Ten-Year Forecast Alternative A would generally result in short-term negligible to minor adverse impacts on Marble Canyon Wildlife and habitat. Cumulative impacts from all actions would generally be long term moderate adverse.

Conclusion *Alternative A* *Wildlife*
East End
Ten-Year Forecast there would be short- and long-term impacts to Wildlife and habitats East End ranging moderate to major adverse in areas beneath and adjacent to air-tour routes. In areas away from air-tour routes including beneath Bright Angel Flight-free Zone impacts would generally be short term negligible to minor adverse. Cumulative impacts from all actions would generally be moderate adverse, but major adverse under air-tour routes.

Conclusion *Alternative A* *Wildlife*
Central
Ten-Year Forecast Alternative A would generally result in short-term negligible to minor adverse impacts on Central area Wildlife and habitats, with impacts up to moderate adverse in areas near air-tour routes. Cumulative impacts from all actions would generally be long term moderate adverse.

Conclusion *Alternative A* *Wildlife*
West End
Ten-Year Forecast Alternative A would result in short- and long-term moderate to major adverse impacts to wildlife located under and near Green-4, Blue-2, and Blue Direct routes. Short-term minor to moderate adverse impacts would result at Location Points near Brown routes. Impacts under Sanup Flight-free Zone and south of the park in the SFRA would be negligible. Cumulative impacts from all actions would generally be long-term moderate adverse, but major adverse under air-tour routes.

ALTERNATIVE E **ALTERNATING SEASONAL USE** **WILDLIFE**

See Alternative A for species and habitat descriptions.

Overall Alternative E would result in beneficial changes in impacts compared with Alternative A due to reduced area exposed to high Average Sound Level and Percent Time Audible for long periods. Ten-Year Forecast, the majority of habitat (68% Peak Season, 71% Off-Peak Season) would have air-tour aircraft noise Percent Time Audible less than 5% of the day. Wildlife habitat exposed to air-tour Percent Time Audible greater than 25% would be reduced to 16 and 14%, Base Year Peak and Off-Peak Seasons respectively, compared to 47% in Alternative A. Ten-Year Forecast Peak and Off-Peak Seasons, 51 to 53% of SFRA habitat would have air-tour aircraft Average Sound Level less than 15 dBA. This would result in greatly reduced impacts on Wildlife and habitat with greater areas of the park protected from air-tour aircraft sights and sounds. Wildlife habitat would be improved, and fewer disturbances to wildlife would occur over the majority of the park and SFRA.

Marble Canyon **Alternative E** **Wildlife**

Marble Canyon *Alternative E* *Wildlife*
All Scenarios

Predominant Marble Canyon habitats are old-desert scrub and river/riparian. Based on contour data as shown in Appendix F, in 100% of these Marble Canyon habitats, aircraft Percent Time Audible would be 5% or less of the day. Almost the entire habitat would experience Average Sound Level of 15 dBA or less.

Under Alternative E, Marble Canyon would be in Bright Angel Flight-free Zone. As shown in Tables 4.123 and 4.124, air-tour aircraft Percent Time Audible would be less than 5% and Average Sound Level would be below 13 dBA, a zero to 16 dBA decrease from Alternative A. Aircraft would be barely audible and at very low levels. There would generally be no air-tour aircraft visible from most points on the ground. Improvements over Alternative A would occur at all Marble Canyon Location Points, and most at **North and South Canyon** Location Points. Wildlife would rarely be disturbed by air-tour aircraft operations. Negligible impacts would occur, a short-term negligible to minor beneficial change in impacts to Wildlife and habitat compared with Alternative A.

TABLE 4.123 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	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	-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

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	1,665	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

East End **Alternative E** **Wildlife**

In the majority of East End, Wildlife and habitat would experience a decrease in adverse effects from air-tour operations at some point during the year depending on seasonal air-tour corridor use.

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. Along North and South Rims, habitat is mostly ponderosa pine and old-conifer forest.

East End *Alternative E* *Wildlife*

Base Year Peak Season

As shown in Appendix F, Wildlife and habitats would experience aircraft Percent Time Audible greater than 25% of the day in most old-conifer forest habitat (95%), likely due to the habitat being near Grand Canyon Airport. Aircraft Percent Time Audible would be greater than 25% in 41% of piñon-juniper, 44% of cold-desert scrub, 17% of ponderosa pine forest, and 31% of riparian habitat.

As shown in Tables 4.125 and 4.126 areas where air-tour operations would have highest level of effect would be under and adjacent to **Zuni Point Corridor**, represented by **Temple Butte, Grid Location Point 14,** and **Tusayan Museum** Location Points. This results from high air-tour noise Percent Time Audible during the day of 75 to 84%, an 11 to 20% increase from Alternative A. Air-tour Average Sound Level would be 38 to 42 dBA, an increase of one to 7 dBA from Alternative A. Air-tour aircraft would be closer to points on the ground than Alternative A at Temple Butte (450 meters closer) and Tusayan Museum (1,566 meters closer) Location Points. Because routes would become active rather abruptly, there may be a higher level of reaction, and some individuals could abandon area use resulting in potential localized population changes. Under and near Zuni Point Corridor there would be moderate to major adverse impacts with short-term minor to moderate adverse change in impacts compared to Alternative A.

Dragon Corridor routes would not be in use and aircraft Percent Time Audible **under and near Dragon Corridor** would be zero to 13% of the day, a decrease of 71 to 96% compared to Alternative A at **Hermit Basin, Tower of Ra,** and **96-mile Camp** Location Points. Air-tour aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from Alternative A. Due to substantial reduction in time and level of audible aircraft sound and visual impact, wildlife would experience near natural conditions with limited to no disruption in behaviors as a result of air-tour operations. Because Wildlife daily activities and behaviors in the Dragon Corridor area would be less often interrupted due to air-tour aircraft, negligible to minor adverse impacts would occur resulting in short-term major beneficial change in impacts from Alternative A.

In **Bright Angel Flight-free Zone** and **Toroweap/Shinumo Flight-free Zone's eastern portion**, there would be a decline in air-tour noise. When Zuni Point Corridor is in use, air-tour aircraft Percent Time Audible at **Grid Location Point 11** would decline from 55% of the day in Alternative A to 6% under Alternative E, a decrease of 49%. Average Sound Level would be 9 dBA, a 9 dBA decrease. This would expand the East End area where substantially fewer disruptions would occur to wildlife. Negligible impacts would occur, a short-term moderate to major beneficial change in impacts compared to Alternative A in the Flight-Free Zones and areas west of routes due to high reduction in Percent Time Audible. The middle of Flight-free Zones would remain quiet, as represented by **Grid Location Points 12 and 13**, and would experience negligible to minor adverse impacts with negligible change in impacts from Alternative A.

East End *Alternative E* *Wildlife*

Ten-Year Forecast Peak Season

As shown in Table 4.125 air-tour aircraft Percent Time Audible at **Zuni Point Corridor** Location Points **(Temple Butte, Grid Location Point 14,** and **Tusayan Museum)** would decline to 50 to 66%, an 8 to 18% decrease from Alternative A, due to conversion to quiet-technology aircraft. Average aircraft sound levels would range 35 to 40 dBA, similar to Alternative A. Aircraft distance would be the same as Base Year. Given the Percent Time Audible decrease, there may be less of a wildlife reaction to routes abruptly becoming active. Although moderate to major adverse impacts would continue under and near Zuni Point Corridor, there would be short-term minor beneficial change in impacts compared to Alternative A. However, changes that may occur to populations as routes become active reduce level of expected benefit from decline in aircraft audibility.

Under and near Dragon Corridor (**Tower of Ra, Hermit Basin,** and **96-mile Camp** Location Points**)**, impacts would be similar to Base Year Peak Season.

At **Grid Location Points 11, 12** and **13** impacts would be almost the same as Base Year Peak Season.

East End *Alternative E* *Wildlife*

Base Year Off-Peak Season

Aircraft noise would decrease in all habitats except old-conifer forest. When Zuni Point Corridor becomes inactive, amount of old-conifer forest habitat exposed to aircraft sounds more than 25% of the day decreases dramatically to 18%, with over two-thirds of the habitat experiencing aircraft sounds less than 5% of the day.

Dragon Corridor would be in use, and air-tour aircraft Percent Time Audible at **Tower of Ra** and **Hermit Basin** Location Points would be 61 and 71% of the day, respectively, a decrease of 28 to 36% from Alternative A. Air-tour aircraft Average Sound Level at Hermit Basin and Tower of Ra Location Points would be 23 and 46 dBA, a decrease of 19 dBA from Alternative A at Hermit Basin, and an increase of 2 dBA at Tower of Ra. At **96-mile Camp** along the river, Percent Time Audible would decline to 26% of the day from 72% in Alternative A, although Average Sound Level would remain relatively high at 37 dBA. Air-tour aircraft would be further from locations on the ground than in Alternative A. Although Percent Time Audible and Average Sound Level decline, they would still be high, so animals may avoid areas under and near routes as more suitable areas would be available without interference from aircraft sights and sounds. Moderate to major adverse impacts would occur, but there would be a short-term moderate beneficial change in impacts from Alternative A.

Routes in **Zuni Point Corridor** would be inactive, so air-tour aircraft Percent Time Audible would be one percent of the day or less, a 62 to 69% decrease from Alternative A. Average Sound Level would be 3 to 7 dBA, a 62 to 69 dBA reduction. Visual impacts from air-tour aircraft would be eliminated during this period. Wildlife would experience very quiet conditions with little to no air-tour aircraft disturbance. Negligible impacts would occur under and near Zuni Point Corridor, a short-term major beneficial change in impacts compared to Alternative A.

When Dragon Corridor air-tour routes would be active, areas in **Bright Angel Flight-free Zone close to air-tour routes** (represented by **Grid Location Point 11**) would experience aircraft sounds 23% of the day, a 32% decrease from Alternative A, at 12 dBA, a 6 dBA decline, due to fewer aircraft operations and higher altitudes air-tour aircraft would be required to fly. Although air-tour noise would still be present, reduction in noise would result in an increased amount of area and habitat available for wildlife with fewer disturbances from aircraft noise. This would represent moderate adverse impacts with a short-term moderate to major beneficial change in impacts compared to Alternative A due to large reduction in Percent Time Audible. 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 from Alternative A.

East End *Alternative E* *Wildlife*

Ten-Year Forecast Off-Peak Season

In areas under and near Zuni Point Corridor (Location Points **Temple Butte, Grid Location Point 14,** and **Tusayan Museum),** there would be negligible impacts with major beneficial change in impacts compared to Alternative A similar to Base Year Off-Peak Season.

Ten-Year Forecast there would be a further decline in Percent Time Audible and Average Sound Level from conversion to quiet-technology aircraft. Percent Time Audible in areas near and under Dragon Corridor (**Hermit Basin, Tower of Ra,** and **96-mile Camp** Location Points) would be 17 to 49%; a decline of 49 to 67% from Alternative A. Average Sound Level would range 18 to 44 dBA, a one to 24 dBA decrease. These improvements would be substantial in areas where aircraft Percent Time Audible is greatly reduced, such as near 96-mile Camp along the river. Although moderate adverse impacts would occur, this would be a short-term moderate to major beneficial change in impacts from Alternative A.

Beneficial changes in impacts in **Bright Angel Flight-free Zone** at **Grid Location Points 11, 12** and **13**, would generally be similar to Base Year Off-Peak Season, except there would be a reduction to 16% Percent Time Audible for Grid Location Point 11 (a 7% decrease from Base Year, and a 41% decrease compared to Alternative

A), due primarily to conversion to quiet-technology aircraft. This would result in moderate adverse impacts with moderate to major beneficial change from Alternative A near air tour routes, and negligible impacts with negligible change from Alternative A away from routes and amid Bright Angel Flight-free Zone.

East End *Alternative E* *Wildlife*

Ten-Year Forecast Peak and Off-Peak Season

As shown in Appendix F, amount of habitat exposed to aircraft noise 25% or more Percent Time Audible would decrease from Base Year: old-conifer forest (49% Peak Season; 10% Off-Peak); piñon-juniper (22% Peak Season; 20% Off-Peak); cold-desert scrub (32% Peak Season; 10% Off-Peak); ponderosa pine forest (one percent Peak Season; one percent Off-Peak); and river/riparian (20% Peak Season; 5% Off-Peak). The majority of all habitats would be exposed to Average Sound Level 15 dBA or less.

TABLE 4.125 ALTERNATIVE E AVERAGE SOUND LEVEL EAST END

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	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	71	-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	-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
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	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
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	-41	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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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	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

Central Alternative E 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 similar to Alternative A. As shown in Appendix F and Ten-Year Forecast, aircraft Percent Time Audible would be 5% of the day or less in the majority of habitats: 97 to 99% of cold- and old-desert scrub, 94% of piñon-juniper, and 98% of river/riparian habitats. Nearly all Central habitats (98 to 100%) would be exposed to aircraft sound levels of 15 dBA or less.

Central Alternative E Wildlife

Base Year Peak Season

There would be little difference in sound metrics compared to Alternative A. As shown in Tables 4.127 and 4.128 air-tour aircraft Percent Time Audible would be less than 5% of the day (except **Prospect Canyon** Location Point at 15%), with air-tour aircraft Average Sound Level 3 to 18 dBA. Air-tour aircraft would be greater than 7,000 meters from locations on the ground. Daily wildlife behaviors such as foraging, resting, breeding, and nesting would be little affected by air-tour aircraft.

South of the GCNP boundary, Wildlife and habitat would be most affected in areas beneath Brown-1 and Brown-6. Areas near these routes as represented by **South Supai Canyon** and **Havatagvitch Canyon** Location Points would experience aircraft Average Sound Level 7 to 18 dBA, a one to 9 dBA decrease compared to Alternative A. Aircraft Percent Time Audible would be one percent of the day or less, similar to Alternative A. At Havatagvitch Canyon Location Point, aircraft would be nearly 1,200 meters more Distant than in Alternative A. Near Brown-1, aircraft Percent Time Audible would be approximately 15% of the day at 18 dBA based on **Prospect Canyon** Location Point. Negligible impacts would occur with negligible change in impacts from Alternative A.

Central Alternative E Wildlife

Base Year Off-Peak Season

Ten-Year Forecast Peak and Off-Peak Season

Impacts would be similar to Base Year Peak Season, generally negligible with negligible change in impacts compared to Alternative A.

TABLE 4.127 ALTERNATIVE E AVERAGE SOUND LEVEL CENTRAL

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	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	-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	18	-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

TABLE 4.128 ALTERNATIVE E SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	Alternative E	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Havatagvitch 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

West End Alternative E Wildlife

West End is a mixture of warm- and cold-desert scrub, piñon-juniper, and riparian habitat along the river. As shown in Appendix F, in cold-desert scrub habitat, Base Year 62% of habitat would be exposed to aircraft Percent Time Audible greater than 25% of the day. Amount of piñon-juniper and river/riparian habitat exposed to high levels of audible noise (Percent Time Audible) would be 17 and 27%, respectively, Base Year. Because warm-desert scrub habitat is found under Blue-2 and Green-4, this habitat would also be exposed to high sound levels, as 14% of the habitat would experience Average Sound Level greater than 35 dBA (decreased to 6% Ten-Year Forecast), and 40% of the habitat would experience Percent Time Audible greater than 25% (decreasing slightly to 33% Ten-Year Forecast). Wildlife in this habitat could be disturbed often during daily activities. Given the persistence of air-tour noise during the day, some wildlife could abandon or avoid the area under air-tour routes.

West End Alternative E Wildlife
All Scenarios

Wildlife located under **Sanup Flight-free Zone** and **areas near the south SFRA boundary** would be negligibly affected by air-tour operations. Air-tour aircraft would rarely be audible at Average Sound Level of zero to 8 dBA as reflected in Location Point data at **Diamond Creek** and **Pumpkin Springs**. Impacts would be negligible with negligible change from Alternative A.

West End Alternative E Wildlife
Base Year Peak Season

Wildlife and habitat near Green-4 and Blue-2 (represented by **Burnt Springs Canyon, Bat Cave,** and **Grid Location Point 33** Location Points) would be exposed to air-tour aircraft impacts similar to those described in Alternative A. As shown in Table 4.129 and 4.130 air-tour aircraft Percent Time Audible would be 70 to 92% of the day at Average Sound Level 42 to 47 dBA. Daily animal activities would be disrupted frequently which may result in abandoning or avoiding otherwise suitable habitat that could affect population levels. Short-term major adverse impacts would occur under air-tour routes with negligible to minor beneficial change in impacts compared to Alternative A.

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 be no 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 more than

2,500 meters from locations on the ground. Wildlife would be disturbed for relatively small portions of the day. Moderate adverse impacts would occur with short-term negligible to minor adverse change in impacts from Alternative A.

At the SFRA's northern boundary, represented by **Andrus Canyon** Location Point, air-tour Average Sound Level would be 37 dBA, an increase of 15 dBA from Alternative A, and Percent Time Audible 50% of the day, a 28% increase due to reconfiguration of Blue Direct North. Major adverse impacts would occur with short-term moderate to major adverse change in impact compared to Alternative A.

Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire Camp,** and **Grid Location Point 32** would experience a 28 to 40% decrease in Percent Time Audible compared to Alternative A to less than 4% of the day. Aircraft Average Sound Level would also decrease by 6 to 24 dBA compared to Alternative A to 18 to 21 dBA. Due to Blue Direct movement north, Sanup/Shivwits area wildlife would be less disturbed, which may result in increased density of wildlife and populations in this area of the park and **Grand Canyon-Parashant National Monument**. Distances from aircraft to points on the ground would increase to more than 18,000 meters. Negligible to minor adverse impacts would occur, a short- and long-term moderate to major beneficial change in impacts compared to Alternative A.

West End *Alternative E* *Wildlife*

Ten-Year Forecast Peak Season

Near Blue-2 and Green-4, air-tour aircraft Percent Time Audible would be 62 to 84%, a 12 to 37% decrease from Alternative A. Average Sound Level at **Burnt Springs Canyon** Location Point would be 43 dBA, a 4 dBA decrease from Alternative A. **Bat Cave** Location Point would be nearly the same as Alternative A, and **Grid Location Point 33** would decrease to 37 dBA, a 6 dBA decrease compared to Alternative A. Major adverse impacts would occur under air-tour routes, but there would generally be minor to major beneficial change in impacts compared to Alternative A.

Whitmore Rapids and **Parashant Wash** Location Points near Brown routes would have air-tour aircraft Percent Time Audible 14 to 21% of the day, a one to 8% increase from Alternative A at Whitmore Rapid Location Point due to realignment of Blue Direct North. There would be no appreciable change at Parashant Wash Location Point. Average Sound Level would be 21 to 28 dBA, no appreciable difference from Base Year Peak Season. Aircraft would be more than 2,500 meters from locations on the ground. Wildlife would be disturbed for relatively small portions of the day. Moderate adverse impacts would occur with short-term negligible to minor adverse change in impacts from Alternative A.

At the SFRA's northern boundary, represented by **Andrus Canyon** Location Point, Percent Time Audible would increase to 57%, but Average Sound Level would stay about the same as Base Year, and there would be major adverse impacts with moderate to major adverse change in impacts compared to Alternative A.

Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire Camp,** and **Grid Location Point 32** impacts would be very similar to Base Year Peak Season, negligible to minor adverse impacts with moderate to major beneficial change in impacts from Alternative A.

West End *Alternative E* *Wildlife*

Base Year Off-Peak Season

Impacts would increase slightly at Location Points **under Blue-2 and Green-4** (a 4 to 9% Percent Time Audible increase, but only a one dBA Average Sound Level increase) compared to Base Year Peak Season. Impacts would remain major adverse under air-tour routes, and there would be negligible to minor adverse change in impacts from Alternative A.

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 would increase to 14 and 24%, a 2 to 12% increase compared to Alternative A. Due to increase in Percent Time Audible, moderate adverse impacts would occur with negligible to minor adverse change in impacts from Alternative A.

Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire Camp,** and **Grid Location Point 32** impacts would be very similar to Base Year Peak Season, negligible to minor adverse impacts with moderate to major beneficial change from Alternative A.

West End *Alternative E* *Wildlife*

Ten-Year Forecast Off-Peak Season

Percent Time Audible and Average Sound Level would generally decline a small amount Base Year to Ten-Year Forecast (except **Grid Location Point 33** which declines 29%), but impacts would continue major adverse under Green-4 and Blue-2 similar to those described Base Year Off-Peak Season with negligible to minor beneficial change in impacts compared to Alternative A.

Whitmore Rapids and **Parashant Wash** Location Points near Brown routes would have air-tour aircraft Percent Time Audible 18 to 25% of the day, a 12% increase from Alternative A at Whitmore Rapid Location Point due to realignment of Blue Direct North. There would be no appreciable change at Parashant Wash Location Point. Average Sound Level would be 25 to 28 dBA; within 5 dBA of Alternative A. Aircraft would be more than 2,500 meters from locations on the ground. Wildlife would be disturbed for relatively small portions of the day. Moderate adverse impacts would occur with short-term negligible to minor adverse change in impacts from Alternative A.

Areas previously under Blue Direct routes represented by Location Points **Mt. Dellenbaugh, Shivwits Fire Camp,** and **Grid Location Point 32** impacts would be very similar to Base Year Peak Season with negligible to minor adverse impacts and moderate to major beneficial change in impacts compared to Alternative A.

West End *Alternative E* *Wildlife*

Base Year and Ten-Year Forecast Off-Peak Season

At the SFRA's northern boundary, represented by **Andrus Canyon** Location Point, Percent Time Audible would be 55 to 65% Off-Peak Season, an increase of 5 to 8% compared to Peak Season, but Average Sound Level would be 38 to 39 dBA, a one to 2 dBA increase compared to Peak Season, and 21 to 22 dBA higher than Alternative A. This represents moderate to major adverse impacts with moderate to major adverse changes in impacts compared to Alternative A.

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	-23	1	-28	1	-31	18	-23	19	-23
Shivwits Fire Camp	35	39	38	38	1	-34	2	-38	18	-19	19	-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	7	0	7	0	0	0	0	0	7	0	8	0
Castle Peak	27	30	18	48	45	18	50	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

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

Cumulative Impacts Alternative E Wildlife

In all areas, noise from aircraft flying above and outside the SFRA would continue to have long-term moderate adverse impact on Wildlife as described in Alternative A. Noise from other non-aircraft sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative E contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under Alternatives.

Noise from aircraft flying above and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative E as discussed above, would generally have long-term moderate adverse cumulative impacts on Wildlife throughout all four areas (Marble Canyon, East End, Central, and West End), except under East and West End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A.

Conclusion Alternative E Wildlife

Overall Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced amount of area exposed to high Percent Time Audible and high Average Sound Level for long periods of the day. The majority of habitat would experience large reduction in aircraft Percent Time Audible; Ten-Year Forecast Peak and Off-Peak Seasons, half the SFRA habitat would have air-tour aircraft Average Sound Level less than 15 dBA. This would result in greatly reduced impacts on Wildlife and habitat with larger areas protected from air-tour aircraft sights and sounds. Wildlife habitat would be improved, and fewer disturbances to wildlife would occur compared to Alternative A.

Cumulative impacts from all actions in all areas, when combined with impacts of Alternative E, would generally be long-term moderate adverse, except under East and West End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A.

Because they would be audible a very high percentage of the day, the combination of aircraft sounds from all sources would generally be the overriding cumulative noise influence on Wildlife and habitat.

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. Cumulative impacts from all actions would be moderate adverse.

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.

Cumulative impacts from all actions would generally be long term moderate adverse, except under East End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A.

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. Cumulative impacts from all actions would be long term moderate adverse.

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 from all actions would be long term moderate adverse, except under West End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A.

ALTERNATIVE F MODIFIED CURRENT CONDITIONS WILDLIFE

See Alternative A for species and habitat descriptions.

Wildlife would experience noise from air-tour aircraft that would disturb individuals, affect behaviors, population numbers, and species distributions in nearly half the Study Area Base Year. Ten-Year Forecast there would be improvement in wildlife habitat and reduction of impacts on wildlife as aircraft noise is reduced through implementation of quiet-technology incentives and conversion. Ten-Year Forecast 34% of the park would have air-tour Percent Time Audible greater than 25% of the day, predominantly in East and West Ends under and near air-tour routes. Air-tour Average Sound Level would generally be low, less than 25 dBA, in about 70% of the SFRA. Greatest exposure to noise and visual impacts would occur in East and West Ends where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75%. Although there would be localized impacts to species in East and West Ends close to air-tour routes, large habitat areas would be relatively undisturbed by air-tours in Marble Canyon and the Central area.

Marble Canyon Alternative F Wildlife

Marble Canyon's predominant plateau habitat is old-desert scrub. Based on Appendix F contour data, Base Year Peak Season 87% of Marble Canyon old-desert scrub habitat would have aircraft Percent Time Audible 5% of the day or less and 79% would have Average Sound Level 15 dBA or less. In Marble Canyon along the river where background sounds can be loud, 94% of habitat would experience air-tour sounds less than 5% with 77% of habitat exposed to aircraft sound of 15 dBA or less.

Marble Canyon Alternative F Wildlife
Base Year and Ten-Year Forecast Peak Season

In Marble Canyon, as shown in Tables 4.131 and 4.132, impacts of air-tour aircraft noise would be similar to Alternative A Peak Season Base Year and Ten-Year Forecast. Directly under air-tour routes, air-tour aircraft Percent Time Audible would be 3%. As represented by Location Points **Cliff Dwellers Lodge, Grid Location Points 4 and 5,** and **Marble Canyon Dam Site**, the majority of Marble Canyon wildlife habitat would have air-tour Average Sound Level of 15 dBA or less. Aircraft would generally be more than 2,000 meters away from points on the ground. At **Grid Location Point 2,** aircraft would be about 860 meters from points on the ground. There would be little potential to disturb or displace wildlife in these locations. In some areas directly beneath routes, Average Sound Level would be higher such as at **North** and **South Canyon** Location Points, and areas where air-tour routes would be close to the canyon rim, potential for wildlife disturbance in desert-scrub habitat could increase. Negligible to minor adverse impacts would generally occur with negligible change from Alternative A.

Marble Canyon Alternative F Wildlife
Base Year and Ten-Year Forecast Off-Peak Season

Impacts would be 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 reductions in air-tour aircraft visibility, and Average Sound Level would be zero, a decrease of 21 and 24 dBA compared to Alternative A. Marble Canyon wildlife habitat would be improved to a small degree as air-tour aircraft sounds would be very low. Although adverse impacts would occur, there would be long-term negligible to minor beneficial change in impacts compared to Alternative A.

TABLE 4.131 ALTERNATIVE F AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				Alternative F															
					Peak Season								Off-Peak Season							
	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
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	-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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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

East End **Alternative F** **Wildlife**

As shown in Appendix F, Base Year Peak Season, animals would be exposed to aircraft Percent Time Audible greater than 25% of the day in the majority of piñon-juniper (83%), ponderosa pine (81%), cold-desert scrub (78%), and old-conifer forest (98%) habitats. However, most habitats would be exposed to low Average Sound Level of 25 dBA or less similar to Alternative A. In 58% of river/riparian habitat, aircraft Percent Time Audible would be greater than 25% of the day and Average Sound Level would be 25 dBA or less in 65% of the habitat. With quiet-technology conversion, noise impacts would decrease Ten-Year Forecast.

East End *Alternative F* *Wildlife*

Base Year Peak Season

There would be little difference in impacts to wildlife compared to Alternative A under routes in **Zuni Point** and **Dragon Corridors** and adjacent areas. Proximity of air-tour aircraft to locations on the ground would not differ notably from Alternative A. As shown in Tables 4.133 and 4.134 air-tour aircraft Percent Time Audible would be 62 to nearly 100% of the day in areas beneath air-tour routes, with Average Sound Level 28 to 49 dBA at representative Location Points. Given close proximity of flights to **The Basin** and **1.5 km southeast of Moran Point** Location Points, and persistent air-tour noise in areas under routes, there would be potential to disrupt normal behavior patterns such as breeding, feeding or sheltering. Moderate to major adverse impacts would continue with negligible change from Alternative A.

Beneath Bright Angel Flight-free Zone, effects of air-tour aircraft would generally be similar to Alternative A. **Grid Location Points 12 and 13** and **Phantom Ranch** Location Point, air-tour aircraft Percent Time Audible would be one to 3% of the day, with aircraft Average Sound Level 12 to 13 dBA. However, **Cedar Ridge** Location Point Percent Time Audible would be 81%, **Point Sublime** Location Point Percent Time Audible would be 100%, and **Grid Location Point 11** Percent Time Audible would be 60%. Aircraft would be much greater than 2,000 meters. Air-tour aircraft would rarely be audible at relatively low sound levels with negligible to minor adverse impacts away from routes in the middle of Bright Angel Flight-free Zone, but audible most of the time with moderate to major adverse impacts at locations near flight routes. Impacts would continue with negligible change in impacts compared to Alternative A.

East End *Alternative F* *Wildlife*

Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible would be 41 to 53% in **Zuni Point Corridor**, a decrease of 21 to 28% from Alternative A, and 47 to 98% in **Dragon Corridor**, a decrease of 2 to 27% from Alternative A. Air-tour aircraft Average Sound Level would be 24 to 31 dBA in Zuni Point Corridor, declining 4 to 7 dBA from Alternative A, and 37 to 46 dBA in Dragon Corridor, a decline of 3 to 5 dBA. Aircraft would be visible as in Base Year. There could be modest improvement for wildlife breeding, nesting, and foraging due to decline in aircraft Percent Time Audible. Although moderate to major adverse impacts would continue under and near heavily used air-tour routes, there would generally be long-term minor to major beneficial change in impacts compared to Alternative A.

East End *Alternative F* *Wildlife*

Base Year Off-Peak Season

Wildlife habitat beneath **Zuni Point Corridor** would experience a decrease in aircraft noise effects. Aircraft Percent Time Audible would be 33 to 45% of day; a decrease of 26 to 33% from Alternative A. Average aircraft sound levels would range 29 to 31 dBA at **Grid Location Point 14, Temple Butte,** and **Lipan Point** Location Points, a decrease of 4 to 6 dBA from Alternative A. However, sound levels would increase to 38 dBA at **Grid Location Point 15**, an increase of 10 dBA from Alternative A. Distance from areas on the ground would be similar to Base Year Peak Season. Moderate to major adverse impacts would occur with minor to major beneficial change in impacts from Alternative A, except for Grid Location Point 15.

When Dragon Corridor shifts seven-miles west Off-Peak Season, in areas that were under routes in Peak Season (**96-mile Camp, Tower of Ra,** and **Hermit Basin** Location Points) would experience a decrease in Percent Time Audible one to 60%, a 39 to 80% decrease from Alternative A. Air-tour aircraft Average Sound Level would also decline to 13 to 23 dBA, a 19 to 31 dBA decrease from Alternative A. Aircraft would rarely be visible from locations on the ground. Wildlife habitat would be temporarily improved with less interruption. However, at

Eremita Mesa Location Point, which would still be under active air-tour routes in the shifted Dragon Corridor, sound levels and Percent Time Audible would not change appreciably from Peak Season, or more than a negligible amount from Alternative A. Negligible to minor adverse impacts would occur, and overall in Dragon Corridor there would be moderate to major beneficial change in impacts compared to Alternative A.

When Dragon Corridor shifts seven-miles west Off-Peak Season, at **Bass Camp** and **Rainbow Plateau** Location Points aircraft Percent Time Audible would be 24 to 37% of the day, an increase of 24 to 36% compared to Alternative A. Average Sound Level would increase to 13 to 33 dBA, an increase of 7 to 26 dBA. In contrast, these sites would experience very little air-tour noise Peak Season (Percent Time Audible less than one percent at Average Sound Level 7 dBA). Because the route shift would be abrupt, there may be a higher reaction level which could result in area avoidance and localized population level changes as animals abandon habitat. Short-term moderate to major adverse impacts would occur Off-Peak Season with moderate to major adverse change in impacts from Alternative A at sites under and near the shifted corridor location.

East End *Alternative F* *Wildlife*

Ten-Year Forecast Off-Peak Season

Dragon Corridor Percent Time Audible would further decline to less than one percent at **96-mile Camp** Location Point and 6 to 32% at **Tower of Ra** and **Hermit Basin** Location Points respectively. Percent Time Audible would be reduced 68 to 92% compared to Alternative A. At **Point Sublime** Location Point, near air-tour routes, air-tour aircraft Percent Time Audible would be 24% Ten-Year Forecast, a 75% decrease from Alternative A, with air-tour aircraft Average Sound Level declining to 19 dBA, a decrease of 16 dBA from Alternative A. At **Eremita Mesa** Location Point, impacts would decline 12% Percent Time Audible, and 2 dBA Average Sound Level compared to Base Year Off-Peak Season. Although adverse impacts would continue, there would be moderate to major beneficial change in impacts compared to Alternative A.

For **Zuni Point Corridor** Location Points, reductions of 16 to 23% Percent Time Audible and 3 to 6 dBA would occur Base Year to Ten-Year Forecast Off-Peak Season, with major beneficial changes (reductions of 43 to 55% Percent Time Audible) compared to Alternative A due to quiet-technology conversion requirements.

Impacts due to Alternative F Off-Peak Season Dragon Corridor route shift would be reduced due to quiet-technology conversion requirements. At **Bass Camp** Location Point, aircraft Percent Time Audible would be 20% of the day, a 17% reduction from Base Year, but a 20% increase from Alternative A. At **Rainbow Plateau** Location Point, aircraft Percent Time Audible would be 2% of the day, a 22% reduction from Base Year, and similar to Alternative A. Average Sound Level would be 10 to 29 dBA, a 3 to 4 dBA decrease from Base Year, but still a 4 to 22 dBA increase from Alternative A. Wildlife activities and behaviors would less frequently be interrupted by air-tour aircraft. Although negligible to moderate adverse impacts would occur, there would be negligible to moderate adverse changes in impacts compared to Alternative A.

East End *Alternative F* *Wildlife*

Ten-Year Forecast Peak and Off-Peak Season

Beneath Bright Angel Flight-free Zone, impacts and level of change at **Grid Location Points 12 and 13** and at **Phantom Ranch** Location Point would be negligible with negligible change from Alternative A. However, at **Cedar Ridge** Location Point and **Grid Location Point 11**, there would be a 47 to 78% reduction in Percent Time Audible to 5 to 10%, representing minor adverse impacts and moderate to major beneficial change in impacts compared to Alternative A.

TABLE 4.133 ALTERNATIVE F AVERAGE SOUND LEVEL EAST END

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
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	-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	-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	-23	46	0	41	-5	22	-21	11	-35	41	-5	38	-9
Ten X Meadow	64	68	49	49	67	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	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

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	8,081	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	1,341	-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

Central Alternative F Wildlife

The Central area is composed of cold- and old-desert scrub, piñon-juniper, and river/riparian habitat. As shown in Appendix F, overall Wildlife and habitat would be exposed to little aircraft noise. Base Year Peak Season, aircraft Percent Time Audible would be 5% of the day or less in the majority of habitats: 97% of cold- and old-desert scrub, 86% of piñon-juniper, and 97% of river/riparian habitats. Average Sound Level would also be relatively low with the majority of the area exposed to aircraft sound of 15 dBA or less.

Central Alternative F Wildlife

Base Year and Ten-Year Forecast Peak Season

Similar to Alternative A, wildlife throughout most of Central area would be little affected by air-tour aircraft noise. As shown in Table 4.135 Percent Time Audible would generally be one percent or less, similar to Alternative A. Wildlife would be exposed to air-tour Average Sound Level generally 8 dBA or less, similar to Alternative A. As shown in Table 4.136, aircraft proximity would be mostly greater than 7,000 meters away from points on the ground. Given low aircraft audibility, sound levels, and air-tour aircraft distant from locations on the ground, there would be little potential to disturb wildlife behaviors or activities, or to affect population levels or area use, although some individuals may be disturbed for short periods. Negligible impacts would occur, with negligible change in impacts compared to Alternative A, and little change Base Year to Ten-Year Forecast.

Outside the park in the SFRA near **South Supai Canyon** and **Havatagvitch Canyon** Location Points, aircraft noise would be similar to Alternative A. Air-tour aircraft Percent Time Audible would be one to 7% at Average Sound Level 7 to 25 dBA. There would be negligible to minor adverse impacts with negligible change in impacts compared to Alternative A, and little change Base Year to Ten-Year Forecast.

Central Alternative F Wildlife

Base Year Off-Peak Season

Air-tour noise would be similar to Peak Season (generally negligible impacts with negligible change from Alternative A), except **Fossil Canyon** Location Point where there would be a 16% increase in Percent Time Audible compared to Base Year (a moderate adverse impact with moderate adverse change in impacts at that site compared to Alternative A).

Central Alternative F Wildlife

Ten-Year Forecast Off-Peak Season

Most sites would be similar to Base Year Off-Peak Season (generally negligible impacts with negligible changes in impacts from Alternative A). An exception would be **Prospect Canyon** Location Point, which would experience a 5% increase in Percent Time Audible from Base Year, but still a 14% decrease compared to Alternative A (a moderate adverse impact with moderate beneficial change in impacts from Alternative A).

TABLE 4.135 ALTERNATIVE F AVERAGE SOUND LEVEL CENTRAL

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
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	0	-2	0	-2	6	-5	7	-5
Prospect Canyon	22	25	22	22	6	-16	13	-12	18	-4	21	-2	6	-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	25	-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

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	0
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	10,346	0
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	11,103	0
South Supai Canyon	1,480	1,480	0

Δ indicates change in noise metric data from Alternative A

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.

Aircraft would be 1,800 to 4,200 meters from points on the ground, an increase of zero to 1,338 meters from Alternative A. Wildlife may be disturbed minimally by audible air-tour aircraft sounds; however, normal activities would be expected to recover after disturbance, without population level impacts. Minor adverse impacts would continue with negligible to minor beneficial change in impacts from Alternative A.

Wildlife habitat located in **Sanup Flight-free Zone** and **south of the SFRA boundary** would be negligibly affected by air-tour operations, as reflected in the data at **Pumpkin Springs, Diamond Creek,** and **Grid Location Point 34** Location Points. Base Year Peak Season in this West End area, air-tour Average Sound Level would be less than one to 9 dBA with air-tour Percent Time Audible less than one percent of the day. Wildlife would experience very little disturbance from air-tour aircraft in this southern West End area similar to Alternative A. There would be negligible impacts with negligible change in impacts from Alternative A in Sanup Flight-free Zone.

TABLE 4.137 ALTERNATIVE F AVERAGE SOUND LEVEL WEST END

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
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	27	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	-26	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	-14	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	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
Meriwhitca	0	1	7	8	0	0	1	0	8	1	8	1	0	0	1	0	7	1	8	1
Andrus Canyon	22	24	17	17	2	-20	1	-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

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

Cumulative Impacts Alternative F Wildlife

In all areas, noise from aircraft flying above and outside the SFRA would continue to have long-term moderate adverse impact on Wildlife as described in Alternative A. Noise from other non-aircraft sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible though, noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative F contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under Alternatives.

Noise from aircraft flying above and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative F as discussed above, would generally have long-term moderate adverse cumulative impacts on Wildlife throughout all four areas (Marble Canyon, East End, Central, and West End), except under East and West End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A.

Conclusion Alternative F Wildlife

Overall, Alternative F will generally result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high Percent Time Audible and high Average Sound Level for long periods of the day. Alternative F would result in wildlife habitat improvement and reduction of impacts on wildlife as aircraft noise is reduced due to quiet-technology incentives and conversion. Ten-Year Forecast 34% of the park would have air-tour aircraft Percent Time Audible 25% or more of the day predominantly in East and West Ends under and near air-tour 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 aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75% of the day. However, there would also be large areas of habitat relatively undisturbed by air-tours in Marble Canyon and the Central area.

Cumulative impacts from all actions in all areas, when combined with impacts of Alternative F, would generally be long term moderate adverse except under East and West End air-tour routes where cumulative impacts would be major adverse. 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.

Conclusion *Alternative F* *Wildlife*
Marble Canyon
Alternative F would generally result in negligible to minor adverse impacts on wildlife and habitats with negligible change in impacts Peak Season, and negligible to minor beneficial change in impacts from Alternative A Off-Peak Season Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion *Alternative F* *Wildlife*
East End
Base Year Peak Season, there would be moderate to major adverse impacts under and near heavily used air-tour routes in Zuni Point and Dragon Corridors, with negligible changes from Alternative A. Base Year Off-Peak Season, Zuni Point Corridor would be similar to Peak Season, but with the seasonal shift in Dragon Corridor, in Off-Peak Season the moderate to major adverse impacts would move seven-miles west, with mixed results between moderate adverse and moderate beneficial changes in impacts compared to Alternative A, depending on location. Ten-Year Forecast aircraft Percent Time Audible would be reduced due to quiet-technology incentives and conversion still resulting in moderate to major adverse impacts under the routes but minor to major beneficial changes in impacts compared to Alternative A. Peak Season, and mixed results due to the Dragon Corridor shift in Off-Peak Season.

In areas away from air-tour routes such as amid Bright Angel Flight-free Zone, there would generally be negligible to minor adverse impacts with negligible changes in impacts compared to Alternative A. Base Year Peak and Off-Peak Season, with up to major beneficial changes in impacts Ten-Year Forecast Peak and Off-Peak Season. Cumulative impacts from all actions would generally be long term moderate adverse except under East End air-tour routes where cumulative impacts would be major adverse.

Conclusion *Alternative F* *Wildlife*
Central
Alternative F would generally result in negligible to minor adverse impacts with negligible change in impacts to Wildlife and habitat compared to Alternative A in the Central area Peak Season, and negligible impacts with negligible change in impacts compared to Alternative A Off-Peak Season Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion *Alternative F* *Wildlife*
West End
In All Scenarios Alternative F would generally result in short-term moderate to major adverse impacts under Blue-2 and Green-4, with minor adverse to minor beneficial change in impacts compared to Alternative A. In All Scenarios in areas under Blue Direct routes, there would be moderate to major adverse impacts with negligible to minor adverse changes in impacts compared to Alternative A. Near Whitmore Rapids and Parashant Wash there would be minor to moderate adverse impacts with negligible change in impacts compared to Alternative A. In All Scenarios, in areas under Sanup Flight-free Zone, there would be negligible impacts with negligible change in impacts from Alternative A. Cumulative impacts from all actions would generally be long term moderate adverse, except under West End air-tour routes where cumulative impacts would be major adverse.

NPS PREFERRED ALTERNATIVE **WILDLIFE**

See Alternative A for species and habitat descriptions.

Overall the NPS Preferred Alternative would result in a beneficial change in impacts from Alternative A to wildlife and habitat. Base Year, percent of the park in which air-tour aircraft Percent Time Audible would be greater than 25% of the day would increase slightly Peak Season from 45% in Alternative A to 47%, but would decline to 37% Off-Peak Season. Ten-Year Forecast, percent of the park greater than 25% Percent Time Audible would decline to 33% Peak Season and 23% Off-Peak Season. Amount of the park in which air-tour aircraft Average Sound Level

would exceed 35 dBA Ten-Year Forecast Peak Season would be 12% compared to 23% in Alternative A. Although aircraft noise would continue to cause wildlife disturbance and affect wildlife habitat, Ten-Year Forecast there would be reduced aircraft Percent Time Audible and Average Sound Level due in large part to the requirement for quiet-technology aircraft conversion.

Marble Canyon NPS Preferred Alternative Wildlife

Marble Canyon wildlife habitat conditions would be quiet, similar to Alternative A Peak and Off-Peak Seasons. Based on Appendix F contour data, air-tour aircraft in 93 to 100% of Marble Canyon old-desert scrub and river habitats would have air-tour aircraft Percent Time Audible 5% or less of the day with air-tour Average Sound Level less than 15 dBA.

Marble Canyon NPS Preferred Alternative Wildlife
Base Year Peak Season

Impacts at representative **Marble Canyon Location Points** would generally be similar to Alternative A (negligible to minor adverse) as shown in Tables 4.139 and 4.140. However, aircraft Percent Time Audible would be 2% or less (lower than Alternative A), and Average Sound Level would be zero to 18 dBA, a decrease of one to 20 dBA compared to Alternative A (except at **Grid Location Points 4 and 5** where Average Sound Level would increase by 14 and 7 dBA, and **Cliff Dwellers Lodge** Location Point, where Average Sound Level would increase by 12 dBA compared to Alternative A). In most areas, aircraft would be much farther away (4,000 to 9,500 meters) from locations on the ground (however, aircraft would be closer at Grid Location Points 4 and 5, and Cliff Dwellers Lodge Location Point). Improvements over Alternative A would occur at all Location Points close to the canyon rim and river, and most at **North** and **South Canyon** Location Points. Wildlife would rarely be disturbed from normal daily activities, and would be expected to resume normal behaviors and return to pre-disturbance conditions shortly after an aircraft event. Negligible to minor adverse impacts would continue with generally short-term negligible to minor beneficial change in impacts compared to Alternative A. However, at points close to the new route, there would be minor adverse impacts with minor adverse change in impacts compared to Alternative A.

Marble Canyon NPS Preferred Alternative Wildlife
Ten-Year Forecast Peak Season
Base Year and Ten-Year Forecast Off-Peak Season

Levels of benefits would not be appreciably different from Base Year Peak Season, except for three Location Points (**Grid Location Points 4 and 5,** and **Cliff Dwellers Lodge**) close to new routes which would experience little air-tour noise Off-Peak Season.

