

SOUNDSCAPES

GUIDING REGULATIONS AND POLICIES

An intact natural soundscape enhances visitor experience and allows for natural functioning of wildlife communication. Regarding general soundscape management, *NPS Management Policies 2006*, Section 4.9 “Soundscape Management,” requires that the Park Service to “preserve, to the greatest extent possible, the natural soundscapes of parks.” Additionally, NPS “will restore to the natural condition wherever possible those soundscapes that have become degraded by the unnatural sounds (noise), and will protect natural soundscapes from unacceptable impacts” (NPS 2006a). Director’s Order 47: Soundscape Preservation and Management, was developed to emphasize NPS policies “that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources.” This Director’s Order also directs park managers to measure acoustic conditions, differentiate existing or proposed human-made sounds that are consistent with park purposes, set acoustic goals based on the sounds deemed consistent with the park purpose, and determine which noise sources are impacting the parks (NPS 2000).

Additionally, 36 CFR 2.12, “Audio Disturbance,” prohibits the operation of motorized vehicles on lands administered by NPS that create noise in excess of 60 A-weighted decibels (dBA) at a distance of 50 feet from the source or, if below that noise level, noise which is unreasonable. Reasonableness is dependent on several factors including the nature and purpose of the factor’s conduct, location and time of occurrence, the park’s purpose and the impact the noise has on park users (36 CFR 2.12).

METHODOLOGY AND ASSUMPTIONS

The metric chosen for soundscapes impact assessment purposes was the A-weighted L_{\max} (maximum sound level during the pass-by of one ORV). While consideration of other indicators could be desirable, there is insufficient information on the number of ORVs using each area/road and the precise location of the vehicles at specific times to accurately model time-dependent metrics such as L_{eq} ¹³ or percent time audible. The analysis of L_{\max} provides a reasonable basis for comparing the sound levels resulting from the various alternatives that involve restrictions on operating areas and vehicle sound emissions limits.

In order to assess L_{\max} sound levels, it was first necessary to define the noise characteristics of the ORVs operating in Glen Canyon. The characterization of ORV noise for this EIS was based on a detailed study of ORV noise emissions conducted at Lake Meredith National Recreation Area (Wyle 2011). The study at Lake Meredith developed a “composite source” to represent average noise emissions for analysis purposes. The composite source was developed based on noise monitoring 20 feet from the entrance to the Rosita Flats ORV area at Lake Meredith and included ATVs, motorcycles (both two- and four-stroke engine types), various OHVs and conventional motor vehicles. The average composite source results in a L_{\max} of 80.1 dBA at a distance of six meters from the source.

The Lake Meredith study also developed a composite source for proposed limits on motor vehicle sound levels. This composite source is referred to as the “96 dBA composite source” and was also adopted for use in this EIS because the concept of imposing a 96 dBA limit (measured 0.5 meters from the tailpipe) is also under consideration

¹³ L_{eq} is the constant sound level that conveys the same energy as the variable sound levels during the analysis period. Refer to chapter 3 for more information on the definitions of various soundscapes metrics.

at Glen Canyon.¹⁴ The “96 dBA composite source” results in a L_{max} of 75.2 dBA at a distance of six meters from the source. The 95 dBA composite source is about 5 dBA quieter than the average composite source, which means it will result in a smaller impact area than the average composite source impact area.

NPS has created a spreadsheet noise analysis tool that incorporates the average composite source and the 96 dBA composite source characteristics. The spreadsheet noise analysis tool includes conventional vehicle noise spectra at 15, 25, and 55 mph based on the research conducted during the development of the Federal Highway Administration Traffic Noise Model (FHWA 1995). The conventional motor vehicle noise spectra was used in analyzing the ORV areas/roads open to conventional motor vehicles only. OHVs and street-legal ATVs are generally louder than conventional motor vehicles. ORV areas, roads and designated ORV routes shared with conventional motor vehicles were therefore conservatively modeled as OHV and street-legal ATV roads.