TABLE 4.139 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				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	1	0	1	-1	18	12	18	9	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	8	-8	1	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	1	0	1	0	14	14	15	13	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	1	-1	1	-1	15	7	15	4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	2	-1	1	-3	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	1	-2	1	-2	5	-19	5	-21	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	1	-2	1	-2	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

TABLE 4.140 NPS PREFERRED ALTERNATIVE SLANT DISTANCES MARBLE CANYON

Location Point Name	Alternative A	NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Cliff Dwellers Lodge	3,695	1,059	-2,636
Grid Location Point 1	1,665	7,109	5,445
Grid Location Point 2	858	4,204	3,345
Grid Location Point 3	2,958	9,585	6,627
Grid Location Point 4	4,585	1,486	-3,099
Grid Location Point 5	2,335	1,499	-836
Marble Canyon Dam Site	3,845	4,218	374
North Canyon	999	5,962	4,963
South Canyon	816	4,742	3,926

Δ indicates change in noise metric data from Alternative A

East End NPS Preferred Alternative Wildlife

Beneficial impacts to East End Wildlife and habitat are clearly seen in modeled results due to short-loop tours only in Dragon Corridor during Peak Season and, conversely, Zuni Point Corridor Off-Peak Season (but long-loop tours from Zuni Point Corridor to Dragon Corridor would be allowed all year for quiet-technology aircraft).

Base Year Peak Season East End noise conditions in wildlife habitats would generally be similar to Alternative A. As shown in Appendix F, Wildlife would be exposed to aircraft Percent Time Audible greater than 25% of the day in the majority of piñon-juniper (83%), ponderosa pine (85%), cold-desert scrub (79%), and old-conifer forest (97%) habitats. The majority of these habitats would be exposed to Average Sound Level of 25 dBA or less similar to Alternative A. In river/riparian habitat, aircraft Percent Time Audible would be greater than 25% of the day in 56% of the habitat, and Average Sound Level would be 25 dBA or less in 62% of the habitat.

Ten-Year Forecast with implementation of quiet-technology incentives and conversion requirements, noise impacts would substantially decrease particularly in the area where aircraft Percent Time Audible would be greater than 25% of the day: piñon-juniper (54% Peak Season; 26% Off-Peak), ponderosa pine (27% Peak Season; 5% Off-Peak), cold-desert scrub (55% Peak Season; 36% Off-Peak), and old-conifer forest (64% Peak Season; 71% Off-Peak). These values are all much less than in Alternative A.

East End NPS Preferred Alternative Wildlife

Base Year Peak Season

As shown in Tables 4.141 and 4.142, areas where air-tour operations would have highest 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 air-tour Percent Time Audible of 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. Although moderate to major adverse impacts would occur under and near Dragon Corridor routes, there would be short- term negligible to minor beneficial change in impacts compared to Alternative A.

When Zuni Point Corridor short-loop routes would be inactive (but the long-loop would still be active), **under and near Zuni Point Corridor** at Location Points **Temple Butte** and **Grid Location Points 14 and 15** aircraft Percent Time Audible would be 58 to 67% of the day, a decrease of 3 to 8% compared to Alternative A. Aircraft Average Sound Level would be 37 to 39 dBA, an increase of up to 11 dBA from Alternative A. Wildlife activities could be interrupted by aircraft sounds portions of the day. Moderate to major adverse impacts would continue with negligible to minor beneficial change from Alternative A.

In Bright Angel Flight-free Zone, when Dragon Corridor is in use, air-tour aircraft Percent Time Audible would increase by 4% to 13% 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 34% in areas near **Grid Location Point 16**, 17% at **Point Imperial** Location Point, and 8% at **Grid Location Point 11** compared to Alternative A. Average Sound Level would range 10 to 44 dBA, similar to Alternative A, except at Point Imperial Location Point where sound levels would be reduced by 20 dBA from 38 to 18 dBA. Aircraft would generally be greater than 2,000 meters from locations on the ground, except for The Basin Location Point which would be less than 900 meters. Moderate 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 Location Points, and a moderate to major beneficial change in impacts compared to Alternative A at Point Imperial and Grid Location Point 16 Location Points. Amid Bright Angel Flight-free Zone away from tour routes would remain quiet, as represented by **Grid Location Points 12 and 13** and **Phantom Ranch** Location Points, with negligible impacts and negligible change in impacts from Alternative A.

East End NPS Preferred Alternative Wildlife

Ten-Year Forecast Peak Season

Under and near Dragon Corridor air-tour aircraft Percent Time Audible would decline to 41 to 88%, a 10 to 50% decrease from Alternative A, due to conversion to quiet-technology aircraft. Average aircraft sound levels would range 16 to 38 dBA; a decrease of 7 to 26 dBA from Alternative A. Aircraft Distance would be the same

as Base Year. Although moderate to major adverse impacts would continue, there would be short-term minor to moderate beneficial change in impacts compared to Alternative A.

Under and near Zuni Point Corridor, there would be reduction in air-tour aircraft noise primarily due to quiet-technology aircraft conversion. Aircraft Percent Time Audible would be 42 to 61% of the day, a 13 to 27% decrease compared to Alternative A. Average Sound Level would be 37 dBA, slightly increased compared to Alternative A. Wildlife would generally be disrupted less frequently during the day, which may improve feeding, breeding, and nesting. Although moderate to major adverse impacts would continue, there would generally be a short-term moderate beneficial change in impacts compared to Alternative A, although Average Sound Level would increase a negligible amount at **Grid Location Points 14 and 15**.

Aircraft audibility 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 18 to 40% of the day, a decrease of 21 to 39% from Alternative A (and a decrease of 29 to 32% from Base Year). Average air-tour sounds would be only slightly lower than Alternative A, and range 13 to 23 dBA. **Point Imperial** Location Point Percent Time Audible would be 11%, a reduction of 56% from Alternative A, with Average Sound Level 16 dBA, a 22 dBA reduction from Alternative A. 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 29% from Base Year (39% from Alternative A). Declines would be due primarily to quiet-technology conversion. Wildlife would be much less frequently disturbed during daily activities compared to Base Year and Alternative A. Although moderate adverse impacts would continue, there would be short-term moderate to major beneficial change in impacts compared to Alternative A in areas near air-tour routes. The middle of the Bright Angel Flight-free Zone would remain quiet, represented by **Grid Location Points 12 and 13**, with negligible impacts and negligible change in impacts from Alternative A and from Base Year Peak Season.

North Rim wildlife habitat would improve at **Point Imperial, The Basin,** and **Grid Location Point 16** Location Points. Aircraft Percent Time Audible would be 11 to 37% of the day, a 30 to 60% decrease from Alternative A. Average Sound Level would range 16 to 40 dBA, a 7 to 22 dBA decline. There would be much less interruption or disturbance of breeding, nesting, and foraging activities. Although moderate to major adverse impacts would continue, there would be short-term moderate to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Wildlife*

Base Year Off-Peak Season

Dragon Corridor would experience less air-tour use; air-tour aircraft Percent Time Audible would be 10 to 36% of the day, a 61 to 64% decrease from Alternative A. Average Sound Level would be 13 to 34 dBA, a 10 to 29 dBA reduction. When aircraft on long-loop tours are present, they would be at the same Distance as Peak Season. Wildlife would experience much less frequent disturbance from aircraft compared to Peak Season and Alternative A. Although moderate to major adverse impacts would continue, there would be short-term moderate to major beneficial change in impacts compared to Alternative A.

Aircraft noise would increase in **Zuni Point Corridor** as short-loop tour routes would be active in addition to long-loop routes. At Location Points **Grid Location Point 14** and **Temple Butte**, aircraft Percent Time Audible would be 52 to 77% of the day, a one to 7% increase compared to Alternative A. Average Sound Level would range 35 to 41 dBA similar to Alternative A. Moderate to major adverse impacts would continue with negligible change in impacts from Alternative A.

Aircraft Percent Time Audible in **Bright Angel Flight-free Zone** would increase to 81% of the day near **Cape Royal** Location Point; a 22% increase from Alternative A with Average Sound Level of 29 dBA similar to Alternative A. Air-tour aircraft may be more visible during this time of year as short-loop tour routes in Zuni Point Corridor would be active. Moderate to major adverse impacts would occur with minor to moderate adverse change in impacts compared to Alternative A.

There would be improvement in areas close to **Dragon Corridor**. At **Grid Location Point 11**, aircraft Percent Time Audible would be 9%, a 46% decrease compared to Alternative A, and Average Sound Level 13 dBA, a 5 dBA decrease from Alternative A. Wildlife activities and behaviors near Grid Location Point 11would be rarely

disrupted by aircraft, but as long-loop tours would continue year-round, **points across North Rim** and at some locations near Dragon Corridor would continue to receive noise impacts (e.g., **The Basin** Location Point would be at 29% Percent Time Audible and 40 dBA; **Tower of Ra** Location Point would be at 36% Percent Time Audible and 34 dBA; however, these would be reductions of 44 to 61% Percent Time Audible and 8 to 10 dBA compared to Alternative A). Although moderate to major adverse impacts would occur, there would generally be short-term moderate to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Wildlife*

Ten-Year Forecast Off-Peak Season

There would be further reduction in aircraft noise **in and near Dragon Corridor**. Aircraft Percent Time Audible would be 7 to 28% of the day, a reduction of 68 to 86% compared to Alternative A. Average Sound Level would range 11 to 30 dBA, a 14 to 31 dBA decrease from Alternative A. Although minor to moderate adverse impacts would occur, there would be short-term minor to major beneficial change in impacts compared to Alternative A.

Percent Time Audible in areas near and under **Zuni Point Corridor** would be 40 to 68%; a decline of 6 to 29% from Alternative A. Average aircraft sound levels would range 34 to 39 dBA, similar to Alternative A. Although moderate to major adverse impacts would continue under air-tour routes, there would generally be short-term negligible to moderate beneficial change in impacts from Alternative A.

Aircraft Percent Time Audible would decline along **Bright Angel Flight-free Zone** edges. Aircraft Percent Time Audible would be 54% of the day near Zuni Point Corridor at **Cape Royal** Location Point, a decrease of 7% from Alternative A. Near Dragon Corridor at **Grid Location Point 11**, Percent Time Audible would be 4%, a 52% reduction compared to Alternative A, with reductions of one to 10 dBA in Average Sound Level from Alternative A. **The Basin** and **Tower of Ra** Location Points would receive further reductions in noise from Base Year, with Percent Time Audible 19 to 28% and Average Sound Level 30 to 37 dBA, reductions of 57 to 70% Percent Time Audible and 11 to 14 dBA from Alternative A. Although moderate adverse impacts would occur near air-tour routes, there would be short-term minor to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Wildlife*

Base Year and Ten-Year Forecast Off-Peak Season

Conditions in habitats along **North Rim** would improve at Location Points **Point Imperial, The Basin,** and **Grid Location Point 16** as Percent Time Audible would decrease 15 to 48% compared to Base Year Peak Season, and 5 to 18% compared to Ten-Year Forecast Peak Season. Reductions in Percent Time Audible compared to Alternative A would be 33 to 59% Base Year, and 57 to 62 % Ten-Year Forecast Off-Peak Season. Although moderate to major adverse impacts would occur, there would be short-term moderate to major beneficial change in impacts compared to Alternative A.

TABLE 4.141 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL EAST END

Location Point Name	Alternative A				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	13	-22	13	-22
Nankoweap Mesa	87	90	43	43	78	-9	57	-33	31	-12	29	-14	79	-8	54	-36	28	-15	26	-17
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	10	-61	7	-68	30	-15	29	-16
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	36	-61	28	-70	34	-10	30	-14
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	84	-16	67	-33	28	-21	24	-25
Hermit Basin	99	100	42	42	96	-4	50	-50	20	-22	16	-26	35	-64	13	-86	13	-29	11	-31
North Rim																				
Cape Royal	59	61	25	26	72	13	40	-21	27	2	23	-3	81	22	54	-7	29	4	25	-1
Point Imperial	66	68	38	39	48	-17	11	-56	18	-20	16	-22	33	-33	6	-62	14	-24	14	-25
Bright Angel Point	47	48	24	24	58	12	18	-30	24	0	17	-7	59	12	9	-39	19	-4	15	-9
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	29	-44	19	-57	40	-8	37	-11
Grid Location Point 16	80	84	33	34	47	-34	24	-60	32	-1	24	-9	22	-59	12	-72	26	-7	21	-13
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	67	-3	61	-13	39	6	37	2	77	7	68	-6	41	8	39	4
Grid Location Point 15	65	69	28	29	58	-8	42	-27	39	11	37	8	52	-13	40	-29	36	8	34	6
Temple Butte	62	66	37	38	58	-5	45	-21	37	0	37	-1	63	1	45	-22	35	-3	35	-3
Lipan Point	74	77	34	35	78	5	57	-20	35	0	30	-5	87	14	65	-12	34	0	32	-3
South Rim																				
Tusayan Museum	64	67	35	36	67	3	47	-20	36	1	31	-5	79	15	54	-13	34	-1	31	-4
El Tovar	95	96	19	20	93	-2	16	-80	20	0	14	-6	44	-51	8	-87	13	-6	9	-10
Zuni Alpha	43	46	46	46	44	2	33	-13	49	3	47	0	57	14	42	-4	49	3	47	1
Ten X Meadow	64	68	49	49	60	-4	33	-35	52	3	51	2	66	1	41	-27	53	4	52	3
1.5 km SE of Moran Point	64	68	41	41	65	1	54	-15	40	-1	41	0	78	14	65	-3	46	5	46	5
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	89	9	6	-76	19	1	14	-5	60	-21	9	-73	16	-2	13	-7
Grid Location Point 11	55	56	18	18	47	-8	18	-39	20	2	13	-6	9	-46	4	-52	13	-5	9	-10
Grid Location Point 12	1	1	13	14	2	1	3	2	13	0	12	-1	2	1	2	1	12	-1	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	13	1	10	-3	5	5	1	0	12	0	11	-1
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	6	-6	1	-2	1	-3	7	-5	5	-7
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	27	-65	4	-88	17	-8	12	-13
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	21	-39	8	-52	10	-6	9	-8
Point Sublime	100	100	35	35	100	0	94	-6	35	-1	28	-7	73	-27	33	-67	24	-12	18	-17
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	1	-6	0	-7
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	5	-2	0	0	0	0	2	-4	2	-5

TABLE 4.142 NPS PREFERRED ALTERNATIVE SLANT DISTANCES EAST END

Location Point Name	Alternative A	NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	5,705	4,256
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	1,228	-230
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	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 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 21% Percent Time Audible at **Prospect Canyon** Location Point), with Average Sound Level zero to 16 dBA (except Prospect Canyon Location Point at 22 dBA and **South Supai Canyon** Location Point at 27 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.

TABLE 4.143 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				NPS Preferred Alternative															
					Peak Season								Off-Peak Season							
	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
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	1	0	0	-1	11	0	12	0	1	0	0	-1	11	-1	12	0
Mohawk Canyon	2	2	11	12	2	0	2	0	11	0	11	-1	1	-1	2	-1	10	-1	11	-1
Prospect Canyon	22	25	22	22	21	-1	25	0	22	0	22	-1	22	-1	23	-2	22	0	21	-1
The Dome	1	1	16	16	1	0	1	0	15	0	16	0	1	0	1	0	15	-1	16	0
Fossil Canyon	2	2	12	12	2	0	1	-1	13	1	10	-2	1	-1	1	-1	9	-3	9	-3
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	17	-1	23	3	12	0	13	0	14	-5	21	1	11	-2	12	-1
Grid Location Point 25	11	12	9	10	10	-1	13	1	9	0	10	0	8	-3	11	-1	9	-1	10	0
Grid Location Point 9	1	1	5	5	1	0	1	0	6	1	3	-2	1	0	1	0	3	-2	3	-3
South Supai Canyon	6	7	27	27	6	0	7	0	27	0	27	-1	6	0	7	0	28	1	26	-1

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

TABLE 4.144 NPS PREFERRED ALTERNATIVE SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	NPS 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

West End NPS Preferred Alternative Wildlife

A range of aircraft noise intensities and audibility would affect Wildlife and habitats. West End is a mixture of warm- and cold-desert shrub, 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 Blue-2, Green-4, and Blue Direct North. Base Year Peak Season, aircraft Percent Time Audible would be greater than 25% of the day in 37% of piñon-juniper habitat; 69% of cold-desert scrub; 45% of warm-desert scrub; and 28% of river/riparian habitat (due to masking by river sounds). However, in areas away from routes (Sanup Flight-free Zone), there is also a large amount of habitat that would experience very infrequent aircraft noise, with Average Sound Level relatively low (the majority of the area exposed to sound levels of 25 dBA or less). Conditions would be similar Off-Peak Season and Ten-Year Forecast.

West End NPS Preferred Alternative Wildlife
Base Year Peak and Off-Peak Season

Wildlife 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 and shown in Tables 4.145 and 4.146. Air-tour aircraft Percent Time Audible would be 71 to 93% of the day at Average Sound Level 42 to 49 dBA. Wildlife activities could be disrupted frequently which may result in displacement from suitable habitats for nesting and foraging that could affect population levels. Short-term major adverse impacts would continue with negligible change in impacts from Alternative A.

West End NPS Preferred Alternative Wildlife
Ten-Year Forecast Peak and Off-Peak Season

Near Green-4 and Blue-2, air-tour aircraft Percent Time Audible would decrease to 68 to 88%, a 7 to 10% decline from Alternative A. Average Sound Level would be similar to Alternative A. Although short-term major adverse impacts would continue under air-tour routes, there would generally be a short-term minor beneficial change in impacts compared to Alternative A.

West End NPS Preferred Alternative Wildlife
All Scenarios

Areas under Blue Direct North would experience impacts similar to Alternative A. As represented by **Grid Location Points 27 and 32**, aircraft Percent Time Audible would be 19 to 42% of the day, with Average Sound Level 26 to 27 dBA. Aircraft would be nearly 5,000 meters or greater from locations on the ground. Wildlife

activities could be interrupted frequently throughout the day by aircraft. Moderate adverse impacts would continue with negligible change from Alternative A.

Near Brown routes, represented by **Parashant Wash** and **Whitmore Rapids** Location Points, aircraft Percent Time Audible would be 11 to 12% at Average Sound Level 21 to 32 dBA, similar to Alternative A. Aircraft would be at least 1,800 to nearly 3,000 meters away. Wildlife would be disturbed for relatively small portions of the day. Minor to moderate adverse impacts would occur with negligible change from Alternative A.

Base Year Peak Season Wildlife and habitat located **under Sanup Flight-free Zone** and **areas near the south SFRA boundary** would be negligibly affected by air-tour operations. Air-tour aircraft would be rarely audible at Average Sound Level of less than one to 7 dBA as reflected in Location Point data at **Diamond Creek, Pumpkin Springs,** and **Grid Location Point 34**. Impacts of air-tour aircraft on wildlife in Sanup Flight-free Zone and to the south would be negligible with negligible change in impacts from Alternative A.

TABLE 4.145 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				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
Burnt Springs Canyon	70	75	46	47	71	1	68	-8	48	2	46	-1	69	-2	64	-11	47	1	44	-3
Bat Cave	93	95	47	48	93	0	88	-7	49	2	48	0	92	-1	86	-9	49	2	48	0
Grid Location Point 33	87	90	42	43	87	0	80	-10	42	0	39	-4	88	1	77	-13	42	0	38	-4
Whitmore Rapids	12	13	21	21	12	-1	12	-2	21	0	21	-1	9	-3	10	-4	20	-1	18	-3
Grid Location Point 27	20	23	26	27	19	-1	22	-1	26	0	26	0	21	0	21	-3	26	0	26	-1
Grid Location Point 28	14	16	17	18	13	-1	7	-9	17	0	18	0	13	-1	7	-9	17	0	18	0
Grid Location Point 31	37	41	42	43	35	-2	40	-1	42	0	41	-1	36	-1	37	-4	43	1	41	-2
Mt. Dellenbaugh	29	32	41	42	27	-2	31	-2	41	0	40	-1	29	0	28	-4	42	1	40	-2
Shivwits Fire Camp	35	39	38	38	33	-2	38	-1	37	0	37	-1	35	0	36	-4	39	1	37	-2
Grid Location Point 32	44	49	27	28	42	-2	47	-1	27	0	27	0	43	-1	44	-4	27	0	27	-1
Granite Peak	2	2	17	18	2	0	2	0	17	0	18	0	2	0	2	0	17	0	18	0
NPS Administration site	44	49	31	32	42	-2	47	-1	31	0	31	-1	43	-1	44	-5	32	1	31	-1
Castle Peak	27	30	18	48	26	-2	26	-5	18	0	19	-29	28	1	23	-7	18	0	19	-29
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	11	-1	14	0	32	0	32	-1	12	-1	13	-1	34	1	31	-2
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	8	0	0	0	0	0	7	0	8	0
Meriwhitca	0	1	7	8	0	0	1	0	7	0	7	0	0	0	1	0	7	0	7	0
Andrus Canyon	22	24	17	17	20	-2	20	-4	16	-1	17	0	22	0	18	-6	16	-1	17	0

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

TABLE 4.146 NPS PREFERRED ALTERNATIVE SLANT DISTANCES WEST END

Location Point Name	Alternative A	NPS Preferred Alternative	
	Slant Distance (m)	Slant Distance (m)	
		Base Year	Δ
Burnt Springs Canyon	1,215	1,421	206
Bat Cave	1,134	827	-307
Grid Location Point 33	1,105	1,107	2
Whitmore Rapids	1,804	1,804	0
Grid Location Point 27	3,388	4,923	1,535
Grid Location Point 28	8,327	16,314	7,987
Grid Location Point 31	502	502	0
Mt. Dellenbaugh	824	824	0
Shivwits Fire Camp	1,669	1,669	0
Grid Location Point 32	2,016	6,332	4,316
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	34,512	7,404
Parashant Wash	2,852	2,852	0
Pumpkin Springs	12,630	19,695	7,065
Meriwhitca	15,742	15,550	-192
Andrus Canyon	1,393	1,392	-1

Δ indicates change in noise metric data from Alternative A

Cumulative Impact NPS Preferred Alternative Wildlife

In all areas, noise from aircraft flying above and outside the SFRA would continue to have long-term moderate adverse impact on Wildlife as described in Alternative A. Noise from other non-aircraft sources (vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Especially in terms of Percent Time Audible, though, noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under NPS Preferred Alternative contributes by far the most non-natural noise over most of the SFRA and overwhelms any localized benefits realized under Alternatives.

Noise from aircraft flying above and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under the NPS Preferred Alternative as discussed above, would generally have long-term moderate adverse cumulative impacts on Wildlife throughout all four areas (Marble Canyon, East End, Central, and West End), except under East and West End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A.

Conclusion NPS Preferred Alternative Wildlife

Overall, the NPS Preferred Alternative would result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high Percent Time Audible and high Average Sound Level. Ten-Year Forecast the NPS Preferred Alternative would result in improvement in wildlife habitat and reduction of impacts on wildlife as aircraft noise is reduced by implementation of quiet-technology incentives and conversion requirements. Ten-Year Forecast Peak Season, 33% of the park would have air-tour aircraft Percent Time Audible greater than 25% of the day, and Average Sound Level would generally be less than 25 dBA in about 69% of the SFRA. Greatest exposure to noise and visual impacts would occur predominantly under and near heavily-used air-tour routes East and West Ends where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75% of the day. However, there would also be large portions of habitat relatively undisturbed by air-tours in Marble Canyon and the Central area.

Cumulative impacts from all actions in all areas, when combined with impacts of the NPS Preferred Alternative, would generally be long-term moderate adverse, except under East and West End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A. Because they would be audible a very high percentage of the day, the combination of aircraft sounds from all sources would generally be the overriding cumulative influence on Wildlife and habitat.

Conclusion **NPS Preferred Alternative** **Wildlife**

Conclusion *NPS Preferred Alternative* *Wildlife*

Marble Canyon

All Scenarios, the NPS Preferred Alternative would generally result in negligible to minor adverse impacts with negligible to minor beneficial changes in impacts to Marble Canyon wildlife compared to Alternative A. However, in areas close to the new route, impacts would be minor adverse with a minor adverse change in impacts compared to Alternative A. Cumulative impacts from all actions would generally be long-term moderate adverse.

Conclusion *NPS Preferred Alternative* *Wildlife*

East End

East End there would be localized beneficial change in impacts to Wildlife and habitat due to rotational use of short-loop air-tour routes in Zuni Point and Dragon Corridors. Base Year Peak Season impacts to Wildlife and habitat beneath and adjacent to active Dragon Corridor short-loop routes would be short-term moderate to major adverse with negligible to minor beneficial change in impacts compared to Alternative A. Ten-Year Forecast with conversion to quiet-technology aircraft, there would still be moderate to major adverse impacts under and near the corridor, but there would be minor to moderate beneficial change in impacts compared to Alternative A. Off-Peak Season, when Dragon Corridor would be closed to short-loop tour use, there would be moderate to major adverse impacts Base Year, and minor to moderate adverse impacts Ten-Year Forecast, with long-term minor to major beneficial change in impacts compared to Alternative A.

Peak Season when Zuni Point Corridor short-loop tour routes would be inactive, there would generally be moderate to major adverse impacts with negligible to moderate beneficial change in impacts compared to Alternative A in Zuni Point Corridor Base Year and Ten-Year Forecast, due to use of long-loop tour routes. Off-Peak Season, when Zuni Point Corridor short-loop tour routes would be active, impacts would continue moderate to major adverse with negligible to moderate beneficial change in impacts compared to Alternative A Base Year and Ten-Year Forecast.

Under and near North Rim routes, moderate to major adverse impacts would occur to wildlife Base Year Peak Season with a negligible change in impacts from Alternative A but, Ten-Year Forecast Peak Season, although impacts would remain at moderate to major adverse levels they would decrease and there would be a moderate to major beneficial change in impacts at many points compared to Alternative A due to conversion to quiet-technology aircraft. Off-Peak Season, although there would be moderate to major adverse impacts, there would be moderate to major beneficial change in impacts compared to A in areas along North Rim, Base Year and Ten-Year Forecast.

At locations in Bright Angel Flight-free Zone and near air-tour routes, there would be short-term moderate adverse impacts Peak Season, a moderate to major beneficial change in impacts compared to Alternative A Base Year and Ten-Year Forecast. Off-Peak Season there would be moderate adverse impacts with minor to major adverse change in impacts compared to Alternative A at Location Points near Zuni Point Corridor with active short-loop air-tour routes Base Year and Ten-Year Forecast.

In other East End areas removed from air-tour routes, such as amid Bright Angel Flight-free Zone, there would be negligible to minor adverse impacts with negligible change from Alternative A Base Year, and negligible impacts with minor to major beneficial change in impacts from Alternative A Ten-Year Forecast.

Cumulative impacts from all actions would generally be long term moderate adverse, except under East End air-tour routes where there would be major adverse cumulative impacts as described in Alternative A.

Conclusion *NPS Preferred Alternative* *Wildlife*
Central
All Scenarios, there would generally be negligible to minor adverse impacts in the Central area with negligible change in impacts on Wildlife and habitat compared to Alternative A. Cumulative impacts from all actions would generally be long term moderate adverse.

Conclusion *NPS Preferred Alternative* *Wildlife*
West End
All Scenarios, in areas under and near Green-4 and Blue-2 routes, there would be short-term major adverse impacts with minor beneficial change in impacts compared to Alternative A. All Scenarios, in areas near Brown routes, wildlife would experience minor to moderate adverse impacts with negligible change in impacts compared to Alternative A. All Scenarios, under Blue Direct North, wildlife would experience moderate adverse impacts with negligible change in impacts compared to Alternative A. All Scenarios, Wildlife in Sanup Flight-free Zone and near the southern SFRA boundary would generally experience negligible impacts with negligible change in impacts compared to Alternative A.

Cumulative impacts from all actions would generally be long term moderate adverse except under West End air-tour routes where there would be major adverse cumulative impacts as described in Alternate A.

SPECIAL-STATUS SPECIES

General Methodology

As described in Chapter 3, area of analysis for Special Status Species includes the park, but may also extend to the SFRA and throughout the Study Area. To the extent habitat and species occurrences correlate, impacts to park species and habitats are expected to be similar in the entire Study Area. Effects of aircraft noise and proximity to Special Status Species and their habitats are analyzed in the context of natural variability and ecosystem integrity, as well as effects on individuals and populations. Responses to impacts may sometimes be species-specific. This analysis applies to Federal, state, and tribal listed species and, in the context of NPS lands, other Special Status Species as discussed in Chapter 3. Impacts are assessed for each Alternative by species: American peregrine falcon, California condor, and Mexican spotted owl. Other Special Status Species (see Appendix E) are not included here for reasons described in Chapter 1, Impact Topics Considered and Dismissed from Detailed Analysis.

Analysis relies on noise modeling results at Location Points in the park and SFRA. Noise data by Location Point is often presented as a range to provide understanding of level of effect for specific areas influenced by air-tour operations. In addition, as presented in Appendix F, spatial analysis for Mexican spotted owls and California condors was conducted using noise contour data (Chapter 4, Methodology) to determine percent of each Special Status Species use area within a range of sound metrics (Average Sound Level and Percent Time Audible) for each geographic area (Marble Canyon, East End, Central, and West End).

General Assumptions

In the thresholds below, and as described in Chapter 4,Wildlife, General Assumptions, all aspects of aircraft noise intensity and duration including, but not limited to, audibility, aircraft Average Sound Level (sound energy metrics), and timing are considered in the phrase *impacts due to the event*. Audibility is the ability of animals and humans with normal hearing to hear a given sound. Audibility is affected by the animal's hearing ability, other simultaneous interfering sounds or stimuli, sound frequency content and amplitude, and whether the sound contains information the animal has learned to pay attention to or ignore. Sound energy metrics include Average Sound Level and Percent Time Audible decibel levels.

Percent Time Audible relates to human hearing (audibility) used here as a surrogate for sounds heard by wildlife, understanding different animals can hear sounds at different sound frequencies and levels, and some hear sounds at frequencies humans cannot. Use of human audibility as a surrogate for impacts related to wildlife audibility is reasonable for this impact analysis because the type of noise generated by aircraft mostly falls within the human hearing range, and wildlife species of interest in this analysis can also hear quite well in the human hearing range even though some can also hear in ranges humans cannot.

A measure of Distance between representative Special Status Species habitat Location Points and aircraft routes is used as an indicator related to effects of aircraft in close proximity to sensitive wildlife species or habitats, including aircraft visibility and presence to wildlife on the ground. While there is usually close correlation between distance and sound intensity, this distance measure is included primarily to address effects other than aircraft sound. Distance of aircraft to locations on the ground is also used as an indicator of potential for collisions with California condor and peregrine falcon. In late 1999 and early 2000, a formal section 7 consultation (2-21-97-F-085) was conducted by Grand Canyon National Park and the U.S. Fish and Wildlife Service Arizona Ecological Services Office regarding new flight rules for commercial air-tours in the vicinity of the park. During this process potential for collisions with aircraft was identified as an issue of concern. Bird strikes have occurred in Grand Canyon National Park in the past; however, they were not considered significant enough to report to the FAA (61 FR 54044). As condors, falcons, and air-tour aircraft may occupy the same airspace, potential exists for collisions; therefore, this issue is addressed in analysis for these species.

Although wildlife would tend to habituate (i.e., become accustomed to or tolerant of noise) to frequent audible aircraft with lower Average Sound Level (especially those not close to the ground), habituation in natural areas in a national park is an adverse impact (Barber, Turina, and Fristrup 2009/2010).

Impact Intensity Threshold Descriptions **Special Status Species**

Professional judgment and knowledge of Grand Canyon wildlife and habitat was applied in using intensity thresholds described below to make impact determinations for Special Status Species where data related to specific situations fell into more than one intensity threshold (negligible, minor, moderate, major). Not all conditions need to be met for an impact threshold level to apply. For example, where Percent Time Audible is at levels considered major in the thresholds (greater than 25% Percent Time Audible), but Average Sound Level and Distance are at levels considered negligible (less than or equal to 15 dBA and greater than or equal to 2,000 meters), then impact level would generally be considered moderate adverse, when reasonably consistent with other portions of thresholds for moderate levels (observable and measurable impacts, no risk of extirpation, changes outside natural variability, etc.), absent any over-riding information more relevant to impact determination indicating a different level.

Similarly, where Percent Time Audible is at levels considered moderate in the thresholds (greater than 10% and less than or equal to 25% Percent Time Audible), but Average Sound Level and Distance are at levels considered negligible (less than or equal to 15 dBA and greater than or equal to 2,000 meters), then impact level would generally be considered minor adverse, when reasonably consistent with other portions of thresholds for minor levels (observable or measurable impacts, changes not outside natural variability and no effects at the population level, etc.), absent any over-riding information more relevant to impact determination indicating a different level.

Threshold Levels **Special Status Species**

Negligible Impacts due to the event have no observable effects to a Special Status Species or habitat

Impacts outside critical periods such as breeding season

Distance from points of interest to aircraft routes greater than or equal to 2000 meters

Aircraft noise rarely audible, i.e., aircraft audible less than or equal to 5% of the 12-hour day in this analysis

Aircraft noise intensity in a specific area is less than or equal to 15 dBA

Minor Impacts due to the event have observable or measurable effects to individuals of a Special Status Species or localized habitats

Severity and timing of changes to parameter measurements not outside natural variability and have no effects on species at the population level, including distributions, behaviors, habitat, or ecosystem processes

	Impacts outside critical periods such as breeding season
	Distance from points of interest to aircraft routes greater than or equal to 1,000 meters and less than 2,000 meters
	Aircraft noise audible for a small portion of applicable time periods, i.e., aircraft audible greater than 5% and less than or equal to 10% of the 12-hour day
	Aircraft noise intensity in a specific area greater than 15 dBA and less than or equal to 25 dBA
Moderate	Impacts due to the event observable and measurable to individuals or a population of a Special Status Species or its habitat
	No species is at risk of being extirpated
	Severity and timing of changes to parameter measurements sometimes fall outside natural variability, and changes within natural variability might be long term
	Measurable changes occur from natural variability (which could be from displacement) on species' populations including numbers, structure, distributions, behaviors, genetic variability, or other demographic factors
	Some impacts affect critical periods, key habitat, ecosystem processes, or activities necessary for survival, but effects are temporary and populations expected to return to pre-disturbance conditions, and remain indefinitely stable and viable
	Distance from points of interest to aircraft routes greater than or equal to 500 meters and less than 1,000 meters
	Aircraft noise audible for an intermediate portion of applicable time periods, i.e., aircraft audible greater than 10% and less than or equal to 25% of the 12-hour day Aircraft noise intensity in a specific area greater than 25 dBA and less than or equal to 35 dBA
Major	Impacts due to the event readily measurable to a population of a Special Status Species or its habitat
	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
	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
	In severe adverse cases, species at risk of extirpation, key ecosystem processes could be disrupted, or habitat for one or more species rendered not functional
	Substantial impacts could occur during critical time periods
	Distance from points of interest to aircraft routes less than 500 meters
	Aircraft noise audible for a large portion of applicable time periods, i.e., aircraft audible greater than 25% of the 12-hour day
	Aircraft noise intensity in a specific area greater than 35 dBA

Type of Impact **Special Status Species**

Adverse Impacts adversely affect size, continuity, or integrity of Special Status Species or habitat outside 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

Beneficial Impacts positively affect size, continuity, or integrity of individual Special Status Species 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

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	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 4.148 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	4,585
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**
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.

East End, areas more distant from air-tour routes would experience lower levels of air-tour noise. In **Toroweap/Shinumo Flight-free Zone's eastern portion**, away from Dragon Corridor and amid Bright Angel Flight-free Zone, represented by Location Points **Phantom Ranch, Grid Location Points 12 and 13,** and **Bass Camp**, falcons would experience quiet conditions. Air-tour sounds would interrupt or disturb falcon behaviors less often with air-tour aircraft Percent Time Audible less than 5% of the day with Average Sound Level 7 to 13 dBA. In these areas, air-tour aircraft would be very far from locations on the ground, approximately 8,000 to over 13,000 meters. Individuals may be disturbed from normal behaviors, but would be expected to return to within normal ranges after air-tour activity with no population-level changes. In these areas, short-term impacts on falcons would be negligible to minor adverse.

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 East End.

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	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

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

Central Alternative A Special Status Species
Peregrine Falcon
Base Year

In the **Central area**, falcons would be little affected by air-tour and general-aviation aircraft noise. This area comprises **Toroweap/Shinumo Flight-free Zone**'s middle and western portions, as well as **Fossil Canyon and Tuckup General Aviation Corridors**. Based on Location Point data in Tables 4.151 and 4.152, Percent Time Audible would range less than one to 11%, and falcons would be exposed to low air-tour Average Sound Level less than one to 13 dBA. Aircraft in the Central area would be greater than 7,000 meters Distant. With limited presence of air-tour noise at low Average Sound Level, and air-tour aircraft distant from locations on the ground, there would be little potential for falcon disturbance with no expected effect on population levels. Individuals may be disturbed from normal behaviors, but would be expected to return to normal ranges after air-tour activity. Impacts to falcons would be short-term negligible to minor adverse.

Central 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.

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

TABLE 4.152 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	9,625
Upper Deer Creek	23,683

West End Alternative A Special Status Species

Peregrine Falcon

Base Year

West End, falcons would be affected by heavy helicopter traffic for river access near Grand Canyon West and, to a lesser extent, the Whitmore area, and by direct fixed-wing flight routes between Las Vegas and Grand Canyon Airport. However, a large West End portion would be mostly free from air-tour noise under Sanup Flight-free Zone.

In areas under Green-4 and Blue-2, represented by Location Points **Bat Cave, Burnt Springs Canyon,** and **Grid Location Point 33** and shown in Tables 4.153 and 4.154, air-tour aircraft Percent Time Audible would be 70 to 93% of the day with aircraft Average Sound Level 42 to 47 dBA. Aircraft would be approximately 1,100 to 1,215 meters from the ground. Under and close to these routes, there would be potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering. This level of aircraft noise may result in long-term changes in population numbers and structure. As a result, short- and long-term moderate to major adverse impacts on falcons would occur due to noise persistence at high sound levels in areas close to Green-4/Blue-2.

In areas **under Blue Direct routes** where falcon territories occur, represented by **Grid Location Points 27 and 32**, air-tour aircraft Percent Time Audible would be 20 to 44% of the day at Average Sound Level 26 to 27 dBA. In these areas aircraft would be at 2,016 to 3,388 meters from points on the ground. Impacts to falcons in areas 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 sounds, 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

Other than air-tour aircraft sounds, impacts on peregrine falcons and habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park),

although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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 peregrine falcons by creating openings for foraging.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative A contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on peregrine falcons and habitat. Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative A as discussed above, would generally have long-term moderate adverse cumulative impacts on peregrine falcons throughout all four areas (Marble Canyon, East End, Central, and West End) except under East End air-tour routes where there would be major adverse cumulative impacts.

Cumulative Impacts Marble Canyon *Alternative A* *Special Status Species*
Peregrine Falcon
At Marble Canyon Location Points, noise from aircraft above and outside the SFRA is audible 16 to 36% of the day. Alternative A would generally result in negligible to minor adverse impacts to falcons in Marble Canyon. When impacts of Alternative A are combined with impacts of other aircraft above and outside the SFRA, with impacts from non-aircraft noise sources, and with beneficial impacts of fire management activities, cumulative impacts would be long term moderate adverse, Base Year and Ten-Year Forecast.

Cumulative Impacts East End *Alternative A* *Special Status Species*
Peregrine Falcon
East End, aircraft above and outside of the SFRA are audible 27 to 71% of the day. Alternative A would generally result in impacts to falcons in East End that would range up to major adverse in areas beneath and adjacent to air-tour routes. When impacts of Alternative A are combined with impacts of other aircraft above and outside the SFRA, impacts from non-aircraft noise sources, and beneficial impacts of fire management activities, cumulative impact would generally be long term moderate adverse, except under East End air-tour routes where there would be major adverse cumulative impacts, Base Year and Ten-Year Forecast.

Cumulative Impacts Central *Alternative A* *Special Status Species*
Peregrine Falcon
In the Central area, noise from aircraft above and outside of the SFRA is audible 16 to 65% of the day. Alternative A would generally result in short-term negligible to minor adverse impacts to falcons. When impacts of Alternative A are combined with impacts of other aircraft above and outside the SFRA, with impacts from non-aircraft noise sources, and beneficial impacts of fire management activities, cumulative impacts would generally be short term moderate adverse Base Year and Ten-Year Forecast.

Cumulative Impacts West End *Alternative A* *Special Status Species*
Peregrine Falcon
At West End Location Points, noise from aircraft above and outside of the SFRA is audible 12 to 51% of the day. Alternative A would generally result in moderate adverse impacts to falcons at Location Points under Green-4, Blue-2, and Blue Direct routes. But in areas under Sanup Flight-free Zone impacts would be negligible. When impacts of Alternative A are combined with impacts of other aircraft above and outside the SFRA, with impacts from non-aircraft noise sources, and beneficial impacts of fire management activities, cumulative impacts would generally be long term moderate adverse with up to major adverse under West End tour routes Base Year and Ten-Year Forecast.

Conclusion **Alternative A** **Special Status Species**
Peregrine Falcon

Peregrine falcons occur along the river and canyons throughout the park and SFRA. In Marble Canyon, Central areas, and West End's southern portions (Sanup Flight-free Zone), Average Sound Level would generally be less than 15 dBA, and aircraft would be audible less than 5% of the day. There would be little disturbance to falcons or their habitat. Greatest exposure to aircraft noise and visual impacts would occur near heavily-used air-tour routes in East End and portions of West End where Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75%. Under Alternative A, falcon populations would stay stable, but in East End air-

tour route areas and West End portions, falcon populations and behaviors could be disrupted with falcons displaced from suitable habitats and from establishing additional nesting sites. Although aircraft operations and Average Sound Level would increase a small amount over all areas, impacts would not change appreciably Base Year to Ten-Year Forecast.

Conclusion Marble Canyon *Alternative A* *Special Status Species*
Peregrine Falcon
Base Year and Ten-Year Forecast Alternative A would result in short-term negligible to minor adverse impacts on peregrine falcons in Marble Canyon. Impacts would increase a small amount Ten-Year Forecast, but would generally remain at the same impact intensity levels. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion East End *Alternative A* *Special Status Species*
Peregrine Falcon
Base Year there would be short- and long-term moderate to major adverse impacts to falcons, particularly in areas beneath and adjacent to air-tour routes. In areas away from air-tour routes including beneath Bright Angel Flight-free Zone impacts would 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. Cumulative impacts from all actions would generally be moderate adverse, except under air-tour routes where there would be major adverse cumulative impacts.

Conclusion Central *Alternative A* *Special Status Species*
Peregrine Falcon
Base Year and Ten-Year Forecast, Alternative A would result in short-term negligible to minor adverse impacts on falcons in the Central area. Impacts would increase a small amount Ten-Year Forecast, but would generally remain at the same impact intensity level. Cumulative impacts from all actions would generally be long term moderate adverse.

Conclusion West End *Alternative A* *Special Status Species*
Peregrine Falcon
Base Year, Alternative A would result in moderate to major adverse impacts to falcons beneath Green-4 and Blue-2. In areas under Blue Direct routes where falcon territories occur, aircraft would be farther away from points on the ground. Impacts to falcons in areas under and near air-tour routes would be short-term moderate adverse. Short- and long-term minor to moderate adverse impacts would result under and near Brown routes. Impacts under Sanup Flight-free Zone would be negligible. Impacts would increase a small amount Ten-Year Forecast, but would generally remain at the same impact intensity level as Base Year. Cumulative impacts from all actions would generally be long term moderate with up to major adverse under West End tour routes.

ALTERNATIVE E **PEREGRINE FALCON** **SPECIAL STATUS SPECIES**
ALTERNATING SEASONAL USE

Overall Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced amount of area exposed to high Average Sound Level for long periods of the day. This would result in greatly reduced impacts on falcons with greater areas of the park mostly free from air-tour aircraft sights and sounds.

Marble Canyon **Alternative E** **Special Status Species**
Peregrine Falcon
All Scenarios

Under Alternative E, **Marble Canyon** would be in Bright Angel Flight-free Zone where air-tour aircraft Percent Time Audible would generally be less than 5% and Average Sound Level below 13 dBA, a 3 to 24 dBA decrease from Alternative A as shown in Tables 4.155 and 4.156. Aircraft would be barely audible and at very low levels. Air-tour aircraft would generally not be visible from points on the ground. Improvements over Alternative A would occur at all Location Points, and most at **North** and **South Canyon** Location Points. Although negligible to minor adverse impacts would continue, there would be short-term negligible to minor beneficial change in impacts to peregrine falcons compared with Alternative A.

TABLE 4.155 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	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	-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

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
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 the change in noise metric data from Alternative A

East End **Alternative E** **Special Status Species**
Peregrine Falcon

In the majority of East End, falcons would experience a decrease in adverse effects from air-tour operations at some point during the year dependent on when air-tour routes would be in use.

East End *Alternative E* *Special Status Species*
Peregrine Falcon
Base Year Peak Season

Areas where air-tour operations would have the highest level of effect would be under and adjacent to **Zuni Point Corridor** air-tour routes, represented by **Temple Butte, Grid Location Point 14,** and **Tusayan Museum** Location Points as shown in Table 4.157 and 4.158. This results from high Percent Time Audible of air-tour noise during the day of 75 to 84%, an 11 to 20% increase from Alternative A. Average Sound Level would be 38 to 42 dBA, an increase of one to 7 dBA from Alternative A. Air-tour aircraft would be closer to points on the ground than in Alternative A at Temple Butte (450 meters closer) and Tusayan Museum (1,566 meters closer). Because routes become active rather abruptly when falcons have established residency, there may be a higher level of reaction, and some falcons could abandon area use resulting in localized population changes. Given air-tour aircraft Distance from the ground, there would also be potential for collision with aircraft. Under and near air-tour routes in Zuni Point Corridor, moderate to major adverse impacts would continue with short-term minor to moderate change in impacts compared to Alternative A due to increased aircraft Percent Time Audible.