The spreadsheet analysis tool also accounts for the attenuation of sound with increasing distance from the source, including atmospheric effects. The data inputs include the distance from the source, relative humidity, atmospheric pressure and temperature. Physical obstructions and topography that may attenuate noise levels at the receptor location are not included, thus providing a conservative assessment of noise levels. The spreadsheet was based on attenuation over land; therefore areas of water were excluded from the analysis. The reported acreages potentially affected by motorized vehicle noise refer to land area only.

For OHVs and street-legal ATVs, the spreadsheet noise analysis tool assumes a range of vehicle speeds based on the data from Lake Meredith; it cannot be used to predict the difference in noise levels as a result of a change in speed. There is insufficient data available to characterize the effect of speed limit changes on noise at Glen Canyon. However, this limitation would not substantially change the results or relative comparisons between the alternatives. The importance of speed in overall vehicle noise levels is greatest on paved surfaces, where the total noise level at higher speeds is dominated by tire-pavement interaction. At lower speeds (such as those occurring on unpaved roads in Glen Canyon), total noise is dominated by engine noise. Speed is less important to total noise on unpaved roads. Therefore, the change in the speed limit on unpaved GMP roads under the action alternatives would have a minor effect on overall noise levels (no speed limit change is proposed on paved roads). Speed effects on noise were taken into account for areas open to conventional motor vehicles, based on the Federal Highway Administration data noted above.

The noise spreadsheet analysis tool was used to determine the distance from the source at which motor vehicle noise would decrease to be equivalent to the natural ambient level. The natural ambient sound level is the sound level that would occur in the absence of human activities. The natural ambient sound level assumption selected for the analysis based was a uniform 20 dBA across all areas of Glen Canyon, based on the monitoring data (see chapter 3). The 20 dBA natural ambient level is representative of daytime summer conditions. Although higher natural ambient levels were estimated in some areas of Glen Canyon near Lone Rock, those estimates were not considered reliable because human-caused sounds were audible for greater than 75% of the time in those locations. The 20 dBA natural ambient level is supported by the majority of the monitoring sites.

Meteorological inputs were also selected to represent summer daytime conditions in Page, Arizona (85 °F, 20% relative humidity and atmospheric pressure of 30 inches of mercury).

¹⁴ The 96 dBA limit is under consideration as a potential mitigation measure for this ORV management plan/DEIS. The 96 dBA limit was selected because it is an established industry standard with a well-defined measurement protocol (SAE J1287 standard). <http://www.amrracing.com/resources/SAE-J1287.pdf>. The 96 dBA limit is a practicable limit that has been used by other states, including California. http://ohv.parks.ca.gov/?page_id=24891.

As described above, the average composite ORV source noise¹⁵ has an L_{\max} of 80.1 dBA at a distance of six meters (18 feet) from the source. Based on the input assumptions described above, it takes 8,020 feet from the source for the average composite source noise to drop down to be equal to the natural ambient level of 20 dBA. With the proposed 96 dB tailpipe noise limit, this distance is reduced to 5,460 feet. Within these distances, ORVs would result in a 3 dBA or greater increase in sound levels over the natural ambient level. This is because decibels are expressed on a logarithmic scale and cannot be added together directly. Through “decibel addition,” two sources at the same sound level combine to create a total sound level 3 dBA higher (FTA 2006).

For ORV areas open to conventional motor vehicles only operating at a maximum speed of 15 mph (such as Lone Rock Beach under alternative D, and accessible shorelines under alternatives A and D), noise levels would drop to equal the natural ambient level of 20 dBA at 2,900 feet from the source. These off-road uses of conventional motor vehicles on accessible shorelines were evaluated as part of direct impacts.

As part of the assessment of cumulative impacts, conventional motor vehicle-only GMP roads were analyzed. Conventional vehicle use on GMP roads was not included as part of direct impacts because it is not the subject to management actions under this plan/DEIS. Thus, the cumulative impact scenario for each alternative includes all the direct impacts, plus the use of conventional motor vehicles on GMP roads. Although the speed limit on GMP roads varies, these roads were conservatively assumed to operate at 55 mph, though the actual speed is generally less than 45 mph (except in Orange Cliffs Unit where 15 mph is the speed limit) (NPS 2013a). At 55 mph, conventional motor vehicle noise would take 10,850 feet to drop to equal the natural ambient level.

An increase in the ambient noise level affects the ability of humans and animals to perceive other sounds within a certain distance. In general, the higher the ambient noise level, the shorter the distance from which other sounds (for example those of a songbird) can be heard. This concept is expressed in terms of listening area and alerting distance. In terms of impact metrics, a 3 dBA increase in the natural ambient level is an important indicator of potential impact because it results in a 50% reduction in listening area for humans and animals and a 30% reduction in alerting distance, as described below (NPS 2010a).

Reduction in listening area quantifies the loss of hearing ability to humans and animals as a result of an increase in ambient noise level. Under natural ambient conditions a sound is audible within a certain area around a visitor or animal. If the ambient level is increased due to a noise event, the area in which the sound is audible decreases. Table 32 and figure 30 illustrate the relationship between increased ambient and listening area reduction.

TABLE 32: REDUCTION IN LISTENING AREA AND ALERTING DISTANCE DUE TO INCREASES IN AMBIENT LEVELS

dBA Ambient Increase	3	6	10	20
Percent Reduction in Listening Area	50%	75%	90%	99%
Percent Reduction in Alerting Distance	30%	50%	70%	90%

¹⁵ Based on a mix of ATVs, motorcycles (both two- and four-stroke engine types), various OHVs and conventional motor vehicles at Rosita Flats, Lake Meredith National Recreation Area (Wyle 2011).