When Dragon Corridor routes would not be in use, aircraft would be audible under and near **Dragon Corridor** zero to 13% of the day, a decrease of 71 to 96% compared to Alternative A at **Hermit Basin, Tower of Ra, and 96-mile Camp** Location Points. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from Alternative A. As Dragon Corridor routes would be inactive at this time, aircraft would be far less visible than in Alternative A at locations on the ground. Due to substantial reduction in time and level of audible aircraft sound and reduced visual impact, falcons would experience near natural conditions with limited to no disruption in behaviors as a result of air-tour operations. When falcons are present July through mid-September, falcon behaviors would be less often interrupted due to air-tour aircraft. Although negligible to minor adverse impacts would continue, this would result in short-term major beneficial change in impact from Alternative A.

In **Bright Angel Flight-free Zone**, where numerous falcon territories exist, there would be a decline in air-tour noise. When Zuni Point Corridor is in use, air-tour aircraft Percent Time Audible at **Grid Location Point 11** would decline from 55% in Alternative A to 6% under Alternative E, a decrease of 49%. Average Sound Level would be 9 dBA, a 9 dBA decrease from Alternative A. This would expand the East End area where peregrine falcons could roost and forage with substantially fewer disruptions in daily activities due to air-tour noise. Although negligible to minor adverse impacts would continue, there would be short-term moderate to major beneficial change in impacts compared to Alternative A in Bright Angel Flight-free Zone due to reduced Percent Time Audible. The middle of Bright Angel Flight-free Zone would remain quiet, as represented by **Grid Location Points 12 and 13**, which would experience negligible impacts and negligible change in impacts from Alternative A.

East End *Alternative E* *Special Status Species*
Peregrine Falcon
Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible near **Zuni Point Corridor** Location Points would decline to 50 to 66%, an 8 to 18% decrease from Alternative A, due to quiet-technology aircraft conversion. Average aircraft sound levels would range 35 to 40 dBA; similar to Alternative A. Distance of aircraft would be the same as Base Year. Given the Percent Time Audible decrease, there may be less of a reaction from falcons to routes becoming abruptly active. Although moderate to major adverse impacts would occur under and near Zuni Point Corridor, there would be short-term minor beneficial change in impacts compared to Alternative A. Although there would be higher level of reduction in audibility Ten-Year Forecast, change that may occur to populations as a result of routes becoming active reduces level of expected benefit from decline in aircraft audibility.

In areas under and near **Dragon Corridor** and **Bright Angel Flight-free Zone** Location Points, beneficial change in impacts would be similar to Base Year Peak Season.

East End *Alternative E* *Special Status Species*
Peregrine Falcon
Base Year Off-Peak Season

Routes in and near **Zuni Point Corridor** Location Points would be inactive, and air-tour aircraft Percent Time Audible would be one percent of the day or less, a 62 to 69% decrease from Alternative A. Average Sound Level would be 3 to 7 dBA, a 62 to 69 dBA reduction. Visual aircraft impacts would be mostly eliminated for this period. Peregrine falcons would experience very quiet conditions with little to no disturbance from air-tour aircraft. March through June, when falcons would be present Off-Peak Season, falcon nesting and rearing of chicks may improve in Zuni Point Corridor without interference from aircraft which may result in positive population-size changes. There would be negligible impacts under and near Zuni Point Corridor with short-term major beneficial change in impacts compared to Alternative A.

When **Dragon Corridor** would be in use and falcons present (March through June), air-tour aircraft Percent Time Audible at **Tower of Ra** and **Hermit Basin** Location Points would be 61 to 71%, a decrease of 28 to 36% from Alternative A. Aircraft Average Sound Level would be 23 to 46 dBA, a decrease of 19 dBA from Alternative A at **Hermit Basin** Location Point, probably due to the Dragon Corridor dogleg. At **96-mile Camp** Location Point along the river, Percent Time Audible would decline to 26% from 72% in Alternative A although Average Sound Level would be remain relatively high at 37 dBA. Air-tour aircraft would be more Distant than in Alternative A at locations on the ground. Although Percent Time Audible and Average Sound Level decline, falcons may avoid establishing territories and eyries under and near routes as more suitable areas would be available elsewhere without interference from aircraft sights and sounds. Although moderate to major adverse impacts on falcons would continue under Dragon Corridor air-tour routes, there would be short-term moderate to major beneficial change in impacts from Alternative A.

When Dragon Corridor would be active, **Bright Angel Flight-free Zone** areas close to air-tour routes (**Grid Location Point 11**) would experience aircraft sounds 23% of the day, a 32% decrease from Alternative A, and at 12 dBA, a 6 dBA decline due to fewer aircraft operations and higher altitudes air-tour aircraft would be required to fly. Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A could result in increased potential that peregrine falcons would establish territories and eyries March through June in this area. With less frequent falcon behavior interruption there may be increased localized population levels. This would represent minor to moderate adverse impact with moderate beneficial change in impacts to falcons compared to Alternative A. The midst of Bright Angel Flight-free Zone would remain quiet, as represented by **Grid Location Points 12 and 13**, with negligible change in impacts from Alternative A.

East End *Alternative E* *Special Status Species*
Peregrine Falcon
Ten-Year Forecast Off-Peak Season

In areas under and near **Zuni Point Corridor**, beneficial change in impacts would be similar to Base Year Off-Peak Season.

Aircraft Percent Time Audible in areas near and under **Dragon Corridor** would be 17 to 49%, a decline of 49 to 67% from Alternative A. Average Sound Level would range 18 to 44 dBA, a one to 24 dBA decrease. Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A would result in increased potential peregrine falcons would establish territories and eyries March through June. With less frequent interruption in falcon behavior, there may be increase in localized population levels. This improvement would be substantial in areas where Percent Time Audible is greatly reduced such as near **96-mile Camp** Location Point along the river. Although moderate adverse impacts would continue, this would be short-term moderate to major beneficial change in impacts from Alternative A.

Beneficial changes in impacts in **Bright Angel Flight-free Zone** would generally be similar to Base Year Off-Peak Season, except Percent Time Audible would be reduced to 16% at **Grid Location Point 11** (a 7% decrease from Base Year, and a 41% decrease compared to Alternative A), due primarily to conversion to quiet-technology aircraft.

TABLE 4.157 ALTERNATIVE E AVERAGE SOUND LEVEL EAST END

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	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	61	-36	49	-49	46	2	44	-1
Hermit Basin	99	100	42	42	13	-87	16	-83	10	-32	10	-32	71	-28	32	-67	23	-19	18	-24
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
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	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	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
South Rim																				
Tusayan Museum	64	67	35	36	84	20	50	-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	-7	53	12	51	10	4	-60	6	-62	5	-36	4	-37
Bright Angel Flight Free Zone																				
Cape Royal	59	61	25	26	77	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	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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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	-198
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	9,014	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

Central Alternative E Special Status Species

Peregrine Falcon

All Scenarios

Similar to Alternative A, peregrine falcon territories throughout most of the Central area would be little affected by aircraft noise. Peak Season, when Dragon Corridor would not be in use, there would generally be little difference in sound metrics compared to Alternative A. As shown in Table 4.159 and 4.160 air-tour aircraft Percent Time Audible would be less than 5% of the day, with aircraft Average Sound Level zero to 14 dBA. Air-tour aircraft would be greater than 7,000 meters Distant. Falcon daily behaviors such as foraging and roosting would be little affected by air-tour aircraft. Negligible impacts would occur with negligible change in impacts from Alternative A.

TABLE 4.159 ALTERNATIVE E AVERAGE SOUND LEVEL CENTRAL

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	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	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	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	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

TABLE 4.160 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

West End **Alternative E** **Special Status Species**
Peregrine Falcon
Base Year Peak Season

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.

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.

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.

West End *Alternative E* *Special Status Species*
Peregrine Falcon
Ten-Year Forecast Peak Season

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.

Impacts at **Whitmore Rapids** and **Parashant Wash** Location Points would be similar to Base Year Peak Season.

West End *Alternative E* *Special Status Species*
Peregrine Falcon
Base Year Off-Peak Season

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.

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.

West End *Alternative E* *Special Status Species*
Peregrine Falcon
Ten-Year Forecast Off-Peak Season

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.

Impacts at **Whitmore Rapids** and **Parashant Wash** Location Points would be similar to Base Year Off-Peak Season.

West End *Alternative E* *Special Status Species*
Peregrine Falcon
Base Year and Ten-Year Forecast Off-Peak Season and Ten-Year Forecast Peak Season
Grid Location Points 27 and 32 impacts would be similar to Base Year Peak Season.

West End *Alternative E* *Special Status Species*
Peregrine Falcon
All Scenarios
Peregrine falcon territories and habitat located near **Sanup Flight-free Zone** would be negligibly affected by air-tour operations. Air-tour aircraft Percent Time Audible would be zero percent of the day with Average Sound Level of zero to 7 dBA as reflected in data at **Diamond Creek, Pumpkin Springs** and **Grid Location Point 34** Location Points. Distance to aircraft from points on the ground would decrease by 10,000 to 16,000 meters. Impact of air-tour aircraft on falcons in Sanup Flight-free Zone would be negligible with negligible change in impacts from Alternative A.

TABLE 4.161 ALTERNATIVE E AVERAGE SOUND LEVEL WEST END

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	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	-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	1	0	0	7	7	1	1
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 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	-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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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
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 32	2,016	18,618	16,602
Diamond Creek	27,108	10,814	-16,294
Grid Location Point 27	3,388	11,852	8,464
Grid Location Point 34	28,206	11,732	-16,474
Parashant Wash	2,852	6,359	3,507
Pumpkin Springs	12,630	22,337	9,707

Δ indicates change in noise metric data from Alternative A

Cumulative Impacts Alternative E Special Status Species
Peregrine Falcon

Other than air-tour aircraft sounds, impacts on peregrine falcons and habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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 peregrine falcons by creating openings for foraging.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative E contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on peregrine falcons and habitat. Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative E as discussed above, would generally have long-term moderate adverse cumulative impacts on peregrine falcons throughout all four areas (Marble Canyon, East End, Central, and West End) except under East and West End air-tour routes where there would be major adverse cumulative impacts.

Conclusion Alternative E Special Status Species
Peregrine Falcon

Overall Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high Average Sound Level long periods of the day. Ten-Year Forecast the majority of falcon habitat would experience a large reduction in aircraft Percent Time Audible and in Average Sound Level. This would result in greatly reduced impacts on falcons and their habitat with fewer disturbances from air-tour aircraft compared to Alternative A.

Cumulative impacts from all actions in all areas, when combined with impacts of Alternative E, would generally be long-term moderate adverse, except under East and West End air-tour routes where there would be up to major adverse cumulative impacts. Because aircraft would be audible a very high percentage of the day, the combination of aircraft from all sources would be the over-riding cumulative noise influence on peregrine falcons and habitat in most areas.

Conclusion Marble Canyon Alternative E Special Status Species
Peregrine Falcon
Alternative E would continue to have negligible to minor adverse impacts on falcons in Marble Canyon; however, there would be a short-term negligible to minor beneficial change in impacts to falcons compared to Alternative A due to decreased time air-tours would be audible, because Marble Canyon would be in Bright Angel Flight-free Zone under Alternative E. Impacts would not appreciably differ Peak and Off-Peak Season or Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be moderate adverse.

Conclusion East End Alternative E Special Status Species
Peregrine Falcon
In the majority of East End there would be moderate to major beneficial change in impacts from Alternative A to falcons due to alternating seasonal use of Zuni Point and Dragon Corridors. Base Year Peak Season, when Zuni Point Corridor would be open for air-tour use, impacts to falcons beneath and adjacent to active 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), and minor to moderate adverse change in impacts compared to Alternative A under the active flight corridor. Ten-Year Forecast, with conversion to quiet-technology aircraft, there would be moderate to major adverse impacts with short-term minor beneficial change in impacts compared to Alternative A under the active flight corridor. 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. However, Ten-Year Forecast, beneficial changes in impacts compared to Alternative A would increase due to Alternative E's quiet-technology conversion requirements.

In areas under and near Dragon Corridor, Base Year Peak Season 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 Off-Peak Season, when Dragon Corridor would be open for air-tour use, areas under and near the active corridor would experience moderate to major adverse impacts, a moderate to major beneficial change in impacts compared to Alternative A. Ten-Year Forecast Peak and Off-Peak Season would be similar to Base Year Peak and Off Peak Season respectively although beneficial changes in impacts compared to Alternative A would increase due to Alternative E's quiet-technology conversion requirements.

In areas away from air-tour routes, such as beneath Bright Angel Flight-free Zone, impacts Base Year Peak and Off-Peak Season would generally be negligible to moderate adverse with short-term moderate to major beneficial change in impacts compared to Alternative A. Ten-Year Forecast Peak Season impacts would generally be negligible to minor with moderate to major beneficial change in impacts compared to Alternative A. Off Peak Season impacts would generally be minor to moderate with moderate beneficial change in impacts compared to Alternative A. However, beneficial changes in impacts compared to Alternative A would increase Peak and Off-Peak Season due to Alternative E's quiet-technology conversion requirements. Cumulative impacts from all actions would generally be long term moderate adverse except under East End air-tour routes where there would be major adverse cumulative impacts.

Conclusion Central *Alternative E* *Special Status Species Peregrine Falcon*

Impacts due to Alternative E All Scenarios would generally be negligible with negligible change in impacts compared to Alternative A to falcons in the Central area. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion West End *Alternative E* *Special Status Species Peregrine Falcon*

Base Year Peak and Off Peak Season under and near Green-4 and Blue-2, impacts would be major adverse with negligible change in impacts to peregrine falcons and their habitat compared to Alternative A. Peak Season Ten-Year Forecast major adverse impacts would continue with short-term minor to major beneficial change in impacts compared to Alternative A as a result of reduction in air-tour Percent Time Audible due to quiet-technology conversion. Off Peak Ten-Year Forecast impacts would be major adverse with negligible change in impacts compared to Alternative A.

Areas along West End's northern SFRA boundary would experience increased aircraft noise and visual impacts due to Blue Direct North's realignment. Impact would be minor adverse with short- and long-term moderate beneficial change in impacts on falcons compared to Alternative A.

Brown route impacts All Scenarios would generally range from minor to moderate adverse with negligible to moderate 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 from all actions would generally be long term moderate adverse except under West End air-tour routes where there would be major adverse cumulative impacts.

ALTERNATIVE F MODIFIED CURRENT CONDITIONS SPECIAL STATUS SPECIES PEREGRINE FALCON

In Alternative F, Off-Peak Season is 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 on falcons as a result of this shift and, therefore, **no analysis of Off-Peak Season is presented under Alternative F**.

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 Fore-cast	Base Year	Ten-Year Fore-cast	Base Year	Δ	Ten-Year Fore-cast	Δ	Base Year	Δ	Ten-Year Fore-cast	Δ
Cliff Dwellers Lodge	1	1	6	10	1	0	1	0	6	0	6	-3
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

East End **Alternative F** **Special Status Species**
Peregrine Falcon
Base Year Peak Season

There would be little difference in impacts to falcons compared to Alternative A under **Zuni Point** and **Dragon Corridors** and adjacent areas. As shown in Tables 4.165 and 4.166, Distance from air-tour aircraft to locations on the ground does not differ notably from Alternative A. Air-tour aircraft Percent Time Audible would be 62 to nearly 100% of the day in areas beneath air-tour routes, and would have Average Sound Level 28 to 49 dBA at representative Location Points. In areas with flights close to the rim and in areas under routes with persistent air-tour noise, there would be potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering and for collisions with aircraft along rims where aircraft would be at lower altitudes. As noted under Alternative A, nearly continuous audibility would result in reduced eyrie densities beneath air-tour routes displacing peregrine use of suitable habitats (NPS 2010c). Moderate to major adverse impacts would continue under and near air-tour routes with negligible change in impacts from Alternative A.

In **Bright Angel Flight-free Zone,** where numerous falcon territories exist, there would be decline in air-tour noise. Base Year Peak Season, when Zuni Point Corridor is in use, air-tour aircraft Percent Time Audible would be 60% of the day at **Grid Location Point 11**, a 5% increase from Alternative A. **Cape Royal, Bright Angel Point** and **The Basin** Location Points would be the same as Alternative A. Average Sound Level would be 12 to 19 dBA at points away from tour routes, and 24 to 48 dBA at points close to tour routes, the same as Alternative A. In areas along South and North Rims, represented by Location Points **The Basin** and **1.5 km SE of Moran Point**, Distance of air-tours from the ground would be less than 500 meters. In areas under and near routes persistent air-tour noise would have potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering and for collisions with aircraft especially along the rims where aircraft would be at lower altitudes. Moderate to major adverse impacts would continue near air-tour routes, and minor to moderate adverse impacts away from routes, with negligible change in impacts from Alternative A.

East End *Alternative F* *Special Status Species*
Peregrine Falcon
Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible would be 41 to 53% of the day in **Zuni Point Corridor**, a decrease of 21 to 28% from Alternative A, and 47 to 94% of the day in **Dragon Corridor**, a decrease of 6 to 27% compared to Alternative A due to quiet-technology conversion. Average Sound Level would decrease to 24 to 46 dBA similar to Alternative A. Distance of air-tour aircraft from points on the ground would range 687 to 2,890 meters. Although falcon activities and behaviors could be interrupted frequently, there would be localized areas of improvement. Although moderate to major adverse impacts would continue under air-tour routes, there would be short-term moderate to major beneficial change in impacts compared to Alternative A due to reduction in Percent Time Audible.

Air-tour Percent Time Audible would range one to 10% in **Bright Angel Flight-free Zone** away from routes (**Grid Location Points 11, 12, and 13** and **Phantom Ranch** Location Point), a decrease of zero to 47% from Alternative A, and 12 to 40% at points near tour routes (**Cape Royal, Bright Angel Point, The Basin** Location Points), a decrease of 35 to 44% compared to Alternative A. Average Sound Level would be 7 to 12 dBA at points away from routes, and 18 to 45 dBA at points near routes, with all points decreasing 7 dBA or less from Alternative A. Distance from locations on the ground would be as described Base Year. Although minor to moderate adverse impacts would continue, there would be short-term negligible to major beneficial changes in impacts compared to Alternative A Ten-Year Forecast due to quiet-technology incentives and conversion requirements.

East End *Alternative F* *Special Status Species*
Peregrine Falcon
Base Year and Ten-Year Forecast Off-Peak Season

In Alternative F, 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 4.165 ALTERNATIVE F AVERAGE SOUND LEVEL EAST END

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
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	-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
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	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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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	1,341	-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

Central Alternative F Special Status Species
Peregrine Falcon
All Scenarios

Similar to Alternative A, falcons throughout most of the Central area would be little affected by air-tour and general-aviation aircraft noise. As shown in Table 4.167, aircraft Percent Time Audible would generally range less than 2%, with little change from Alternative A, except a 9% decrease at **Grid Location Point 25**. Falcons would be exposed to air-tour Average Sound Level from 4 to 17 dBA, generally similar to Alternative A. Distance of aircraft would generally be greater than 7,000 meters away from points on the ground as shown in Table 4.168. 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 for falcon disturbance. Negligible impacts would occur with short-term negligible to minor beneficial change in impacts compared to Alternative A.

Central Alternative F Special Status Species
Peregrine Falcon
Base Year and Ten-Year Forecast Off-Peak Season

In Alternative F, 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 4.167 ALTERNATIVE F AVERAGE SOUND LEVEL CENTRAL

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
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	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

TABLE 4.168 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 9	11,103	11,103	0
Grid Location Point 20	22,053	22,053	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	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

West End **Alternative F** **Special Status Species**

Peregrine Falcon

Base Year Peak Season

Impacts to falcons would not be appreciably different from Alternative A. Aircraft sound would be more persistent under **Green-4 and Blue-2**, represented by Location Points **Bat Cave, Burnt Springs Canyon,** and **Grid Location Point 33**. As shown in Table 4.169, air-tour aircraft Percent Time Audible would be 75 to 88% of the day, a 4% increase (at Burnt Springs Canyon) to 12% decrease (at Grid Location Point 33) from Alternative A. Aircraft Average Sound Level would be 42 to 47 dBA, similar to Alternative A. Aircraft would be approximately 1,000 meters from the ground similar to Alternative A (Table 4.170). There would be similar potential to Alternative A to disrupt normal behavior patterns such as breeding, feeding, or sheltering in areas under and close to these routes. Moderate to major adverse impacts would continue under Green-4 and Blue-2 with short-term negligible to moderate beneficial change in impacts compared to Alternative A.

In areas under Blue Direct routes where falcon territories occur, represented by **Grid Location Points 27 and 32**, air-tour aircraft Percent Time Audible would be 28 to 47% at Average Sound Level 33 to 36 dBA, a negligible to minor change in impacts compared to Alternative A. In these areas aircraft would be 1,233 to 2,995 meters away from points on the ground. Falcon daily activities could be interrupted and, similar to East End, falcon nesting may be inhibited in suitable habitat under routes. Moderate to major adverse impacts to falcons would continue in localized areas under and near air-tour routes with negligible to minor change in impacts compared to Alternative A.

Near Brown routes at Location Points **Whitmore Rapids** and **Parashant Wash** Percent Time Audible would be 7 to 9% of the day and Average Sound Level 23 to 33 dBA, both negligible changes in impacts from Alternative A. Aircraft would be 1,800 to 4,200 meters from points on the ground, an increase in distance of zero to 1,338 meters from Alternative A. Falcons may be disturbed to a minimal level during the day by audible air-tour aircraft sounds; however, normal activities would recover after disturbance and there would not be population-level impacts. Negligible to minor adverse impacts would continue with negligible change in impacts from Alternative A.

Peregrine falcon eyries and habitat located in and south of **Sanup Flight-free Zone** would be negligibly affected by air-tour operations as reflected in data at Location Points **Pumpkin Springs, Diamond Creek,** and **Grid Location Point 34**. In this area, air-tour Average Sound Level would be less than one to 9 dBA with air-tour Percent Time Audible less than one percent of the day. With these negligible impacts, falcons would experience very little if any disturbance from air-tour aircraft similar to Alternative A. There would be negligible change in impacts from Alternative A in Sanup Flight-free Zone.

West End *Alternative F* *Special Status Species*

Peregrine Falcon

Ten-Year Forecast Peak Season

At points described near **Green-4 and Blue-2**, air-tour aircraft Percent Time Audible would range 65 to 83% of the day, a 6 to 25% decline compared to Alternative A. Average Sound Level would be similar to Alternative A. Major adverse impacts would occur with minor to moderate beneficial change in impacts compared to Alternative A.

Near Blue Direct at **Grid Location Points 27 and 32,** Percent Time Audible would be 35 to 51% of the day, an increase of 2 to 12% compared to Alternative A, a minor increase from Base Year Peak Season. Average Sound Level and aircraft Distance would not be appreciably different from Base Year Peak Season. Major adverse impacts would occur with short-term negligible to minor adverse change in impacts compared to Alternative A.

Impacts near Brown routes, at Location Points **Whitmore Rapids** and **Parashant Wash** would be similar to Base Year Peak Season. At Location Points **Pumpkin Springs, Diamond Creek,** and **Grid Location Point 34,** impacts would be similar to Base Year Peak Season near Sanup Flight-free Zone.

West End *Alternative F* *Special Status Species*

Peregrine Falcon

Base Year and Ten-Year Forecast Off-Peak Season

In Alternative F, 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 4.169 ALTERNATIVE F AVERAGE SOUND LEVEL WEST END

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
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	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
Grid Location Point 27	20	23	26	27	28	8	35	12	36	10	38	11	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	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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

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	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 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 A

Cumulative Impacts Alternative F Special Status Species
Peregrine Falcon

Other than air-tour aircraft sounds, impacts on peregrine falcons and habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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 peregrine falcons by creating openings for foraging.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative F contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on peregrine falcons and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative F as discussed above, would generally have long-term moderate adverse cumulative impacts on peregrine falcons throughout all four areas (Marble Canyon, East End, Central, and West End) except under East and West End air-tour routes where there would be major adverse cumulative impacts.

Conclusion Alternative F Special Status Species
Peregrine Falcon

Because Alternative F's Off-Peak Season is December to January when peregrine falcons would not be present, no analysis for peregrine falcons is presented Off-Peak Season Alternative F.

Overall, Alternative F will result in beneficial change in impacts to peregrine falcons compared with Alternative A due to reduced area exposed to high Average Sound Level long periods of the day. Ten-Year Forecast Alternative F would result in an improvement in peregrine falcon habitat and a reduction of impacts on peregrine falcons as aircraft noise is reduced by quiet-technology incentives and conversion requirements. Greatest exposure to noise and visual impacts would occur under heavily-used air-tour routes in East and West Ends where Average Sound Level would generally be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75% of the day. There would also be large portions of habitat relatively undisturbed by air-tours in Marble Canyon and Central area.

Cumulative impacts from all actions in all areas, when combined with Alternative F impacts, would generally be long term moderate adverse, except under East and West End air-tour routes where there would be major adverse cumulative impacts. Because aircraft would be audible a high percentage of the day, combination of aircraft sound from all sources would be the over-riding cumulative influence on peregrine falcon and habitat in most areas in the park and SFRA.

Conclusion Marble Canyon Alternative F Special Status Species
Peregrine Falcon
Alternative F would result in aircraft sights and sounds that would result in negligible to minor adverse impacts with negligible change in impacts from Alternative A in Marble Canyon Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be moderate adverse.

Conclusion East End Alternative F Special Status Species
Peregrine Falcon
Base Year Peak Season, in areas under and adjacent to East End air-tour routes, there would generally be moderate to major adverse impacts with negligible change in impacts to falcons from Alternative A. Ten-Year Forecast, there would be reduction in aircraft Percent Time Audible due to quiet-technology incentives and conversion requirements resulting in short-term moderate to major beneficial changes in impacts compared to Alternative A. Base Year Peak Season, amid Bright Angel Flight-free Zone there would be moderate to major adverse impacts near air-tour routes, and minor to moderate adverse impacts away from routes, with negligible

change in impacts compared to Alternative A. Ten-Year Forecast Peak Season, minor to moderate adverse impacts would occur with short-term negligible to major beneficial changes in impacts due to quiet-technology incentives and conversion requirements compared to Alternative A. Cumulative impacts from all actions would generally be moderate adverse, except under East End air-tour routes where there would be major adverse cumulative impacts.

Conclusion Central *Alternative F* *Special Status Species*
Peregrine Falcon
Alternative F would result in negligible impacts with negligible to minor beneficial change in impacts on falcons at most Central area Location Points Base Year and Ten-Year Forecast compared to Alternative A. Cumulative impacts from all actions would be moderate adverse.

Conclusion West End *Alternative F* *Special Status Species*
Peregrine Falcon
Base Year Peak Season moderate to major adverse impacts would occur under Green-4 and Blue-2, and there would be short-term negligible to moderate beneficial change in impacts compared to Alternative A. Moderate to major adverse impacts would occur in localized areas under and near Blue Direct air-tour routes with negligible to minor adverse change in impacts compared to Alternative A. Near Brown routes, negligible to minor adverse impacts would occur with negligible 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.

Ten-Year Forecast Peak Season major adverse impacts would occur under Green-4 and Blue-2 with short-term minor to moderate beneficial change in impacts compared to Alternative A. Major adverse impacts to falcons would occur in localized areas under and near Blue Direct routes with negligible to minor adverse change in impacts compared to Alternative A. Impacts from Brown routes and Sanup Flight-free Zone would be similar to Base Year Peak Season. Cumulative impacts from all actions would generally be moderate adverse except under West End air-tour routes where there would be major adverse cumulative impacts.

NPS PREFERRED ALTERNATIVE **SPECIAL STATUS SPECIES**
PEREGRINE FALCON

Overall the NPS Preferred Alternative would result in a beneficial change compared to Alternative A in peregrine falcon habitat condition with substantially fewer disturbances to falcons, especially Ten-Year Forecast. Although adverse impacts would occur with disturbances to falcon behaviors and daily activities near air-tour routes, Ten-Year Forecast there would be substantial improvement in natural conditions particularly Off-Peak Season.

Marble Canyon **NPS Preferred Alternative** **Special Status Species**
Peregrine Falcon

Peak and Off-Peak Season Marble Canyon would be similar to Alternative A. In most areas, air-tour aircraft would also be more distant than in Alternative A.

Marble Canyon *NPS Preferred Alternative* *Special Status Species*
Peregrine Falcon
Base and Ten-Year Forecast Peak Season
Impacts at representative Location Points around **Marble Canyon** would generally be negligible to minor adverse similar to Alternative A as shown in Table 4.171 and 4.172. However, air-tour aircraft Percent Time Audible would be 2% or less, lower than Alternative A, and aircraft Average Sound Level would be zero to 18 dBA, a decrease of one to 20 dBA compared to Alternative A (except at **Grid Location Points 4 and 5** where Average Sound Level would increase by 14 and 7 dBA, and **Cliff Dwellers Lodge** Location Point, where Average Sound Level would increase by 12 dBA compared to Alternative A). In most areas, aircraft would be much farther away and not very visible from locations on the ground, ranging from approximately 4,000 to 9,500 meters (however, aircraft would be closer at Grid Location Points 4 and 5 and Cliff Dwellers Lodge). Improvement over Alternative A would occur at all Location Points close to the rim and river, and most at **North** and **South Canyon** Location Points. Falcons would rarely be disturbed from normal daily activities and would resume normal behaviors and return to pre-disturbance conditions shortly after an aircraft event. Although

negligible to minor adverse impacts would occur, there would generally be short-term negligible to minor beneficial change in impacts compared with Alternative A, although at points closer to new routes (Grid Location Points 4 and 5 and Cliff Dwellers Lodge) there would be negligible to minor adverse change in impacts compared to Alternative A.

Marble Canyon *NPS Preferred Alternative* *Special Status Species*
Peregrine Falcon
Base and Ten-Year Forecast Off-Peak Season

Off-Peak Season, Marble Canyon Percent Time Audible would be similar to Peak Season. However, Average Sound Level would be reduced by up to 18 dBA from Peak Season and by 2 to 25 dBA compared to Alternative A. This would result in negligible impacts with negligible to minor beneficial change in impacts compared to Alternative A.

TABLE 4.171 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				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	1	0	1	-1	18	12	18	9	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	8	-8	1	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	1	0	1	0	14	14	15	13	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	1	-1	1	-1	15	7	15	4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	2	-1	1	-3	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	1	-2	1	-2	5	-19	5	-21	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	1	-2	1	-2	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

TABLE 4.172 NPS PREFERRED ALTERNATIVE SLANT DISTANCES MARBLE CANYON

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Cliff Dwellers Lodge	3,695	1,059	-2,636
Grid Location Point 1	1,665	7,109	5,445
Grid Location Point 2	858	4,204	3,345
Grid Location Point 3	2,958	9,585	6,627
Grid Location Point 4	4,585	1,486	-3,099
Grid Location Point 5	2,335	1,499	-836
Marble Canyon Dam Site	3,845	4,218	374
North Canyon	999	5,962	4,963
South Canyon	816	4,742	3,926

Δ indicates change in noise metric data from Alternative A

East End **NPS Preferred Alternative** **Special Status Species**
Peregrine Falcon
Base Year Peak Season

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 moderate 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.

When Zuni Point Corridor routes would not be in use, at Location Points **Temple Butte** and **Grid Location Points 14 and 15** aircraft Percent Time Audible would be 58 to 67% of the day, a decrease of 3 to 8% compared to Alternative A. Aircraft Average Sound Level would be 37 to 39 dBA, an increase of up to 11 dBA from Alternative A. As short-loop routes would be inactive in Zuni Point Corridor at this time (but long-loop routes would be active), aircraft would be visible less often than in Alternative A at locations on the ground. Air-tour operations would have similar impacts as described in Alternative A. Falcon activities could be interrupted for large portions of the day from aircraft sounds. Moderate to major adverse impacts would continue under and near Zuni Point Corridor with negligible change in impacts from Alternative A.

In **Bright Angel Flight-free Zone** when Dragon Corridor is in use, air-tour aircraft Percent Time Audible would be 58 to 89% of the day, an increase of 4 to 13% 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 34% in areas near **Grid Location Point 16** (to 47%), 17% at **Point Imperial** Location Point (to 48%), and 8% at **Grid Location Point 11** (to 47%) compared to Alternative A. Average Sound Level would range 10 to 44 dBA, similar to Alternative A, except at 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 for 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 *NPS Preferred Alternative* *Special Status Species*
Peregrine Falcon
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 50% decrease from Alternative A, due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would range 16 to 38 dBA, a decrease of 7 to 26 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 short-term 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 42 to 61% of the day, a 13 to 27% decrease compared to Alternative A. Average Sound Level would be 37 dBA, slightly increased compared to Alternative A. Although moderate to major adverse impacts would continue under Zuni Point Corridor, there would generally be short-term 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 18 to 40% of the day, a decrease of 21 to 39% from Alternative A (and a decrease of 29 to 32% from Base Year). Air-tour Average Sound Level would be only slightly lower than Alternative A at 13 to 23 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 29% from Base Year (39% 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 impacts would continue, there would be short-term moderate to major beneficial change in impacts compared to Alternative A in areas near air-tour routes. 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 from Alternative A and Base Year Peak Season.

North Rim falcon habitat would improve at Location Points **Point Imperial, Bright Angel Point, The Basin,** and **Grid Location Point 16**. Aircraft Percent Time Audible would be 11 to 37% of the day; a 30 to 60% decrease from Alternative A. Average Sound Level would range 16 to 40 dBA, a 7 to 22 dBA decline from Alternative A. There would be less interruption or disturbance to falcons breeding, nesting, and foraging. Although moderate adverse impacts would continue, there would be short-term minor to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
Peregrine Falcon
Base Year Off-Peak Season

Routes in **Dragon Corridor** (Location Points **96-mile Camp, Tower of Ra,** and **Hermit Basin)** would experience less air-tour use since there are only long-loop tours Off-Peak Season. Air-tour aircraft Percent Time Audible would be 10 to 36%, a 61 to 64% decrease from Alternative A. Average Sound Level would be 13 to 34 dBA, a 10 to 29 dBA reduction. When aircraft are present, they would be at the same Distance as Peak Season, but aircraft on short-loop tours would be further away in Zuni Point Corridor Off-Peak Season. Peregrine falcons would experience much less frequent disturbance from aircraft compared to Peak Season and Alternative A. March through April, when falcons would be present Off-Peak Season, falcon breeding and nesting success may improve in Dragon Corridor with less interference from aircraft which may result in positive population size changes. Although moderate adverse impacts would occur under and near Dragon Corridor, there would be short-term moderate to major beneficial change in impacts compared to Alternative A.

Aircraft noise would increase in **Zuni Point Corridor** as air-tour routes would be active. In locations such as **Grid Location Point 14** and **Temple Butte** Location Point, aircraft Percent Time Audible would be 63 to 77% of the day; a one to 7% increase compared to Alternative A. Average Sound Level would range 35 to 41 dBA similar to Alternative A. Falcons are present March to early October. With air-tour activity occurring in the corridor, falcons may avoid establishing territories and eyries under and near routes as other suitable areas would be available without interference from aircraft sights and sounds. Moderate to major adverse impacts on falcons would continue with negligible change in impacts from Alternative A.

Aircraft Percent Time Audible would increase to 81% of the day near **Cape Royal** Location Point, a 22% increase from Alternative A with Average Sound Level 29 dBA similar to Alternative A. Air-tour aircraft may be frequently visible during this time of year as short-loop tour routes in Zuni Point Corridor would be active. Moderate to major adverse impacts would occur with minor to moderate adverse change in impacts compared to Alternative A. There would be improvement in areas close to Dragon Corridor since short-loop tours would be inactive during this period. At **Grid Location Point 11**, aircraft Percent Time Audible would be 9%, a 46% decrease compared to Alternative A with Average Sound Level of 13 dBA, a decrease of 5 dBA from Alternative A. Falcon daily activities near Grid Location Point 11 would be rarely disrupted by aircraft, but as long-loop tour routes would continue year-round, points across North Rim and at some locations near Dragon Corridor would continue to receive noise impacts (e.g., **The Basin** Location Point Percent Time Audible would be 29% and 40 dBA, and **Tower of Ra** Location Point Percent Time Audible would be at 36% and 34 dBA; however, these would be reductions in Percent Time Audible of 44 to 61%, and 8 to 10 dBA compared to Alternative A). Although moderate adverse impacts would continue, there would be short-term moderate to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
Peregrine Falcon
Ten-Year Forecast Off-Peak Season

There would be further aircraft noise reduction in and near **Dragon Corridor** (Location Points **96-mile Camp, Tower of Ra,** and **Hermit Basin)**. Aircraft Percent Time Audible would be 7 to 28%, a reduction of 68 to 86% compared to Alternative A. Average Sound Level would range 11 to 30 dBA, a 14 to 31 dBA decrease from Alternative A. Although minor to moderate adverse impacts would continue under and near Dragon Corridor there would be short-term minor to major beneficial change in impacts compared to Alternative A.

Percent Time Audible near and under Zuni Point Corridor (Location Points **Temple Butte** and **Grid Location Points 14 and 15)** would be 40 to 68%, a decline of 6 to 29% from Alternative A. Aircraft Average Sound Level would range 34 to 39 dBA, similar to Alternative A. Although air-tour noise would still be present, reduction in air-tour aircraft Percent Time Audible compared to Alternative A would result in increased potential for peregrine falcons to establish territories and eyries. Although moderate to major adverse impacts would continue, this would be a short-term negligible to moderate beneficial change in impacts from Alternative A.

Aircraft Percent Time Audible would decline along **Bright Angel Flight-free Zone** edges. Aircraft Percent Time Audible would be 54% of the day near Zuni Point Corridor at Location Point **Cape Royal**, a decrease of 7% from Alternative A, and 4% of the day near Dragon Corridor at **Grid Location Point 11**, a 52% reduction compared to Alternative A, with reductions of one to 10 dBA in Average Sound Level from Alternative A. Percent Time Audible at Location Points **Point Imperial** and **Grid Location Point 16** would be 6 to 12%, a 62 to 72% decrease compared to Alternative A with Average Sound Level 14 to 21 dBA, a 13 to 25 dBA decrease from Alternative A. **The Basin** and **Tower of Ra** Location Points would receive further noise reductions from Base Year, with Percent Time Audible 19 to 28% and Average Sound Level 30 to 37 dBA, 57 to 70% and 11 to 14 dBA reductions from Alternative A. Although minor to moderate adverse impacts would continue, there would be short-term minor to major beneficial change in impacts compared to Alternative A.

TABLE 4.173 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL EAST END

Location Point Name	Alternative A				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
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	10	-61	7	-68	30	-15	29	-16
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	36	-61	28	-70	34	-10	30	-14
Hermit Basin	99	100	42	42	96	-4	50	-50	20	-22	16	-26	35	-64	13	-86	13	-29	11	-31
North Rim																				
Bright Angel Point	47	48	24	24	58	12	18	-30	24	0	17	-7	59	12	9	-39	19	-4	15	-9
Point Imperial	66	68	38	39	48	-17	11	-56	18	-20	16	-22	33	-33	6	-62	14	-24	14	-25
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	29	-44	19	-57	40	-8	37	-11
Grid Location Point 16	80	84	33	34	47	-34	24	-60	32	-1	24	-9	22	-59	12	-72	26	-7	21	-13
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	67	-3	61	-13	39	6	37	2	77	7	68	-6	41	8	39	4
Grid Location Point 15	65	69	28	29	58	-8	42	-27	39	11	37	8	52	-13	40	-29	36	8	34	6
Temple Butte	62	66	37	38	58	-5	45	-21	37	0	37	-1	63	1	45	-22	35	-3	35	-3
South Rim																				
Tusayan Museum	64	67	35	36	67	3	47	-20	36	1	31	-5	79	15	54	-13	34	-1	31	-4
1.5 km SE of Moran Point	64	68	41	41	65	1	54	-15	40	-1	41	0	78	14	65	-3	46	5	46	5
Bright Angel Flight Free Zone																				
Cape Royal	59	61	25	26	72	13	40	-21	27	2	23	-3	81	22	54	-7	29	4	25	-1
Grid Location Point 11	55	56	18	18	47	-8	18	-39	20	2	13	-6	9	-46	4	-52	13	-5	9	-10
Grid Location Point 12	1	1	13	14	2	1	3	2	13	0	12	-1	2	1	2	1	12	-1	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	13	1	10	-3	5	5	1	0	12	0	11	-1
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	6	-6	1	-2	1	-3	7	-5	5	-7
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	27	-65	4	-88	17	-8	12	-13
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	21	-39	8	-52	10	-6	9	-8
Point Sublime	100	100	35	35	100	0	94	-6	35	-1	28	-7	73	-27	33	-67	24	-12	18	-17
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	1	-6	0	-7
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	5	-2	0	0	0	0	2	-4	2	-5

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.174 NPS PREFERRED ALTERNATIVE SLANT DISTANCES EAST END

Location Point Name	Alternative A	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	1,228	-230
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	-12
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	14,878	14,974	96

Δ indicates change in noise metric data from Alternative A

Central NPS Preferred Alternative Special Status Species

Peregrine Falcon

All Scenarios

Similar to Alternative A, peregrine falcon territories would be little affected by aircraft noise. As shown in Table 4.175, Base Year and Ten-Year Forecast Peak Season when Dragon Corridor would be in use for short- and long-loop tours, there would be little difference in sound metrics compared to Alternative A. Air-tour aircraft Percent Time Audible would generally be less than 10% of the day, with aircraft Average Sound Level zero to 13 dBA. Air-tour aircraft would generally be greater than 7,000 meters from locations on the ground as shown in Table 4.176. Off-Peak Season impacts would be similar to Peak Season. Falcon daily behaviors such as foraging and roosting would be little affected by air-tour aircraft. Negligible to minor adverse impacts would continue with negligible change from Alternative A.

TABLE 4.175 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				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
1 km W of Kanab Point	2	2	9	9	2	0	2	0	10	1	9	0	2	0	2	0	7	-1	9	-1
Grid Location Point 9	1	1	5	5	1	0	1	0	6	1	3	-2	1	0	1	0	3	-2	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	10	-1	13	1	9	0	10	0	8	-3	11	-1	9	-1	10	0
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	9	3	6	-1	1	0	1	0	5	-1	5	-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	13	0	14	0	0	0	0	0	12	-1	13	-1
Upper Deer Creek	1	1	1	1	1	0	1	0	2	1	1	-1	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.176 NPS PREFERRED ALTERNATIVE SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
1 km W of Kanab Point	18,850	18,857	8
Grid Location Point 9	11,103	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

West End **NPS Preferred Alternative** **Special Status Species**

Peregrine Falcon

All Scenarios

Areas under Blue Direct North would experience impacts similar to Alternative A. As represented by **Grid Location Points 27 and 32** and shown in Table 4.177, aircraft Percent Time Audible would be 19 to 44% of the day, with Average Sound Level 26 to 27 dBA. As shown in Table 4.178, aircraft would be 5,000 meters or greater from locations on the ground. Minor to moderate adverse impacts would continue with negligible change in impacts from Alternative A.

Near Brown routes, represented by Location Points **Parashant Wash** and **Whitmore Rapids**, air-tour aircraft Percent Time Audible would be 9 to 13% of the day at Average Sound Level 18 to 34 dBA, similar to Alternative A. Aircraft would be 1,800 to nearly 3,000 meters away from locations on the ground. Minor adverse impacts would continue with negligible change from Alternative A.

Peregrine falcon and habitat located in **Sanup Flight-free Zone** and areas south would be negligibly affected by air-tour operations. Air-tour aircraft Percent Time Audible would be zero percent of the day with Average Sound Level of less than one to 8 dBA as reflected in data at Location Points **Diamond Creek, Pumpkin Springs** and **Grid Location Point 34**. Impact of air-tour aircraft on falcons in Sanup Flight-free Zone would be negligible with no change in impact from Alternative A.

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 Alternative A. Air-tour aircraft Percent Time Audible would be 64 to 93% of the day at Average Sound Level 38 to 49 dBA similar to Alternative A. Falcon daily activities could be disrupted frequently, which may result in displacement from suitable habitats for nesting and foraging that could affect population levels. Short-term moderate to major adverse impacts would continue with negligible to minor beneficial change in impacts from Alternative A.

TABLE 4.177 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				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
Burnt Springs Canyon	70	75	46	47	71	1	68	-8	48	2	46	-1	69	-2	64	-11	47	1	44	-3
Bat Cave	93	95	47	48	93	0	88	-7	49	2	48	0	92	-1	86	-9	49	2	48	0
Grid Location Point 33	87	90	42	43	87	0	80	-10	42	0	39	-4	88	1	77	-13	42	0	38	-4
Whitmore Rapids	12	13	21	21	12	-1	12	-2	21	0	21	-1	9	-3	10	-4	20	-1	18	-3
Grid Location Point 32	44	49	27	28	42	-2	47	-1	27	0	27	0	43	-1	44	-4	27	0	27	-1
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	19	-1	22	-1	26	0	26	0	21	0	21	-3	26	0	26	-1
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	32	0	32	-1	12	-1	13	-1	34	1	31	-2
Pumpkin Springs	0	0	7	8	0	0	0	0	7	0	8	0	0	0	0	0	7	0	8	0

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.178 NPS PREFERRED ALTERNATIVE 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 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

Cumulative Impact NPS Preferred Alternative Special Status Species
Peregrine Falcon

Other than air-tour aircraft sounds, impacts on peregrine falcons and habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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 peregrine falcons by creating openings for foraging.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under the NPS Preferred Alternative contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on peregrine falcons and habitat. Noise from aircraft flying over 18,000 feet and/or outside the SFRA, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under the NPS Preferred Alternative as discussed above, would generally have long-term moderate adverse cumulative impacts on peregrine falcons throughout all four areas (Marble Canyon, East End, Central, and West End) except under East and West End air-tour routes where there would be major adverse cumulative impacts.