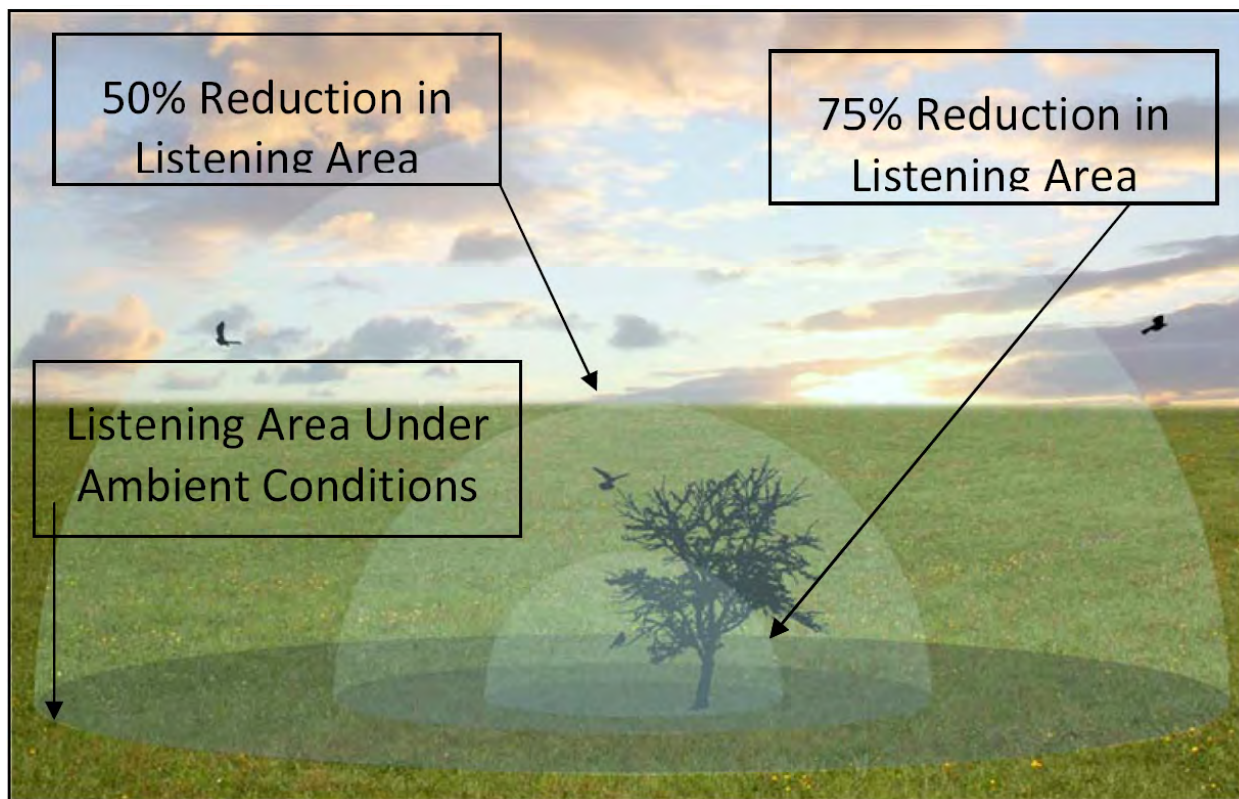


FIGURE 30: REDUCTION IN LISTENING AREA

For example, under natural ambient conditions, an owl perched in a tree may be able to hear a mouse scurrying through the brush anywhere within an area of 100-square-meters of the perch. If a noise event increases the ambient level by 3 decibels (dBA), the area in which the owl can hear a mouse would decrease by 50% to approximately 50 square meters.

Reduction in alerting distance is closely related to reduction in listening area. The residual alerting distance is equal to the square root of the residual listening area. Instead of addressing losses in terms of an area, reduction in alerting distance expresses the reduction as a linear distance from a source. For example, under natural ambient conditions, a hiker may be alerted to the sound of a flash flood at a distance of 1 mile. If a noise such as an ORV increases the ambient level by 6 dBA, the distance at which the flood could be detected would decrease by 50% to approximately 1/2 mile or 2,640 feet (NPS 2010a).

Visitors and wildlife are impacted by their failure to hear natural sounds that would have been audible in the absence of noise: a bird misses the sound of a worm, a mouse misses the footfall of a coyote, or a visitor misses the sound of a distant waterfall. Reductions in listening area and alerting distance capture these types of impacts.

Impact Calculations

The acreage of Glen Canyon that would experience a 3 dBA increase in sound levels over the existing natural ambient level due to motorized vehicles was determined for each alternative using GIS. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Direct impacts on soundscapes were assessed based on the areas where a change in management actions is being considered in this plan/DEIS. The analysis of direct impacts on soundscapes included:

- Lone Rock Beach and Lone Rock Beach Play Area (all vehicle types, including conditions where only conventional motor vehicles would be allowed (e.g., Lone Rock Beach under alternative D)).
- Accessible shorelines (all vehicle types, including conditions where only conventional motor vehicles would be allowed (e.g., alternatives A and D)).
- GMP roads (only those roads where OHVs and street-legal ATVs would be allowed, not conventional motor vehicle- only roads).
- Ferry Swale ORV routes.

The analysis of direct impacts did not include paved roads and unpaved GMP roads accessible only to conventional motor vehicles because use of this type of motor vehicle on these roads would not be changed within the scope of this plan/DEIS. However, a separate impact calculation was performed for purposes of analyzing cumulative soundscape impacts that included GMP roads allowed to be used only by conventional motor vehicles and not by OHVs or street-legal ATVs.

The direct and cumulative impact analyses were focused on determining the impact of motorized vehicle use on soundscapes within the Glen Canyon boundaries only. Given the prevalence of motor vehicle use on surrounding federal lands and the already elevated noise levels associated with such uses, analysis of impacts on areas outside the boundaries of Glen Canyon was not the focus of this study.

Context

The study area for the soundscapes impact assessment was defined as the entire Glen Canyon area.

ALTERNATIVE A: NO ACTION

As shown in figure 31a, direct impacts as a result of noise generated from conventional motor vehicles, OHVs, and street-legal ATVs under alternative A total 362,269 acres of land (28.88% of the Glen Canyon land area). These areas could potentially experience a 3 dBA increase in natural ambient level due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur.

Lone Rock Beach and Play Area

Lone Rock Beach and the Lone Rock Beach Play Area would remain open to conventional motor vehicles, OHVs, and street-legal ATVs under alternative A. The level of use of these areas is expected to remain high and similar to existing conditions (77,000 vehicle entrances in 2011; see the “Socioeconomics” section in this chapter). Impacts would extend up to 8,020 feet away from Lone Rock Beach and the play area. All of Lone Rock Beach would be within the noise effect zone of motor vehicle use at the Lone Rock Beach Play Area under alternative A (see figure 31a). This would include impacts on the listening area of wildlife and non-motorized human uses. The duration of impacts during each day could be extensive—the play area in particular can result in nearly continuous motorized vehicle use during the day (see chapter 3). Although not accounted for in the quantitative analysis, the higher speed and frequent maneuvers conducted in the play area (vehicles operating at full throttle) contributes to relatively higher intensity of soundscape impacts in comparison to the impacts from the same vehicles operating under cruise conditions along roadways.

Accessible Shorelines

Thirteen accessible shoreline areas Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp), would remain open to conventional motor vehicles, subject to water-level closures. No OHVs or street-legal ATVs would be allowed on these shorelines. Access to Paiute Farms and Nokai Canyon would be discontinued and no direct impacts on soundscapes would occur. Impacts from conventional vehicles operating at 15 mph would extend up to 2,900 feet from each shoreline during times when the vehicles are operating. However, the typical usage pattern at the accessible shorelines is that vehicles drive to the beach and park, thus the duration of impacts would be short term and the intensity of impacts would be low. Under alternative A, occasional illegal use could occur in areas adjacent to the accessible shorelines where the designated ORV areas is no longer bounded by natural features and are exposed to off-road use where motorized vehicles are not permitted. The extent to which illegal use would occur is not known.

Travel on GMP Roads in Glen Canyon

In addition to conventional motor vehicles, street-legal ATVs would be allowed to operate on all GMP roads in Glen Canyon under alternative A, with the exception of the Orange Cliffs Unit, where street-legal ATVs would not be allowed. Street-legal ATVs would likely be substantially louder than conventional motor vehicles and would be the predominate noise source (see the Soundscapes' methodology section for sources of noise source data). Impacts would extend up to 8,020 feet away from each road during an ATV pass-by (each individual pass-by would be a short-term event). Impacts on the listening area of wildlife and non-motorized human uses would occur in adjacent areas of land, as shown in figure 31a. The extent of impacts could be greater than shown in figure 31a due to illegal off-road use. Although no data is available on exact volumes, the GMP roads (especially unpaved roads) have low traffic volumes. Therefore, the duration of street-legal ATV impacts on soundscapes would be short-term and the intensity of impacts would be low.

Ferry Swale

Soundscape impacts (3 dBA increase or greater over the natural ambient level) would extend up to 8,020 feet from the approximately 53 miles of designated ORV routes under alternative A. Most of the noise effect zones of the designated ORV routes overlap with the noise effect zones of GMP roads, however the intensity of impacts would be increased with OHV and street-legal ATV activity along the routes. The extent of impacts could be increased further should illegal occasional off-road use occur.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions both outside and within Glen Canyon have the potential to impact soundscapes in Glen Canyon. Actions by others potentially contributing to cumulative impacts on soundscapes are described below followed by the cumulative impacts conclusion for alternative A.

Cumulative Impact of Motorized Vehicle Use in Glen Canyon

The cumulative noise effect zone under alternative A would cover 38.88% of Glen Canyon land area (see figure 31b). The cumulative noise effect zone under alternative A would include unpaved GMP roads where only conventional motor vehicles are authorized (in the Orange Cliffs Unit), plus the direct impacts discussed above.