Conclusion NPS Preferred Alternative Special Status Species
Peregrine Falcon

Overall, the NPS Preferred Alternative would result in beneficial change in impacts to peregrine falcons compared with Alternative A due to reduced amount of area exposed to high Average Sound Level long periods of the day. Ten-Year Forecast the NPS Preferred Alternative would result in improvement in peregrine habitat and reduction of impacts on peregrine falcons as aircraft noise is reduced by quiet-technology incentives and conversion requirements. Greatest impacts would occur under East and West End heavily-used air-tour routes where Average Sound Level would generally be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75% of the day. However, there would also be large portions of habitat relatively undisturbed by air-tours in Marble Canyon and the Central area. Cumulative impacts from all actions in all areas, when combined with impacts of the NPS Preferred Alternative, would generally be long term moderate adverse except under East and West End air-tour routes where there would be major adverse cumulative impacts.

Conclusion Marble Canyon NPS Preferred Alternative Special Status Species
Peregrine Falcon
All Scenarios, the NPS Preferred Alternative would generally result in negligible to minor adverse impacts with negligible to minor beneficial changes in impacts to falcons in Marble Canyon compared to Alternative A, except under Black-4 where there would be short term negligible to minor adverse change in impacts compared to Alternative A. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion East End NPS Preferred Alternative Special Status Species
Peregrine Falcon
East End, there would be seasonal decreases in impacts to falcons due to seasonally alternating use of short-loop air-tour routes in Zuni Point and Dragon Corridors (long-loop tour routes would be open in both Corridors all year).

Base Year Peak Season, impacts to falcons beneath and adjacent to active Dragon Corridor routes would be short term moderate to major adverse with negligible to minor beneficial impacts compared to Alternative A. Ten-Year Forecast Peak Season with conversion to quiet-technology aircraft, there would be a short-term minor to major beneficial change in impacts compared to Alternative A. Base Year and Ten-Year Forecast Off-Peak Season, when Dragon Corridor is closed to short-loop tour use, there would be a range of short-term minor to major beneficial change in impacts compared to Alternative A.

In Zuni Point Corridor, Base Year Peak Season when short-loop tour routes would be inactive there would be moderate to major adverse impacts due to long-loop tours, with negligible change in impacts compared to Alternative A. Base Year Off-Peak Season, when Zuni Point Corridor short-loop tour routes would be active, impacts would be moderate to major adverse with negligible change in impacts compared to Alternative A. Ten-Year Forecast Peak and Off-Peak Season impacts would generally be reduced near Zuni Point Corridor, but there would still be moderate to major adverse impacts directly under routes. These represent negligible to major beneficial changes in impacts compared to Alternative A.

Base Year Peak Season, moderate to major adverse impacts to falcons would continue under and near North Rim air tour routes (The Basin, Point Imperial, and Bright Angel Point Location Points). There would be negligible to moderate adverse change in impacts compared Alternative A to at many Location Points, except Point Imperial Location Point which would experience moderate to major beneficial change in impacts. Impacts at these location points Ten-Year Forecast Peak Season would be reduced to minor adverse. These represent moderate to major beneficial changes in impacts from Alternative A due to conversion to quiet-technology aircraft. Ten-Year Forecast Off-Peak Season there would be minor to moderate adverse impacts, a minor to major beneficial change in impacts compared to Alternative A beneath and adjacent to North Rim routes.

Ten-Year Forecast Peak Season in other East End areas removed from air-tour routes such as amid Bright Angel Flight-free Zone, impacts would be negligible; a negligible beneficial change from Alternative A. Cumulative impacts from all actions would generally be long-term moderate adverse except under East End air-tour routes where there would be major adverse cumulative impacts.

Conclusion Central *NPS Preferred Alternative* *Special Status Species*
Peregrine Falcon
Base Year and Ten-Year Forecast Peak and Off-Peak Season there would be negligible to minor adverse impacts with negligible change in impacts compared to Alternative A on falcons. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion West End *NPS Preferred Alternative* *Special Status Species*
Peregrine Falcon
Under Green-4 and Blue-2, there would be moderate to major adverse impacts with negligible to minor beneficial change in impacts compared to Alternative A.

In areas near Blue Direct North there would be minor to moderate adverse impacts with negligible change in impact compared to Alternative A. In areas near Brown routes there would be minor adverse impacts with negligible change in impacts from Alternative A. In areas under and near Sanup Flight-free Zone there would be negligible impacts with negligible change in impacts compared to Alternative A. Cumulative impacts from all actions would generally be long term moderate adverse except under West End air-tour routes where there would be major adverse cumulative impacts.

CALIFORNIA CONDOR SPECIAL STATUS SPECIES

In addition to data presented in tables in this section, also see Appendix F Tables 9 to 16 which contain a summary of California condor habitat exposed to various sound levels. See Chapter 3, Special Status Species for information on California condor at GCNP.

ALTERNATIVE A NO ACTION SPECIAL STATUS SPECIES CALIFORNIA CONDOR

Under Alternative A, a range of aircraft noise intensities and audibility would affect California condors in Marble Canyon, East End, and Central areas. Condor use areas are located in these geographic areas and in areas of the Kaibab National Forest and Vermilion Cliffs National Monument. 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**.

Under Alternative A, condors would experience greatest exposure to air-tour noise in East End where aircraft Average Sound Level would be 40 to 50 dBA and Percent Time Audible would be greater than 75%. In Marble Canyon and Central areas there would be little effect on condors as aircraft Average Sound Level would generally be less than 15 dBA and Percent Time Audible would be less than 5%. As a result, the condor population would likely remain stable although East End condor distribution and densities may be suppressed due to high air-tour Percent Time Audible at moderately high sound levels. As these birds are large and easily visible and pilots are aware of their presence, likelihood of collision is low.

Under Alternative A, aircraft noise effects on condors Base Year and Ten-Year Forecast would not be appreciably different.

Marble Canyon Alternative A Special Status Species
California Condor

Base Year

Based on contour data (Appendix F Tables 9-10), **Marble Canyon** would be quiet with air-tour aircraft Percent Time Audible in 86% of condor use areas zero to 5% of the day. In 3% of the area, directly under air-tour routes, air-tour aircraft Percent Time Audible would be 25% of the day or greater. The majority of condor use area in Marble Canyon (83%) would have Average Sound Level 15 dBA or less. Tables 4.179 and 4.180 for Location Points **Cliff Dwellers Lodge, Grid Location Points 4 and 5,** and **Marble Canyon Dam Site**, show aircraft would generally be more than 2,000 meters away from points on the ground. At **Grid Location Point 2** which is in a condor high-use area, aircraft would be about 800 meters from points on the ground. With limited persistence of air-tour noise at sound levels near or below background levels in the majority of the region, and with air-tour aircraft modestly distant from locations on the ground, there would be little potential to disturb or displace condors. In some areas directly beneath routes (e.g., **North** and **South Canyon** Location Points) Average Sound Level would be higher and air-tour routes closer to the canyon rim which could increase potential for condor behavior disturbance. As these birds are large and easily visible and pilots aware of their presence, collision likelihood is low. Impacts to condors would be short term negligible to minor adverse in the majority of the Marble Canyon area.

Marble Canyon Alternative A Special Status Species
California Condor

Ten-Year Forecast

Impacts would increase a small amount Ten-Year Forecast compared to Base Year, but would generally remain at the same impact intensity levels.

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

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	2,335
Marble Canyon Dam Site	3,845
North Canyon	999
South Canyon	816

East End Alternative A Special Status Species
California Condor

East End condor use areas occur in the park and south in Kaibab National Forest. As shown in Appendix F, the majority of condor high-use areas would be surrounded by air-tour routes, and Base Year approximately 77% of the condor use area would be exposed to air-tour aircraft Percent Time Audible more than 25% of the day. In most of East End, aircraft Average Sound Level would be relatively low with 68% of condor use area exposed to sound 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 Level would be above 35 dBA or greater.

East End Alternative A Special Status Species
California Condor
Base Year

As shown in Table 4.181, **under and near Zuni Point and Dragon Corridors**, air-tour Percent Time Audible would be 62 to 100% of the day with Average Sound Level of 25 to 49 dBA. At **Eremita Mesa** Location Point for example, air-tour aircraft Average Sound Level would be 49 dBA. In areas along South Rim such as Location Point **1.5 km SE of Moran Point** and North Rim Location Points such as **The Basin**, Distance of air-tours from the ground would be less than 500 meters (Table 4.182). Given close proximity of flights to the rim and over condor high-use areas, there would be potential to disrupt normal behaviors such as breeding, feeding, or sheltering. Although aircraft may be closer to points on the ground near the rim, potential for collisions with aircraft would be unlikely given bird size and pilot awareness. Impacts under and near tour routes would be short term moderate to major adverse.

Areas away from air-tour routes would be exposed to less noise from air-tour aircraft. Areas northwest of Dragon Corridor such as Location Points **Bass Camp** and **Rainbow Plateau** and amidst Bright Angel Flight-free Zone such as **Phantom Ranch** Location Point and **Grid Location Points 12 and 13** would have aircraft Percent Time Audible less than 3% of the day with Average Sound Level 6 to 13 dBA. In these locations air-tour aircraft would be greater than 7,000 meters from points on the ground. Impacts in these areas would generally be negligible with little disturbance of condor activities.

East End Alternative A Special Status Species
California Condor
Ten-Year Forecast

Impacts would increase a small amount Ten-Year Forecast compared to Base Year, but would generally remain at the same impact intensity levels.

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

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	7,925
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

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.

Central *Alternative A* *Special Status Species*
California Condor
Ten-Year Forecast

Impacts would increase a small amount Ten-Year Forecast compared to Base Year, but would generally remain at the same impact intensity levels.

TABLE 4.183 ALTERNATIVE A NOISE METRICS AND SLANT DISTANCES CENTRAL

Location Point Name	Alternative A				
	Percent Time Audible (%)		Average Sound Level (dBA)		
	Base Year	Ten-Year Forecast	Base Year	Ten-Year Forecast	Slant Distance (m)
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

West End **Alternative A** **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 **Alternative A** **Special Status Species**
California Condor

Other than air-tour aircraft sounds, impacts on California condors and habitat result from sounds of high-altitude aircraft above 18,000 feet and aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative A contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on California condors and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative A as discussed above, would generally have long-term moderate adverse cumulative impacts on California condors throughout the three areas (Marble Canyon, East End, and Central) analyzed. However, under East End air-tour routes cumulative impacts would be major adverse.

Cumulative Impacts Marble Canyon *Alternative A* *Special Status Species*
California Condor
At Marble Canyon Location Points where aircraft operate at higher altitudes, noise from aircraft above and outside the SFRA would be audible 16 to 36% of the day. Alternative A would generally result in negligible to minor adverse impacts to condors in Marble Canyon. When impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA, highly localized impacts from humans, noise from other non-aircraft sources, and beneficial impacts from fire management activities, cumulative impacts would be long term minor to moderate adverse Base Year and Ten-Year Forecast.

Cumulative Impacts East End *Alternative A* *Special Status Species*
California Condor
East End aircraft Percent Time Audible above and outside the SFRA would be 27 to 71%. Alternative A would generally result in impacts to condors that would generally be short term moderate adverse; however, in areas beneath and adjacent to air-tour routes impacts could be up to major adverse. In the majority of East End, when impacts of Alternative A are combined with impacts of other aircraft outside and above the SFRA, highly localized impacts from humans, noise from other non-aircraft sources, and beneficial impacts from fire management activities, cumulative impacts would generally be long term moderate adverse, with up to major adverse effects under East End tour routes.

Cumulative Impacts Central *Alternative A* *Special Status Species*
California Condor
Noise from aircraft above outside the SFRA would be audible 16 to 65% of the day. Alternative A would generally result in negligible adverse impacts to condors in the Central area. When impacts of Alternative A are combined with impacts of other aircraft noise outside and above the SFRA, highly localized impacts from humans, noise from other non-aircraft sources, and beneficial impacts from fire management activities, cumulative impacts would be long term minor to moderate adverse.

Cumulative Impacts West End *Alternative A* *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.

Conclusion **Alternative A** **Special Status Species**
California Condor

Under Alternative A, condors would experience greatest exposure to air-tour noise in East End. In Marble Canyon and the Central area there would be negligible impact on condors as aircraft Percent Time Audible and Average Sound Level would be low. As a result, the condor population would likely remain stable, although East End distribution and densities may change in areas near air-tour routes due to high air-tour Percent Time Audible at moderately high Average Sound Level.

East End is the area with greatest potential for impacts on condors and, Ten-Year Forecast Peak Season, 14% of East End condor use areas would be in low noise areas with air-tour aircraft Percent Time Audible 10% or less of the day; 8% of condor use areas would have air-tour Average Sound Level of 15 dBA or less. 78% of East End condor use areas would have frequent aircraft noise disturbances with air-tour Percent Time Audible greater than 25% of the day. Cumulative impacts from all actions in all areas, when combined with impacts of Alternative A, would be long term moderate adverse with greatest cumulative impacts on condors East End.

Conclusion Marble Canyon *Alternative A* *Special Status Species*
California Condor
Alternative A Base Year would result in short-term negligible to minor adverse impacts on California condors in most Marble Canyon locations. Impacts would increase a small amount Ten-Year Forecast, but would generally remain at the same impact intensity levels. Cumulative impacts from all actions would be long term minor to moderate adverse.

Conclusion East End *Alternative A* *Special Status Species*
California Condor
There would be moderate to major adverse impacts to condors in areas beneath and adjacent to air-tour routes. In areas away from air-tour routes including beneath Bright Angel Flight-free Zone, impacts would be negligible. Impacts would increase a small amount Ten-Year Forecast, but would generally remain at the same impact intensity levels as Base Year. Cumulative impacts from all actions would generally be moderate adverse. However, under East End air-tour routes cumulative impacts would be up to major adverse.

Conclusion Central *Alternative A* *Special Status Species*
California Condor
Alternative A would result in negligible impacts on condors Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be long term minor to moderate adverse.

Conclusion West End *Alternative A* *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.

ALTERNATIVE E **ALTERNATING SEASONAL USE** **SPECIAL STATUS SPECIES**

Overall, Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high Average Sound Level for long periods of the day. Habitat in condor use areas would be improved with less disturbance from aircraft operations.

Marble Canyon **Alternative E** Special Status Species
California Condor
All Scenarios
Under Alternative E, **Marble Canyon** would be in Bright Angel Flight-free Zone. As shown in Tables 4.184 and 4.185, air-tour aircraft Percent Time Audible would generally be one percent or less of day and Average Sound Level would range zero to 13 dBA, a decrease of 3 to 24 dBA compared to Alternative A. There would generally be negligible impacts on condors in this area, with no potential for disturbance by or collisions with air-tour aircraft, a long-term negligible to minor beneficial change in impacts compared to Alternative A.

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	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	-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

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

East End **Alternative E** Special Status Species
California Condor

In the majority of East End, condor use areas would see a decrease in effects from air-tour operations at some point during the year dependent on when air-tour routes are not in use.

Base Year Peak and Off-Peak Season, 59 to 64% of condor use area (as opposed to 15% under Alternative A) would experience air-tour Percent Time Audible 10% of the day or less. Area exposed to frequent aircraft noise would be much reduced with 31 to 26% of condor use area (as opposed to 77% under Alternative A) experiencing aircraft noise greater than 25% of the day. 76 to 77% of condor use area Peak and Off-Peak Season, respectively (as opposed to 42% in Alternative A) would have Average Sound Level less than 15 dBA. These would represent moderate to major beneficial changes in impacts compared to Alternative A Base Year.

Ten-Year Forecast Peak Off-Peak Season, areas with low noise would increase to 73 and 78% Peak and Off-Peak Seasons, respectively with aircraft Percent Time Audible 10% or less of the day (compared to 14% in Alternative A), and 78 and 80% with Average Sound Level 15 dBA or less (compared to 8% in Alternative A). Areas with high Average Sound Level would decrease to 18 and 12% with aircraft Percent Time Audible greater than 25% of the day (compared to 78% in Alternative A), and one and 3% with Average Sound Level greater than 35 dBA (compared to 20% in Alternative A) Peak and Off-Peak Seasons, respectively. These would represent major beneficial changes in impacts compared to Alternative A Ten-Year Forecast.

East End *Alternative E* *Special Status Species*
California Condor
Base Year Peak Season

When Zuni Point Corridor would be in use, condor use areas **under and near Zuni Point Corridor** would be exposed to higher air-tour noise levels more frequently during the day. As shown in Table 4.186, air-tour Percent Time Audible would be 75 to 88% of the day at Location Points **Grid Location Point 14, Lipan Point, Tusayan Museum,** and **Temple Butte**, an 11 to 20% increase compared to Alternative A. Average air-tour aircraft Average Sound Level would be greater than Alternative A by one to 7 dBA and 38 to 42 dBA. Similar to Alternative A, as shown in Table 4.187, air-tour aircraft would be greater than 1,000 meters from locations on the ground for most of the route except along South Rim when aircraft are departing or returning Grand Canyon Airport. In this area, air-tour aircraft would be approximately 950 meters from the ground such as Lipan Point Location Point, and 450 meters at Tusayan Museum Location Point. Because routes would become active rather abruptly, there may be a higher level of reaction as condors could abandon the area resulting in localized East End population changes. As the route opens in July it is unlikely to adversely affect breeding or nesting. Moderate to major adverse impacts to condors from air-tour aircraft would continue under and near Zuni Point Corridor with negligible to minor adverse change in impacts compared to Alternative A.

In **Bright Angel Flight-free Zone** there would be a decline in air-tour noise. Base Year Peak Season, when Zuni Point Corridor would be in use, air-tour aircraft Percent Time Audible at **Grid Location Point 11** would decline from 55% in Alternative A to 6% under Alternative E, a decrease of 49%. Average Sound Level would be 9 dBA, a 9 dBA decrease from Alternative A. This would expand East End area where condors could forage, breed, and nest with substantially fewer disruptions in daily activities due to air-tour noise. Negligible impacts would occur with short-term moderate to major beneficial change in impacts compared to Alternative A in Bright Angel Flight-free Zone in areas west of routes due to high reduction in air-tour aircraft Percent Time Audible. The middle of the 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.

East End *Alternative E* *Special Status Species*
California Condor
Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible would decline in **Zuni Pont Corridor** area to 50 to 66% of the day, a decrease of 8 to 18% due to conversion to quiet-technology air-tour aircraft. Aircraft Average Sound Level would range 35 to 40 dBA, similar to Alternative A (within 4 dBA). Distance would be the same as Base Year. Given decrease in aircraft Percent Time Audible, there may be less of a reaction of condors to routes becoming active. Although moderate to major adverse impacts would continue under and near Zuni Point Corridor, there

would be short-term minor beneficial change in impacts compared to Alternative A. Although there would be greater reduction in Percent Time Audible Ten-Year Forecast, impacts that may occur to condors as a result of routes becoming abruptly active would reduce level of benefit from decline in aircraft audibility.

In **Bright Angel Flight-free Zone**, beneficial changes in impacts would nearly be the same as Base Year Peak Season, except at **Cedar Ridge** Location Point where there would be negligible impacts with major beneficial change in impacts from Alternative A.

East End *Alternative E* *Special Status Species*
California Condor
Base Year Off-Peak Season

Routes in and near **Zuni Point Corridor** would be inactive, and air-tour aircraft Percent Time Audible 8% of the day or less, a 62 to 69% decrease from Alternative A. Average Sound Level would be 3 to 7 dBA, a 27 to 33 dBA reduction from Alternative A. Air-tour aircraft visual impacts would be virtually eliminated for this period. Condors would experience very quiet conditions with little to no disturbance from air-tour aircraft. As condors breed in December and lay eggs late January through early April, there may be increased breeding, nesting, and rearing success. Negligible impacts would occur under and near Zuni Point Corridor with short-term major beneficial change in impacts compared to Alternative A.

When **Dragon Corridor** would be in use, air-tour aircraft Percent Time Audible would be 61 to 71% of the day, a decrease of 28 to 36%. Aircraft Average Sound Level would be less than Alternative A, 23 to 46 dBA, a decrease of 19 dBA at **Hermit Basin** Location Point, probably due to the Dragon Corridor dogleg. At **96-mile Camp** along the river, aircraft Percent Time Audible would decline to 26% of the day from 72% in Alternative A although Average Sound Level would be remain relatively high at 37 dBA. Air-tour aircraft would be more distant than in Alternative A at locations on the ground. Although Percent Time Audible and Average Sound Level would decline, condors would likely be disturbed by relatively high levels of air-tour sounds for long periods of the day. As they breed December through early April, there may be a decline in nesting and fledgling success. Although moderate to major adverse impacts on condors would continue, there would be a short-term minor beneficial change in impacts from Alternative A. Level of benefit would be reduced due to potential for disruption during critical breeding periods.

Areas in **Bright Angel Flight-free Zone** close to active Dragon Corridor air-tour routes would experience aircraft Percent Time Audible 23% of the day, a 32% decrease from Alternative A at Average Sound Level 12 dBA, a 6 dBA decline from Alternative A due to higher altitudes air-tour aircraft would be required to fly. Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A would result in improved conditions to forage, breed, and nest. This would represent minor to moderate adverse impacts with short-term moderate beneficial change in impacts compared to Alternative A to condors due to large reduction in Percent Time Audible. 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.

East End *Alternative E* *Special Status Species*
California Condor
Ten-Year Forecast Off-Peak Season

In areas under and near **Zuni Point Corridor**, beneficial change in impacts would be similar to Base Year Off-Peak Season.

There would be further decline in Percent Time Audible and Average Sound Level due to conversion to quiet-technology aircraft. Percent Time Audible in areas near and under **Dragon Corridor** would be 17 to 49%, a decline of 49 to 67% from Alternative A. Aircraft Average Sound Level would range 18 to 44 dBA, a one to 24 dBA decrease from Alternative A. Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A would result in less disruption of daily activities and may increase potential for breeding and nesting compared to Base Year. These improvements would be substantial in areas where aircraft Percent Time Audible is greatly reduced such as near **96-mile Camp** Location Point along the river. Although moderate adverse impacts would continue, this would be a short-term moderate to major beneficial change in impacts from Alternative A.

Beneficial changes in impacts in **Bright Angel Flight-free Zone** would generally be similar to Base Year Off-Peak Season, except there would be a reduction to 16% Percent Time Audible at **Grid Location Point 11** (a 7% decrease from Base Year, and a 41% decrease compared to Alternative A), due primarily to quiet-technology aircraft conversion.

East End *Alternative E* *Special Status Species*

California Condor

Base Year and Ten-Year Forecast Peak Season

When **Dragon Corridor** routes would not be in use, aircraft Percent Time Audible would be zero to 13% of the day, a decrease of 71 to 96% compared to Alternative A at Location Points **Hermit Basin, Tower of Ra,** and **96-mile Camp**. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from Alternative A. As routes would be inactive at this time, aircraft would be far less visible than in Alternative A at locations on the ground. Due to substantial reduction aircraft Average Sound Level, Percent Time Audible, and reduced visual impact, condors would experience near natural conditions with limited to no disruption in behaviors as a result of Peak Season air-tour operations. Although negligible to minor adverse impacts would occur, this would be a short-term major beneficial change from Alternative A.

TABLE 4.186 ALTERNATIVE E AVERAGE SOUND LEVEL EAST END

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	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	71	-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	-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
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	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
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	-41	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

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	573	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

Central **Alternative E** Special Status Species

California Condor

All Scenarios

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 Level 15 dBA or less. As shown in Table 4.189, air-tour aircraft would be greater than 7,000 meters from locations on the ground. Condor behaviors and activities such as foraging, roosting, nesting, and breeding would be little affected by air-tour aircraft. Negligible to minor adverse impacts would occur with negligible change in impacts from Alternative A.

West End **Alternative E** Special Status Species

California Condor

All Scenarios

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.

TABLE 4.188 ALTERNATIVE E AVERAGE SOUND LEVEL CENTRAL

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	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
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	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

TABLE 4.189 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

Cumulative Impacts **Alternative E** **Special Status Species**
California Condor

Other than air-tour aircraft sounds, impacts on California condors and habitat result from sounds of high-altitude aircraft above 18,000 feet and aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative E contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on California condors and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative E as discussed above, would generally have long-term moderate adverse cumulative impacts on California condors throughout the three areas (Marble Canyon, East End, and Central) analyzed. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion **Alternative E** Special Status Species
California Condor

Overall, Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced amount of area exposed to high Average Sound Level long periods of the day. Ten-Year Forecast, the majority of condor use areas would experience a large reduction in air-tour aircraft Percent Time Audible and Average Sound Level. Habitat in condor use areas would be improved with less disturbance from aircraft operations.

As shown in Appendix F, East End (the area with greatest potential for impacts on condors) Ten-Year Forecast Peak Season, low noise areas would increase to 73% of condor use areas with air-tour aircraft Percent Time Audible 10% or less of the day (compared to 14% in Alternative A), and 78% of condor use areas with air-tour Average Sound Level 15 dBA or less (compared to 8% in Alternative A). Condor use areas with frequent aircraft noise disturbances would be greatly reduced with 18% of areas with air-tours audible greater than 25% of the day (compared to 78% in Alternative A). These would represent minor to major beneficial changes in impacts Ten-Year Forecast Peak Season compared to Alternative A.

Cumulative impacts from all actions in all areas, when combined with Alternative E impacts, would be long term moderate adverse. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion Marble Canyon *Alternative E* *Special Status Species*
California Condor
All Scenarios, Alternative E would result in negligible impacts to condors with long-term negligible to minor beneficial change in impacts compared to Alternative A due to inclusion of Marble Canyon in the expanded Bright Angel Flight-free Zone. Cumulative impacts from all actions would generally be long term moderate adverse.

Conclusion East End *Alternative E* *Special Status Species*
California Condor
In the majority of East End there would be minor to major beneficial change in impacts from Alternative A on condors due to alternating seasonal use of Zuni Point and Dragon Corridors. Base Year Peak Season, when Zuni Point Corridor would be open for air-tour use, there would be moderate to major adverse impacts to condors beneath and adjacent to routes with negligible to minor change in impacts from Alternative A. Ten-Year Forecast Peak

Season with conversion to quiet-technology there would be less air-tour noise under the active flight corridor resulting in moderate to major adverse impacts with short-term minor beneficial change in impacts compared to Alternative A. When Zuni Point Corridor routes are inactive Base Year and Ten-Year Forecast Off-Peak Season, there would be negligible impact in areas under and near the inactive corridor and short-term major beneficial change in impacts compared to Alternative A.

In areas away from air-tour routes including beneath Bright Angel Flight-free Zone impacts would be negligible to minor adverse with negligible change in impacts from Alternative A.

In and near Dragon Corridor Base Year and Ten-Year Forecast Peak Season when the corridor is inactive, impacts would be negligible to minor adverse with major beneficial change in impacts from Alternative A. Base Year Off-Peak Season when Dragon Corridor routes would be open for use by air-tours, impacts would be moderate to major adverse, a minor beneficial change in impacts compared to Alternative A. Ten-Year Forecast Off-Peak Season impacts would be moderate adverse with moderate to major beneficial change in impact compared to Alternative A due to conversion to quiet-technology aircraft. Cumulative impacts from all actions would generally be long term moderate adverse. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion Central *Alternative E* *Special Status Species*
California Condor
Alternative E would generally result in negligible to minor adverse impacts, a negligible change in impacts compared to Alternative A. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion West End *Alternative E* *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.

ALTERNATIVE F MODIFIED CURRENT CONDITIONS SPECIAL STATUS SPECIES
CALIFORNIA CONDOR

Alternative F would result in negligible changes in impacts to condor use areas Base Year compared with Alternative A. Ten-Year Forecast, with quiet-technology incentives and conversion requirements, noise impacts would decrease. Greatest exposure to noise and visual impacts would occur East End where Average Sound Level would be 40 to 50 dBA, and aircraft Percent Time Audible would be greater than 75%. In Marble Canyon and the Central area, condors would be little impacted by air-tour operations as aircraft Average Sound Level would generally be less than 15 dBA, and Percent Time Audible would be less than 5%. Because Alternative F includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast in all condor use areas.

Marble Canyon **Alternative F** **Special Status Species**
California Condor
Base Year and Ten-Year Forecast Peak Season

In **Marble Canyon**, impacts of air-tour aircraft noise in Alternative F would generally be similar to Alternative A during Peak Season. Based on contour data in Appendix F, Marble Canyon would be quiet with air-tour 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 aircraft Percent Time Audible would be greater than 25% of the day. The majority of condor use area in Marble Canyon (83%) would have air-tour Average Sound Level of 15 dBA or less. As shown in Tables 4.190 and 4.191 at **Cliff Dwellers Lodge, Grid Location Points 4 and 5,** and **the Marble Canyon Dam Site** Location Points, aircraft would generally be more than 2,000 meters away from points on the ground, Percent Time Audible would be zero to 3% of the day, and Average Sound Level would be 2 to 8 dBA, similar to Alternative A. At **Grid Location Point 2,** a condor high-use area, aircraft would be about 800 meters from points on the ground; Percent Time Audible would be 2% of the day with Average Sound Level 16 to 17 dBA, similar to Alternative A. There would be little potential to disturb or displace condors. In some areas directly beneath routes, Average Sound Level would be higher such as at **North Canyon** Location Point, and where air-tour routes would be close to the rim, potential for disturbance of condor behavior could increase. As these birds are large and easily visible,

and pilots aware of their presence, collision likelihood is low. Negligible to minor adverse impacts would continue with negligible change in impacts from Alternative A.

Marble Canyon *Alternative F* ***Special Status Species***
California Condor
Base Year and Ten-Year Forecast Off-Peak Season

Air-tour aircraft noise would generally be reduced compared to Peak Season. Especially at **North** and **South Canyon** Location Points, with reduced operations Off-Peak Season, aircraft Percent Time Audible would be less than one percent of the day; aircraft Average Sound Level would be reduced to zero, a decrease of 21 and 25 dBA compared to Alternative A. Negligible impacts would continue with long-term negligible to minor beneficial change in impacts compared to Alternative A.

TABLE 4.190 ALTERNATIVE F AVERAGE SOUND LEVEL 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
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	-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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.191 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

East End **Alternative F** **Special Status Species**
California Condor

As shown in Appendix F, 15 to 27% of condor use area Base Year Peak and Off-Peak Season, respectively, (as opposed to 15% under Alternative A) would experience air-tour Percent Time Audible 10% of the day or less. Area exposed to frequent aircraft noise would be much reduced as well with 77 to 48% of condor use area (as opposed to 77% under Alternative A) experiencing aircraft noise greater than 25% of the day. 40 to 49% of condor use area (as opposed to 42% in Alternative A) would have air-tour Average Sound Level less than 15 dBA Peak and Off-Peak Seasons, respectively, with 14 and 8% greater than 35 dBA. These would represent negligible to moderate beneficial changes in impacts compared to Alternative A.

Areas with low noise would increase to 44 and 64%, with aircraft Percent Time Audible 10% or less of the day Ten-Year Forecast Peak and Off-Peak Seasons, respectively (compared to 14% in Alternative A), and 54 and 61% with Average Sound Level of 15 dBA or less (compared to 8% in Alternative A). Areas with high Average Sound Level would decrease to 39 and 17% with aircraft Percent Time Audible greater than 25% of the day (compared to 78% in Alternative A), and only 9 and 4% with Average Sound Level greater than 35 dBA (compared to 20% in Alternative A) Peak and Off-Peak Seasons, respectively. Ten-Year Forecast these would represent major beneficial changes in impacts compared to Alternative A.

East End *Alternative F* ***Special Status Species***
California Condor
Base Year Peak Season

There would be little difference in impacts to condors compared to Alternative A under **Zuni Point** and **Dragon Corridors** and adjacent areas. Proximity of air-tour aircraft to locations on the ground would not differ notably from Alternative A. As shown in Tables 4.192 and 4.193 air-tour aircraft Percent Time Audible would be 62 to nearly 100% of the day in areas beneath air-tour routes, with Average Sound Level 28 to 49 dBA, similar to Alternative A. Given close proximity of flights to South and North Rim and high levels of air-tour audibility in areas under routes, there would be potential to disrupt normal behavior patterns such as breeding, feeding, or sheltering. Major adverse impacts would continue with negligible change in impacts from Alternative A.

East End *Alternative F* ***Special Status Species***
California Condor
Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible would be 41 to 53% in **Zuni Point Corridor**, a decrease of 21 to 28% from Alternative A, and 47 to 98% of the day in Dragon Corridor, a decrease of 2 to 27% compared to Alternative A. Aircraft Average Sound Level would be 24 to 31 dBA in Zuni Point Corridor, declining 4 to 7 dBA from Alternative A, and 37 to 46 dBA in **Dragon Corridor**, a decrease of 3 to 5 dBA compared to Alternative A. Aircraft Distance would be as described Base Year. There may be improvement for condor breeding, nesting, and foraging due to decline in aircraft Percent Time Audible. Although moderate to major adverse impacts would continue, there would be long-term moderate beneficial change in impacts compared to Alternative A.

East End *Alternative F* ***Special Status Species***
California Condor
Base Year Off-Peak Season

Condor use areas beneath **Zuni Point Corridor** would experience a decrease in aircraft noise effects with Percent Time Audible 33 to 45% of the day, a decrease of 26 to 33%, compared to Alternative A. Aircraft Average Sound Level would range 29 to 38 dBA, within 10 dBA of Alternative A. Distance from areas on the ground would be as for Peak Season. Moderate to major adverse impacts would continue with generally moderate beneficial change in impacts from Alternative A.

When **Dragon Corridor** shifts west Off-Peak Season, in areas under routes (**96-mile Camp, Tower of Ra, and Hermit Basin** Location Points) Percent Time Audible would be one to 60%, a 39 to 80% decrease from Alternative A. Aircraft Average Sound Level would decline to 13 to 23 dBA, a 19 to 31 dBA decrease from Alternative A. Aircraft would be farther from locations on the ground in the northern part of Dragon Corridor. Condor use of this area would be temporarily improved with less interruption of activities and, as improvements

occur during breeding and initial nesting season, there may be improvement in breeding success. Although negligible to moderate adverse impacts would continue, there would be moderate to major beneficial change in impacts compared to Alternative A.

Dragon Corridor's seven-mile Off-Peak Season shift would occur during condor breeding and initial nesting season. Aircraft Percent Time Audible would be 24 to 37% at **Bass Camp** and **Rainbow Plateau** Location Points, an increase of 24 to 36% compared to Alternative A. Aircraft Average Sound Level would be 13 to 33 dBA, an increase of 7 to 26 dBA. Because the route shift would be abrupt, there may be a higher level of reaction which could result in decreased condor breeding and nesting success in this localized area. Short-term moderate adverse impacts would continue with minor to moderate adverse change in impacts from Alternative A.

East End *Alternative F* *Special Status Species*
California Condor
Ten-Year Forecast Off-Peak Season

Aircraft Percent Time Audible in **Dragon Corridor** would further decline to less than one percent at **96-mile Camp** Location Point, and 6 to 32% at **Tower of Ra** and **The Basin** Location Points respectively, a decrease of 68 to 92% from Alternative A. Aircraft Average Sound Level at those points would decline to 10 to 19 dBA, a decrease of 23 to 35 dBA from Alternative A. Aircraft Distance would be similar to Base Year Off-Peak Season. **Point Sublime** Location Point near air-tour routes would have air-tour aircraft Percent Time Audible at 24% Ten-Year Forecast, a 75% decrease from Alternative A. Although negligible to moderate adverse impacts would continue, there would be moderate to major beneficial change in impacts compared to Alternative A.

Impacts of **Dragon Corridor's** route shift would be reduced due to quiet-technology incentives and conversion requirements. At **Bass Camp** Location Point, aircraft Percent Time Audible would be 20% of the day, a 20% increase from Alternative A. At **Rainbow Plateau** Location Point, aircraft Percent Time Audible would be 2% of the day, similar to Alternative A. Average Sound Level would be 10 to 29 dBA, a 4 to 22 dBA increase. Condor use and behaviors would be less frequently interrupted by air-tour aircraft than Base Year. Negligible to moderate adverse impacts would continue with short-term negligible to moderate adverse change in impacts compared to Alternative A at these locations.

East End *Alternative F* *Special Status Species*
California Condor
All Scenarios

Beneath **Bright Angel Flight-free Zone**, effects of air-tour aircraft would be similar to Alternative A. **Grid Location Points 12 and 13** would have air-tour aircraft Percent Time Audible one percent of the day, with aircraft Average Sound Level 8 to 13 dBA. Aircraft would be at Distances greater than 2,000 meters. Air-tour aircraft would be rarely audible at relatively low sound levels in Bright Angel Flight-free Zone. Negligible impacts would occur with negligible change in impacts compared to Alternative A.

TABLE 4.192 ALTERNATIVE F AVERAGE SOUND LEVEL EAST END

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
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	-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	-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	-23	46	0	41	-5	22	-21	11	-35	41	-5	38	-9
Ten X Meadow	64	68	49	49	67	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	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	2	13	7	10	4

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	9,837	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 /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

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.

Central *Alternative F* *Special Status Species*
California Condor
Base Year and Ten-Year Forecast Off-Peak Season

Average Sound Level and impacts would be similar to Base Year Peak Season, except **Grid Location Point 8** Base Year Off-Peak Season where Percent Time Audible would increase 21% compared to Base Year Peak Season, and by 23% compared to Alternative A.

West End **Alternative F** **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.

TABLE 4.194 ALTERNATIVE F AVERAGE SOUND LEVEL CENTRAL

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
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

TABLE 4.195 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

Cumulative Impacts Alternative F Special Status Species
California Condor

Other than air-tour aircraft sounds, impacts on California condors and habitat result from sounds of high-altitude aircraft above 18,000 feet and aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative F contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on California condors and habitat. Noise from aircraft flying over 18,000 feet and/or outside the SFRA Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative F as discussed above, would generally have long-term moderate adverse cumulative impacts on California condors throughout the three areas (Marble Canyon, East End, and Central) analyzed. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion Alternative F Special Status Species
California Condor

Overall in condor use areas, Alternative F would result in negligible to minor change in impacts Base Year compared with Alternative A. Greatest exposure to noise and visual impacts would occur in East End. In Marble Canyon and the Central area, condors would be little impacted by air-tour operations. Because Alternative F includes quiet-technology incentives and conversion requirements, noise impacts would decrease Base Year to Ten-Year Forecast in all condor use areas with beneficial change in both area of Percent Time Audible and Average Sound Level.

East End, the area with greatest potential for impacts on condors, Ten-Year Forecast Peak Season, low noise areas would increase, with 44% of condor use areas with air-tour aircraft Percent Time Audible 10% or less of the day (compared to 14% in Alternative A), and 54% of condor use areas with air-tour Average Sound Level 15 dBA or less (compared to 8% in Alternative A). Condor use areas with frequent aircraft noise disturbances would be greatly reduced with only 39% of areas with air-tours Percent Time Audible greater than 25% of the day (compared to 78% in Alternative A). These would represent major beneficial changes in impacts Ten-Year Forecast Peak Season compared to Alternative A.

Cumulative impacts from all actions in all areas, when combined with impacts of Alternative F, would be long term moderate adverse impacts compared to Alternative A. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion Marble Canyon Alternative F ***Special Status Species***
California Condor
Base Year and Ten-Year Forecast Peak Season Alternative F would result in negligible to minor impacts to condors in Marble Canyon with negligible change in impacts compared to Alternative A. Base Year and Ten-Year Forecast Off-Peak Season Alternative F would result in negligible impacts to condors in Marble Canyon with negligible to minor beneficial change in impacts compared to Alternative A. Cumulative impacts from all actions would generally be moderate adverse.

Conclusion East End *Alternative F* *Special Status Species*
California Condor
East End impacts would vary depending on proximity to air-tour routes in Zuni Point and Dragon Corridors and across North Rim, with generally moderate to major adverse impacts under and near tour routes with minor to major change in impacts compared to Alternative A. In Bright Angel Flight-free Zone Base Year and Ten-Year Forecast there would be negligible impacts with negligible change in impacts compared to Alternative A.

Base Year Peak Season, air-tour aircraft impacts on condors would not be appreciably different from Alternative A. Ten-Year Forecast Peak Season, moderate to major adverse impacts would occur but there would be reduction in aircraft Percent Time Audible and Average Sound Level due to quiet-technology conversions resulting in short-term moderate beneficial change in impacts compared to Alternative A.

Base Year Off-Peak Season, there would be moderate to major beneficial change in impacts compared to Alternative A on condors near Zuni Point and Dragon Corridors; however, this would be off-set somewhat by minor to moderate adverse change in impacts compared to Alternative A due to Dragon Corridor's westward Off-Peak Season shift.

Ten-Year Forecast Off-Peak Season, these impacts would decline to negligible to moderate adverse due to reduction in aircraft audibility due primarily to quiet-technology conversion resulting in overall moderate to major beneficial changes in impacts compared to Alternative A. Cumulative impacts from all actions would generally be moderate adverse. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion Central *Alternative F* *Special Status Species*
California Condor
Alternative F would result in negligible impacts with negligible change in impacts on condors compared to Alternative A at most Location Points in the Central area Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be moderate adverse.

Conclusion West End *Alternative F* *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.

NPS PREFERRED ALTERNATIVE **SPECIAL STATUS SPECIES**
CALIFORNIA CONDOR

Overall, the NPS Preferred Alternative would result in beneficial change in impacts compared with Alternative A due to reduced amount of condor use area exposed to high audibility for long periods of the day. Condor use areas would experience fewer disturbances from aircraft operations.

Marble Canyon **NPS Preferred Alternative** **Special Status Species**
California Condor

Condor use areas would be quiet similar to Alternative A Peak and Off-Peak Seasons. As shown in Appendix F, based on contour data, air-tour aircraft in 96% of Marble Canyon would have air-tour aircraft audible 5% or less of the day with Average Sound Level 15 dBA or less.

Marble Canyon *NPS Preferred Alternative* *Special Status Species*
California Condor
Base Year Peak Season
As shown in Tables 4.196 and 4.197, air-tour aircraft Percent Time Audible would be one percent or less of the day, and aircraft Average Sound Level would generally be zero to 18 dBA, a decrease of one to 20 dBA compared to Alternative A. In most areas, aircraft would be much farther away from locations on the ground, ranging from approximately 4,000 to 9,500 meters. Greatest reductions in Average Sound Level would be at **North** and **South Canyon** Location Points (19 to 20 dBA reductions from Alternative A). Condors would be rarely disturbed from normal daily activities and would be expected to resume normal behaviors and return to

pre-disturbance conditions shortly after an aircraft event. Although negligible to minor adverse impacts would occur there would generally be short-term minor beneficial change in impacts compared to Alternative A.

Improvements over Alternative A would occur at **all Location Points**, except **Cliff Dwellers Lodge** and **Grid Location Points 4 and 5**. In areas near Cliff Dwellers Lodge and Grid Location Points 4 and 5 aircraft would be 836 to 3,099 meters closer to air-tour routes compared to Alternative A due to reconfiguration of Black-4 along Marble Canyon's western SFRA boundary. Due to route reconfiguration, aircraft Average Sound Level would increase to 14 and 18 dBA, a 7 to 14 dBA increase compared to Alternative A. Although Average Sound Level would increase it would still be relatively low. In this area, there would be minor adverse impacts with negligible to minor adverse change in impacts compared to Alternative A.

Marble Canyon *NPS Preferred Alternative* *Special Status Species*
California Condor
Ten-Year Forecast Peak Season and Base Year and Ten-Year Forecast Off-Peak Season

Impact levels would not be appreciably different from Base Year Peak Season with the following exceptions: Base Year and Ten-Year Forecast Off-Peak Season there would be reductions in Percent Time Audible and Average Sound Level to zero at **Location Points North Canyon, South Canyon, Marble Canyon Dam Site,** and **Grid Location Points 4 and 5**, a negligible to minor beneficial change in impacts from Peak Season and Alternative A.

TABLE 4.196 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				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	1	0	1	-1	18	12	18	9	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	8	-8	1	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	1	0	1	0	14	14	15	13	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	1	-1	1	-1	15	7	15	4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	2	-1	1	-3	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	1	-2	1	-2	5	-19	5	-21	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	1	-2	1	-2	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

TABLE 4.197 NPS PREFERRED ALTERNATIVE SLANT DISTANCES MARBLE CANYON

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Cliff Dwellers Lodge	3,695	1,059	-2,636
Grid Location Point 1	1,665	7,109	5,445
Grid Location Point 2	858	4,204	3,345
Grid Location Point 3	2,958	9,585	6,627
Grid Location Point 4	4,585	1,486	-3,099
Grid Location Point 5	2,335	1,499	-836
Marble Canyon Dam Site	3,845	4,218	374
North Canyon	999	5,962	4,963
South Canyon	816	4,742	3,926

Δ indicates change in noise metric data from Alternative A

East End **NPS Preferred Alternative** **Special Status Species**
California Condor

As shown in Appendix F Tables 15 and 16, Base Year Peak Season approximately 14% of East End condor use area would experience air-tour sounds 10% of the day or less (as opposed to 15% under Alternative A). Area exposed to frequent aircraft noise would be about the same as Alternative A with 78% of condor use area experiencing aircraft noise greater than 25% of the day (as opposed to 77% under Alternative A). Approximately 39% of condor use area would have air-tour Average Sound Level of 15 dBA or less (as opposed to 42% in Alternative A). These would represent negligible changes in impacts compared to Alternative A.

Ten-Year Forecast Peak Season levels would be reduced from Base Year, mainly due to quiet-aircraft technology conversion requirements, to 42% of condor use area with aircraft Percent Time Audible 10% or less of the day (compared to 14% in Alternative A), and 51% of condor use area with Average Sound Level of 15 dBA or less (compared to 8% in Alternative A). Condor use area with high Average Sound Level would be greatly reduced with only 45% of areas with air-tours audible greater than 25% of the day (compared to 78% in Alternative A). These would represent major beneficial changes in impacts compared to Alternative A.

Base Year and Ten-Year Forecast Off-Peak Season, condor use areas with low Average Sound Level would increase compared to Peak Season, with 27 to 55% of areas experiencing 10% or less Percent Time Audible (compared to 14% in Alternative A), and 52 to 59% of areas with Average Sound Level of 15 dBA or less (compared to 8% in Alternative A), Base Year and Ten-Year Forecast, respectively. Use areas with high Average Sound Level would similarly decrease from Peak Season, with 50 to 22% of areas with Percent Time Audible greater than 25%, and 8 to 5% with greater than 35 dBA, Base Year and Ten-Year Forecast, respectively (compared to 78% greater than 25%, and 20% greater than 35 dBA in Alternative A). These would represent moderate to major beneficial changes in impacts Ten-Year Forecast compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
California Condor
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 active Dragon Corridor air-tour routes, generally with short-term minor beneficial change in impacts compared to Alternative A.

When Zuni Point Corridor short-loop tour routes would not be in use (long-loop tour routes would be open year-round), areas **under and near Zuni Point Corridor** (represented by Location Points **Temple Butte** and **Grid Location Points 14 and 15**) would experience aircraft Percent Time Audible 58 to 67% of the day, a 3 to 8% decrease compared to Alternative A. Aircraft Average Sound Level would be 37 to 39 dBA, an increase of up to 11 dBA from Alternative A. As short-loop tour routes would be inactive, only aircraft on long-loop tours would be visible (fewer aircraft visible than in Alternative A) at locations on the ground. Condor activities could be interrupted for large portions of the day from aircraft sounds. Moderate to major adverse impacts would continue with mixed results of minor adverse to minor beneficial change in impacts compared to Alternative A.

In **Bright Angel Flight-free Zone**, when Dragon Corridor short-loop tour routes are in use, air-tour aircraft Percent Time Audible would increase by 13% from Alternative A in areas near **Cape Royal** Location Point (Percent Time Audible 72%). Average Sound Level would range 10 to 27 dBA, similar to Alternative A. Aircraft would be greater than 4,000 meters from locations on the ground. Moderate adverse impacts would continue with negligible to minor adverse 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 48% of the day, a 17 to 34% 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. Condor daily activities would be occasionally interrupted by aircraft

sounds. Although moderate adverse impacts would occur there would be short-term moderate beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
California Condor
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 50% decrease from Alternative A due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would range 16 to 38 dBA, a decrease of 7 to 26 dBA. Aircraft Distance would be the same as Base Year. Although moderate to major adverse impacts would continue under and near Dragon Corridor there would be short-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 42 to 61% of the day, a 13 to 27% decrease from Alternative A. Average Sound Level would be 37 dBA, up to an 8 dBA increase compared to Alternative A. Aircraft noise would be present less frequently during the day which may improve feeding, breeding, and nesting. Moderate to major adverse impacts would continue under and near Zuni Point Corridor air-tour routes with mixed results, short-term minor adverse change to moderate to major beneficial change in impacts compared to Alternative A.

In condor use areas in **Bright Angel Flight-free Zone** represented by Location Points **Cape Royal** and **Grid Location Point 11** aircraft Percent Time Audible would be 18 to 40% of the day, a decrease of 21 to 39% compared to Alternative A. Air-tour Average Sound Level would be similar to Alternative A and range 13 to 23 dBA. Condors would be infrequently disturbed during daily activities. Although minor to moderate adverse impacts would occur there would be short-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 condor use areas in **Bright Angel Flight-free Zone** would improve at areas represented by Location Points **Point Imperial** and **Grid Location Point 16**. Aircraft Percent Time Audible would be 11 to 24% of the day; a 56 to 60% decrease from Alternative A. Average Sound Level would range 16 to 24 dBA, a 9 to 22 dBA decline. There would be much less interruption or disturbance to condor breeding, nesting, and foraging than Base Year Peak Season. Although minor to moderate adverse impacts would occur there would be short-term minor to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
California Condor
Base Year Off-Peak Season

When Dragon Corridor short-loop tour routes would not be in use (long-loop tour routes would be open year-round), **Dragon Corridor** would experience fewer air-tour operations, and air-tour aircraft Percent Time Audible would be 10 to 36% of the day, a 61 to 64% decrease from Alternative A. Average Sound Level would be 13 to 34 dBA, a 10 to 29 dBA reduction. When aircraft are present they would be at the same Distance as Peak Season. Condors would experience much less frequent aircraft disturbance. Condor foraging and rearing of young may improve in Dragon Corridor with less interference from aircraft. Although minor to moderate adverse impacts would continue there would be short-term moderate to major beneficial change in impacts compared to Alternative A.

Aircraft noise would increase in **Zuni Point Corridor** as both long- and short-loop air-tour routes would be active. In Location Points such as **Grid Location Point 14** and **Temple Butte**, aircraft Percent Time Audible would be 63 to 77% of the day; a one to 7% increase compared to Alternative A. Average Sound Level would range 35 to 41 dBA, a negligible change from Alternative A. With air-tour aircraft activity in Zuni Point Corridor, condors may avoid the area under routes as suitable areas would be available elsewhere without interference from aircraft sights and sounds. High levels of aircraft sounds would occur during critical time periods when condors would be breeding and nesting. Moderate to major adverse impacts on condors would continue with negligible change in impacts from Alternative A.

In **Bright Angel Flight-free Zone** near air-tour routes, as represented by **Cape Royal** Location Point aircraft Percent Time would increase to 81% of the day; a 22% increase from Alternative A with Average Sound Level of 29 dBA similar to Alternative A. Air-tour aircraft may be visible more frequently during this time of year as Zuni Point Corridor long- and short-loop tour routes would be active. Moderate to major adverse impacts would occur with minor adverse change in impacts compared to Alternative A. There would be improvement in areas near Dragon Corridor during this period. At **Grid Location Point 11**, aircraft Percent Time Audible would be 9%; a 46% decrease compared to Alternative A. Average Sound Level would be 13 dBA, a decrease of 5 dBA from Alternative A. Condor daily activities would be disrupted by fewer aircraft, only those on long-loop tour routes. Although negligible to minor adverse impacts would occur there would be short-term minor to moderate beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
California Condor
Ten-Year Forecast Off-Peak Season

There would be further reduction in aircraft noise under and near **Dragon Corridor** compared to Peak Season due to fewer air-tour operations and conversion to quiet-technology aircraft. Aircraft Percent Time Audible would be 7 to 28% of the day; a reduction of 68 to 86% compared to Alternative A. Average Sound Level would range 11 to 30 dBA, a 14 to 31 dBA decrease. Although minor to moderate adverse impacts would continue under and near Dragon Corridor there would be short-term major beneficial change in impacts compared to Alternative A.

In areas near and under **Zuni Point Corridor** aircraft Percent Time Audible would be 45 to 68%; a decline of 6 to 22% from Alternative A. Aircraft Average Sound Level would range 35 to 39 dBA, a negligible change from Alternative A. Although moderate to major adverse impacts would occur this would be short-term negligible to moderate beneficial change in impacts from Alternative A.

Along edges of **Bright Angel Flight-free Zone,** aircraft Percent Time Audible would be 54% of the day near Zuni Point Corridor at **Cape Royal** Location Point, a decrease of 7%, and Percent Time Audible 4% of the day near Dragon Corridor at **Grid Location Point 11**, a 52% reduction compared to Alternative A. There would be negligible change in Average Sound Level ranging 9 to 25 dBA. Although minor to moderate adverse impacts would occur there would be short-term minor to major beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
California Condor
Base Year and Ten-Year Forecast Off-Peak Season

Conditions in **Bright Angel Flight-Free Zone** condor use areas along North Rim would improve from Base Year Peak Season at **Point Imperial, The Basin,** and **Grid Location Point 16** Location Points. Although moderate adverse impacts would occur there would be short-term moderate to major beneficial change in impacts compared to Alternative A.

TABLE 4.198 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL EAST END

Location Point Name	Alternative A				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	13	-22	13	-22
Nankoweap Mesa	87	90	43	43	78	-9	57	-33	31	-12	29	-14	79	-8	54	-36	28	-15	26	-17
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	10	-61	7	-68	30	-15	29	-16
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	36	-61	28	-70	34	-10	30	-14
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	84	-16	67	-33	28	-21	24	-25
Hermit Basin	99	100	42	42	96	-4	50	-50	20	-22	16	-26	35	-64	13	-86	13	-29	11	-31
North Rim																				
Cape Royal	59	61	25	26	72	13	40	-21	27	2	23	-3	81	22	54	-7	29	4	25	-1
Point Imperial	66	68	38	39	48	-17	11	-56	18	-20	16	-22	33	-33	6	-62	14	-24	14	-25
Bright Angel Point	47	48	24	24	58	12	18	-30	24	0	17	-7	59	12	9	-39	19	-4	15	-9
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	29	-44	19	-57	40	-8	37	-11
Grid Location Point 16	80	84	33	34	47	-34	24	-60	32	-1	24	-9	22	-59	12	-72	26	-7	21	-13
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	67	-3	61	-13	39	6	37	2	77	7	68	-6	41	8	39	4
Grid Location Point 15	65	69	28	29	58	-8	42	-27	39	11	37	8	52	-13	40	-29	36	8	34	6
Temple Butte	62	66	37	38	58	-5	45	-21	37	0	37	-1	63	1	45	-22	35	-3	35	-3
Lipan Point	74	77	34	35	78	5	57	-20	35	0	30	-5	87	14	65	-12	34	0	32	-3
South Rim																				
Tusayan Museum	64	67	35	36	67	3	47	-20	36	1	31	-5	79	15	54	-13	34	-1	31	-4
El Tovar	95	96	19	20	93	-2	16	-80	20	0	14	-6	44	-51	8	-87	13	-6	9	-10
Zuni Alpha	43	46	46	46	44	2	33	-13	49	3	47	0	57	14	42	-4	49	3	47	1
Ten X Meadow	64	68	49	49	60	-4	33	-35	52	3	51	2	66	1	41	-27	53	4	52	3
1.5 km SE of Moran Point	64	68	41	41	65	1	54	-15	40	-1	41	0	78	14	65	-3	46	5	46	5
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	89	9	6	-76	19	1	14	-5	60	-21	9	-73	16	-2	13	-7
Grid Location Point 11	55	56	18	18	47	-8	18	-39	20	2	13	-6	9	-46	4	-52	13	-5	9	-10
Grid Location Point 12	1	1	13	14	2	1	3	2	13	0	12	-1	2	1	2	1	12	-1	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	13	1	10	-3	5	5	1	0	12	0	11	-1
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	6	-6	1	-2	1	-3	7	-5	5	-7
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	27	-65	4	-88	17	-8	12	-13
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	21	-39	8	-52	10	-6	9	-8
Point Sublime	100	100	35	35	100	0	94	-6	35	-1	28	-7	73	-27	33	-67	24	-12	18	-17
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	1	-6	0	-7
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	5	-2	0	0	0	0	2	-4	2	-5

TABLE 4.199 NPS PREFERRED ALTERNATIVE SLANT DISTANCES EAST END

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	5,705	4,256
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	1,228	-230
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	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 NPS Preferred Alternative Special Status Species

California Condor

All Scenarios

Similar to Alternative A, condors throughout most of the Central area would be little affected by aircraft noise. Base Year Peak Season when Dragon Corridor would be in use, there would be little difference in sound metrics compared to Alternative A. Air-tour aircraft Percent Time Audible would be 10% or less of the day as shown in Appendix F and Table 4.200, in 90% of condor use areas Base Year Peak Season, and 99% Ten-Year Forecast Peak Season, with aircraft Average Sound Level 15 dBA or less in 100% of the Central area Base Year and Ten-Year Forecast. Similar Percent Time Audible and Average Sound Level would occur Base Year and Ten-Year Forecast Off-Peak Season. As shown in Table 4.201, air-tour aircraft would be greater than 7,000 meters from locations on the ground. Condor 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.

West End **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.

TABLE 4.200 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL CENTRAL

Location Point Name	Alternative A				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
1 km W of Kanab Point	2	2	9	9	2	0	2	0	10	1	9	0	2	0	2	0	7	-1	9	-1
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	8	-2	4	1	1	-2	8	-2	7	-3
Grid Location Point 9	1	1	5	5	1	0	1	0	6	1	3	-2	1	0	1	0	3	-2	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	9	3	6	-1	1	0	1	0	5	-1	5	-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	2	1	1	-1	1	0	1	0	0	-1	0	-1

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.201 NPS PREFERRED ALTERNATIVE SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	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

Cumulative Impacts NPS Preferred Alternative Special Status Species
California Condor

Other than air-tour aircraft sounds, impacts on California condors and habitat result from sounds of high-altitude aircraft above 18,000 feet and aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. 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.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under the NPS Preferred Alternative contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on California condors and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under NPS Preferred Alternative as discussed above, would generally have long-term moderate adverse cumulative impacts on California condors throughout the three areas (Marble Canyon, East End, and Central) analyzed. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion NPS Preferred Alternative Special Status Species California Condor

Overall, the NPS Preferred Alternative would result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high Average Sound Level for long periods of the day. Habitat in condor use areas would be improved with fewer disturbances from aircraft operations.

In East End, the area with greatest potential for impacts on condors, Ten-Year Forecast Peak Season, low noise areas would increase with 42% of condor use areas with air-tour aircraft Percent Time Audible 10% or less of the day (compared to 14% in Alternative A), and 51% of condor use areas with air-tour Average Sound Level of 15 dBA or less (compared to 8% in Alternative A). Condor use areas with frequent aircraft noise disturbances would be greatly reduced with 45% of areas with air-tours audible greater than 25% of the day (compared to 78% in Alternative A). These would represent major beneficial changes in impacts compared to Alternative A.

Cumulative impacts from all actions in all areas, when combined with impacts of the NPS Preferred Alternative, would generally be long term moderate adverse impacts compared to Alternative A. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion Marble Canyon NPS Preferred Alternative Special Status Species California Condor

Base Year and Ten-Year Forecast Peak and Off-Peak Season, the NPS Preferred Alternative would range negligible to minor adverse impacts with negligible to minor beneficial changes in impacts to condors in Marble Canyon compared to Alternative A except under relocated Black-4 route where impacts would be short term negligible to minor adverse compared to Alternative A. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion East End NPS Preferred Alternative Special Status Species California Condor

East End there would generally be beneficial change in impacts to condors Ten-Year Forecast due to seasonally alternative use of air-tour routes in Zuni Point and Dragon Corridors and quiet-technology aircraft conversion.

Base Year Peak Season impacts to condors beneath and adjacent to Dragon Corridor active long- and short-loop tour routes and along North Rim would be short term moderate to major adverse with minor beneficial change in impacts compared to Alternative A. Ten-Year Forecast Peak Season, with conversion to quiet-technology aircraft, there would be short-term minor to major beneficial change in impacts compared to Alternative A. Base Year Off-Peak Season, when Dragon Corridor would be closed to short-loop tour use, there would be minor to moderate adverse impacts with short-term moderate to major beneficial change in impacts compared to Alternative A. Ten-Year Forecast Off-Peak season there would be major beneficial change in impacts compared to Alternative A.

Zuni Point Corridor Base Year Peak Season when short-loop tour routes would be inactive there would be moderate to major adverse impact with short-term minor adverse to minor beneficial change in impacts due to changes in route locations compared to Alternative A. Ten-Year Forecast Peak and Off-Peak Seasons impacts would continue to be mixed due to route location changes, with minor adverse to moderate to major beneficial change in impacts compared to Alternative A.

Ten-Year Forecast there would generally be minor to moderate adverse impacts with short-term minor to major beneficial change in impacts compared to Alternative A at locations beneath Bright Angel Flight-free Zone near air-tour routes and along North Rim in Peak and Off-Peak Seasons. In East End areas removed from air-tour routes, such as amid Bright Angel Flight-free Zone, there would be negligible adverse impacts and negligible beneficial change from Alternative A. Cumulative impacts from all actions would generally be long-term moderate adverse. However, under East End air-tour routes cumulative impacts would be major adverse.

Conclusion Central *NPS Preferred Alternative* *Special Status Species*
California Condor
In the Central area, All Scenarios, there would be negligible to minor adverse impacts with negligible change in impacts on condors compared to Alternative A. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion West End *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.

MEXICAN SPOTTED OWL **SPECIAL STATUS SPECIES**

Based on Mexican spotted owl (MSO) activity surveys conducted in Grand Canyon related to air-tour operations where owls have been found using areas with elevated air-tour sound levels, these elevated sound levels would not be expected to prevent habitat occupancy or reproduction (NPS 2008d). MSO seem to prefer Grand Canyon's habitat of steep canyons below the rim. This suggests aircraft overflights would often be obscured from MSO, but high canyon walls may also amplify sound and repeat it through echoes. In Delaney et al. 1999, MSO showed an alert response when aircraft were an average 403 meters from the owls, and no response at distances greater than 660 meters. In areas along South and North Rims, Distance of air-tours from the ground would be less than 500 meters. When owls are using upper reaches of presently occupied side canyons or are above the rim, there could be potential for disturbance from air-tour aircraft. Given the majority of air-tour-route operations occur during MSO breeding period (March 15 through August 30), and that helicopters are required to pass over the rims 300 feet above ground level, potential for eliciting flushing responses and increased metabolic costs exists (NPS 1999). Although noise metrics may be high in locations under air-tour routes, MSO surveys indicate air-tour noise is not likely affecting habitat occupancy or owl reproduction.

In addition to data presented in tables in this section, please also see Appendix F Tables 1 to 8 for a summary of MSO habitat exposed to various sound levels.

ALTERNATIVE A **NO ACTION** **SPECIAL STATUS SPECIES**
MEXICAN SPOTTED OWL

Under Alternative A, a range of aircraft noise intensities would affect MSO in Marble Canyon, East End, and the Central area. MSO critical habitat and most Protected Activity Centers (PAC) occur in these areas, Kaibab National Forest, and Vermilion Cliffs National Monument.

Under Alternative A, as shown in Appendix D, MSO would experience greatest exposure to air-tour noise under and near East End heavily-used air-tour routes where aircraft Average Sound Level would generally be 40 to 50 dBA, and Percent Time Audible greater than 75%. In Marble Canyon and the Central area there would be little effect on MSO as Average Sound Level would generally be less than 15 dBA with aircraft Percent Time Audible less than 5% of the day. As a result, the MSO population would likely remain stable although their East End distribution and densities may be suppressed due to high air-tour Percent Time Audible at moderately high Average Sound Level.

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 1and 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

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	2,931
Grid Location Point 18	8,449
Point Sublime	3,760
Bass Camp	13,358
Rainbow Plateau	14,878

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 Level15 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.

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
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

Forecast indicates Ten-Year Forecast

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

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

Cumulative Impacts Alternative A Special Status Species
Mexican Spotted Owl

Other than air-tour aircraft sounds, impacts on MSO and their habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican spotted owl habitat that would have long-term moderate adverse impact.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative A contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on MSO and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative A as discussed above, would generally have long-term moderate adverse cumulative impacts on MSO throughout all four areas (Marble Canyon, East End, Central, and West End).

Cumulative Impacts Marble Canyon *Alternative A* *Special Status Species*
Mexican Spotted Owl
At Marble Canyon Location Points where aircraft operate at higher altitudes, noise from aircraft above and outside the SFRA is audible 16 to 36% of the day and, when combined with impacts of in Alternative A, and impacts of other actions in the area, results in cumulative short- and long-term minor to moderate adverse impacts to MSO.

Cumulative Impacts East End *Alternative A* *Special Status Species*
Mexican Spotted Owl
Aircraft above and outside the SFRA are audible 27 to 71% of the day. In the majority of East End, when high audibility of air-tours in MSO habitat under Alternative A is combined with adverse impacts of other aircraft noise above and outside the SFRA, and impacts of fire management activities and other actions in the area, cumulative effect would be long-term moderate adverse on MSO.

Cumulative Impacts Central *Alternative A* *Special Status Species*
Mexican Spotted Owl
In the Central area, noise from aircraft above and outside the SFRA is audible 16 to 65% of the day. When impacts of Alternative A are combined with impacts of other aircraft noise above and outside SFRA, and impacts of fire management activities and other actions, cumulative effect would be long term minor to moderate adverse on MSO.

Cumulative Impacts West End *Alternative A* *Special Status Species*
Mexican Spotted Owl
At West End Location Points, noise from aircraft above and outside the SFRA is audible 12 to 51% of the day and, when combined with impacts of Alternative A, and impacts of fire management activities and other actions, cumulative effect would be long term moderate adverse.

Conclusion **Alternative A** **Special Status Species**
Mexican Spotted Owl

In Marble Canyon and the Central area, Average Sound Level would be less than 15 dBA in 96 to 100% of MSO habitat Base Year, and 15 to 91% Ten-Year Forecast. Aircraft would be audible less than 5% of the day in 68 to 89% of MSO habitat Base Year and Ten-Year Forecast. In these areas, when air-tour aircraft would be audible it would be infrequent and at low sound levels resulting in little MSO disturbance.

Greatest exposure to noise and visual impacts would occur in East End (76% of MSO habitat with Percent Time Audible greater than 25% of the day) and portions of West End (most Location Point near air-tour routes would experience aircraft Percent Time Audible greater than 40% of the day). In these areas, MSO populations and behaviors could sometimes be disrupted, and MSO may be displaced from suitable habitats.

Conclusion Marble Canyon *Alternative A* *Special Status Species*
Mexican Spotted Owl
Base Year and Ten-Year Forecast, Alternative A would result in short-term negligible to minor adverse impacts on MSO and their critical habitat in Marble Canyon. Under Alternative A, aircraft noise effects would not be appreciably different Base Year and Ten-Year Forecast. Cumulative impacts from all actions would generally be long term minor to moderate adverse.

Conclusion East End *Alternative A* *Special Status Species*
Mexican Spotted Owl
Base Year and Ten-Year Forecast, there would be short-term impacts to MSO and their critical habitat that would range to moderate adverse particularly in areas beneath and adjacent to air-tour routes. In areas away from air-tour routes, including beneath Bright Angel Flight-free Zone, impacts would be short term negligible to minor adverse. Cumulative impacts from all actions would be moderate adverse.

Conclusion Central *Alternative A* *Special Status Species*
Mexican Spotted Owl
Base Year and Ten-Year Forecast 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. Cumulative impacts from all actions would be long term minor to moderate adverse.

Conclusion West End *Alternative A* *Special Status Species*
Mexican Spotted Owl
Base Year and Ten-Year Forecast, Alternative A would result in moderate adverse impacts to MSO and their critical habitat near Blue Direct routes. In areas away from routes, impacts would be negligible to minor adverse. Cumulative impacts from all actions would be long term moderate adverse.

ALTERNATIVE E **ALTERNATING SEASONAL USE** **SPECIAL STATUS SPECIES**
MEXICAN SPOTTED OWL

Overall, Alternative E would result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high Average Sound Level for long periods of the day. Critical habitat would be improved with fewer disturbances to Mexican spotted owls from aircraft operations.

Marble Canyon **Alternative E** **Special Status Species**
Mexican Spotted Owl
All Scenarios

Under Alternative E, Marble Canyon would be included in **Bright Angel Flight-free Zone**. As shown in Appendix F and Tables 4.209 and 4.210, air-tour aircraft Percent Time Audible would be less than 5% of the day in 99% of Marble Canyon MSO habitat with Average Sound Level 15 dBA or less in 100% of Marble Canyon MSO habitat, with a decrease of 3 to 25 dBA and Percent Time Audible up to 3% compared to Alternative A. There would be negligible impact to MSO with a negligible to minor long-term beneficial change in impacts compared to Alternative A.

TABLE 4.209 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	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	-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

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

EAST END **ALTERNATIVE E** **SPECIAL STATUS SPECIES**
MEXICAN SPOTTED OWL

In the majority of East End, Mexican spotted owl habitats would see a decrease in effects from air-tour operations at some point during the year dependent on when air-tour routes would be in use near specific habitat areas.

Base Year Peak and Off-Peak Season respectively, 60 and 65% of MSO East End habitat would experience air-tour sounds 5% of the day or less (14% under Alternative A) as shown in Appendix F. Area exposed to frequent aircraft noise would be much reduced with 29 to 21% of MSO habitat (76% under Alternative A) experiencing aircraft noise greater than 25% of the day. 82 to 86% of East End MSO habitat would have air-tour Average Sound Level 15 dBA or less (44% in Alternative A), major beneficial changes in impacts compared to Alternative A.

Ten-Year Forecast Peak and Off-Peak Season, low-noise area would increase to 73 to 80% of MSO East End habitat Percent Time Audible 5% or less of the day, and 85 to 89% Average Sound Level less than 15 dBA, with a corresponding drop in high-noise area to 16 to 9% with aircraft Percent Time Audible greater than 25% of the day. This would represent a major beneficial change in impacts compared to Alternative A.

East End *Alternative E* *Special Status Species*
Mexican Spotted Owl
Base Year Peak Season

When **Zuni Point Corridor** would be in use, MSO and 18 PAC would be exposed to high levels of air-tour noise frequently during the day. As shown in Table 4.211, air-tours Percent Time Audible would be 75 to 88% of the day at Location Points represented by **Grid Location Point 14, Lipan Point, Tusayan Museum,** and **Temple Butte**, an 11 to 20% increase compared to Alternative A. Average air-tour aircraft Average Sound Level would be greater than Alternative A by one to 7 dBA, and 38 to 42 dBA. As shown in Table 4.212 aircraft Distance would be similar to Alternative A, at greater than 1,000 meters from locations on the ground for most of the route, except along South Rim when aircraft are departing or approaching Grand Canyon Airport. In this area, air-tour aircraft would be approximately 950 meters from locations on the ground such as Lipan Point Location Point, and 450 meters at Tusayan Museum Location Point. Because routes would become active rather abruptly, there may be a higher level of reaction, and MSO could abandon area use which would result in localized East End population changes. As routes open in July it is unlikely to adversely affect MSO breeding or nesting. Impacts to MSO from air-tour aircraft would represent a moderate adverse impact with negligible to minor adverse change in impacts compared to Alternative A.

East End *Alternative E* *Special Status Species*
Mexican Spotted Owl
Ten-Year Forecast Peak Season

Air-tour aircraft Percent Time Audible would decline at **Zuni Point Corridor** Location Points due to quiet-technology aircraft conversion to 50 to 66% of the day, a decrease of 8 to 18% from Alternative A. Aircraft Average Sound Level would range 35 to 40 dBA similar to Alternative A. Aircraft Distance would be the same Base Year. Given decrease in aircraft Percent Time Audible, there may be less of a MSO reaction to routes becoming active. Although moderate adverse impacts would occur under and near Zuni Point Corridor air-tour routes, there would be short-term minor beneficial change in impacts compared to Alternative A. Although there would be higher reduction in Percent Time Audible Ten-Year Forecast due to quiet-technology conversion, individuals may be displaced due to routes becoming active abruptly, which would reduce benefit level due to decline in aircraft Percent Time Audible.

East End *Alternative E* *Special Status Species*
Mexican Spotted Owl
Base Year and Ten-Year Forecast Off-Peak Season

Routes in and near **Zuni Point Corridor** would be inactive and air-tour aircraft Percent Time Audible would be 12% of the day or less, a 62 to 73% decrease from Alternative A. Average Sound Level would be 2 to 7 dBA, a 27 to 33 dBA reduction. Visual aircraft impacts would be negligible for this period. MSO would experience quiet conditions with little disturbance from air-tour aircraft. As MSO nest March and April during this Off-Peak Season, there may be an increase in breeding, nesting, and rearing success. Negligible to minor adverse impacts

would occur under and near Zuni Point Corridor air-tour routes Off-Peak Season with short-term moderate to major beneficial change in impacts compared to Alternative A.

Off-Peak Season when Dragon Corridor air-tour routes would be active, areas in **Bright Angel Flight-free Zone** close to air-tour routes represented by **Grid Location Point 11** would experience aircraft sounds 16 to 23% of the 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 air-tour aircraft would be required to fly. Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A would result in improved conditions to forage, breed, and nest. This would represent short-term minor to moderate adverse impacts with minor to moderate beneficial change in impacts compared to Alternative A due to reduction in Percent Time Audible. 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.

East End *Alternative E* *Special Status Species*
Mexican Spotted Owl
Base Year and Ten-Year Forecast Peak Season

When **Dragon Corridor** routes would not be in use, aircraft Percent Time Audible would be one to 16% of the day, a decrease of 71 to 97% compared to Alternative A at **Hermit Basin, Tower of Ra,** and **96-mile Camp** Location Points. Aircraft Average Sound Level would be 8 to 10 dBA, a decrease of 32 to 37 dBA from Alternative A. As routes would be inactive at this time, aircraft would be further away from locations on the ground than in Alternative A. Due to substantial reduction in time and level of audible aircraft sound and reduced visual impact, MSO and four PACs would experience near natural conditions with limited disruption resulting from air-tour operations. Negligible to minor adverse impacts would occur, a short-term moderate to major beneficial change from Alternative A.

In **Bright Angel Flight-free Zone**, where there are ten PAC, there would be a decline in air-tour noise when Zuni Point Corridor is in use. Air-tour aircraft Percent Time Audible would decline from 55% in Alternative A to 6 to 8% under Alternative E, a decrease of 49% at **Grid Location Point 11**. Average Sound Level would be 9 dBA, a 9 dBA decrease. This would expand East End area where MSO could forage, breed, and nest with few disruptions in daily activities. Negligible impacts would occur with short-term moderate beneficial change in impacts 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. 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.

East End *Alternative E* *Special Status Species*
Mexican Spotted Owl
Base Year Off-Peak Season

When **Dragon Corridor** would be in use, air-tour aircraft Percent Time Audible under and adjacent to routes would be 26 to 71% of the day, a decrease of 28 to 46% from Alternative A. Aircraft Average Sound Level would be less than Alternative A, 23 to 46 dBA, a decrease of up to 19 dBA at **Hermit Basin, Tower of Ra,** and **96-mile Camp** Location Points. Air-tour aircraft would be more Distant from locations on the ground than in Alternative A. Although Percent Time Audible and Average Sound Level decline, MSO would likely be disturbed by air-tour sounds long periods of the day. As MSO nest March and April, there may be a decline in nesting and fledgling success in this area. Although moderate to major adverse impacts on MSO would continue, representing a short-term minor to moderate beneficial change in impacts compared to Alternative A, level of benefit would be reduced due to potential for disruption during critical breeding periods.

East End *Alternative E* *Special Status Species*
Mexican Spotted Owl
Ten-Year Forecast Off-Peak Season

There would be reduction in Percent Time Audible and Average Sound Level due to conversion to quiet-technology aircraft. Percent Time Audible in areas near and under **Dragon Corridor** Location Points would be 17 to 49%, a decline of 49 to 67% from Alternative A. Aircraft Average Sound Level would range 18 to 44 dBA, a one to 24 dBA decrease. Although air-tour noise would still be present, reduction in Average Sound Level compared to Alternative A would result in less disruption of daily activities and may increase potential for

breeding and nesting success compared to Base Year. These improvements would be substantial in areas where Percent Time Audible is greatly reduced such as near **96-mile Camp** Location Point along the river. Although moderate adverse impacts would occur, this would be a short-term moderate to major beneficial change in impacts from Alternative A.

TABLE 4.211 ALTERNATIVE E AVERAGE SOUND LEVEL EAST END

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	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	71	-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	-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
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	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
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	-41	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

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	573	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

Central **Alternative E** **Special Status Species**

Mexican Spotted Owl

All Scenarios

13 Mexican spotted owl PAC and critical habitat throughout most of the Central area would be little affected by aircraft noise. Base Year Peak Season, there would be little difference in sound metrics compared to Alternative A. Based on contour data as shown in Appendix F and Tables 4.213 and 4.214, in approximately 99% of MSO critical habitat Percent Time Audible would be 5% or less of the day (compared to 89% in Alternative A), with aircraft Average Sound Level less than 15 dBA in 100% of MSO habitat (same as Alternative A). Air-tour aircraft would be greater than 7,000 meters from locations on the ground. MSO behaviors and activities such as foraging, roosting, nesting, and breeding would be little affected by air-tour aircraft. Negligible impacts would occur with negligible change in impacts from Alternative A.

TABLE 4.213 ALTERNATIVE E AVERAGE SOUND LEVEL CENTRAL

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	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
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	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

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

West End **Alternative E** **Special Status Species**

Mexican Spotted Owl

All Scenarios

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.

TABLE 4.215 ALTERNATIVE E AVERAGE SOUND LEVEL WEST END

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	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	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

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
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

Cumulative Impacts Alternative E Special Status Species
Mexican Spotted Owl

Other than air-tour aircraft sounds, impacts on MSO and their habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican spotted owl habitat that would have long-term moderate adverse impact.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative E contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on MSO and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative E as discussed above, would generally have long-term moderate adverse cumulative impacts on MSO throughout all four areas (Marble Canyon, East End, Central, and West End).

Conclusion Alternative E Special Status Species
Mexican Spotted Owl

Overall Alternative E would result in beneficial change in impacts compared with Alternative A on MSO and their habitat due to reduced area exposed to high Average Sound Level for long periods of the day. Ten-Year Forecast the majority of MSO habitat would experience a large reduction in aircraft Percent Time Audible and in Average Sound Level. This would result in greatly reduced impacts on MSO and their habitat with greater areas with fewer disturbances compared to Alternative A.

East End (the area with greatest potential for impacts on MSO) Ten-Year Forecast Peak Season, areas of low noise would increase, with 73% of MSO habitat areas with air-tour aircraft Percent Time Audible 5% or less of the day (compared to 14% in Alternative A), and 85% of MSO habitat areas with air-tour Average Sound Level of 15 dBA or less (compared to 3% in Alternative A). MSO habitat areas with frequent aircraft noise disturbances would be greatly reduced with only 16% of areas with air-tours Percent Time Audible greater than 25% of the day (compared to 76% in Alternative A). These would represent major beneficial changes in impacts compared to Alternative A Ten-Year Forecast Peak Season.

Cumulative impacts from all actions in all areas, when combined with Alternative E impacts, would be long term moderate adverse change impacts compared to Alternative A.

Conclusion Marble Canyon Alternative E Special Status Species
Mexican Spotted Owl
Base Year Peak Season, Alternative E would result in negligible impacts with long-term negligible to minor beneficial changes in impacts compared to Alternative A because Marble Canyon would be included in Bright Angel Flight-free Zone. Impacts would be essentially the same All Scenarios. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion East End Alternative E Special Status Species
Mexican Spotted Owl
There would be beneficial change in impacts on MSO from Alternative E due to seasonal rotational use of air-tour routes. When air-tour routes are active, there would be negligible to moderate adverse impacts to MSO beneath and adjacent to routes with negligible to major beneficial changes in impacts from Alternative A Base Year Peak Season. Ten-Year Forecast, with conversion to quiet-aircraft technology, there would be less air-tour noise resulting in moderate adverse impacts with up to major beneficial changes in impacts compared to Alternative A. Ten Year Forecast Off-Peak Season when Dragon Corridor is in use, there would be moderate adverse impacts with moderate

to major beneficial change in impacts compared to Alternative A. Base Year and Ten-Year Forecast Peak Season when routes are inactive, there would be negligible to minor adverse impacts with moderate to major beneficial change in impacts in areas near and under routes compared to Alternative A. In areas away from air-tour routes including beneath Bright Angel Flight-free Zone there would be negligible to moderate adverse impacts with negligible to moderate beneficial change in impacts compared to Alternative A. The middle of Bright Angel Flight-free Zone would remain quiet with negligible impacts and negligible change in impacts from Alternative A. These effects would occur Base Year and Ten-Year Forecast. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion Central *Alternative E* *Special Status Species*
Mexican Spotted Owl
MSO behaviors and activities such as foraging, roosting, nesting, and breeding would be little affected by air-tour aircraft. Alternative E would result in negligible impacts with negligible change in impacts on MSO Base Year and Ten-Year Forecast Peak and Off-Peak Season. Cumulative impacts from all actions would be long term moderate adverse.

Conclusion West End *Alternative E* *Special Status Species*
Mexican Spotted Owl
There would be minor adverse impacts with minor to moderate beneficial change in impacts resulting from decreased audibility due to repositioning Blue Direct North and eliminating Blue Direct South route. Cumulative impacts from all actions would be long term moderate adverse.

ALTERNATIVE F **MODIFIED CURRENT CONDITIONS** **SPECIAL STATUS SPECIES**
MEXICAN SPOTTED OWL

Overall in MSO critical habitat, Alternative F Base Year would generally result in negligible changes in impacts compared with Alternative A. Greatest exposure to noise and visual impacts would occur East End where aircraft Average Sound Level would be 40 to 50 dBA, and Percent Time Audible would be greater than 75% of the time. In Marble Canyon and the Central area, MSO would be little impacted by air-tour operations as aircraft Average Sound Level would generally be less than 15 dBA with Percent Time Audible less than 5% of the time. Because Alternative F includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast in all MSO critical habitat.

Marble Canyon **Alternative F** **Special Status Species**
Mexican Spotted Owl
Base Year Peak Season
Air-tour aircraft noise impacts would be similar to Alternative A. Based on Appendix F contour data, Marble Canyon would be quiet in 67% of MSO habitat with Percent Time Audible 5% or less of the day (compared to 68% in Alternative A). In 4% of Marble Canyon MSO habitat, directly under air-tour routes, air-tour aircraft Percent Time Audible would be 25% of the day or greater (same as Alternative A). 96% of MSO critical habitat in Marble Canyon would have air-tour Average Sound Level of 15 dBA or less. As shown in Tables 4.217 and 4.218, at Location Points **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. At **Grid Location Point Location 2** aircraft would be about 800 meters from points on the ground. There would be little potential to disturb or displace MSO. In some areas directly beneath routes, Average Sound Level would be higher at **North and South Canyon** Location Points, and air-tour routes would be close to the canyon rim which could increase potential for MSO behavior disturbance. Negligible to minor adverse impacts would occur with negligible change in impacts from Alternative A.

Marble Canyon *Alternative F* *Special Status Species*
Mexican Spotted Owl
Ten-Year Forecast Peak Season
Impacts and level of change would be similar to Base Year Peak Season as shown in Appendix F, except much more MSO habitat would be in the low audibility category, 85% at 5% or less Percent Time Audible compared to 67% Base Year.

Marble Canyon *Alternative F* *Special Status Species*
Mexican Spotted Owl
Base Year Ten-Year Forecast Off-Peak Season

Conditions would be similar to Peak Season, except in Marble Canyon's southern part. As represented by **North and South Canyon** Locations Points, with reduced Off-Peak Season operations, aircraft Percent Time Audible would rarely be audible, less than one percent of the day, and Average Sound Level would be reduced to zero, a decrease of 21 to 25 dBA compared to Alternative A. Marble Canyon MSO critical habitat would be improved to a small degree with a further increase in area with aircraft Percent Time Audible at 5% or less of the day to 99 to 100%. Negligible impacts would occur with long-term minor to moderate beneficial change in impacts compared to Alternative A.

TABLE 4.217 ALTERNATIVE F AVERAGE SOUND LEVEL 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
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	-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

Δ indicates change in noise metric data from Alternative A
Forecast indicates Ten-Year Forecast

TABLE 4.218 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

East End **Alternative F** **Special Status Species**
Mexican Spotted Owl

Base Year and Ten-Year Forecast Peak Season, as shown in Appendix F, approximately 76% of MSO critical habitat would have air-tour aircraft Percent Time Audible over 25% of the day, same as Alternative A. Ten-Year Forecast with quiet-technology incentives and conversion requirements, area exposed to high aircraft audibility would be reduced to 41% (a reduction of 35% from Alternative A). Area with low audibility would be the reverse, with 14% of MSO habitat Percent Time Audible at 5% or less Base Year (same as Alternative A) changing to 37% Ten-Year Forecast (an increase of 23% from Alternative A). Aircraft Average Sound Level less than 15 dBA would occur in 44% of the area Base Year similar to Alternative A. Ten-Year Forecast, 59% of MSO habitat would experience Average Sound Level 15 dBA or less, a substantial increase in area with low levels of aircraft noise compared to 3% under Alternative A.

Base Year and Ten-Year Forecast Off-Peak Season (December and January) effects of aircraft would be less than Peak Season and Alternative A. Ten-Year Forecast Off-Peak Season, only 13% of MSO critical habitat would experience Percent Time Audible greater than 25% of the day. Base Year nearly 55% of MSO critical habitat would be exposed to air-tour Average Sound Level less than 15 dBA, but Ten-Year Forecast area would increase to 66% compared to 3% under Alternative A. Alternative F would result in large areas of MSO critical habitat exposed to much lower air-tour aircraft noise impacts which would improve MSO ability to breed, nest, and forage.

East End *Alternative F* *Special Status Species*
Mexican Spotted Owl
Base Year Peak Season

There would be little difference in impacts to MSO compared to Alternative A under **Zuni Point** and **Dragon Corridors** and adjacent areas. As shown in Table 4.219, air-tour aircraft Percent Time Audible would be 62% to nearly 100% of the day in areas beneath the Corridors with Average Sound Level 28 to 45 dBA at representative Location Points. As shown in Table 4.220, Distance to locations on the ground does not differ notably from Alternative A. With close proximity of flights to the rim and persistent air-tour noise in areas under routes, there would be potential to disrupt normal behavior such as breeding, feeding, or sheltering. Moderate adverse impacts would continue with negligible change in impacts from Alternative A.

East End *Alternative F* *Special Status Species*
Mexican Spotted Owl
Ten-Year Forecast Peak Season

In **Zuni Point** and **Dragon Corridors** air-tour aircraft Percent Time Audible would be 41 to 90%, a decrease of 8 to 28% from Alternative A. Aircraft Average Sound Level would be 24 to 41 dBA, declining 4 to 7 dBA from Alternative A. Aircraft would at Distances shown in Table 4.220. There would be improvement in conditions for MSO breeding, nesting, and foraging due to decline in aircraft Percent Time Audible. Moderate adverse impacts would continue with long-term minor to moderate beneficial change in impacts compared to Alternative A.

East End *Alternative F* *Special Status Species*
Mexican Spotted Owl
Base Year Off-Peak Season

Critical MSO habitat beneath **Zuni Point Corridor** would experience a decrease in aircraft noise effects. Aircraft Percent Time Audible would be 36 to 45% of day, a decrease of 26 to 29% from Alternative A. Average Sound Level would range 29 to 31 dBA, a 4 to 6 dBA decrease from Alternative A. Distance from areas on the ground would be as described Peak Season. Moderate adverse impacts would occur with minor to moderate beneficial change in impacts from Alternative A.

In areas under **Dragon Corridor** represented by Location Points **96-mile Camp, Tower of Ra,** and **Hermit Basin**, air-tour Percent Time Audible would be one to 60%, a 39 to 80% decrease from Alternative A. Aircraft Average Sound Level would also decline to 13 to 23 dBA, a 19 to 31 dBA decrease from Alternative A. Aircraft would be much further away from locations on the ground due to Dragon Corridor's seasonal shift. Critical habitat would be temporarily improved with less interruption of activities and, as improvements occur during breeding and initial nesting season, there may be improvement in breeding success. Negligible to moderate adverse impacts would continue with moderate to major beneficial change in impacts compared to Alternative A.

Dragon Corridor's seven-mile shift under Alternative F would occur during MSO breeding and initial nesting season. At **Bass Camp** and **Rainbow Plateau** Location Point, aircraft Percent Time Audible would be 24 to 37% of the day; an increase of 24 to 36% compared to Alternative A. Aircraft Average Sound Level would increase to 13 to 33 dBA, an increase of 7 to 26 dBA. Because the route shift would be abrupt, there may be a higher level of reaction which could result in decreased MSO breeding and nesting success in this localized area. Moderate adverse short-term impacts would occur with moderate adverse change in impacts compared to Alternative A at habitat areas under and near shifted Dragon Corridor.

East End *Alternative F* *Special Status Species*
Mexican Spotted Owl
Ten-Year Forecast Off-Peak Season

Under **Dragon Corridor**, Percent Time Audible would decline to less than one percent at **96-mile Camp** Location Point, and 6 to 32% at **Tower of Ra** and **Hermit Basin** Location Points respectively, a decrease of 68 to 92% from Alternative A. **Point Sublime** Location Point, near air-tour routes, would have air-tour aircraft Percent Time Audible 24%, a 75% decrease from Alternative A. Aircraft Average Sound Level would decline to 10 to 19 dBA, a decrease of 23 to 35 dBA from Alternative A. Aircraft would be at similar Distances as Base Year Off-Peak Season. Minor to moderate adverse impacts would continue with moderate to major beneficial change in impacts compared to Alternative A.

In **Dragon Corridor**, route-shift impacts would be reduced somewhat by quiet-technology incentives and conversion requirements. At **Bass Camp** Location Point, aircraft Percent Time Audible would be 20% of the day, a 20% increase from Alternative A. At **Rainbow Plateau** Location Point, aircraft Percent Time Audible would be 2% of the day, a 2% increase from Alternative A. Average Sound Level would be 10 to 29 dBA, a 4 to 22 dBA increase from Alternative A. MSO critical habitat and behaviors could be infrequently interrupted by air-tour aircraft. Negligible to minor adverse impacts would continue with minor to moderate adverse change in impacts compared to Alternative A.

East End *Alternative F* *Special Status Species*
Mexican Spotted Owl
All Scenarios

Beneath **Bright Angel Flight-free Zone**, effects of air-tour aircraft would be similar to Alternative A. **Grid Location Points 12 and 13** would have air-tour aircraft Percent Time Audible one percent of the day, with Average Sound Level 8 to 13 dBA. Aircraft would be at Distances greater than 2,000 meters. Air-tour aircraft would be rarely audible at relatively low sound levels. Negligible to minor adverse impacts would occur with negligible change in impacts compared to Alternative A.