Aircraft Overflights

Monitoring data shows that jet aircraft (commercial and military) are audible on average between 19% (summer) and 28% (winter) of the time in back country areas. Propeller aircraft such as those typically used by air tour

operators are audible less often, around 3% of the time in the summer and winter (see chapter 3). Air tours are more common in certain areas of Glen Canyon, such as the Rainbow Bridge area in the summer. Overall, aircraft are the predominate source of human-caused sound in the remote backcountry areas distant from roads and waterbodies and an important contributor to cumulative impacts on soundscapes.

There are two designated air strips in Glen Canyon: Bullfrog and Hite. These are used by visitors and NPS staff.

The surface of Lake Powell is also a designated landing area, subject to certain restrictions (36 CFR 7.70).

Military bases in the vicinity of Glen Canyon include Hill Air Force Base, Nellis Air Force Base, and Creech Air Force Base. Aircraft from these military installations, as well as others in the vicinity, contribute to the ambient noise level at Glen Canyon from overflights.

One event that has increased air tours and air traffic in Glen Canyon was the 2009 development of the Amangiri Resort in Utah, near the boundaries of Glen Canyon. The Amangiri Resort is located south of U.S. 89 and approximately 1/2 mile north of the Arizona border. The resort launches hot air balloon tours directly from this site and assists guests in arranging air tours by plane from nearby airports, including Page, Arizona (Amangiri n.d). No information is available on frequency of air tours over Glen Canyon or the sound levels generated by aircraft and balloons during these events.

An Air Tour Management Plan does not currently exist for Glen Canyon. The operation of air tours over Glen Canyon is granted by FAA per the interim operating authority allowed by the National Parks Air Tour Management Act final rule (14 CFR 136) There are currently no near-term plans to develop an Air Tour Management Plan at Glen Canyon.¹⁶

Watercraft

Recreational watercraft (including personal watercraft) use on Lake Powell is a substantial source of human-caused noise, particularly in developed areas where watercraft can be audible 35% or more of the time during the summer. Watercraft were audible 3% of the time on average in backcountry areas (see chapter 3).

Personal watercraft use at Glen Canyon has been comprehensively addressed through the 2003 Personal Watercraft Rulemaking EIS (NPS 2003). A key outcome of this rulemaking is that all personal watercraft two-stroke carbureted engines would be prohibited at the end 2012, substantially reducing personal watercraft noise because two-stroke engines are louder than four-stroke engines. Personal watercraft noise would not be eliminated though, and would still be a prominent aspect of the soundscape on the water and near shorelines. Personal watercraft are not discernible above the natural soundscape in areas of Glen Canyon more than 1 or 2 miles away from the shoreline (NPS 2003).

2008 Uplake Development Concept Plan/Environmental Assessment

The Uplake DCP/EA involves a 15–20 year program of improvements to three marinas—Bull Frog, Halls Crossing and Hite. Collectively, these marinas are referred to as the uplake area. The planned improvements include additional employee and concessionaire housing, additional rental units for visitor overnight stays, campground expansions, an increase in the number of slips available for rental boats/personal watercraft at the marinas, and public boat launch improvements, among others. The uplake improvements would impact soundscapes temporarily

¹⁶ http://www.faa.gov/about/office_org/headquarters_offices/arc/programs/air_tour_management_plan/park_specific_plans/glencanyon.cfm.

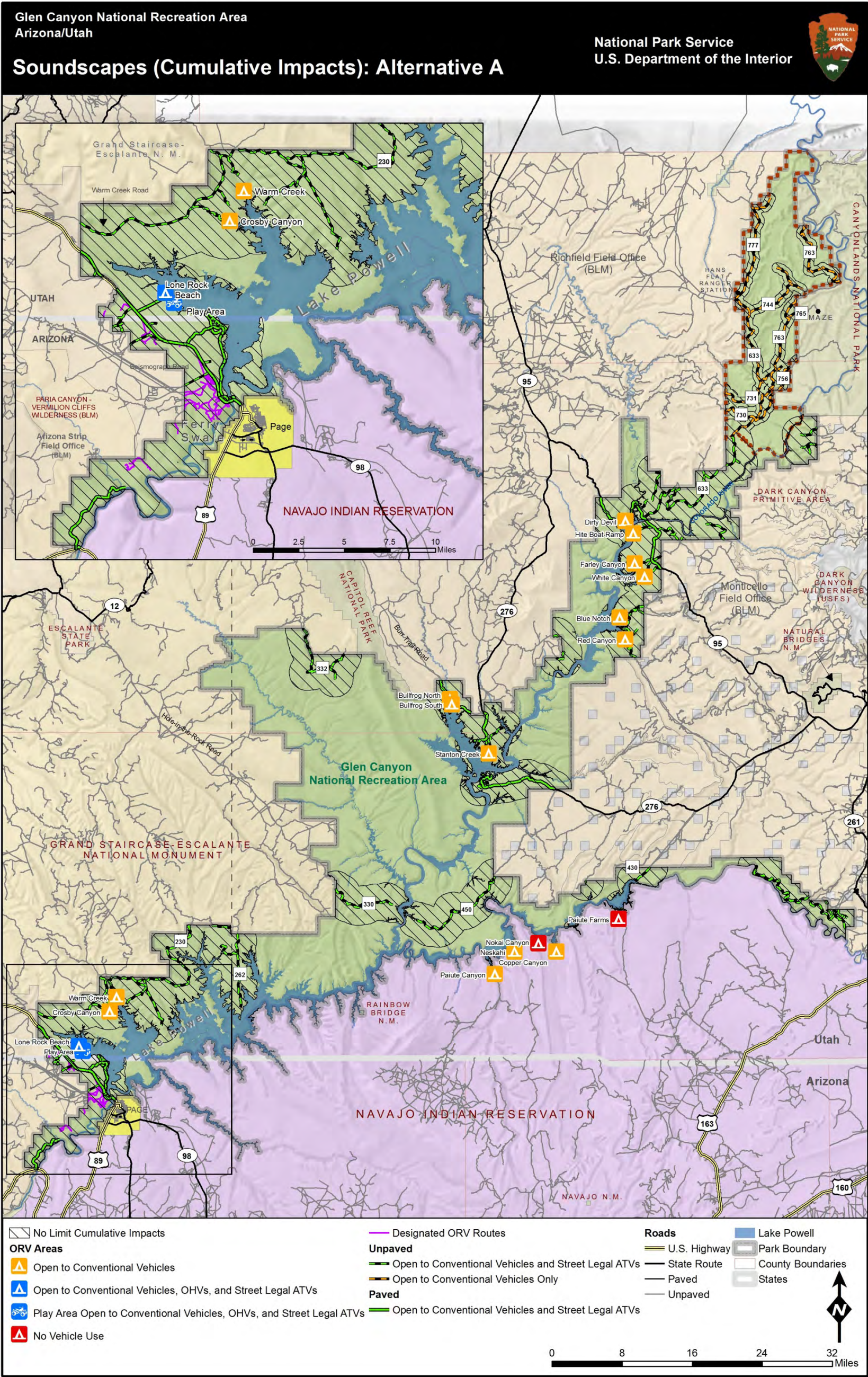
during construction activities and will be mitigated by requiring contractors to maintain mufflers on construction equipment and limiting the construction hours of operation to minimize visitor use impacts (NPS 2008e, 2009c). The uptake improvements could incrementally increase long-term human impacts on natural soundscapes if the new amenities increase visitor levels.

Motorized Vehicle Use on Adjacent Federal Lands

Motorized vehicle use on roads and off-road on adjacent BLM lands (including the Grand Staircase – Escalante National Monument) can contribute to impacts on natural soundscapes within the boundaries of Glen Canyon. This includes unauthorized off-road use as well as authorized use. However, insufficient information on the timing, location and number of users of these areas is available to assess their impacts in detail.

Cumulative Impacts Conclusion

The potentially adverse impacts on soundscapes from aircraft overflights, watercraft, and motorized vehicle use on roads and off-road within Glen Canyon and on adjacent federal lands would result in long-term adverse cumulative impacts when combined with the direct impacts of alternative A.