TABLE 4.219 ALTERNATIVE F AVERAGE SOUND LEVEL EAST END

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
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	-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	-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	-23	46	0	41	-5	22	-21	11	-35	41	-5	38	-9
Ten X Meadow	64	68	49	49	67	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	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	2	13	7	10	4

TABLE 4.220 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	8,081	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	1,341	-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

Central Alternative F Special Status Species

Mexican Spotted Owl

All Scenarios

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.

TABLE 4.221 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	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

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

West End **Alternative F** **Special Status Species**

Mexican Spotted Owl

All Scenarios

West End PAC would be affected by air-tour operations on Blue Direct routes. As shown in Table 4.223, air-tour aircraft Average Sound Level over PAC would be 25 to 34 dBA, a negligible increase from Alternative A. Air-tour aircraft Percent Time Audible would be 39 to 52% of the day, an up to 36% increase, increasing a small additional amount Ten-Year Forecast. Off-Peak Season would generally be similar to Peak Season. Air-tour aircraft would generally be greater than 2,000 meters from locations on the ground as shown in Table 4.224. Noise from air-tour operations may interrupt daily behavior, but is unlikely to affect occupancy or reproduction in area PAC. This would result in moderate adverse impact with negligible to moderate adverse changes in impacts compared to Alternative A.

TABLE 4.223 ALTERNATIVE F AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				Alternative F															
					Peak Season								Off-Peak Season							
	Time Audible (%)		Average Sound Level (dBA)		Time Audible (%)				Average Sound Level (dBA)				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	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

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
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

Cumulative Impacts Alternative F Special Status Species
Mexican Spotted Owl

Other than air-tour aircraft sounds, impacts on MSO and their habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican spotted owl habitat that would have long-term moderate adverse impact.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under Alternative F contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on MSO and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under Alternative F as discussed above, would generally have long-term moderate adverse cumulative impacts on MSO throughout all four areas (Marble Canyon, East End, Central, and West End).

Conclusion Alternative F Special Status Species
Mexican Spotted Owl

Overall, in MSO critical habitat, Alternative F Base Year Peak Season would result in negligible changes in impacts compared with Alternative A. Greatest exposure to noise and visual impacts would occur East End. In Marble Canyon and the Central area, MSO would be little impacted by air-tour operations. Because Alternative F includes quiet-technology incentives and conversion requirements, noise impacts would decrease from Base Year to Ten-Year Forecast in all MSO critical habitat.

East End (the area with greatest potential for MSO impacts) Ten-Year Forecast Peak Season, areas with low noise would increase, with 37% of MSO habitat with air-tour aircraft Percent Time Audible 5% or less of the day (14% in Alternative A), and 59% of MSO habitat areas with air-tour Average Sound Level 15 dBA or less (3% in Alternative A). MSO habitat areas with frequent aircraft noise disturbances would be reduced with 41% of areas with air-tours Percent Time Audible greater than 25% of the day (76% in Alternative A). Ten-Year Forecast Peak Season, these would represent minor to moderate beneficial changes in impacts compared to Alternative A.

Cumulative impacts from all actions in all areas, when combined with impacts of Alternative F, would be long term moderate adverse.

Conclusion Marble Canyon Alternative F Special Status Species
Mexican Spotted Owl
Alternative F would result in negligible to minor adverse impacts with negligible change in impacts to MSO in Marble Canyon Base Year and Ten-Year Forecast Peak Season. Base Year and Ten-Year Forecast Off-Peak Season there would be negligible impacts with minor to moderate beneficial changes in impacts compared to Alternative A. Cumulative impacts from all actions would continue to be moderate adverse.

Conclusion East End Alternative F Special Status Species
Mexican Spotted Owl
East End impacts would vary depending on proximity to air-tour routes in Zuni Point and Dragon Corridors and across North Rim with generally moderate adverse impacts under and near tour routes, and negligible to minor adverse impacts away from routes in Bright Angel Flight-free Zone Base Year and Ten-Year Forecast.

Base Year Peak Season air-tour aircraft impacts on MSO would not be appreciably different from Alternative A, ranging to moderate adverse beneath and adjacent to air-tour routes with negligible impacts compared to Alternative A, and negligible to minor adverse away from routes with negligible impacts compared to Alternative A. Ten-Year

Forecast Peak Season, there would be reduction in aircraft audibility due to quiet-technology conversion resulting in short-term minor to moderate beneficial changes in impacts compared to Alternative A, but with impact levels generally similar to Base Year.

Base Year Off-Peak Season there would generally be negligible to moderate adverse impacts with minor to major beneficial change in impacts compared to Alternative A on MSO near Zuni Point and Dragon Corridors. This would be off-set somewhat by the westward shift in area where moderate adverse impacts with moderate adverse change in impacts compared to Alternative A to MSO would occur under air-tour routes due to Dragon Corridor's Off-Peak Season shift. Ten-Year Forecast, these impacts would decline due to reduction in aircraft Percent Time Audible and Average Sound Level from conversion to quiet-technology aircraft and resulting in minor to moderate adverse impact with moderate to major beneficial changes in impact compared to Alternative A. Impacts due to the westward shift in area would decline Ten-Year Forecast resulting in negligible to minor adverse impacts with minor to moderate adverse change in impacts compared to Alternative A. Cumulative impacts from all actions would continue to be moderate adverse.

Conclusion Central Alternative F Special Status Species Mexican Spotted Owl

All Scenarios Alternative F would generally result in negligible impacts and negligible to minor beneficial change in impacts compared to Alternative A on MSO at most Central area Location Points. Cumulative impacts from all actions would continue to be moderate adverse.

Conclusion West End Alternative F Special Status Species Mexican Spotted Owl

Air-tour operations would have long-term moderate adverse impacts under Blue Direct routes with negligible to moderate adverse change in impacts compared to Alternative A on MSO. Cumulative impacts from all actions would continue to be moderate adverse.

NPS PREFERRED ALTERNATIVE SPECIAL STATUS SPECIES MEXICAN SPOTTED OWL

Overall, the NPS Preferred Alternative would result in beneficial change in impacts compared with Alternative A due to reduced MSO critical habitat exposed to high audibility long periods of the day. Critical habitat would be improved with fewer disturbances from aircraft operations.

Marble Canyon NPS Preferred Alternative Special Status Species Mexican Spotted Owl

Peak and Off-Peak Season Marble Canyon critical habitat would be quiet, similar to Alternative A. Base Year Appendix F contour data shows 95% of Marble Canyon would have air-tour aircraft Percent Time Audible less than 5% of the day (14% in Alternative A) with air-tour Average Sound Level less than 15 dBA in 99% of Marble Canyon. Ten-Year Forecast area increases to almost 100% for Percent Time Audible and Average Sound Level. In most areas, as shown in Table 4.225, aircraft would be much farther away from locations on the ground, ranging approximately 4,000 to 9,500 meters.

Marble Canyon NPS Preferred Alternative Special Status Species Mexican Spotted Owl

Base Year and Ten-Year Forecast Peak Season

Percent Time Audible at representative Marble Canyon Location Points would be one percent or less, similar to Alternative A. As shown in Table 4.226, aircraft Average Sound Level would be zero to18 dBA, a decrease of one to 20 dBA compared to Alternative A. Improvements over Alternative A would occur at all Location Points, except **Cliff Dwellers Lodge** and **Grid Location Points 4 and 5**, and improvements would be greatest at **North and South Canyon** Location Points. MSO would rarely be disturbed from normal daily activities and would be expected to return to pre-disturbance conditions shortly after an aircraft event. Negligible to minor adverse impacts would continue with short-term negligible to minor beneficial change in impacts compared with Alternative A.

In areas near **Cliff Dwellers Lodge** and **Grid Location Points 4 and 5,** aircraft would be closer in Distance compared to Alternative A, ranging 1,059 to 1,499 meters due to reconfiguration of Black-4 along the western SFRA boundary. Due to route reconfiguration, aircraft Average Sound Level would increase to 14 to18 dBA, a 4 to 14 dBA increase compared to Alternative A. In this area, there would be negligible impacts and negligible change compared to Alternative A.

Marble Canyon *NPS Preferred Alternative* *Special Status Species*
Mexican Spotted Owl
Base Year and Ten-Year Forecast Off-Peak Season

In areas near **Cliff Dwellers Lodge** and **Grid Location Points 4 and 5,** aircraft would be the same Distance as Peak Season. Due to route reconfiguration, aircraft Average Sound Level and Percent Time Audible would drop to zero, a zero to 2% decrease in Percent Time Audible, and a zero to 12 dBA decrease in Average Sound Level compared to Alternative A. In this area, there would be negligible impacts with negligible change in impacts compared to Alternative A.

TABLE 4.225 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL MARBLE CANYON

Location Point Name	Alternative A				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	1	0	1	-1	18	12	18	9	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	8	-8	1	-2	1	-2	7	-8	7	-8
Grid Location Point 4	0	0	0	2	1	0	1	0	14	14	15	13	0	0	0	0	0	0	0	-2
Grid Location Point 5	2	2	8	12	1	-1	1	-1	15	7	15	4	0	-2	0	-2	0	-8	0	-12
Marble Canyon Dam Site	0	0	3	4	0	0	0	0	2	-1	1	-3	0	0	0	0	0	-3	0	-4
North Canyon	3	3	24	25	1	-2	1	-2	5	-19	5	-21	0	-2	0	-3	0	-24	0	-25
South Canyon	2	3	21	23	1	-2	1	-2	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

TABLE 4.226 NPS PREFERRED ALTERNATIVE SLANT DISTANCES MARBLE CANYON

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Cliff Dwellers Lodge	3,695	1,059	-2,636
Grid Location Point 1	1,665	7,109	5,445
Grid Location Point 2	858	4,204	3,345
Grid Location Point 3	2,958	9,585	6,627
Grid Location Point 4	4,585	1,486	-3,099
Grid Location Point 5	2,335	1,499	-836
Marble Canyon Dam Site	3,845	4,218	374
North Canyon	999	5,962	4,963
South Canyon	816	4,742	3,926

Δ indicates change in noise metric data from Alternative A

East End NPS Preferred Alternative Special Status Species
Mexican Spotted Owl

As shown in Appendix F Base Year Peak Season approximately 12% of MSO habitat would experience air-tour Percent Time Audible 5% of the day or less (14% under Alternative A). Area exposed to frequent aircraft noise Base Year Peak Season would be about the same as Alternative A with 47% of MSO habitat experiencing aircraft Percent Time Audible greater than 25% of the day (76% under Alternative A). Approximately 44% of MSO habitat area would have air-tour Average Sound Level of 15 dBA or less Base Year Peak Season (44% in Alternative A). Base Year, these would represent negligible changes in impacts compared to Alternative A.

Ten-Year Forecast Peak Season levels would be reduced from Base Year mainly due to quiet-technology aircraft conversion requirements, to 34% of MSO habitat with aircraft Percent Time Audible 5% or less of the day (14% in Alternative A), and 54% of MSO habitat with air-tour Average Sound Level of 15 dBA or less (3% in Alternative A). MSO habitat areas with high Average Sound Level would be reduced with 46% of area with air-tours Percent Time Audible greater than 25% of the day (76% in Alternative A). Ten-Year Forecast Peak Season these would represent moderate beneficial changes in impacts compared to Alternative A.

As shown in Appendix F Base Year and Ten-Year Forecast Off-Peak Season, respectively, MSO habitat with low Average Sound Level would increase compared to Peak Season, with 20 to 44% of areas experiencing 5% or less Percent Time Audible (14% in Alternative A), and 54 to 60% of areas with Average Sound Level of 15 dBA or less (44% Base Year and 3% Ten-Year Forecast in Alternative A). Habitat areas with high Average Sound Level would similarly decrease from Peak Season, with 47 to 22% of areas with greater than 25% Percent Time Audible, and 7 to 5% with greater than 35 dBA, Base Year and Ten-Year Forecast, respectively (76% greater than 25% Percent Time Audible. and 15 to 22% greater than 35 dBA in Alternative A). These would represent moderate beneficial changes in impacts compared to Alternative A Ten-Year Forecast.

East End NPS Preferred Alternative Special Status Species
Mexican Spotted Owl
Base Year Peak Season

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**. As shown in Table 4.227 and 4.228, this results from air-tour Percent Time Audible 59 to 96% of the day, a one to 12% decrease from Alternative A. Air-tour 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 1,500 to 6,400 meters. Although there may be a higher level of reaction when short-loop tour routes shift, MSO would not be expected to abandon area use or experience localized population changes. Moderate adverse impacts would continue under and near active Dragon Corridor short-loop air-tour routes Peak Season with short-term minor beneficial change in impacts compared to Alternative A.

When Zuni Point Corridor short-loop tour routes would not be in use (but long-loop tour routes would be open year-round), areas under and near **Zuni Point Corridor** (represented by Location Points **Temple Butte** and **Grid Location Points 14 and 15**) would experience aircraft Percent Time Audible 58 to 67% of the day, a 3 to 8% decrease compared to Alternative A. Aircraft Average Sound Level would be 37 to 39 dBA, an increase of up to 11 dBA from Alternative A. As short-loop tour routes would be inactive, only aircraft on long-loop tours would be visible (fewer aircraft visible than Alternative A) from locations on the ground. MSO activities could be interrupted by aircraft sounds for substantial portions of the day. Moderate adverse impacts would continue with mixed results of minor adverse change to minor beneficial change in impacts compared to Alternative A.

In **Bright Angel Flight-free Zone**, when Zuni Point Corridor short-loop tour routes are not in use, air-tour aircraft Percent Time Audible would increase by 13% from Alternative A in areas near **Cape Royal** Location Point (to 72% Percent Time Audible). Average Sound Level would range 10 to 27 dBA, similar to Alternative A. Aircraft would be greater than 4,000 meters from locations on the ground. Moderate adverse impacts would continue with negligible to minor adverse change in impacts compared to Alternative A.

Areas along North Rim, in Bright Angel Flight-free Zone away from routes, would experience a decrease in air-tour aircraft noise at Location Points **Point Imperial** and **Grid Location Point 16**, aircraft Percent Time

Audible would be 47 and 48% of the day, a 17 to 34% decrease compared to Alternative A. Average Sound Level would be 18 to 32 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 sound. Moderate adverse impacts would occur with short-term minor to moderate beneficial change in impacts compared to Alternative A.

East End *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 88%, a 10 to 50% decrease from Alternative A, due to conversion to quiet-technology aircraft. Aircraft Average Sound Level would range 16 to 38 dBA, a decrease of 7 to 26 dBA. Aircraft Distance would be the same as Base Year. Given the decrease in time aircraft Percent Time Audible and in Average Sound Level, there would probably be less MSO reaction to short-loop tour routes becoming abruptly active. Moderate adverse impacts would continue under and near Dragon Corridor with short-term minor to moderate beneficial change in impacts compared to Alternative A.

There would be a greater reduction in air-tour aircraft noise in **Zuni Point Corridor** with aircraft Percent Time Audible 42 to 61% of the day, a 13 to 27% decrease compared to Alternative A. Average Sound Level would be 37 dBA, up to an 8 dBA increase compared to Alternative A. Aircraft noise would be present less frequently during the day which may improve feeding, breeding, and nesting. Moderate adverse impacts would continue under and near Zuni Point Corridor with minor 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 18 to 40% of the day, a decrease of 21 to 39% compared to Alternative A. Air-tour Average Sound Level would be similar to Alternative A and range 13 to 23 dBA. MSO would be less frequently disturbed during daily activities. Minor to moderate adverse impacts would occur with short-term minor to 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 37% of the day, a 39 to 60% decrease from Alternative A. Average Sound Level would range 16 to 40 dBA, a 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 short-term moderate beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
Mexican Spotted Owl
Base Year Off-Peak Season

When **Dragon Corridor** short-loop tour routes would not be in use (long-loop tour routes would be open year-round), Dragon Corridor would experience fewer air-tour operations, and air-tour aircraft Percent Time Audible would be 10 to 36% of the day, a 61 to 64% decrease from Alternative A. Average Sound Level would be 13 to 34 dBA, a 10 to 29 dBA reduction. When aircraft are present it would be at the same distance as Peak Season. MSO would experience much less frequent aircraft disturbance. MSO foraging and rearing of young may improve in Dragon Corridor with less interference from aircraft which may result in positive changes in population size. Minor to moderate adverse impacts would continue with short-term moderate beneficial change in impacts compared to Alternative A.

Aircraft noise would increase in **Zuni Point Corridor** as both long- and short-loop air-tour routes would be active. At Location Points **Grid Location Point 14** and **Temple Butte**, aircraft Percent Time Audible would be 63 to 77% of the day; a one to 7% increase compared to Alternative A. Average Sound Level would range 35 to 41 dBA, a negligible change from Alternative A. With air-tour aircraft activity in Zuni Point Corridor, MSO may avoid the area under and near routes as more suitable areas would be available without interference from aircraft sights and sounds. High levels of aircraft sounds would occur during critical time periods when MSO would be

breeding and nesting which may result in localized population changes. Moderate adverse impacts on MSO would continue with negligible change in impacts from Alternative A.

In **Bright Angel Flight-free Zone,** aircraft Percent Time Audible would increase to 81% of the day near Location Point **Cape Royal**, a 22% increase from Alternative A with Average Sound Level of 29 dBA similar to Alternative A. Air-tour aircraft may be more visible during this time of year as short-loop tour routes in Zuni Point Corridor would be active. Moderate adverse impacts would occur with minor adverse change in impacts compared to Alternative A.

In **Bright Angel Flight-free Zone** edges close to Dragon Corridor, at **Grid Location Point 11**, aircraft Percent Time Audible would be 9%, a 46% decrease compared to Alternative A. Average Sound Level would be 13 dBA, a decrease of 5 dBA from Alternative A. As Dragon Corridor routes would not be used for short-loop tours. MSO daily activities in this area could be disrupted less frequently by fewer aircraft (only those on long-loop tour routes). Negligible to minor adverse impacts would continue with short-term minor to moderate beneficial change in impacts compared to Alternative A.

East End *NPS Preferred Alternative* *Special Status Species*
Mexican Spotted Owl
Ten-Year Forecast Off-Peak Season

Under and near **Dragon Corridor**, there would be reduction in aircraft noise due to fewer air-tour operations and conversion to quiet-technology aircraft. Aircraft Percent Time Audible would be 7 to 28% of the day, a reduction of 68 to 86% compared to Alternative A. Average Sound Level would range 11 to 30 dBA, a 14 to 31 dBA decrease. Minor adverse impacts would continue under and near Dragon Corridor with short-term moderate to major beneficial change in impacts compared to Alternative A.

Percent Time Audible in areas near and under **Zuni Point Corridor** would be 45 to 68%, a decline of 6 to 22% from Alternative A. Aircraft Average Sound Level would range 35 to 39 dBA, a negligible change from Alternative A. Although air-tour noise would still be present, reduction in air-tour aircraft Percent Time Audible compared to Alternative A would result in increased potential that MSO would continue to occupy the area and that breeding and nesting could occur. Moderate adverse impacts would occur with short-term minor to moderate beneficial change in impacts from Alternative A.

Aircraft Percent Time Audible would decline along **Bright Angel Flight-free Zone** edges. Aircraft Percent Time Audible would be 54% of the day near Zuni Point Corridor at **Cape Royal** Location Point, a decrease of 7%, and near Dragon Corridor at **Grid Location Point 11** Percent Time Audible would be 4% of the day, a 52% reduction compared to Alternative A. There would be negligible change in Average Sound Level ranging 9 to 25 dBA. Moderate adverse impacts would occur with short-term minor to moderate beneficial change in impacts compared to Alternative A.

Critical habitat conditions **along North Rim** would improve at Location Points **Point Imperial, The Basin,** and **Grid Location Point 16** with Percent Time Audible 6 to 19%, a decrease of 57 to 72% from Alternative A, and Average Sound Level of 14 to 37 dBA, a decrease of 11 to 25 dBA from Alternative A. Minor to moderate adverse impacts would occur with short-term moderate beneficial change in impacts compared to Alternative A.

TABLE 4.227 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL EAST END

Location Point Name	Alternative A				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	13	-22	13	-22
Nankoweap Mesa	87	90	43	43	78	-9	57	-33	31	-12	29	-14	79	-8	54	-36	28	-15	26	-17
Dragon Corridor																				
96 Mile Camp	72	74	45	45	59	-12	41	-33	39	-6	37	-8	10	-61	7	-68	30	-15	29	-16
Tower of Ra	97	98	44	45	96	-1	88	-10	42	-2	38	-7	36	-61	28	-70	34	-10	30	-14
Eremita Mesa	100	100	49	49	100	0	98	-2	36	-13	32	-18	84	-16	67	-33	28	-21	24	-25
Hermit Basin	99	100	42	42	96	-4	50	-50	20	-22	16	-26	35	-64	13	-86	13	-29	11	-31
North Rim																				
Cape Royal	59	61	25	26	72	13	40	-21	27	2	23	-3	81	22	54	-7	29	4	25	-1
Point Imperial	66	68	38	39	48	-17	11	-56	18	-20	16	-22	33	-33	6	-62	14	-24	14	-25
Bright Angel Point	47	48	24	24	58	12	18	-30	24	0	17	-7	59	12	9	-39	19	-4	15	-9
The Basin	73	75	48	48	77	4	37	-39	44	-4	40	-8	29	-44	19	-57	40	-8	37	-11
Grid Location Point 16	80	84	33	34	47	-34	24	-60	32	-1	24	-9	22	-59	12	-72	26	-7	21	-13
Zuni Point Corridor																				
Grid Location Point 14	70	74	34	34	67	-3	61	-13	39	6	37	2	77	7	68	-6	41	8	39	4
Grid Location Point 15	65	69	28	29	58	-8	42	-27	39	11	37	8	52	-13	40	-29	36	8	34	6
Temple Butte	62	66	37	38	58	-5	45	-21	37	0	37	-1	63	1	45	-22	35	-3	35	-3
Lipan Point	74	77	34	35	78	5	57	-20	35	0	30	-5	87	14	65	-12	34	0	32	-3
South Rim																				
Tusayan Museum	64	67	35	36	67	3	47	-20	36	1	31	-5	79	15	54	-13	34	-1	31	-4
El Tovar	95	96	19	20	93	-2	16	-80	20	0	14	-6	44	-51	8	-87	13	-6	9	-10
Zuni Alpha	43	46	46	46	44	2	33	-13	49	3	47	0	57	14	42	-4	49	3	47	1
Ten X Meadow	64	68	49	49	60	-4	33	-35	52	3	51	2	66	1	41	-27	53	4	52	3
1.5 km SE of Moran Point	64	68	41	41	65	1	54	-15	40	-1	41	0	78	14	65	-3	46	5	46	5
Bright Angel Flight Free Zone																				
Cedar Ridge	81	82	19	19	89	9	6	-76	19	1	14	-5	60	-21	9	-73	16	-2	13	-7
Grid Location Point 11	55	56	18	18	47	-8	18	-39	20	2	13	-6	9	-46	4	-52	13	-5	9	-10
Grid Location Point 12	1	1	13	14	2	1	3	2	13	0	12	-1	2	1	2	1	12	-1	12	-2
Grid Location Point 13	1	1	12	13	1	1	1	0	13	1	10	-3	5	5	1	0	12	0	11	-1
Phantom Ranch	3	4	12	12	2	-1	1	-3	10	-2	6	-6	1	-2	1	-3	7	-5	5	-7
Toroweap /Shinumo Flight Free Zone																				
Grid Location Point 10	92	92	25	25	93	1	28	-65	28	3	22	-3	27	-65	4	-88	17	-8	12	-13
Grid Location Point 18	60	60	16	17	91	31	47	-13	19	3	17	0	21	-39	8	-52	10	-6	9	-8
Point Sublime	100	100	35	35	100	0	94	-6	35	-1	28	-7	73	-27	33	-67	24	-12	18	-17
Bass Camp	0	0	7	7	0	0	0	0	8	1	3	-5	0	0	0	0	1	-6	0	-7
Rainbow Plateau	0	0	6	7	0	0	0	0	9	3	5	-2	0	0	0	0	2	-4	2	-5

TABLE 4.228 NPS PREFERRED ALTERNATIVE SLANT DISTANCES EAST END

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Little Colorado River/Nankoweap Area			
Nankoweap River	1,449	5,705	4,256
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	1,228	-230
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	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 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 Corridor short-loop tour routes would be in use, 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 87 to 92% of MSO habitat in the Central area Base Year, and 92% 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 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL CENTRAL**

Location Point Name	Alternative A				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
1 km W of Kanab Point	2	2	9	9	2	0	2	0	10	1	9	0	2	0	2	0	7	-1	9	-1
Grid Location Point 8	3	3	10	10	21	18	1	-2	14	4	8	-2	4	1	1	-2	8	-2	7	-3
Grid Location Point 9	1	1	5	5	1	0	1	0	6	1	3	-2	1	0	1	0	3	-2	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	9	3	6	-1	1	0	1	0	5	-1	5	-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	2	1	1	-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

TABLE 4.230 NPS PREFERRED ALTERNATIVE SLANT DISTANCES CENTRAL

Location Point Name	Alternative A	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 NPS Preferred Alternative Special Status Species

Mexican Spotted Owl

All Scenarios

West End PAC would be affected by Blue Direct North air-tour operations. Impacts on MSO would be similar to those for Alternative A. As shown in Table 4.231 and 4.232, air-tour aircraft Average Sound Level would range 17 to 27 dBA with Percent Time Audible 13 to 47% of the day. 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 is unlikely to affect MSO PAC occupancy or reproduction. There would be minor to moderate adverse impacts with negligible to minor beneficial change in impacts compared to Alternative A.

TABLE 4.231 NPS PREFERRED ALTERNATIVE AVERAGE SOUND LEVEL WEST END

Location Point Name	Alternative A				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
Grid Location Point 28	14	16	17	18	13	-1	7	-9	17	0	18	0	13	-1	7	-9	17	0	18	0
Grid Location Point 32	44	49	27	28	42	-2	47	-1	27	0	27	0	43	-1	44	-4	27	0	27	-1

Δ indicates change in noise metric data from Alternative A

Forecast indicates Ten-Year Forecast

TABLE 4.232 NPS PREFERRED ALTERNATIVE SLANT DISTANCES WEST END

Location Point Name	Alternative A	NPS Preferred Alternative	
		Slant Distance (m)	
	Slant Distance (m)	Base Year	Δ
Grid Location Point 28	8,327	16,314	7,987
Grid Location Point 32	2,016	6,332	4,316

Δ indicates change in noise metric data from Alternative A

Cumulative Impacts NPS Preferred Alternative Special Status Species
Mexican Spotted Owl

Other than air-tour aircraft sounds, impacts on MSO and their habitat result from sounds of high-altitude aircraft above 18,000 feet and, to a lesser degree, aircraft below 18,000 feet and outside the SFRA. Throughout GCNP, these aircraft produce Average Sound Level 22 to 31 dBA, and are usually not highly visible from points on the ground. Audibility of high-altitude aircraft varies throughout the park as presented below. Noise from other non-aircraft sources (e.g., vehicles, building noise) is mostly concentrated in the Developed Zone (2% of the park), although there is a small component added primarily from vehicles on remote roads, motorboats on the Colorado River, and mining activities. Fire management activities in the park and on other Federally-managed lands in mixed-conifer vegetation could create larger burn patch sizes than occurred historically. This would result in areas of localized loss of Mexican spotted owl habitat that would have long-term moderate adverse impact.

Noise generated by aircraft above and outside the SFRA combined with air-tour and related aircraft noise generated under NPS Preferred Alternative contributes by far the most non-natural noise over most of the SFRA, and thus would be the over-riding cumulative noise influence on MSO and habitat. Noise from aircraft flying over 18,000 feet and/or outside the Special Flight Rules Area, when combined with 1) noise from other sources on the ground as discussed above, and 2) noise generated from aircraft under NPS Preferred Alternative as discussed above, would generally have long-term moderate adverse cumulative impacts on MSO throughout all four areas (Marble Canyon, East End, Central, and West End).

Conclusion NPS Preferred Alternative Special Status Species
Mexican Spotted Owl

Overall, the NPS Preferred Alternative would result in beneficial change in impacts compared with Alternative A due to reduced area exposed to high audibility for long periods of the day. MSO and their critical habitat would be improved with fewer disturbances from aircraft operations.

The NPS Preferred Alternative would result in beneficial change in impacts compared with Alternative A on MSO and their habitat due to reduced area exposed to high Average Sound Level for long periods of the day. Ten-Year Forecast the majority of MSO habitat would experience a large reduction in aircraft Percent Time Audible and Average Sound Level. This would result in greatly reduced impacts on MSO and their habitat with greater areas with fewer disturbances compared to Alternative A.

Cumulative impacts from all actions in all areas, when combined with impacts of the NPS Preferred Alternative, would be long-term moderate adverse impacts compared to Alternative A.

Conclusion Marble Canyon NPS Preferred Alternative Special Status Species
Mexican Spotted Owl
Base Year and Ten-Year Forecast Peak and Off-Peak Season, the NPS Preferred Alternative would generally result in negligible to minor adverse impacts with negligible to minor beneficial change in impacts to MSO in Marble Canyon compared to Alternative A. Cumulative impacts from all actions would continue to be long term moderate adverse.

Conclusion East End NPS Preferred Alternative Special Status Species
Mexican Spotted Owl
There would generally be beneficial change in impacts to MSO due to rotational use of air-tour route in Zuni Point and Dragon Corridors. East End (the area with greatest potential for impacts on MSO) Ten-Year Forecast Peak Season, areas of low noise would increase with 34% of MSO habitat areas with air-tour aircraft Percent Time Audible 5% or less of the day (14% in Alternative A), and 54% of MSO habitat areas with air-tour Average Sound Level of 15 dBA or less (3% in Alternative A). MSO habitat areas with frequent aircraft noise disturbances would be greatly reduced with 46% of areas with air-tours Percent Time Audible greater than 25% of the day (76% in Alternative A). Ten-Year Forecast Peak and Off-Peak Season these would represent overall impact of minor to major beneficial changes in impacts compared to Alternative A.

Base Year Peak Season, beneath and adjacent to Dragon Corridor active short-loop tour routes, MSO and their habitat would experience moderate adverse impacts which result in short-term minor beneficial change in impact compared to Alternative A. Ten-Year Forecast Peak Season, with conversion to quiet-technology aircraft, there would be short-term minor to moderate beneficial change in impacts compared to Alternative A. Base Year Off-Peak Season, when Dragon Corridor is closed to use, there would be minor to moderate adverse impacts with short-term moderate beneficial impacts compared to Alternative A. Ten-Year Forecast Off-Peak Season there would be minor adverse impacts with moderate to major beneficial impacts compared to Alternative A.

In Zuni Point Corridor Base Year Peak Season when short-loop tour routes would be inactive, there would be moderate adverse impacts with mixed results from minor adverse to minor beneficial change in impacts compared to Alternative A depending on location. Ten-Year Forecast Peak Season impacts would be reduced with minor to moderate adverse impacts with minor to moderate beneficial change in impacts compared to Alternative A.

Base Year Off-Peak Season, in areas under and near Zuni Point Corridor active short-loop air-tour routes, the NPS Preferred Alternative would have moderate adverse impacts with negligible change in impact compared to Alternative A. Ten-Year Forecast Off-Peak Season, there would be moderate adverse impacts with short-term minor to moderate beneficial change in impact compared to Alternative A.

Ten-Year Forecast there would generally be minor to moderate adverse impacts with short-term minor to moderate beneficial change in impacts at locations beneath Bright Angel Flight-free Zone and along North Rim near air-tour routes Peak and Off-Peak Seasons. In other East End areas removed from air-tour routes, such as amid Bright Angel Flight-free Zone, there would be negligible change from Alternative A. Cumulative impacts from all actions would continue to be long-term moderate adverse.

Conclusion Central *NPS Preferred Alternative* *Special Status Species*
Mexican Spotted Owl
In the Central area there would be negligible to minor adverse impacts with negligible change in impacts on MSO compared to Alternative A Base Year and Ten-Year Forecast Peak and Off-Peak Season. Cumulative impacts from all actions would continue to be long term moderate adverse.

Conclusion West End *NPS Preferred Alternative* *Special Status Species*
Mexican Spotted Owl
West End, All Scenarios, there would be minor to moderate impacts with short-term negligible to minor beneficial change in impact on MSO compared to Alternative A. Cumulative impacts from all actions would continue to be long term moderate adverse.

SOCIOECONOMIC ENVIRONMENT

General Methodology and Assumptions

Socioeconomic impact analysis includes impacts of Action Alternatives (E, F, and NPS Preferred) compared to Alternative A for the following groups or categories

- Air-tour operators
- American Indian tribes
- General aviation
- Regional economy, including gateway communities
- Intrinsic values

Areas Evaluated for Impacts

Areas evaluated for impacts are unique to each socioeconomic group listed above. These areas are defined as

Air-tour Operators Changes to each operators' tour characteristics and business operations (for example, number of tours flown, tour routes, and times of day) could occur in the SFRA. Air-tour operators conducting tours in the SFRA are based in locations surrounding GCNP, as described in Chapter 3, Socioeconomic Environment.

Financial impacts to operators might result in changes to employment and employee earnings, which could affect economic conditions near the operator's base of operations. Employment and income impacts are generally grouped into impacts to 1) East End communities and 2) West End (Las Vegas and surrounding communities).

American Indian Tribes Impacts to various tribes include possible economic changes to tribal budgets and populations living on reservations. Three American Indian tribes are discussed in Chapter 3, Ethnographic Resources, each with unique land areas and tribal economies. Analysis of impacts on each tribe is limited to specific land areas and characteristics of that tribe.

General Aviation Socioeconomic impact analysis for general aviation focuses on flights occurring through the SFRA. Although general-aviation flights may originate from or land at any airport throughout the U.S., geographic area of impact analysis is limited to effects of SFRA changes. Financial impact to aircraft operators is analyzed, and potential for effects on economic activity at the aircraft base of operations is discussed.

Regional Economy Six GCNP gateway communities are located in Coconino County as described in Chapter 3, Socioeconomic Environment. It is uncertain to what extent one community's economy would be impacted by Alternatives compared to another community, and therefore gateway community socioeconomic impacts are presented as an aggregate. Many Grand Canyon air-tour and ground-based visitors come from the Las Vegas area, and impacts to the Las Vegas economy are addressed separately.

Direct Use and Intrinsic Values of Grand Canyon National Park This section addresses changes to direct-use value, that value which visitors receive beyond actual expenditures, from their park visit. In addition, this section considers changes to park intrinsic or non-use values attributed to the general population, which includes people who may never visit the park.

Cumulative Impacts **Socioeconomic Environment**

In addition to prospective SFRA flight-rule changes considered in this EIS, there would be a host of potential events and evolving trends that could affect parties addressed in this socioeconomic impact analysis including

- **Grand Canyon Air-tour Operators** This industry has evolved considerably and this evolution is likely to continue. Marketing air-tours has become much more sophisticated with packaging and an international orientation. Smaller operators have sold out to larger ones, and such consolidation is likely to continue until a small number of large operators comprise the industry. Helicopters have gained a larger share of the overall market. West End has experienced almost all the industry growth in recent years

- **Aircraft Technology** Helicopters and fixed-wing aircraft would continue to improve over time. EC-130 helicopters, a quiet-technology aircraft, have become a market preference among customers and some operators. The shortage of EC-130 production ability should improve as production capability adjusts to the market and as new aircraft options come on the market. Quieter, larger capacity, more efficient aircraft can be expected

- **National and International Economic Conditions** Economic conditions in the U.S. and abroad will continue to be a primary determinant of park visitation, of air-tour demand, and American Indian reservation tourism. Personal income growth, leisure preferences, foreign exchange rates, international relations, and fuel prices are all key influences. Tighter travel budgets might be evident in the future. Along with demographic changes, including growth, these phenomena will bring opportunities and challenges to tourism interests that rely on Grand Canyon's visitor draw

- **Consumer Preferences** U.S. and international traveler preferences will also determine demand for air tours and park and reservation visitation. In recent years, desire for a unique experience, activities combined in a package, and a premium on available time, have been important market determinants

- **Other Cumulative Impacts** Changes related to tribal tourism enterprises other than SFRA flights can be expected. No projections of flight operations were made for tours that access Hualapai lands from outside the SFRA; these may or may not grow at the same rate as the GCNP air-tour industry. No projections were made for other activities occurring on any tribal lands

In sum, prospective SFRA rules changes, while important from a Socioeconomic standpoint, would represent a relatively minor determinant in activity levels and future prospects for air-tour operations, tribal tourism, and park visitation.

SOCIOECONOMIC IMPACT UNCERTAINTIES

It is important to recognize uncertainties associated with socioeconomic impact estimates for this EIS. To estimate socioeconomic effects and impact intensity, it was necessary to make a host of assumptions, but these assumptions might lead to an understatement or overstatement of impacts. Assumptions include

- **Air-tour Industry Conditions** Impact assumptions and estimates are based on trends and industry conditions which existed in **2007 and 2008**. This is a volatile industry undergoing continuous change. Actual impacts will be determined in part by industry conditions at implementation and beyond

- **Consumer Response to SFRA Rules Changes** Park air and ground visitors, along with nearby Native Americans, are subject to both temporary change (i.e., abbreviated vacation time) and long-term change (i.e., recessions). These changing consumer characteristics might change responses to SFRA role changes in unpredictable ways

- **Operator Responses to SFRA Rule Changes** Although operators indicated their likely response to specific rule changes during EIS research, they might act differently following implementation, perhaps in response to unexpected market conditions or business opportunities elsewhere

- **Other Changes in Cumulative Conditions** Tribal governance and regulation of their air-tour industry will ultimately be determined by tribal leaders. Their interest in expanding or contracting the air-tour industry, their fee structure, and development of supporting tourist facilities is fully under respective tribal discretion

Socioeconomic impact estimates in this EIS are point estimates. Actual impacts could differ from those projected (higher or lower). A range of impact estimates was not used since no probabilities could be assigned to that range; such a range would not be defensible. Recognizing the challenge of gathering information from parties affected by eventual rule changes and inherent uncertainties, the EIS study team made a considerable effort to maintain objectivity in Socioeconomic impact estimates.

Over time, intensity of impacts from each Alternative would diminish for two reasons. Cumulative influences on the Grand Canyon tourism industry would predominantly drive economic and social changes. Secondly, air-tour operators, general-aviation participants, and tribal interests would adjust to SFRA rules changes as best they can, to both reduce adverse impacts and take advantage of opportunities.

Impact Intensity Threshold Descriptions **Socioeconomic Environment**

Threshold Levels

Negligible **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

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

Minor **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

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

Moderate **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

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

Major **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

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, apparent in the study area, affecting a large segment of the population and/or many local businesses.

Duration

Short Term Impacts last two years or less

Long Term Impacts last longer than two years

Context

Localized Impacts affect one to a few of the communities in the SFRA

Regional Impacts affect communities throughout the SFRA and/or other nearby airports and their associated gateway communities

Air-tour Operators **Socioeconomic Environment**

Methodology and Assumptions for Analysis of Impacts to Air-tour Operators

Economic impacts were determined for each operator then aggregated to provide a summary of impacts to the industry as a whole. However, this EIS provides a breakdown of impacts by aircraft type; for example, helicopter versus fixed-wing operators, and East or West End. Air-tour operators would experience Socioeconomic changes from each Alternative resulting from combination of changes to specific components of each Alternative. Impacts to each operator's business environment and finances would mainly be due to changes in demand for flights, resulting impact on flight operations, and changes in cost of doing business to a lesser extent. Potential Socioeconomic impacts include changes in Grand Canyon-related flight operations, passenger volume, operator revenues and costs; changes in operator employment and resulting personal income; financial viability; and resulting impacts on local economy. This section of the Socioeconomic impact analysis describes impacts of each Alternative attribute and specific impacts by Alternative. This section also provides a quantitative analysis of predicted Socioeconomic effects on the overall air-tour industry with specific discussion of impacts by location, where applicable.

Data Sources **Air-Tour Operators** **Socioeconomic Environment**

Analysis of impacts to air-tour operators for each Alternative is based on data and information about the Grand Canyon air-tour industry gathered from the FAA and through in-depth interviews with each tour operator (Harvey Economics 2008ab).

FAA provided background on the industry, data on operations, and information about specific aircraft characteristics. FAA also provided information on operations for 2005 as well as quarterly summaries of total operations **2000 through 2006**. This information provided a foundation in terms of annual numbers of flight operations by flight type, aircraft type, and location.

Interviews with operators provided information about annual operations, passenger volume, employment, and financial conditions. Grand Canyon air-tour industry dynamics as of **2007 and 2008** were also discussed. Operators provided insight into the air-tour industry, and also provided general information about how they would respond to specific attributes and Alternatives. Two sets of interviews occurred with each of 13 active operators (one operator was inactive at the time of interviews). The first interview round occurred April and May 2007, and focused on gathering information about each operator's business and likely impacts they anticipated from Alternatives B through F. Although Alternatives B, C, and D were subsequently eliminated, valuable information was gathered from discussions of those Alternatives in terms of how operators would respond to various changes in SFRA attributes since certain of those attributes became part of the NPS Preferred Alternative. In addition to air-tour operators, a representative of the Hualapai Tribe and two consultants knowledgeable about the air-tour industry were also interviewed in spring 2007. Each of these personal interviews were conducted over the course of several hours, and follow-up contact was initiated, if necessary, to obtain additional data or gain clarification on specific points (Harvey Economics 2008 a,b)

A similar, second set of interviews was conducted with each air-tour operator October and November **2008**; these focused on operator responses to attributes of Alternative G; this Alternative was also subsequently eliminated from consideration as part of this EIS. However, valuable information was gained from these interviews regarding industry workings and likely responses of operators to various types of changes, since certain attributes of this Alternative became a part of the NPS Preferred Alternative. These interviews were conducted over the phone, and each interview generally occurred over several hours (Harvey Economics 2008d).

Knowledge of the air-tour industry coupled with information on operators' responses to Alternative-specific details provided the basis for air-tour operator impact analysis. Although no interviews were conducted with operators specifically to discuss the NPS Preferred Alternative, information gathered from previous interviews was applied to NPS Preferred Alternative analysis. Changes in flight operations in each Alternative were estimated based on information gathered from operator interviews and other available industry data. Development of these flight-operations estimates are discussed below. Estimates of changes to passenger volume, operator finances and financial viability, and employment and personal income were based on flight operations data for each Alternative.

Analysis Time Periods and Growth Estimates **Air-Tour Operators** **Socioeconomic Environment**

Analysis of impacts to air-tour operators was completed for two time periods for each Alternative: Base Year and Ten-Year Forecast. Ten-Year Forecast analyses incorporate air-tour industry annual growth assumptions. The FAA's Statistics and Forecasting Branch developed an estimate of 1.3% annual growth for the GCNP air-tour industry and flight operations.[40] The estimated growth rate was agreed on by NPS and FAA for the purpose of this EIS (Volpe 2006).

Projected conditions for each Alternative were compared with that Alternative's Base Year and to Alternative A's Ten-Year Forecast.

Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

Percentage changes in Base Year and Ten-Year Forecast for Action Alternatives were developed based on specific attributes of each Alternative, operator responses to those attributes, and knowledge of the overall air-tour industry (Harvey Economics 2008a and 2008b). Components of each Alternative are described in detail in Chapter 2. A

[40] 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

general description of impact to air-tour operators resulting from changes to each Alternative component is outlined below.

Seasonal Curfews **Air-Tour Operators** **Socioeconomic Environment**
Flight Operations in the SFRA

East End seasonal curfew indicates allowable hours of operation for fixed-wing and helicopter air-tours on East End routes. Curfew times change depending on time of year, generally with longer hours of flight time available in late spring, summer, and early fall, and shorter hours in other months. Generally, the longer the available flight times, the better for tour operators; however, operators prefer to fly in morning hours for several reasons including more stable air conditions for flying, and opportunity for coordination with land-based visitor activities such as bus tours. Therefore, extended (or curtailed) curfew hours in the morning generally have more impact on operators than changes in evening curfew hours. This is especially relevant in winter with earlier darkness; late evening tours are not possible due to lack of visibility. However, several operators rely on running afternoon tours to coordinate with a larger tour package (i.e., ground tours). There are no curfews on West End routes.

- **Alternatives A and F** would not include any changes to the existing seasonal curfew

- **Alternative E** Curfew is linked to sunrise and sunset, which would have an adverse impact on tour operations. There is also potential for confusion by both operators and air-tour visitors about curfew hours as sunrise and sunset times change over the year. Curfew hours would change almost daily, affecting flight operation hours on a continuous basis. Linkage to sunrise would also make it difficult to coordinate air-tours with land-based activities. In addition, non-quiet-technology aircraft would be required to hold off flights for an additional 1.5 hours in morning, and 2.5 hours in evening, reducing operations even further. The one-hour mid-day curfew would also have an adverse impact on operators. Some flights would be re-scheduled for times outside the curfew, but many flights would be lost. A 15% reduction in flight operations was applied to East End tour operations to account for effects of curfew changes in Alternative E

- **NPS Preferred Alternative** A fixed, seasonal curfew would apply to the entire East End, including Marble Canyon. May through September flight times would be 8 a.m. to 5 p.m.; October through April flight times would be 9 a.m. to 4 p.m. Flight times would be reduced by one hour in the afternoon, year-round, compared to Alternative A. Loss of available Off-Peak Season flight time would have an adverse impact on two operators who offer late afternoon tours. Based on loss of tours for those operators, a 3% reduction in flight operations was applied to East End tour operations to account for effects of curfew changes in the NPS Preferred Alternative

Allocation of Tour Operations **Air-Tour Operators** **Socioeconomic Environment**
Flight Operations in the SFRA

Currently, each tour operator has a certain number of air-tour annual allocations for SFRA operations, meaning each operator is authorized to fly a specific number of SFRA flights. Aggregate annual allocations for air-tour and air-tour-related operations are currently set at a total 93,971. Each operator can use their allocations on existing routes throughout the year on any days they choose, and there is no daily cap on number of tours flown. As described in Chapter 3, Socioeconomic Environment, the GCNP air-tour industry is a seasonal business, with a greater number of operations occurring in summer, and a lesser number in other months.

- **Alternatives A and F** would not include any changes to annual allocations

- **Alternative E** Includes the current annual allocation (93,971 flights) with a daily cap of 364 flights, including all air-tours and air-tour-related operations. The air-tour business is highly seasonal for most operators; the majority of tours flown and revenue generated occurs during summer season. The daily cap would result in a substantial reduction of Peak Season operations and a reduction of annual operations for air-tour operators. Daily number of flights each year is not known, but a daily cap of 364 would account for slightly more than half of the 2005 Peak Day air-tour and air-tour-related flights. While this daily cap could result in an immediate curtailment of flights for some operators on the busiest days, it would also allow for

growth in air-tour operations during less busy periods. A 20% reduction was applied to flight operations subject to SFRA allocation, to account for daily cap effects in Alternative E.

- **NPS Preferred Alternative** Includes a daily cap of 364 commercial air-tours, and an annual cap of 65,000 air-tours. All air-tour-related operations would occur outside the SFRA, and flights in the SFRA in support of the Hualapai would be exempt from allocations and caps. Air-tour operators in the aggregate are operating substantially below the daily cap and annual allocation now, but individual operators might be much closer than others. Operators would not necessarily be subject to individual daily caps if the total daily cap was not exceeded, but would be required to adhere to their annual allocation. An adaptive management approach would be taken by the NPS to monitor and manage SFRA sound levels. In the NPS Preferred Alternative, there is some uncertainty regarding how the daily cap would be implemented and enforced and whether a reduction in flights would occur to reach target sound levels. Additionally, daily caps and annual allocations are likely to result in operators becoming more reluctant to trade or lease caps and allocations to each other on the chance they would be needed at some point in the year, potentially limiting operations of some tour companies. Risk and uncertainty discourage business activities, especially capital-intensive businesses such as air tours. For these reasons, a flight-operations reduction of 7% was applied to SFRA commercial tour operations Peak Season to account for annual allocation system effects in the NPS Preferred Alternative. No reductions were applied to operations Off-Peak Season as a result of the modified allocation system

Changes to Tour Routes **Air-Tour Operators** **Socioeconomic Environment**
Flight Operations in the SFRA

Action Alternatives include various changes to fixed-wing and helicopter air-tour routes, including route length, route movement over different areas of the canyon, or route elimination. Changes to each route for each Alternative are described in Chapter 2. Tour aspects most appreciated by customers include time over the canyon and landscape features and scenery viewed during flight. Shortened flight times, changes to route locations, or reduction in number of different tour options offered could impact air-tour marketability, reducing operations. Elimination of routes that serve as entry points for certain operators would also reduce air-tour operations. New routes over Navajo land in the NPS Preferred Alternative could attract customers, resulting in additional operations on that route. A general description of route changes follows, with a projection of anticipated operator responses.

- **Alternative A** would not include any changes

- **Alternative E** Marble Canyon fixed-wing routes and East End southern-entry fixed-wing routes would be eliminated. Additionally, only one East End short-loop route would be available for helicopters and fixed-wing aircraft during the year, and all long-loop route options would be eliminated. These changes would substantially limit tour options available to operators, and could reduce East End tour marketability. Impacts to individual operators would vary, depending on which routes they use, how they use them, and on operator-specific business characteristics. However, overall reduction in East End route operations due to route changes would amount to about 21%. Blue Direct routes would be modified, but no change in operations would be expected as a result. No West End tour routes would be modified in Alternative E; therefore, no changes in West End flight operations would be expected

- **Alternative F** Changes in East End routes would be slight compared to Alternative A. Flights in Nankoweap basin would be eliminated, and modified routes would occur in Dragon Corridor December and January. These minor changes would not have any impact on number of East End flight operations. Operations on Blue Direct routes would shift somewhat due to quiet technology and directional flight restrictions on Blue Direct North. Overall operations on Blue Direct routes would increase by about 12% due to the more attractive Blue Direct North. West End helicopter routes would be modified to eliminate Green-4's southern portion, reducing overall West End helicopter operations by about 4%

- **NPS Preferred Alternative** Southern fixed-wing entry routes and Black-3 entry route from the east would be eliminated which would result in small reductions of operations on other East End fixed-wing routes. One short-loop option would be available for both fixed-wing aircraft and helicopters any day of the year, and one long-loop option would also be available year-round. These options are important from a marketability standpoint in

attracting a variety of customers. Marble Canyon operations could be reduced due to quiet-technology aircraft and northbound-flights-only requirements

A unique NPS Preferred Alternative feature is creation of tour routes that provide helicopter access to and from Navajo lands, and which are connected to Green-1. Tours on Navajo routes would include a landing on Navajo lands. These tours are likely to grow in number slowly until tourist infrastructure, services, and travel patterns are established. Eventually, this route could become popular, similar to West End Hualapai-related flights. A projected six flights per day are assumed initially, and 18 per day Ten-Year Forecast.

The single Blue Direct route included in the NPS Preferred Alternative would accommodate all operations flown on Blue Direct North and South in Alternative A; no change in overall cross-canyon operations would occur. West End routes would be modified slightly; these route changes would not result in any changes in flight operations. Overall, flight operations would be reduced by about 9% due to NPS Preferred Alternative route changes

Seasonal Route Scheduling **Air-Tour Operators** **Socioeconomic Environment**
Flight Operations in the SFRA

Action Alternatives include seasonal route scheduling on some East End routes.

- **Alternative A** does not include seasonal route scheduling

- **Alternative E** All East End tours would take place in Dragon Corridor September 16 to June 30, and in Zuni Point Corridor July 1 to September 15. Availability of only one corridor at any time of the year would limit both offered tour options and tour marketability. Reductions of 25 to 75% were applied to specific operators, depending on routes each currently uses, to account for changes in East End air-tour routes including seasonal route scheduling

- **Alternative F** includes use of a modified Dragon Corridor, located west of the current corridor, December and January. Flight distances and times on specific routes would be lengthened December and January, when the modified corridor would be in use, but use of the modified corridor would not affect number of tour operations. The same tour opportunities would exist December and January as during other times of year; certain routes would just be located in a slightly different location. No reductions were applied to flight operations as a result of Alternative F's seasonal route scheduling

- **NPS Preferred Alternative** Dragon Corridor would be open for short-loop flights May 1 to October 31, and Zuni Point Corridor for short-loop flights November 1 to April 30. The longer loop route between Zuni Point and Dragon Corridors would be open to quiet-technology aircraft year-round. During Peak and Off-Peak Season, a short-loop option and a long-loop option would be available to both helicopter and fixed-wing operators. Availability of these options is important to operators from a marketing standpoint to attract a variety of customers. Therefore, no reductions were applied to operations as a result of seasonal route scheduling in the NPS Preferred Alternative

Changes to SFRA Boundaries and Flight-free Zones
Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

- **Alternative A** does not include boundary changes

- **Alternative F and NPS Preferred Alternative** The SFRA notch (the notch) around Grand Canyon West Airport would be modified to protect specific areas important to the Hualapai. This change would have a large impact on one operator, substantially reducing the operator's SFRA operations, and reducing overall West End helicopter flights by about 5%

- **Alternative E and NPS Preferred Alternative** would raise all Flight-free Zone ceilings to 17,999 feet MSL; no flights would be allowed below that altitude in Alternative E. Additionally, **Alternatives E, F, and the NPS Preferred** include a variety of changes to other SFRA Flight-free Zone boundaries. However, air-tours occur on

defined air-tour routes outside Flight-free Zones; changes to ceilings or other boundaries of these zones would not affect number of air-tour operations in any Alternative

Quiet-technology Conversion and Incentives

Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

Action Alternatives include requirements for conversion to quiet-technology aircraft.[41] Many operators have already converted some or all of their fleets to quiet-technology aircraft. However, quiet-technology conversion requirements potentially place financial pressure on operators that currently fly non- quiet-technology aircraft. Operators may be unable to finance new aircraft in a specified time frame or may be unable to acquire aircraft necessary to completely change their fleet to meet demand if the wait for quiet-technology aircraft is lengthy. Smaller operators may be disproportionately affected by these requirements.

- **Alternative A** does not include conversion requirements
- **Alternative E** Conversion time frame defined only as "by an agreed upon date," which makes operator planning somewhat difficult
- **Alternative F** Includes a 10- to 12-year conversion time frame
- **NPS Preferred Alternative** Requires full conversion within ten years of implementation

For purposes of this EIS, a ten-year conversion time frame from implementation has been assumed for all Alternatives. Impacts of conversion to quiet-technology aircraft vary by operator, depending on a number of factors, including current fleet composition and capabilities to finance fleet conversion.

Action Alternatives (E, F, and the NPS Preferred) also include a variety of quiet-technology incentives as described in Chapter 2. Incentives include routes 1) open only to quiet-technology aircraft or 2) open only to quiet-technology aircraft for a specific part of the day. Until quiet-technology conversion is complete, operators flying quiet-technology aircraft would benefit from additional flight time, especially in morning, or from monopoly of specific routes. Air traffic would be lessened, at least initially, due to fewer aircraft and because quiet-technology aircraft have increased passenger capacity, thereby providing benefits to the customer. Non-quiet-technology operators would be required to re-route tours or ground aircraft during quiet-technology-only hours, which would impact operations. Alternative F also includes overflight fee forgiveness for quiet-technology aircraft, which would provide a financial benefit to operators, but would not likely affect number of operations, which is generally driven by customer demand. In addition to quiet-technology routes, the NPS Preferred Alternative also eliminates annual allocations for quiet-technology flights January 1 to March 31.[42] Lifting the annual allocation requirement during this period would be somewhat helpful to operators in that they would be able to use those allocations during other, perhaps busier, times of year; however, in combination with daily caps, the impact of this incentive becomes uncertain.

Flight Operations Estimates, Base Year

Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

Percent changes described above were applied to Base Year operations data for Alternative A to estimate number of flight operations for Action Alternatives Base Year.

[41] Aircraft designated quiet-technology aircraft for SFRA use are described in Chapter 3, Socioeconomic Environment

[42] Subject to monitoring to ensure legal noise provisions are met

Flight Operations Estimates, Ten-Year Forecast
Flight Operations in the SFRA **Air-Tour Operators** **Socioeconomic Environment**

Estimates of flight operations, Ten-Year Forecast, incorporate Base Year impact on flight operations for that Alternative, a 1.3% annual growth rate, and conversion of all non-quiet-technology aircraft to quiet-technology.[43] The annual growth rate was applied to Base Year operations for each Alternative; subsequently, conversion of operations from non-quiet-technology aircraft to quiet-technology was applied. Conversion ratios are documented in Volpe (2006), and passenger seat information in FAA (2008). Quiet-technology aircraft are generally larger than non-quiet-technology aircraft models that fly over the park, and therefore, quiet-technology conversion would result in a reduction in number of flights with the same customer demand.[44]

For Action Alternatives in which conversion to quiet-technology aircraft would be required, operator financial capability to make those conversions was incorporated into the analysis. Revenue, expenditure, and debt service obligation data obtained from operators were weighed against capital costs of quiet-technology aircraft, changes in operating costs, and the market effect of flying tours on quiet-technology aircraft.

Passenger Volume **Air-Tour Operators** **Socioeconomic Environment**
Flight Operations in the SFRA

The ratio of passengers per flight for each operator in Alternative A was held constant Base Year for other Alternatives to estimate passenger volume. For example, if an operator averaged 5.5 persons per flight in Alternative 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 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 are assumed to reflect normal business conditions for each tour operator; in Alternatives E, F, and the NPS Preferred, operators would be expected to adjust number of employees with variations in number of tours provided. 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.

[43] Details of methodology used to estimate Ten-Year Forecast flight operations can be found in Harvey Economics 2008b

[44] The EC-130 is larger than 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

Total Operating Costs **Air-Tour Operators** **Socioeconomic Environment**
Flight Operations in the SFRA

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 **Air-Tour Operators** **Socioeconomic Environment**
Flight Operations in the SFRA

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, and assumptions of annual industry growth. Tables 4.233 to 4.240 show impact conclusions for each Alternative on Socioeconomic elements and activities and are provided at the end of the analysis.

ALTERNATIVE A **NO ACTION** **SOCIOECONOMIC ENVIRONMENT**
AIR-TOUR OPERATORS

Air-Tour Operators *Alternative A* *Socioeconomic Environment*
Base Year

Alternative A reflects 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.

TABLE 4.233 ALTERNATIVE A AIR-TOUR OPERATORS ECONOMIC IMPACTS BASE YEAR

Economic Measure	Alternative A Base Year
Flight Operations in the SFRA	99,129
Passenger Volume	723,244
Total Gross Revenue GCNP Flights	$203,123,000
GCNP-Related Employment	1,251
Employee Earnings	$40,598,000

Sources: Harvey Economics 2007a; Harvey Economics, 2010
Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights as reported by operators, including Hualapai exempt 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 13.76% increase in air-tours flying over Grand Canyon. This amounts to an increase of about 13,700 flight operations, and about 99,700 passengers. No conversion to quiet-technology aircraft would be required. Operator conditions are shown in Table 4.234.

TABLE 4.234 ALTERNATIVE A TEN-YEAR FORECAST AIR-TOUR OPERATORS ECONOMIC IMPACTS

Economic Measure	Alternative A Ten-Year Forecast	Change from Alternative A, Base Year
Flight Operations in the SFRA	112,796	14%
Passenger Volume	822,961	14%
Total Gross Revenue GCNP Flights	$231,128,000	14%
GCNP-Related Employment	1,424	14%
Employee Earnings	$46,195,000	14%

Source: Harvey Economics 2010

ALTERNATIVE E ALTERNATING SEASONAL USE AIR-TOUR OPERATORS SOCIOECONOMIC ENVIRONMENT

Air-Tour Operators Alternative E Socioeconomic Environment

Base Year

Alternative E would include the following attributes and resulting effects on operations

- Morning and afternoon curfew times linked to sunrise and sunset
- Four hours of additional morning and afternoon curfew times for non-quiet-technology aircraft
- A one-hour mid-day curfew for all aircraft

These curfew requirements would result in a 15% reduction in East End flight operations. Curfew hours would not apply to West End flight operations

- A daily cap of 364 flight operations, including all air-tour and air-tour-related flights. The cap on operations would result in a 20% reduction in all flight operations subject to the annual allocation requirement
- Flights in support of the Hualapai would continue exempt from annual allocations and daily caps
- Elimination of tour routes and changes to remaining routes, including seasonal route scheduling, would result in about a 21% overall reduction in East End operations. No changes would be made to West End tour routes

Combined effect of changes described above would be a decrease in flight operations of about 21%, and a decrease in passenger volume of about 18% Base Year compared to Alternative A. Change in passenger volume is not equal to change in flight operations since average passenger load varies by operator. Impacts of Alternative E on flight operations, passenger volume, revenue, employment, and income are shown in Table 4.235.

TABLE 4.235 ALTERNATIVE E BASE YEAR AIR-TOUR OPERATORS ECONOMIC IMPACTS

Economic Measure	Alternative E Base Year	Change from Alternative A Base Year
SFRA Flight Operations	78,030	-21%
Passenger Volume	590,950	-18%
Total Gross Revenue GCNP Flights	$166,565,000	-18%
GCNP-Related Employment	1,020	-19%
Employee Earnings	$33,834,000	-17%

Source: Harvey Economics 2010

Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights

Almost all overall industry changes described in Table 4.235 would result from impacts to East End operators. These fixed-wing and helicopter operators would experience an estimated 34% reduction in flights, as compared with 3% for West End operators. Effects of reduced employment and personal income would occur throughout the region, depending on individual operator's operations base location. A portion of effects of reductions in gross revenues would be felt locally, as operators make fewer purchases in the region; the remainder would be

experienced on a larger geographic scale, since operators purchase additional goods and services from vendors outside the immediate area.

West End operators would experience smaller changes in flight operations, passenger volume, and economic characteristics for several reasons: 1) operations are not limited by seasonal curfew hours, 2) many operators fly tours considered support for the Hualapai, and are therefore excluded from the annual allocation requirement, and 3) there would be no change to West End fixed-wing or helicopter routes or to the SFRA boundary on the West End (the notch) in Alternative E.

Changes in operating costs due specifically to route changes in Alternative E would likely only occur for those operators flying cross canyon on Blue Direct North and South, and for the operator flying to Supai Village on Brown-6.[45] Blue Direct North would be realigned as described in Chapter 2, resulting in about an eight-nautical mile or 10% increase in distance; Blue Direct South would be moved outside the SFRA, about a 16-nautical mile or 20% increase in distance. Operating costs would increase for flights using these routes due to additional fuel requirements, flight time, and aircraft depreciation on a per-flight basis. Operators using Blue Direct North and South fly a number of different aircraft types; changes in operating costs would be specific to individual aircraft types. Brown-6 would increase by about four nautical miles, about a 14% increase in distance. West End tour routes would not change, and therefore no changes in operating costs would occur related to those routes. East End tour routes would undergo many changes in Alternative E; however, Black-1 and Green-1 through Zuni Point Corridor would remain about the same in terms of length and flight time, and Black-1A and Green-2 through Dragon Corridor would also remain about the same in terms of length, resulting in negligible changes to operating costs on these routes. Additional operating costs would also be incurred by operators if they chose to re-route transportation, repositioning, and other non-tour flights outside the SFRA. Changes in operating costs for these flights would depend on chosen flight route.

Alternative E *Air-Tour Operators* *Socioeconomic Environment*
Ten-Year Forecast

Alternative E requires full conversion to quiet-technology aircraft by a yet-to-be-agreed date. For analysis purposes, conversion is assumed to be completed ten years from implementation. Impacts of Alternative E route and attribute changes, annual air-tour industry growth, and quiet-technology conversion would impact operators as shown in Table 4.236.

TABLE 4.236 ALTERNATIVE E AIR-TOUR OPERATORS ECONOMIC IMPACTS TEN-YEAR FORECAST

Economic Measure	Alternative E Ten-Year Forecast	Difference from Alternative A Ten-Year Forecast
Flight Operations in the SFRA	74,000	-35%
Passenger Volume	657,490	-20%
Total Gross Revenue: GCNP Flights	$176,894,000	-23%
GCNP Related Employment	1,070	-25%
Employee Earnings	$34,544,000	-25%

Source: Harvey Economics 2010

Alternative E Ten-Year Forecast passenger volume projections begin with Alternative E Base Year, were increased by 1.3% per year, and placed in larger quiet-technology aircraft to determine flight operations. Total flight operations would decrease in part due to the relatively larger size of quiet-technology aircraft compared to non-quiet-technology aircraft, mainly for fixed-wing aircraft, along with Alternative E changes. However, passenger volume would decrease much less since larger aircraft hold more customers. Percent changes in gross

[45] 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

revenues and employment differ from passenger volume because each impact is calculated on an individual-operator basis.

Almost all fixed-wing operators are either currently fully converted to quiet-technology aircraft. One small operator would be unable to convert to quiet-technology aircraft and would therefore be excluded from SFRA flights Ten-Year Forecast; for this operator, GCNP air-tours are only a small part of overall business. Each partially converted operator would need to purchase a small number of aircraft for full conversion. Although these operators' debt service would increase as a result of additional aircraft purchase, 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 would need the full ten years allowed for conversion.

Cumulative Effects Alternative E **Air-Tour Operators** **Socioeconomic Environment**

Cumulative Effects Alternative E Air-Tour Operators Socioeconomic Environment Base Year

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 an expansion longer term. By itself, Alternative E Base Year represents a moderate to major adverse impact on the Grand Canyon air-tour industry. Considering Alternative E Base Year impacts with effects of reasonably foreseeable influences, net changes are likely to moderate to major be adverse as challenges of Alternative E combine with chronically high level of industry uncertainty.

Cumulative Effects Alternative E Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

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 an expansion longer term. By itself, Alternative E Ten-Year Forecast represents a moderate to major adverse impact on the Grand Canyon air-tour industry. Considering Alternative E Ten-Year Forecast with effects of reasonably foreseeable influences, net changes are likely to be moderate to major adverse as challenges of Alternative E combine with chronically high level of industry uncertainty.

Conclusion Alternative E **Air-Tour Operators** **Socioeconomic Environment**

Conclusion Alternative E Air-Tour Operators Socioeconomic Environment Base Year

Base Year impacts of Alternative E on air-tour operators would be long term moderate to major adverse. East End air-tour industry impacts would be widespread, and viability of air-tour companies operating there could be threatened.

Conclusion Alternative E Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

Ten-Year Forecast Alternative E impacts would be long-term moderate to major adverse compared Alternative A Ten-Year Forecast. However, air-tour operators would adjust somewhat over time to SFRA rule changes and would mitigate adverse impacts of Alternative E somewhat.

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

- 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; however, passenger volume would increase slightly in Alternative F Base Year. This apparent inconsistency is due to specific changes affecting individual operators. For example, in Alternative F, several helicopter operators would experience a large reduction in number of operations while a few fixed-wing operators would experience a smaller number of increased operations. However, fixed-wing aircraft used by these operators are considerably larger than helicopters, accounting for overall increase in passenger volume. Impacts of Alternative F on flight operations, passenger volume, revenue, employment, and income Base Year are shown in Table 4.237.

TABLE 4.237 ALTERNATIVE F BASE YEAR AIR-TOUR OPERATORS ECONOMIC IMPACTS

Economic Measure	Alternative F Base Year	Change from Alternative A Base Year
Flight Operations in the SFRA	97,610	-2%
Passenger Volume	738,490	2%
Total Gross Revenue GCNP Flights	$199,305,000	-2%
GCNP-Related Employment	1,210	-3%
Employee Earnings	$40,035,000	-1%

Source: Harvey Economics 2010
Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights as reported by operators, including Hualapai exempt 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. These reductions in spending would have a negligible impact on the Boulder City or Las Vegas areas.

Operators flying cross canyon on Blue Direct North and South could experience operations increases due to route realignment in Alternative F. Small increases in employment, personal income, and operator spending as a result of increased operations could occur in the Boulder City and Las Vegas areas and East End communities. 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

Alternative F requires full conversion to quiet-technology aircraft in 10 to 12 years; a ten-year conversion period is assumed for this analysis. Ten-Year Forecast operators would experience decreases in flight operations, but increased passenger volume due to annual-growth assumptions for the air-tour industry coupled with conversion to larger, quiet-technology aircraft. Impacts in Alternative F Ten-Year Forecast are illustrated in Table 4.238.

TABLE 4.238 ALTERNATIVE F TEN-YEAR FORECAST AIR-TOUR OPERATORS ECONOMIC IMPACTS

Economic Measure	Alternative F Ten-Year Forecast	Difference from Alternative A Ten-Year Forecast
Flight Operations in the SFRA	94,160	-17%
Passenger Volume	830,750	1%
Total Gross Revenue GCNP Flights	$218,895,000	-5%
GCNP-Related Employment	1,290	-10%
Employee Earnings	$41,402,000	-10%

Source: Harvey Economics 2010

Almost all fixed-wing operators are either currently fully converted to quiet-technology aircraft One small operator would be unable to convert to quiet-technology aircraft and would therefore be excluded from SFRA flights Ten-Year Forecast; for this operator, GCNP air-tours are only a small part of the overall business. Each partially converted operator would need to purchase a small number of aircraft for full conversion. Although these operators' debt service would increase as a result of additional aircraft purchase, 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.

Cumulative Effects Alternative F Air-Tour Operators Socioeconomic Environment

Cumulative Effects Alternative F Air-Tour Operators Socioeconomic Environment Base Year

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, Alternative F Base Year represents a negligible to minor impact on the Grand Canyon air-tour industry. Considering Alternative F Base Year impacts with effects of reasonably foreseeable influences, net changes are likely adverse but negligible as changes and impacts of Alternative F Base Year lie in range of fluctuation and uncertainty common to this industry.

Cumulative Effects Alternative F Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

Including impacts of Alternative F Ten-Year Forecast, cumulative effects on air-tour operators will be relatively lessened, given all the industry, technological, economic, demographic, and consumer preference factors that face the air-tour industry. Even so, prospective SFRA rule changes would add to industry uncertainty, representing in a minor adverse cumulative impact.

Conclusion Alternative F Air-Tour Operators Socioeconomic Environment

Conclusion Alternative F Air-Tour Operators Socioeconomic Environment Base Year

Impacts would be long term negligible to minor adverse, with one operator excluded from flying SFRA tours.

Conclusion Alternative F Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

Impacts would be long term minor to moderate adverse compared to Alternative A Ten-Year Forecast. Over time, adverse impacts would diminish somewhat as operators adjusted to new flight rules.

NPS PREFERRED ALTERNATIVE AIR-TOUR OPERATORS SOCIOECONOMIC ENVIRONMENT

NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment

Base Year

The NPS Preferred Alternative would include the following attributes and resulting effects on operations

- Seasonal curfew would apply to entire East End, including Marble Canyon, and would reduce flight time by one hour in the afternoon. The change in curfew hours could result in a 3% reduction in East End operations
- A daily cap of 364 commercial-tour operations, along with 65,000 annual allocations. All air-tour-related flight operations (repositioning and transportation flights) would be routed outside the SFRA; resulting in re-routing about 14% of total flight operations. The daily cap could result in a 7% reduction in those flight operations subject to annual allocations
- Flights in support of the Hualapai would continue exempt from annual allocations or daily cap
- Changes to East End tour routes, including seasonal route scheduling and addition of a new tour route over Navajo lands, would result in an overall decrease in operations of about 9%.[46] No reduction in operations would result from West End route changes

Combined impact of changes described above would be about a 10% reduction in overall flight operations and about a 7% reduction in passenger volume. Change in passenger volume is not equal to change in flight operations since the average passenger load varies by operator. Impacts of the NPS Preferred Alternative on flight operations, passenger volume, revenue, employment, and income Base Year are shown in Table 4.239.

In the NPS Preferred Alternative, one small fixed-wing operator would be completely excluded from flying air-tours over Grand Canyon due to elimination of several routes. This operator would likely focus on scenic tours offered in other areas, and on other aviation-related business and would not go out of business due to these route changes. All other operators would experience some decreased operations due to route changes and other NPS Preferred Alternative attributes.[47] The majority of these operators would experience decreases in operations ranging 4 to 9%. East End operators would generally experience higher flight reductions due to route changes coupled with other Alternative attributes, including curfews and annual allocation requirements. West End operators would experience smaller flight reductions due to relatively minor route modifications, lack of curfew times, and Hualapai support flights being excluded from the annual allocation requirement.

TABLE 4.239 NPS PREFERRED ALTERNATIVE AIR-TOUR OPERATORS ECONOMIC IMPACTS BASE YEAR

Economic Measure	NPS Preferred Alternative Base Year	Change from Alternative A Base Year
Flight Operations in the SFRA	88,740	-10%
Passenger Volume	670,540	-7%
Total Gross Revenue: GCNP Flights	$185,479,000	-9%
GCNP Related Employment	1,130	-10%
Employee Earnings	$37,451,000	-8%

Source: Harvey Economics 2010

Annual SFRA flight operations include all air-tours, repositioning flights, training flights, and other support flights as reported by operators, including Hualapai exempt flights.

[46] Tours on the new route over Navajo lands are assumed to be conducted by existing air-tour companies through arrangements with the Navajo Nation, FAA, and NPS, and not by the Navajo Nation directly

[47] Several operators currently flying Blue Direct North as a transportation flight would reclassify these operations as air-tours under the 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

New helicopter routes would be included in the NPS Preferred Alternative to provide access to and over Navajo Nation land. It was estimated that six flights per day would occur on new Navajo routes as part of a Grand Canyon commercial air-tour. The Navajo Nation would allow tour companies to fly over nation land, but tribal involvement in daily flight operations or administrative aspects of tour operations would likely be limited. Potential Navajo flights would help offset adverse impacts of other NPS Preferred Alternative components on overall operations for those companies offering the tours.

Effects of reduced flight operations including reduced employment, personal income, and operator spending would be spread over a large area, including East End communities and Las Vegas and Boulder City areas.

Small changes in operating costs due specifically to route changes in the NPS Preferred Alternative would likely occur for several types of operators or operations: 1) those that would have to fly across the canyon on Blue Direct North instead of Blue Direct South, 2) the operator flying to Supai Village on Brown-6, and 3) operators flying Green-2A or Black-2A in Dragon Corridor May to October. Additional flight times are limited but uncertain due to varying aircraft velocities, wind direction, and speed. Blue Direct North would be the only cross-canyon route available in the NPS Preferred Alternative; operators for whom Blue Direct South would have been more convenient due to airport locations would have to fly an additional 6 to 8 nautical miles, or about 10% farther than using the existing Blue Direct South. Brown-6 would increase by about 4 nautical miles, or about a 14% increase in distance. Green-2A would include a dogleg, which would add about 8 nautical miles to the loop or about 20% to overall flight distance. Black-2A would be affected similarly to Green-2A. Operating costs would increase due to additional fuel requirements, flight time, and aircraft depreciation on a per-flight basis. Operators using these routes fly a number of different aircraft types; changes in operating costs would be specific to individual aircraft types. West End tour routes would undergo minor changes, and no measurable changes in operating costs would likely occur on those routes.

Additional operating costs would also be incurred by operators as a result of re-routing transportation, repositioning, and other non-tour flights outside the SFRA. About 14% of total flight operations would be re-routed; changes in operating costs for these flights would depend on chosen flight route.

NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

The NPS Preferred Alternative requires full conversion to quiet-technology aircraft within ten years of implementation. Operator impacts in Table 4.240 reflect NPS Preferred Alternative changes, conversion to quiet-technology aircraft, industry growth assumptions, and new flight operations on Navajo routes.

TABLE 4.240 NPS PREFERRED ALTERNATIVE AIR-TOUR OPERATORS ECONOMIC IMPACTS TEN-YEAR FORECAST

Economic Measure	NPS Preferred Alternative Forecast	Difference from Alternative A, Forecast
Flight Operations in the SFRA	87,790	-22%
Passenger Volume	762,990	-7%
Total Gross Revenue GCNP Flights	$211,051,000	-9%
GCNP-Related Employment	1,230	-14%
Employee Earnings	$39,601,000	-14%

Source: Harvey Economics 2010

Similar to the other Alternatives, changes in flight operations are greater than Alternative A Ten-Year Forecast due to larger capacity quiet-technology aircraft. 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.

Operations on Navajo tour routes are expected to increase at a faster rate than on other routes due to their marketability as a new tour occurring in a different area than existing routes. Ten-Year Forecast, an estimated 18 flights per day would occur on these routes; this estimate incorporates air-tour industry growth and increased awareness of and interest in the new tour(s).

Cumulative Effects NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment

Cumulative Effects NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment Base Year

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 NPS Preferred Alternative Base Year represents a minor to moderate adverse impact on the Grand Canyon air-tour industry. Considering NPS Preferred Alternative Base Year impacts with effects of reasonably foreseeable influences, net changes are likely to be negligible to minor adverse as changes and impacts of the NPS Preferred Alternative Base Year lie in range of fluctuation and uncertainty common to this industry.

Cumulative Effects NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

Past, present, and reasonably foreseeable influences on Grand Canyon air-tour operators were 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. By itself, the NPS Preferred Alternative Ten-Year Forecast represents a minor to moderate adverse impact on the Grand Canyon air-tour industry. Considering NPS Preferred Alternative forecast impacts with effects of reasonably foreseeable influences, net changes are likely negligible to minor adverse as changes and impacts of the NPS Preferred Alternative Ten-Year Forecast lie in range of fluctuation and uncertainty common to this industry.

Conclusion, NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment

Conclusion NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment Base Year

Impacts would be long term minor to moderate adverse. Many operators would experience measurable impacts from changes, but operator viability would not be threatened except for those few operators whose current routes would be changed or eliminated.

Conclusion NPS Preferred Alternative Air-Tour Operators Socioeconomic Environment Ten-Year Forecast

Impacts would be long term minor to moderate adverse compared to Alternative A Ten-Year Forecast. Impacts would be similar to Base Year, except adverse impacts would diminish over time as operators adjusted to new flight rules.

AIR-TOUR OPERATORS ALTERNATIVE SUMMARIES SOCIOECONOMIC ENVIRONMENT

Tables 4.241 and 4.242 provide summaries of air-tour industry characteristics Base Year and Ten-Year Forecast for each Alternative.

TABLE 4.241 SUMMARY OF ECONOMIC IMPACTS AIR-TOUR OPERATORS BASE YEAR

Economic Measure	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Flight Operations in the SFRA	99,130	78,030	97,610	88,740
Passenger Volume	723,240	590,950	738,490	670,540
Total Gross Revenue GCNP Flights	$203,120,000	$166,570,000	$199,300,000	$185,480,000
GCNP-Related Employment	1,250	1,020	1,210	1,130
Employee Earnings	$40,600,000	$33,830,000	$40,030,000	$37,450,000

Source: Harvey Economics 2010

TABLE 4.242 SUMMARY OF ECONOMIC IMPACTS AIR-TOUR OPERATORS TEN-YEAR FORECAST

Economic Measure	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Flight Operations in the SFRA	112,800	74,000	94,160	87,790
Passenger Volume	822,970	657,490	830,750	762,990
Total Gross Revenue GCNP Flights	$231,130,000	$176,890,000	$218,900,000	$211,050,000
GCNP-Related Employment	1,420	1,070	1,290	1,230
Employee Earnings	$46,190,000	$34,540,000	$41,400,000	$39,600,000

Source: Harvey Economics 2010

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 NPS Preferred) are compared relative to Alternative A, No Action/Current Conditions.

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 2008, almost 41,000 fixed-wing and helicopter flights landed at either Grand Canyon West

Airport or at Quartermaster Canyon landing pads; these flights are exempt from 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 average increase in revenues generated specifically by those operations. No change to overall economic or social conditions of the tribe would be expected.

Hualapai Tribe Alternative E American Indian Tribes Socioeconomic Environment

Hualapai Tribe Alternative E American Indian Tribes Socioeconomic Environment
Base Year Tourism

Although Alternative E would include a daily cap on SFRA flights, tours in support of the Hualapai Tribe would continue exempt from annual allocation and daily cap requirements. Because Green-4 and Blue-2 route configuration would be unchanged, and due to the annual allocation exemption for Hualapai support flights, no changes in air-tour operations to Grand Canyon West Airport or to Quartermaster Canyon would result in 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 effect on flights landing on the Hualapai Reservation, or on reservation tourism in general. However, it is possible some operators using those routes, 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. 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.

Hualapai Tribe Alternative E American Indian Tribes Socioeconomic Environment
Ten-Year Forecast Tourism

Ten-Year Forecast Alternative E, number of Hualapai support flights landing on the reservation via SFRA air-tour routes would decrease by about 8%; however, number of passengers landing would increase by about 5%. These changes would result from the quiet-technology conversion requirement. Quiet-technology aircraft are generally larger than non-quiet-technology aircraft and fewer operations would be able to accommodate a larger number of passengers.

Hualapai Tribe Alternative E American Indian Tribes Socioeconomic Environment
Base Year and Ten-Year Forecast Ranching Operations

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.[48]

Hualapai Tribe Alternative E American Indian Tribes Socioeconomic Environment
Base Year and Ten-Year Forecast Economy and Financial Conditions

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.

[48] No changes to Blue-2 air-tour operations are anticipated under Alternative E

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 (about 5%) based on the assumption the Hualapai charge operators on a per-passenger basis. The small increase in total revenues Ten-Year Forecast would not be enough to impact overall economic conditions of the tribe.

Hualapai Tribe Alternative E American Indian Tribes Socioeconomic Environment
Base Year and Ten-Year Forecast Social Conditions

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.

Cumulative Effects Alternative E American Indian Tribes Socioeconomic Environment
Hualapai Tribe

Cumulative Effects Hualapai Tribe American Indian Tribes Socioeconomic Environment
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 to minor beneficial impact on the Hualapai. Combining Alternative E impacts with effects of reasonably foreseeable influences, cumulative impacts on the Hualapai would be negligible. Table 4.243 summarizes impacts to the Hualapai Tribe by Alternative.

ALTERNATIVE F AMERICAN INDIAN TRIBES SOCIOECONOMIC ENVIRONMENT
HUALAPAI TRIBE

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.[49] 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

[49] 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

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 number of Hualapai support flights landing on the reservation via SFRA air-tour routes would decrease by about 8% compared to Base Year; however, number of passengers landing would increase by about 5%. Changes in flights and passengers would result from quiet-technology conversion requirement; quiet-technology aircraft are generally larger than non-quiet-technology aircraft and fewer operations would be able to accommodate a larger number of passengers.

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. Additionally, anticipated reductions of Green-4 air-tour operations may also have a benefit to cattle ranching operations, again depending on grazing area location.[50]

Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment
Base Year Economy and Financial Conditions

No measurable changes to Hualapai economic conditions would occur as a result of potentially improved ranching conditions.

The 3% decrease in Green-4 flights in support of the Hualapai would result in a small decrease in revenues to the Hualapai Tribe. Reduced revenues would result from lost fees and charges applied to passengers landing on the reservation plus loss of any additional spending on the part of tour passengers. Reduction of fee revenue is estimated to be about $84,000, or less than 2% of total annual tribal revenues (Harvey Economics 2007b). Amount of revenue lost would be sufficiently small compared with total annual Hualapai revenues that negligible changes in employment or wage income would be expected. Economic impacts to the Hualapai as a result of reduced flights would be negligible.

Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment
Ten-Year Forecast Economy and Financial Conditions

Increase in number of passengers landing on the Hualapai Reservation would result in an equivalent increase in revenues generated specifically by air-tour operations (about 5%) compared to Base Year, assuming the Hualapai charge operators on a per-passenger basis. The small increase in total revenues would not be enough to impact overall economic conditions of the tribe.

Hualapai Tribe Alternative F American Indian Tribes Socioeconomic Environment
Base and Ten-Year Forecast Social Conditions

Small amount of revenue lost to the Hualapai Base Year would not result in any changes to the population, demographic conditions, education levels, or poverty levels of the Hualapai Tribe. Likewise, change in revenue would not be expected to affect population, demographic conditions, education levels, or poverty levels of the Hualapai Tribe. Therefore, no impacts to Hualapai social conditions would occur.

Cumulative Effects Alternative F American Indian Tribes Socioeconomic Environment
Hualapai Tribe

Cumulative Effects Alternative F American Indian Tribes Socioeconomic Environment
Base Year and Ten-Year Forecast Hualapai Tribe

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

[50] No changes to Blue 2 air-tour operations are anticipated under Alternative F

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 F American Indian Tribes Socioeconomic Environment
Hualapai Tribe

By itself, Alternative F Base Year and Ten-Year Forecast represent a negligible to minor beneficial impact on the Hualapai. Combining Alternative F impacts with effects of reasonably foreseeable influences, cumulative impacts on the Hualapai would be negligible. Table 4.243 summarizes impacts to the Hualapai Tribe by Alternative.

HUALAPAI TRIBE AMERICAN INDIAN TRIBES SOCIOECONOMIC ENVIRONMENT
NPS PREFERRED ALTERNATIVE

Hualapai Tribe NPS Preferred American Indian Tribes Socioeconomic Environment
Base Year Tourism

In the NPS Preferred Alternative, both Green-4 and Blue-2 would be modified; however, these route changes include only small modifications and would not result in any changes to number of flights in support of the Hualapai. Although the NPS Preferred Alternative would include a daily cap on other SFRA flights, tours in support of the Hualapai Tribe would continue exempt from the annual allocation requirement and daily cap. 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, same as Alternative F. 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 visitation.

Changes in other SFRA air-tour routes (East End and cross-canyon routes) are unlikely to affect flight landings 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. Ground-based visitation to Grand Canyon West would also be unaffected by the NPS Preferred Alternative.

Overall, tourism opportunities and activity on the Hualapai Reservation would not be affected by the NPS Preferred Alternative, and would be expected to remain unchanged compared to Alternative A.

Hualapai Tribe NPS Preferred American Indian Tribes Socioeconomic Environment
Ten-Year Forecast Tourism

Number of Hualapai support flights landing on the reservation via air-tour routes through the SFRA would decrease by about 2%; however, number of passengers landing would increase by almost 11%. These changes would result from the quiet-technology conversion requirement for aircraft flying in the SFRA; quiet-technology aircraft are generally larger than non-quiet-technology aircraft and fewer operations would be able to accommodate a larger number of passengers. Tribal revenues would increase.

Hualapai Tribe NPS Preferred American Indian Tribes Socioeconomic Environment
Base Year and Ten-Year Forecast Ranching Operations

Only small modifications would be made to Blue-2 and Green-4, and no changes to number of flight operations landing on the reservation would occur Base Yea. However, a decrease in air-tours on Blue-2 and Green-4 would result from minor changes to West End routes. Decreased West End operations could provide some benefits to cattle in terms of reduced Average Sound Level depending on grazing area location. Ten-Year Forecast, the 2% decrease in flights landing on the reservation, in addition to decrease in West End air tours, could provide additional benefits to cattle depending on location of grazing areas.

Hualapai Tribe NPS Preferred American Indian Tribes Socioeconomic Environment
Base Year Economy and Financial Conditions

No measurable changes to Hualapai economic conditions would occur as a result of potentially improved ranching conditions. Since tourism activity and number of flights to the Hualapai reservation would not change, impacts to Hualapai Tribe economy or financial conditions would not be expected. No changes to income or employment levels in the tribal population would be expected.

Hualapai Tribe NPS Preferred American Indian Tribes Socioeconomic Environment
Ten-Year Forecast Economy and Financial Conditions

Increased passenger volume to the Hualapai Reservation would result in an equivalent increase in revenues generated specifically by air-tour operations (about 11%) based on assumption the Hualapai charge operators on a per-passenger basis. The small increase in total revenues would have negligible impacts overall on tribal economic conditions.

Hualapai Tribe NPS Preferred American Indian Tribes Socioeconomic Environment
Base Year and Ten-Year Forecast Social Conditions

No changes to tourism on the Hualapai Reservation or to the economy of the tribe are anticipated. Additionally, no changes to 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.

Cumulative Effects NPS Preferred American Indian Tribes Socioeconomic Environment
Hualapai Tribe

Cumulative Effects NPS Preferred American Indian Tribes Socioeconomic Environment
Base Year and Ten-Year Forecasts Hualapai Tribe

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 the 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. 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 NPS Preferred American Indian Tribes Socioeconomic Environment
Hualapai Tribe

By itself, the NPS Preferred Alternative Base Year and Ten-Year Forecasts represent a negligible impact on the Hualapai. Combining the NPS Preferred Alternative impacts with effects of reasonably foreseeable influences, cumulative impacts on the Hualapai would be negligible. Table 4.243 summarizes impacts to the Hualapai Tribe by Alternative.

TABLE 4.243 HUALAPAI TRIBE SUMMARY OF IMPACTS

	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Tourism	*Base Year* No change	*Base Year* No change	*Base Year* 3% reduction air-tour landings and passengers	*Base Year* No change
	Ten-Year Forecast 14% increase in air-tours and passengers	*Ten-Year Forecast* 8% decrease in air-tours, 5% increase in passengers	*Ten-Year Forecast* 8% reduction in landing revenues and 5% increase in passengers	*Ten-Year Forecast* 2% decrease in air-tours, 11% increase in passengers
Economic Conditions	*Base Year* No change	*Base Year* No change	*Base Year* 3% reduction landing revenues	*Base Year* No change
	Ten-Year Forecast 14% increase in landing revenues	*Ten-Year Forecast* 5% increase in landing revenues	*Ten-Year Forecast* 5% increase in landing revenues	*Ten-Year Forecast* 11% increase in landing revenues
Social Conditions	No change	No change	No change	No change

Source: Harvey Economics 2010

HAVASUPAI TRIBE SOCIOECONOMIC ENVIRONMENT

The Havasupai Reservation is remotely located, but accessed by several modes of transportation, including by air on the Brown-6 support route. One air-tour operator offers several flights to Supai Village each day on Brown-6. These are not considered air-tours since their primary purpose is transporting supplies and tribal members into and out of the canyon, but these flights do deliver tourists to the Havasupai Reservation.

Havasupai Tribe Alternative A American Indian Tribes Socioeconomic Environment

Havasupai Tribe Alternative A American Indian Tribes Socioeconomic Environment

Base Year and Ten-Year Forecast

Current demographic, economic, and social conditions of the Havasupai Tribe are detailed in Chapter 3, Socioeconomic Environment. Papillon Airways flies about 330 flights per year to the Havasupai Reservation, carrying about 1,350 passengers. Many of these passengers are Havasupai tribal members; some are tourists. Although not classified as air-tours, flights to Supai Village would increase by about 14% (an increase of about 45 flights) Ten-Year Forecast, based on assumption of annual growth for GCNP air-tour industry. This increase in support flights would result in an equivalent increase in number of passengers (14% or about 200 passengers). The overall economic or social conditions of the Havasupai Tribe would not be greatly affected by these small changes in flights or passengers.

Alternatives E, F, and NPS Preferred American Indian Tribes Socioeconomic Environment Havasupai Tribe

Alternatives E, F, and NPS Preferred American Indian Tribes Socioeconomic Environment

Base Year and Ten-Year Forecast Havasupai Tribe

Number of flights flown to Supai Village on Brown-6 would not change as a result of Alternatives E, F, or the NPS Preferred. Number of flights to Supai Village in these Alternatives would be the same as in Alternative A, Base Year and Ten-Year Forecast. Flights on Brown support routes do not require use of annual allocations, and the small number of flights offered daily on Brown-6 would not be impacted by changes in seasonal curfews. In Alternatives E and the NPS Preferred, Brown-6 location would change slightly to include a dogleg as requested by the Havasupai tribe described in Chapter 2. The dogleg would result in a slightly longer flight, but would not result in any changes to number of flights offered or number of passengers flown to Supai Village. No changes in ground-based visitation to Supai Village are anticipated as a result of Alternatives E, F, or the NPS Preferred.

Alternatives E, F, and NPS Preferred *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Havasupai Tribe* *Tourism*

No changes in number or spending patterns of ground-based or air-tour visitors are anticipated Base Year. There would, however, be an increase in number of passengers flown to the reservation Ten-Year Forecast; spending patterns of these additional visitors would likely be similar to those of existing visitors. No changes to tourist facilities or activities offered by the Havasupai are expected as a result of Alternatives E, F, or the NPS Preferred. Therefore no impacts to Havasupai-related tourism would be expected Base Year from these Alternatives, and a small increase in number of tourists would be expected Ten-Year Forecast.

Alternatives E, F, and NPS Preferred *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Havasupai Tribe* *Economy and Financial Conditions*

Since tourism activity and number of daily flights to Supai Village would not change Base Year, no impacts to Havasupai Tribe economy or financial conditions would be expected. Ten-Year Forecast, tourism would increase; however, this increase would not likely affect overall tribal economy or financial conditions. No changes to income or employment levels in the tribal population would be expected in any Alternative.

Alternatives E, F, and NPS Preferred *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Havasupai Tribe* *Social Conditions*

No changes to Havasupai Reservation tourism or economy are anticipated. No population or other demographic changes would be expected in the tribe. Therefore, no impacts to Havasupai Tribe social conditions are expected as a result of any Action Alternative.

Cumulative Effects **American Indian Tribes** **Socioeconomic Environment**
Alternatives E, F, and NPS Preferred ***Havasupai Tribe***

The Havasupai tourism industry is guided by customer demand and the tribal enterprise. Havasupai tribal tourism, economic and social conditions are likely to continue at similar levels to present with a negligible growth in tourism. None of the Alternatives are expected affect cumulative conditions for the Havasupai.

Conclusion **American Indian Tribes** **Socioeconomic Environment**
Havasupai Tribe

Table 4.244 summarizes impacts to the Havasupai Tribe by Alternative.

TABLE 4.244 HAVASUPAI TRIBE SUMMARY OF IMPACTS

	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Tourism	*Base Year* No change	*Base Year* No change	*Base Year* No change	*Base Year* No change
	Ten-Year Forecast 14% increase in flight operations and passengers	*Ten-Year Forecast* 14% increase in flight operations and passengers	*Ten-Year Forecast* 14% increase in flight operations and passengers	*Ten-Year Forecast* 14% increase in flight operations and passenger
Economic Conditions	No change	No change	No change	No change
Social Conditions	No change	No change	No change	No change

Source: Harvey Economics 2010

NAVAJO NATION AMERICAN INDIAN TRIBES SOCIOECONOMIC ENVIRONMENT

Alternatives, Navajo Nation **American Indian Tribes** **Socioeconomic Environment**

Alternative A *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Navajo Nation* *Tourism, Economic, and Social*

Tourism is part of the Navajo Nation economy, including the Cameron Chapter, but neither the Navajo Nation nor Cameron Chapter is currently involved in the air-tour industry. This would continue and no tourism,

economic, or social impacts to the Navajo Nation would result Base Year or Ten-Year Forecast. Current Navajo Nation demographic, economic, and social conditions are detailed in Chapter 3.

Alternatives E and F, Navajo Nation *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Navajo Nation* *Tourism, Economic, and Social*

None of the changes in Alternatives E or F would affect the Navajo Nation. No new air-tour routes would be created over Navajo Nation land and no new tourism activities would be promoted by Alternatives E or F. Demographic, economic, and social conditions of the Navajo Nation and its members would not be impacted by these Alternatives, and conditions would remain the same as Alternative A Base Year and Ten-Year Forecast.

Cumulative Effects Alternatives E and F American Indian Tribes Socioeconomic Environment
Navajo Nation

The Navajo Nation is a large area with a diversified economy. Growth and social improvement is likely to continue consistent with past trends. Alternatives E and F impacts, when combined with reasonably foreseeable influences will not change air-tour impacts on the Navajo Nation.

Conclusion Alternatives E and F American Indian Tribes Socioeconomic Environment
Navajo Nation

Table 4.245 provides summarizes impacts to the Navajo Nation by Alternative.

TABLE 4.245 NAVAJO NATION SUMMARY OF IMPACTS

	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative[a]
Tourism	No change	No change	No change	6 to 18 flights per day over Navajo lands; 34 to 100 passengers per day
Economic Conditions	No change	No change	No change	$186,000 to $559,000 revenue per year
Social Conditions	No change	No change	No change	Negligible to minor beneficial change

Source: Harvey Economics 2010
[a]NPS Preferred Alternative: The lower end of tourism and economic ranges reflect impacts Base Year, and the higher end reflects Ten-Year Forecast

NPS Preferred Alternative *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Navajo Nation* *Tourism, Economic, and Social*

The Navajo Nation could become involved in the Grand Canyon air-tour industry by allowing established helicopter tour companies to fly over and land on Navajo Nation land through agreements with the tribe, and as authorized by the FAA. A new helicopter entry to and exit from Green-1 over Navajo Nation land would be provided. Impacts to the Navajo Nation are based on air-tours that would use these routes. No other Alternative component would affect conditions of the Navajo Nation.

Base Year, an estimated six flights per day carrying about 34 passengers would occur on new Navajo routes as part of a Grand Canyon commercial air-tour. Ten-Year Forecast, an estimated 18 flights per day would occur on these routes (about 100 passengers per day).

These estimates incorporate air-tour industry growth and increased awareness of and interest in the new tour. Air-tour operations on new Navajo routes would be conducted by existing air-tour companies. Through arrangements made with the Navajo Nation, air-tour companies may fly over nation land. Economic impacts to tour companies flying Navajo routes are discussed in the air-tour operator impact section above. However, helicopter companies that use new Navajo routes would likely be required to pay a per-flight or per-passenger landing fee to the Navajo Nation.

NPS Preferred Alternative *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Navajo Nation* *Tourism*

Air-tours using Navajo routes could have opportunity to land in the Little Colorado River Gorge for a short period to view scenery before returning to Green-1 or exiting the SFRA over tribal lands. Air-tours on the

Navajo route would not necessarily result in increased numbers of tourists to the Reservation or in additional tourism opportunities on Navajo lands based on known plans.

NPS Preferred Alternative *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Navajo Nation* *Economy and Financial Conditions*

Air-tour operators would likely be required to pay a per-flight or per-passenger landing fee to the Navajo Nation. It is assumed this fee structure would be similar to that of air-tour operators and the Hualapai Tribe. Based on interviews with Hualapai-related air-tour operators, a per-flight fee to the Navajo of $90 was assumed for tours using Navajo routes.[51] Given estimated volume of annual flights on Navajo routes (about 2,070 Base Year, and 6,210 Ten-Year Forecast) and the assumed fee structure, annual revenue generated for the Navajo Nation by flights on new routes is estimated to be about $186,000 Base Year, and $559,000 Ten-Year Forecast.[52]

Unless ground-based goods or services were provided in conjunction with air-tour operations, there would be no impacts to Navajo Nation economy or financial conditions other than revenue generated from air-tour fees paid by helicopter companies. However, fee revenue could be used to generate employment or support other activities or services provided the Navajo population. It is unknown how tour-fee revenue would be distributed, i.e., to what chapter or chapters of the nation and for what specific uses. If these funds were made wholly available to the Cameron Chapter, whose land the helicopters would fly over and land on, impact to those members would be minor beneficial Base Year, and moderate beneficial Ten- Year Forecast. If the nation as a whole retains these revenues, impacts would be negligible Base Year, and minor beneficial Ten-Year Forecast, given the Nation's much larger financial base.

NPS Preferred Alternative *American Indian Tribes* *Socioeconomic Environment*
Base Year and Ten-Year Forecast *Navajo Nation* *Social Conditions*

Tour operations on Navajo routes, and fee revenue generated by these tours, would not likely impact Navajo Nation demographic conditions. Population and other demographic characteristics of nation members would not change as a result of new air-tour operations. As for economic conditions, it is unclear how fee revenue would be used by the nation, and it is unlikely fees would equal a large enough sum to measurably impact income level of Navajo Nation members as a whole, although Cameron Chapter could see direct benefits if local revenue increases are retained locally. Therefore, Navajo Nation social conditions would likely remain essentially the same as Alternative A.

Cumulative Effects **American Indian Tribes** **Socioeconomic Environment**
NPS Preferred Alternative **Navajo Nation**

The NPS Preferred Alternative will provide a negligible beneficial economic cumulative impact Base Year, and a minor beneficial cumulative impact Ten-Year Forecast as the Navajo air-tour industry develops.

Conclusion **American Indian Tribes** **Socioeconomic Environment**
NPS Preferred Alternative **Navajo Nation**

Table 4.245 provides summarizes impacts to the Navajo Nation by Alternative.

GENERAL AVIATION — SOCIOECONOMIC ENVIRONMENT

Methodology and Assumptions for Analysis of Impacts **Socioeconomic Environment**
General aviation

General aviation is defined as takeoffs and landings of all civil aircraft, except those classified as air carriers or air taxis (FAA 2009). This includes all aircraft not carrying cargo or passengers for hire or compensation. General-aviation aircraft are allowed to fly over GCNP at specific altitudes depending on flight location and direction.

[51] This is equivalent to about $15 per passenger, assuming 5 to 6 passengers per flight
[52] Flights are assumed to occur 345 days of the year

General-aviation flights occur in the SFRA's general-aviation corridors, over Flight-free Zones, or over other park areas in accordance with FAA regulations regarding flight altitude.

Impacts to SFRA general-aviation operations could result from the following Alternative components

- Closures of general-aviation corridors
- Changes to general-aviation corridor boundaries
- Changes to minimum sector flight altitudes over Flight-free Zones

These changes may result in changes in flight routes or costs if operators need to adjust their routes to comply with new regulations. For example, longer flights would result in additional operating costs as well as additional time.

Maps and descriptions provided in Chapter 2 for each Alternative were relied on to determine general-aviation aircraft flight-path changes, including estimates of changes to total flight mileage. Changes in operating costs and time required to fly over the canyon when using modified flight routes would be specific to each aircraft type and could vary greatly depending on flight route. No annual or longitudinal data on number of SFRA general-aviation operations or distribution of aircraft types for annual flights was available. However, information on general-aviation flight activity over Grand Canyon Peak Day 2005 indicates a total of four general-aviation flights occurred in the SFRA on the following aircraft types: Beech Baron, Cessna Conquest, and an unspecified single-engine aircraft. The Cessna Conquest 441 was chosen as a representative general-aviation aircraft type for this analysis since operating costs were readily available; impacts are presented on a per-flight basis. The quantitative Cessna Conquest impacts represent maximum impact or worst case scenarios; actual changes in flight times and operating costs would depend on specific flight routes. Cessna Conquest 411 operating costs include fuel; maintenance labor; parts, airframe, engine and avionics costs; inspections, component overhauls, and engine restoration; and miscellaneous expenses, including landing and parking fees, crew expenses, and supplies and catering (Harvey Economics 2008c). Specific assumptions are

- Total variable operating costs for the Cessna Conquest 441 amount to about $1,111 per hour, or about $18.50 per minute
- The Cessna Conquest 441 flies at an average speed of 270 knots, which equals about 311 miles per hour or about five miles per minute once cruising altitude is reached. At this speed, variable operating costs amount to about $3.60 per mile
- The aircraft's rate of climb is 2,435 feet per minute

Given limited information available about general-aviation flights over the canyon, including unknown destination information, impacts to general-aviation aircraft are described qualitatively in addition to those quantitatively described for the Cessna Conquest.

Changes in General-aviation Corridors General Aviation Socioeconomic Environment

For Alternatives that include closure of a general-aviation corridor, impacts were based on the additional distance required to fly to and from the nearest surrounding available corridor. Distances were measured using Chapter 2 maps and the Grand Canyon VFR (Visual Flight Rules) Aeronautical Chart (FAA 2001). Cessna Conquest per-mile operating costs were applied to the additional flight miles to estimate any additional costs; the Cessna Conquest average speed was used to estimate additional flight time.

Changes to general-aviation corridor boundaries were evaluated in a similar manner. Changes in flight distances were measured using maps noted above, and changes in operating costs and flight times were calculated based on estimated distance changes.

Changes in Flight-free Zones General Aviation Socioeconomic Environment

Several Alternatives include changes to minimum altitudes over Flight-free Zones. Changes in altitude were calculated, and time required to reach the new altitude was estimated based on the Cessna Conquest's rate of climb. Per minute operating costs for the Cessna Conquest were applied to additional time required to reach new altitudes to determine changes to flight costs.

Changes in Flight-free Zone boundaries would occur in combination with changes to general-aviation corridor boundaries. Impacts were calculated for changes to general-aviation corridor boundaries and were therefore not calculated for changes to Flight-free Zone boundaries, so as not to double count impacts.

ALTERNATIVE A GENERAL AVIATION SOCIOECONOMIC ENVIRONMENT

See Chapter 3 for information on current general-aviation operations and SFRA use.

ALTERNATIVE E GENERAL AVIATION SOCIOECONOMIC ENVIRONMENT

Impacts to SFRA general-aviation flights in Alternative E include

General-aviation Corridors Alternative E General Aviation Socioeconomic Environment
Base Year and Ten-Year Forecast

Fossil Canyon general-aviation corridor would be closed in Alternative E. General-aviation flights which currently use Fossil Canyon Corridor would be diverted to Tuckup or Dragon Corridors, depending on flight route. These diversions would result in longer flight distances and additional operating costs

Dragon Corridor's southeast boundary would be modified to accommodate a dogleg proposed for air-tour routes through this corridor. As a result of Dragon Corridor boundary changes, distance of general-aviation flights routed through Dragon Corridor could potentially increase, lengthening flight times and increasing costs

Tuckup, Dragon, and Zuni Point Corridors would be extended north. These boundary changes would cause pilots to remain at the corridors' required flight altitude for longer periods, but would not increase flight distance or costs.

Flight-free Zones, Alternative E General Aviation Socioeconomic Environment
Base Year and Ten-Year Forecast

Toroweap/Shinumo and Bright Angel Flight-free Zones would be extended to the SFRA's northern boundary. These expansions would cause general-aviation flights to fly at higher elevations for longer periods when flying over the park outside general-aviation corridors, but would not increase overall flight distances, times, or costs with the exception of flights over Marble Canyon, as described below.

Bright Angel Flight-free Zone would include Marble Canyon in Alternative E. Pilots flying over Marble Canyon in an east-west direction would be required to fly above the Flight-free Zone, increasing both flight time and fuel use. The another possibility would be to fly around Bright Angel Flight-free Zone, which would add a number of miles to flight distance, depending on flight route.

All Flight-free Zone ceilings would be raised to 17,999 feet MSL. General-aviation pilots would be required to fly at altitudes over 17,999 feet MSL when flying over Flight-free Zones. This would cause general-aviation flights over the Zones to increase their altitudes by 3,500 feet (Desert View, Bright Angel and Toroweap/ Shinumo Flight-free Zones) or by 10,000 feet (Sanup Flight-free Zone). Increased altitudes would increase flight time and fuel costs for pilots flying over Flight-free Zones. Single-engine piston-aircraft types are generally unable to fly at altitudes greater than 14,500 feet MSL which would therefore be required to fly in general-aviation corridors or around Flight-free Zones, which would result in increased flight times and fuel costs.

Cessna Conquest Flights General Aviation Socioeconomic Environment
Base Year and Ten-Year Forecast Alternative E

Table 4.246 provides per-flight impacts to Cessna Conquest general-aviation flights over the SFRA, in terms of distance, flight times, and operating costs in Alternative E.

Cumulative Effects Alternative E General Aviation Socioeconomic Environment

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, Alternative E will generate a negligible to

minor adverse impact on most SFRA general-aviation flights. Combining impacts of Alternative E with reasonably foreseeable changes to general-aviation, net impacts will be negligible.

Conclusion Alternative E General Aviation Socioeconomic Environment

Base Year and Ten-Year Forecast

Impacts to general-aviation flights in Alternative E 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, impacts to individual general-aviation flights would be negligible to minor adverse in Alternative E as a worst case. Based on a two-hour flight, increases in operating costs would range from less than one up to about 14%, depending on flight route, in Alternative E. A 14% increase in operating costs would result from the need to fly around Marble Canyon due to the increased minimum flight altitude; however, it is unlikely this would affect many flights.

TABLE 4.246 ALTERNATIVE E GENERAL-AVIATION OPERATIONS IMPACTS TO CESSNA CONQUEST 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
[a]GAC General-aviation corridor
[b]FFZ Flight-free Zone

ALTERNATIVE F GENERAL AVIATION SOCIOECONOMIC ENVIRONMENT

General-aviation Corridors

Alternative F General Aviation Socioeconomic Environment

Base Year and Ten-Year Forecast

Fossil Canyon general-aviation corridor would be closed in Alternative F. General-aviation flights using would either use Tuckup or Dragon Corridors depending on flight route. These diversions would result in increased flight distance, flight time, and operating costs.

Dragon Corridor would change locations seasonally. Year-round use for general-aviation flights would occur in the existing Dragon Corridor. Seasonal corridor use for air-tours would not have any impact on general-aviation flights

Eastern and western boundaries of the general-aviation Dragon Corridor would be modified, reducing corridor width. Modified boundaries would result in slightly longer flight distances for general-aviation aircraft.

Alternative F *General Aviation* *Socioeconomic Environment*
Flight-free Zones
Base Year and Ten-Year Forecast

Sanup Flight-free Zone's northern boundary would move south. This would not affect general-aviation flights since minimum flight altitudes outside Sanup Flight-free Zone for general-aviation aircraft in that area are the same as over the Flight-free Zone, 7,999 feet MSL

Toroweap/Shinumo Flight-free Zone's eastern boundary would move west to accommodate modified Dragon Corridor. General-aviation flights would not be affected by this boundary change

Alternative F *General Aviation* *Socioeconomic Environment*
Cessna Conquest Flights
Base Year and Ten-Year Forecast

Table 4.247 provides per flight impacts to Cessna Conquest general-aviation flights over the SFRA in terms of distance, flight times, and operating costs in Alternative F.

TABLE 4.247 ALTERNATIVE F GENERAL-AVIATION OPERATIONS IMPACTS TO CESSNA CONQUEST 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
[a]GAC General-aviation corridor
[b]FFZ Flight-free Zone

Cumulative Effects Alternative F **General Aviation** **Socioeconomic Environment**
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, Alternative F will generate a negligible to minor adverse impact on most general-aviation flights in the SFRA. Combining impacts of Alternative F with reasonably foreseeable changes to general-aviation, net impact will be negligible.

Conclusion Alternative F **General Aviation** **Socioeconomic Environment**
Base Year and Ten-Year Forecast

Impacts to general-aviation flights in Alternative F include increased flight distances, operating costs, and 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 Alternative F, 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, in Alternative F.

NPS PREFERRED ALTERNATIVE **GENERAL AVIATION** **SOCIOECONOMIC ENVIRONMENT**

NPS Preferred Alternative *General Aviation* *Socioeconomic Environment*

Base Year and Ten-Year Forecast

Fossil Canyon Corridor would be pivoted slightly southeast to move the corridor away from Great Thumb Mesa and Supai Village. Location of the pivoted Fossil Canyon Corridor would likely benefit general-aviation pilots who would be able to avoid a potentially sharp turn out of the corridor and around the Toroweap/Shinumo Flight-free Zone boundary.

Dragon Corridor's southeast boundary would be modified to accommodate a dogleg proposed for air-tour routes through this corridor. As a result, general-aviation flights routed through Dragon Corridor could increase in distance by several miles.

Bright Angel Flight-free Zone's southwestern edge would be expanded in response to Dragon Corridor's dogleg. This expansion would not have an impact on general-aviation flights.

The upper boundary of all Flight-free Zone ceilings would be raised to 17,999 feet MSL. No flights would be allowed below 18,000 feet MSL except 1) aircraft in transition on Victor airways V210, V257, and V293 at or above 14,500 feet, 2) aircraft under positive control of an air-traffic control center or tower when necessary for safety, 3) administrative use under an appropriate written waiver approved by both the FAA and the manager(s) of the over-flown land(s). Except under these conditions, general-aviation pilots would be required to fly at elevations over 17,999 feet MSL when flying over Flight-free Zones. This could cause general-aviation flights flying over these zones to increase their flight altitudes by 3,500 feet (Desert View, Bright Angel and Toroweap/Shinumo Flight-free Zones) or by 10,000 feet (Sanup Flight-free Zone). Increased elevation requirements would result in additional flight time and fuel costs for pilots flying over Flight-free Zones. Single-engine piston-aircraft types are generally unable to fly at altitudes greater than 14,500 feet MSL and may therefore be required to fly in general-aviation corridors or around Flight-free Zones, which would result in increased flight times and fuel costs.

NPS Preferred Alternative **General Aviation** **Socioeconomic Environment**

Cessna Conquest Flights

Table 4.248 provides per-flight impacts to Cessna Conquest general-aviation flights over the SFRA, in terms of distance, flight times, and operating costs, in the NPS Preferred Alternative.

TABLE 4.248 NPS PREFERRED GENERAL-AVIATION OPERATIONS IMPACTS TO CESSNA CONQUEST 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
[a]GAC General-aviation corridor
[b]FFZ Flight-free Zone

Cumulative Effects NPS Preferred General Aviation Socioeconomic Environment

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 NPS Preferred Alternative will generate a negligible to minor adverse impact on most general-aviation flights through the SFRA. Combining impacts of the NPS Preferred Alternative with reasonably foreseeable changes to general-aviation, net impacts will be negligible.

Conclusion NPS Preferred General Aviation Socioeconomic Environment

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 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.

REGIONAL SOCIOECONOMIC IMPACTS AND IMPACTS TO PARK VALUES SOCIOECONOMIC ENVIRONMENT

Methodology and Assumptions for Analysis

Regional Socioeconomic Impacts and Impacts to Park Values

Socioeconomic impacts to regional economy would result from changes in number of park visitors (ground visitors and air-tour visitors) and spending patterns of these visitors.[53] Estimating impacts to park values involves values placed on the park both by visitors and non-visitors. Specific methodologies and data sources used to analyze changes in visitor days, impacts to regional economy, and impacts to park values are explained below.

Analysis of regional economic impacts considers only changes to Base Year conditions. Socioeconomic impacts to regional economy were not addressed Ten-Year Forecast since an analysis of future conditions would require projections of regional, national, and international demographic and economic conditions.

[53] 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

Changes in Visitor Days | **Regional Socioeconomic Impacts and Impacts to Park Values** | **Socioeconomic Environment**

Park visitation changes are based on analysis of impacts to visitor experience described in Chapter 4, Visitor Use and Experience, and analysis of impacts to the air-tour industry which includes estimates of changes in number of air-tour customers in each Alternative. 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 and amount of time over the canyon.

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.

Regional Economic Impacts | **Regional Socioeconomic Impacts and Impacts to Park Values** | **Socioeconomic Environment**

Visitor spending patterns by visitor type are described in Chapter 3. Per party per day expenditures were applied to number of park visitors estimated for each Alternative to determine total visitor spending in Coconino County. Regional multipliers were applied to visitor spending to produce employment, income, and economic output estimates for each Alternative.[54] Total impacts account for direct employment, income, and output created by visitor spending as well as secondary effects of spending.[55]

Air-tour operators purchase a portion of their total goods and services in the local area, and the remainder from vendors outside the region. Purchases include such items as employment hours, aircraft parts and supplies, and marketing and advertising services. Changes in number of flight operations and resulting impact on revenues for these operators would influence amount of spending, both in the region and outside the local area. Air-tour operators affected by changes in each Alternative are discussed previously in this section. Changes in spending by air-tour operators domiciled in the Las Vegas area would have a negligible impact on local economy, while changes in spending in East End communities would have a more noticeable impact, due to relative size of economies.

Impacts to Direct Use and Intrinsic Values | **Regional Socioeconomic Impacts and Impacts to Park Values** | **Socioeconomic Environment**

Direct-use values also referred to as consumer surplus, use benefits, or visitor day values, are defined as the additional value of the park to park visitors beyond actual trip expenditures. The park's intrinsic value to park visitors was estimated based on number of park visitors in each Alternative, average length of stay for each type of park visitor, and per-day use values of visitors described in Chapter 3. These use values were estimated by the FAA using a benefits-transfer methodology. An explanation of uses and drawbacks of this methodology can be found in Chapter 3.

Non-use park values refer to values placed on Grand Canyon National Park by park visitors and people who do not plan on visiting the park. Non-use values are independent of onsite or direct-use values. Non-use values are influenced by general park perceptions, likely driven by the landscape, the Colorado River, the history, culture, and physical environment. Presence of aircraft and associated noise is one aspect of that environment. Current non-use park values are described in Chapter 3.

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[54] Multipliers for Coconino County were obtained from Stynes and Sun 2005

[55] Secondary effects are changes in economic activity resulting from re-circulation of money spent by visitors

ALTERNATIVE A **REGIONAL SOCIOECONOMIC IMPACTS AND IMPACTS TO PARK VALUES** **SOCIOECONOMIC ENVIRONMENT**

Number of annual park visitors, visitor contributions to the regional economy, and intrinsic park value in Alternative A are described below. Additional descriptions and details can be found in Chapter 3, Socioeconomic Environment.

Visitor Days *Alternative A* *Regional Socioeconomic Impacts and Impacts to Park Values* *Socioeconomic Environment*

Table 4.249 identifies number of GCNP visitors by type in Alternative A.

TABLE 4.249 ALTERNATIVE A NUMBER OF VISITORS AND VISITOR PARTY DAYS/NIGHTS BY VISITOR TYPE

Visitor Type	Annual Number of Visitors	Number of Party Days/ Nights*
Day Trip	1,164,330	380,950
In-Park Hotel	464,410	203,440
In-Park Camp	268,520	127,820
Backcountry Camper	149,670	92,810
Outside Park Hotel	1,980,900	683,190
Outside Park Camp	352,160	147,610
River Runners	22,010	72,400
Total	**4,402,000**	**1,708,220**

Sources: Stynes and Sun 2005;NPS 2006c; Harvey Economics 2010
*Number of party days/nights is estimated by dividing number of visitors by type by average visitors per party, then by average number of days or nights in the region

Regional Economic Impacts Alternative A *Regional Socioeconomic Impacts and Impacts to Park Values* *Socioeconomic Environment*

Total visitor spending in Alternative A amounts to $358.7 million. Table 4.250 provides information on sales, income, and employment effects of that visitor spending. Direct effects accrue to tourism-related businesses and their employees that sell directly to park visitors. These businesses include accommodations, restaurants, retail outlets, and other tourist attractions. Secondary effects relate to businesses that provide goods and services to directly impacted businesses and also include spending by households that earn income from visitor spending.

TABLE 4.250 ALTERNATIVE A REGIONAL ECONOMIC IMPACTS OF VISITOR SPENDING

	Sales (millions)	Personal Income (millions)	Employment
Direct Effects	$316.5	$119.0	6,006
Secondary Effects	$139.3	$47.6	1,922
Total Impact	$455.8	$166.6	7,928

Sources: Stynes and Sun 2005;NPS 2006c; Harvey Economics 2010
Direct sales are less than total visitor spending since only retail and wholesale margins on visitor purchases accrue to the local economy

Local spending by air-tour operators occurs near where operators are domiciled. For East End-domiciled operators, local spending occurs in Coconino County; for West End, local spending generally occurs in Clark County, Nevada. Total spending as a portion of revenues varies by operator, as does amount of local spending. Total annual gross revenues for all air-tour operators amounts to about $203 million; local spending makes up a portion of this amount (see Chapter 3 for operator revenues). Total sales of all establishments located in Coconino County exceed about $4.5 billion annually (US Census Bureau 2002). Total sales of all establishments in Clark County exceed about $60

billion annually (US Census Bureau 2007). Therefore, local spending by air-tour operators is a very small part of total spending in either county.

Direct Use and Intrinsic Park Values Alternative A | *Regional Socioeconomic Impacts and Impacts to Park Values* | *Socioeconomic Environment*

A 1999 FAA study found GCNP direct-use values beyond trip expenditures amounted to about $92 per visitor day for river runners, $37 per visitor day for backcountry users, and $49 per visitor day for the other visitors (FAA 2000c). A more detailed discussion of direct-use values is provided in Chapter 3. Table 4.251 offers an estimate of direct-use park values by park visitors in Alternative A.

TABLE 4.251 ALTERNATIVE A DIRECT-USE VALUE GCNP

Visitor Type	Total Visitor Days	Use Value per Visitor Day[a]	Total Use Value
Backcountry	312,800	$37.10	$11,614,490
River Runner	144,170	$92.40	$13,326,660
Other	7,384,420	$48.70	$359,768,990
Total	7,841,390	N/A[b]	$384,710,140

Sources: Stynes and Sun 2005;NPS 2006c; FAA 2008c; Harvey Economics 2010
[a]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
[b] These values are not additive

Non-use values were also discussed in Chapter 3. Total non-use value for the Glen Canyon National Recreation Area/Grand Canyon area, as obtained from previous studies, was estimated between $3.0 to $4.3 billion (2004 dollars) based on per-household non-use values ranging from about $17 to $26 (Welsh et al. 1995, Loomis, Douglas, and Mapman 2005). This is assumed to be Alternative A's non-use value.

ALTERNATIVES E, F, AND NPS PREFERRED | **REGIONAL SOCIOECONOMIC IMPACTS AND IMPACTS TO PARK VALUES** | **SOCIOECONOMIC ENVIRONMENT**

Number of annual park visitors, impacts to the regional economy, and changes to intrinsic park values as a result of Alternatives E, F, and the NPS Preferred are described below.

Visitor Days Alternatives E, F, and NPS Preferred | *Regional Socioeconomic Impacts and Impacts to Park Values* | *Socioeconomic Environment*

In Alternatives E, F, and the NPS Preferred, number of visitors to GCNP would remain the same as Alternative A based on the underlying assumption that, in general, people want to visit Grand Canyon and the National Park in order to experience the extraordinary and unique aspects of this land feature, and the magnitude of change in noise would be insufficient to encourage more frequent visits or increase number of visitor days beyond a negligible extent. Grand Canyon exerts a powerful draw for millions of visitors from all over the world each year due to its scenic beauty, recreational opportunities, and other features. Trip lengths are normally planned well in advance, so length of stay would not be noticeably affected by changes in noise as envisioned in Alternatives E, F, and the NPS Preferred; reduced audibility might have a beneficial impact on certain visitors overall park experience and perception once they were onsite, as discussed in Chapter 4, Visitor Use and Experience. Changes in audibility would vary by location for each Alternative as explained in Chapter 4, Soundscape, inside the park. This might entice a small number of visitors, such as backcountry campers, to visit more frequently, but effect would be negligible.

Number of GCNP visitors is expected to remain essentially the same in all Alternatives. Table 4.252 shows number of park visitors, by visitor type, in Alternatives E, F, and the NPS Preferred compared with visitor days in Alternative A.

In Alternatives E, F, and NPS Preferred, air-tour passenger volume would change as described in Impacts to Air-tour Operators above. However, it is assumed changes in air-tour visitation would not result in changes to national park visitation, as visitors would continue to experience the park in other ways. Many West End air-tour visitors never visit the park, using air-tours from Las Vegas or landing only on Hualapai lands.

TABLE 4.252 ALTERNATIVES E, F, AND THE NPS PREFERRED NUMBER OF VISITORS AND VISITOR PARTY DAYS/NIGHTS BY VISITOR TYPE

Type of Visitor	Annual Number of Visitors	Number of Party Days/ Nights	% Change from Alternative A
Day Trip	1,164,330	380,950	0.0%
In-Park Hotel	464,410	203,440	0.0%
In-Park Camp	268,520	127,820	0.0%
Backcountry Camper	149,670	92,810	0.0%
Outside Park Hotel	1,980,900	683,190	0.0%
Outside Park Camp	352,160	147,610	0.0%
River Runners	22,010	72,400	0.0%
Total	**4,402,000**	**1,708,220**	**0.0%**

Source: Harvey Economics 2010

Regional Economic Impacts Alternatives E, F and the NPS Preferred *Regional Socioeconomic Impacts and Impacts to Park Values* *Socioeconomic Environment*

Visitor area spending is determined by number of visitors, as shown in Table 4.253, and visitor spending patterns. Spending patterns are assumed to remain constant for all Alternatives, and total annual visitor spending in Alternatives E, F, and the NPS Preferred would be the same as for Alternative A, $358.7 million. Table 4.253 provides visitor spending data for Alternatives E, F and the NPS Preferred as well as comparisons to Alternative A.

TABLE 4.253 ALTERNATIVES E, F, AND THE NPS PREFERRED REGIONAL ECONOMIC IMPACTS OF VISITOR SPENDING

	Sales (millions)	Personal Income (millions)	Employment
Direct Effects	$316.5	$119.0	6,006
Secondary Effects	$139.3	$47.6	1,922
Total Impact	$455.8	$166.6	7,928
Percent Change from Alternative A	0.0%	0.0%	0.0%

Source: Harvey Economics 2010
Direct sales are less than total visitor spending since only retail and wholesale margins on visitor purchases accrue to the local economy

In Alternatives E, F, and the NPS Preferred, air-tour passenger volume would change as described in Impacts to Air-tour Operators above. Would-be air-tour passengers who elect not to spend money on an air-tour would presumably spend on alternative activities, somewhat offsetting effects of a decrease in air-passenger expenditures. Further, only a portion of air-passenger expenditures are re-spent in the region. Given these facts, net impacts of reduced air-tour volume would have negligible impacts on visitor spending on regional economies, given size and diversity of these economies.

Amount of local spending by air-tour operators and their employers would also change in combination with changes in flight operations and revenues, as described earlier. Changes in air-tour revenues and operator expenditure are likely to have a direct correlation. A large portion of air-tour operator expenditures, beyond employment, fuel, and other materials and supplies goes to pay debt service on aircraft of this capital-intensive industry. Those and other specialized expenditures go to vendors outside the region, so a reduction in air-tour operator expenditure has limited regional and economic effects. Similarly, reduction in air-tour employment is dispersed among many communities

and therefore has a modest regional impact, and any changes in spending on the operators' part would be negligible compared to size of Coconino or Clark County economies.

Direct Use and Intrinsic Park Values Alternatives E, F and NPS Preferred *Regional Socioeconomic Impacts and Impacts to Park Values* *Socioeconomic Environment*

Park visitation would not be expected to change in Alternatives E, F, and the NPS Preferred compared to Alternative A; therefore, total visitor days in these Alternatives would also remain the same as Alternative A. Per-day direct-use values for park visitors would also remain unchanged for most visitors, with exception of backcountry visitors.

Direct-use values for most visitors would be unchanged primarily because noise changes would be insufficient to appreciably change visitor experience, as described in Chapter 4, Visitor Use and Experience. Most visitors are subject to other sound sources, i.e., vehicles, other people, and the Colorado River for river runners. Backcountry visitors, such as backpackers, often make a considerable effort to experience wilderness away from others. In absence of other intrusions, aircraft noise would detract from intrinsic direct-use values of those backcountry visitors who encountered it.

Alternatives E and the NPS Preferred include seasonal routing, and attempt to avoid popular backcountry trails and campsites. Both Alternatives would result in fewer flight operations, and these reductions would be greater Ten-Year Forecast.

An estimated increase in direct-use value of $12 per day is assumed for backcountry visitors in Alternative E and NPS Preferred. This one-third increase in direct-use value beyond Alternative A conditions reflects the importance of natural Soundscapes for backcountry visitors; this increase would raise total direct-use value of backcountry visitors approximately to the level of other park visitors. Alternative F would not represent a sufficient change in routes or curfews or seasonal use to change impacts of aircraft noise on backcountry visitors. Tables 4.254 and 4.255 offer total visitor days and direct-use values for GCNP in Alternatives E, F, and the NPS Preferred.

TABLE 4.254 ALTERNATIVES E AND NPS PREFERRED DIRECT-USE VALUE GCNP

Visitor Type	Total Visitor Days	Use Value per Visitor Day[a]	Total Use Value
Backcountry	312,800	$49.10	$15,368,170
River Runner	144,170	$92.40	$13,326,660
Other	7,384,420	$48.70	$359,768,990
Total	7,841,390	N/A[b]	$388,463,820
Percent Change from Alternative A	0.0%		1.0%[c]

Source: Harvey Economics 2010
[a]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
[b] These values are not additive
[c] This represents a 32% increase in backcountry visitor values

Alternatives E, F, and the NPS Preferred would generate small incremental benefits for backcountry visitors due to a reduced number of flights and quiet-technology aircraft, in addition to seasonal routing and other changes described previously.

Any change in non-use park values would be driven by

- Magnitude of change in park sound levels
- Noise in the context of the park's characteristics which create non-use values

Both these factors are considered in turn.

TABLE 4.255 ALTERNATIVE F DIRECT-USE VALUE GCNP

Visitor Type	Total Visitor Days	Total Use Value
Backcountry	312,800	$11,614,490
River Runner	144,170	$13,326,660
Other	7,384,420	$359,768,990
Total	7,841,390	$384,710,140
Percent Change from Alternative A	0.0%	0.0%

Source: Harvey Economics 2010
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

Magnitude of change in park sound levels is addressed in Chapter 4, Soundscape, and the significance of those changes to humans is indicated in Chapter 4, Visitor Use and Experience. In sum, changes vary in intensity by location. Assuming a change in visitor experience would be one indicator of a change in non-use park values, these values would be expected to be similar to visitor experience impacts. Whereas a specific study or survey was not found to measure relative importance of park characteristics in the public's mind, park features which make it well known throughout the world are clear enough: scenery, geologic features, the Colorado River, history, American Indian culture, desert landscape, and environment, among others. Soundscape is one element of that environment, and aircraft noise is one element of the sound environment. Given all its prominent characteristics, aircraft noise is likely to be a small consideration with most non-park users, although this has not been documented.

In sum, non-use park values are approximately between $3.0 and $4.3 billion. A reduction in park aircraft noise might or might not increase non-use values. There is potential benefit in knowing an effort has been made to protect the park's resources, presumably for future generations, a basic tenet of non-use values. Such values are recognized in the Organic Act which established national park system's fundamental purpose as preserving park resources for enjoyment and value.

Cumulative Effects Alternatives E, F, NPS Preferred

Regional Socioeconomic Impacts and Impacts to Park Values

Socioeconomic Environment

Visitation and regional economic impacts from GCNP are affected by a host of national and international economic conditions as well as demographic changes and evolving consumer preferences. Some of these conditions change quickly and others slowly, suggesting there is no typical year, but that visitation trends should be upward for the foreseeable future. By themselves, SFRA rule changes included in Alternatives E, F, and the NPS Preferred would not measurably change visitation or regional economic impacts. Combined with any Alternative, cumulative impacts are likely to show an upward visitation trend around wide annual fluctuations.

Intrinsic direct-use values will mirror visitation impact, except backcountry visitors would experience some use value benefits from Alternatives E and the NPS Preferred. Cumulative impacts suggest a minor to moderate benefit for those visitors, but a negligible benefit in intrinsic direct-use values overall since backcountry visitors are a small portion of total visitors.

Intrinsic non-use values for GCNP have probably changed little in past years since those values are driven by a perception rooted in literature, history, and other records of the country's heritage. The Alternatives by themselves would not generate a change sufficient to change non-use value measurably from a relative standpoint. Over time, cumulative impacts other than prospective SFRA rule changes examined in this EIS, would dominate changes to intrinsic values. Overall, relative importance of rule changes would diminish over time.

Conclusion Alternatives E, F, NPS Preferred | **Regional Socioeconomic Impacts and Impacts to Park Values** | **Socioeconomic Environment**

Tables 4.256 and 4.257 provide summaries of Socioeconomic conditions by Alternative Base Year and Ten-Year Forecast, respectively. Tables 4.258 and 4.259 provide summaries of Socioeconomic impact intensity determinations by Alternative Base Year and Ten-Year Forecast, respectively.

Base Year Alternative E air-tour operators would experience short-term moderate to major adverse impacts, and short-term minor to moderate adverse impacts in NPS Preferred Alternative.

Base Year Alternative F negligible impacts can be expected.

American Indian tribes are expected to be mostly unaffected or negligibly affected by any Alternative. The Navajo Nation would be beneficially affected, albeit negligibly, from the NPS Preferred Alternative.

General-aviation would likely experience a negligible to minor adverse Socioeconomic effect in all Alternatives. The largest Socioeconomic resource categories, regional economy and intrinsic values, would be essentially unchanged by any Alternative. Number of park and other regional visitors is unlikely to change in any Alternative. Intrinsic direct-use values, whereas quite substantial in Alternative A, would be unlikely to change for park users and non-users Base Year.

Socioeconomic impact results Ten-Year Forecast are similar to those Base Year with certain important exceptions. Level of impacts on air-tour operators would be similar, but number of operations would be less because conversion to quiet-technology aircraft would mean larger capacities, fewer flights carrying more people. Longer term, air-tour operators would adjust somewhat to changes in all Alternatives, reducing impact intensity. The Hualapai Tribe would experience a reduction in flights due to quiet-technology conversion, but an increase in visitors, which would lead to increased tribal revenues of negligible to minor beneficial amounts. The Havasupai Tribe would experience essentially no effects. The Navajo Nation would experience negligible economic benefits as its air-tour industry develops. Intrinsic park values, largest of the Socioeconomic resource categories, would be unchanged by any Alternative.

1 **TABLE 4.256 SUMMARY OF SOCIOECONOMIC CONDITIONS BASE YEAR**

	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Air-tour Operators[a]				
Flight Operations	99,130	78,030	97,610	88,740
Passenger Volume	723,240	590,950	738,490	670,540
Total Gross Revenue	$203,123,000	$166,565,000	$199,305,000	$185,479,000
Employment	1,250	1,020	1,210	1,130
Personal Income	$40,598,000	$33,834,000	$40,035,000	$37,451,000
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 due to increased flight altitudes	No additional operating costs or flight time 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 8 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	Six flights per day, $186,000 annual revenue
Regional Economy[a]				
Visitors	4,402,000	No change	No change	No change
Visitor Spending	$316.5 million	No change	No change	No change
Total Sales[c]	$455.8 million	No change	No change	No change
Personal Income[c]	$166.6 million	No change	No change	No change
Employment[c]	7,928	No change	No change	No change
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
[a]Impacts to air-tour operators and regional economy are reported on an annual basis
[b]Impacts to general-aviation are reported on a per flight basis
[c]Total sales, personal income, and employment measures for regional economy include both direct and secondary effects
[d]Park intrinsic values are in addition to visitor spending

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TABLE 4.257 SUMMARY OF SOCIOECONOMIC CONDITIONS TEN-YEAR FORECAST

	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Air-tour Operators				
Flight Operations	112,796	74,004	94,160	87,787
Passenger Volume	822,961	657,488	830,748	762,994
Total Gross Revenue	$231,128,000	$176,894,000	$218,895,000	$211,051,000
Employment	1,424	1,071	1,291	1,227
Personal Income	$46,195,000	$34,544,000	$41,402,000	$39,601,000
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	8% decrease in air-tours, 5% increase in passengers, uncertain change in landing revenue	8% decrease in air-tours, 5% increase in passengers from Base Year, uncertain change in landing revenue	2% decrease in air-tours, 11% increase in passengers, uncertain change in 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	18 flights per day, $559,000 of annual revenue
Regional Economy[b]	NA	NA	NA	NA
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

[a]Landing revenue to the Hualapai in Alternatives E, F, and the NPS Preferred would depend on whether fees are by flight or by passenger Ten-Year Forecast

[b]Impacts to the regional economy were not analyzed Ten-Year Forecast due to the myriad of economic and other factors that must projected as part of the analysis, and the uncertainty surrounding those projections

TABLE 4.258 SUMMARY OF SOCIOECONOMIC IMPACT INTENSITY BASE YEAR

	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Air-tour Operators	Baseline for comparison	Long term moderate to major adverse	Long term negligible to minor adverse	Long term minor to moderate adverse
American Indian Tribes				
Hualapai Tribe	Baseline for comparison	Negligible	Long term negligible to minor adverse	Negligible
Havasupai Tribe	Baseline for comparison	Negligible	Negligible	Negligible
Navajo Nation	Baseline for comparison	Negligible	Negligible	Beneficial long term minor
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
Intrinsic Park Values	Baseline for comparison	Negligible	Negligible	Negligible

Source: Harvey Economics 2010

TABLE 4.259 SUMMARY OF SOCIOECONOMIC IMPACT INTENSITY TEN-YEAR FORECAST

	Alternative A	Alternative E	Alternative F	NPS Preferred Alternative
Air-tour Operators	Baseline for comparison	Long term moderate to major adverse	Long term minor to moderate adverse	Long term minor to moderate adverse
American Indian Tribes				
Hualapai Tribe	Baseline for comparison	Long term negligible to minor beneficial	Long term negligible to minor beneficial	Long term negligible to minor beneficial
Havasupai Tribe	Baseline for comparison	Long term negligible to minor beneficial	Long term negligible to minor beneficial	Long term negligible to minor beneficial
Navajo Nation	Baseline for comparison	Negligible	Negligible	Beneficial long term minor to moderate
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
Intrinsic Park Values	Baseline for comparison	Negligible	Negligible	Negligible

Source: Harvey Economics 2010