ALTERNATIVE B: NO OFF-ROAD USE

As shown in figure 32a, direct impacts under alternative B total 351,408 acres of land (28.02% of the Glen Canyon land area). These areas could potentially experience a 3 dBA increase in natural ambient level due to motorized vehicle operations. During times when no motorized vehicles are operating in a particular area, no impacts would occur. The degree and geographic extent of impacts on soundscapes would be substantially decreased through implementation of the 96 dBA limit on ATVs (80,906 fewer acres within the direct impact noise effect zone or 21.57% of Glen Canyon).

Lone Rock Beach and Play Area

Off-road use would be discontinued at Lone Rock Beach and the Lone Rock Play under alternative B. Therefore, no direct impacts on soundscapes would occur from these areas under alternative B.

However, Lone Rock Road (the paved road that ends at the beginning of Lone Rock Beach) would remain open to conventional motor vehicles and street-legal ATVs. As a result of this road remaining open, all of Lone Rock Beach would remain in the motorized vehicle noise effect zone during vehicle pass-bys (with the 96 dBA limit). However, the number of vehicles using Lone Rock Road could likely be reduced without the beach or play area being open. This would result in a corresponding reduction in the duration of human changes in soundscapes and associated impacts on wildlife listening area and non-motorized human uses. The elimination of off-road uses would eliminate soundscapes impacts associated with higher speed activities at the Lone Rock Beach Play Area.

Implementation of the 96 dBA limit would likely provide a noticeable reduction in overall street-legal ATV sound levels operating on Lone Rock Road by eliminating the loudest vehicles.

Accessible Shorelines

Off-road use would be discontinued at accessible shorelines under alternative B, therefore no direct impacts on soundscapes would occur due to accessible shorelines under alternative B. Portions of the shoreline areas would be within the noise effect zone of street-legal ATVs operating on nearby GMP roads, but the extent of this impact would be reduced through implementation of the 96 dBA limit.

Travel on GMP Roads in Glen Canyon

Adoption of the 96 dBA tailpipe limit would likely provide a noticeable reduction in overall motorized vehicle sound levels by eliminating the loudest street-legal ATVs. With the tailpipe noise limit, impacts would extend 5,460 feet from the road during an ATV pass-by. In addition, a minor reduction in the noise effect zone could occur due to the reduction of the speed limit on unpaved GMP roads from 45 mph to 25 mph. For reasons discussed in the methodology section, this potential benefit was not accounted for in the spreadsheet analysis and tabulation of acreage within the noise effect zone.

Ferry Swale

No ORV routes would be designated in the Ferry Swale area under alternative B, therefore no direct impacts on soundscapes would occur.

Cumulative Impacts

The actions contributing to cumulative impacts under alternative B would be the same as described for alternative A. Approximately 38.36% of Glen Canyon would be in the cumulative noise effect zone under alternative B, with a

limit on street-legal ATV noise. The cumulative impact percentage would not increase without the 96 dBA limit on street-legal ATVs because conventional motor vehicle effects dominate the overall cumulative impact acreage calculation. The southern parts of Crosby Canyon and Warm Creek that would be within the cumulative noise effect zone under alternative A would not be in the cumulative noise effect zone under alternative B. The extent of cumulative impacts would be reduced around Bullfrog North and South although portions of these areas would still be within the noise effect zone of unpaved GMP roads under alternative B. The portions of Paiute Canyon, Neskahi, and Copper Canyon within Glen Canyon would no longer be within the motorized vehicle noise effect zone.

The potentially adverse impacts on soundscapes from aircraft overflights, watercraft, and motorized vehicle use on roads and off-road within Glen Canyon and on adjacent federal lands would result in long-term adverse cumulative impacts when combined with the direct impacts of alternative B. Cumulative impacts would be less than those under alternative A because of the elimination of off-road use by all types of motor vehicles, including conventional motor vehicles, OHVs, and street-legal ATVs, within Glen Canyon and would be further reduced through mitigation (e.g., the 96 dBA limit).

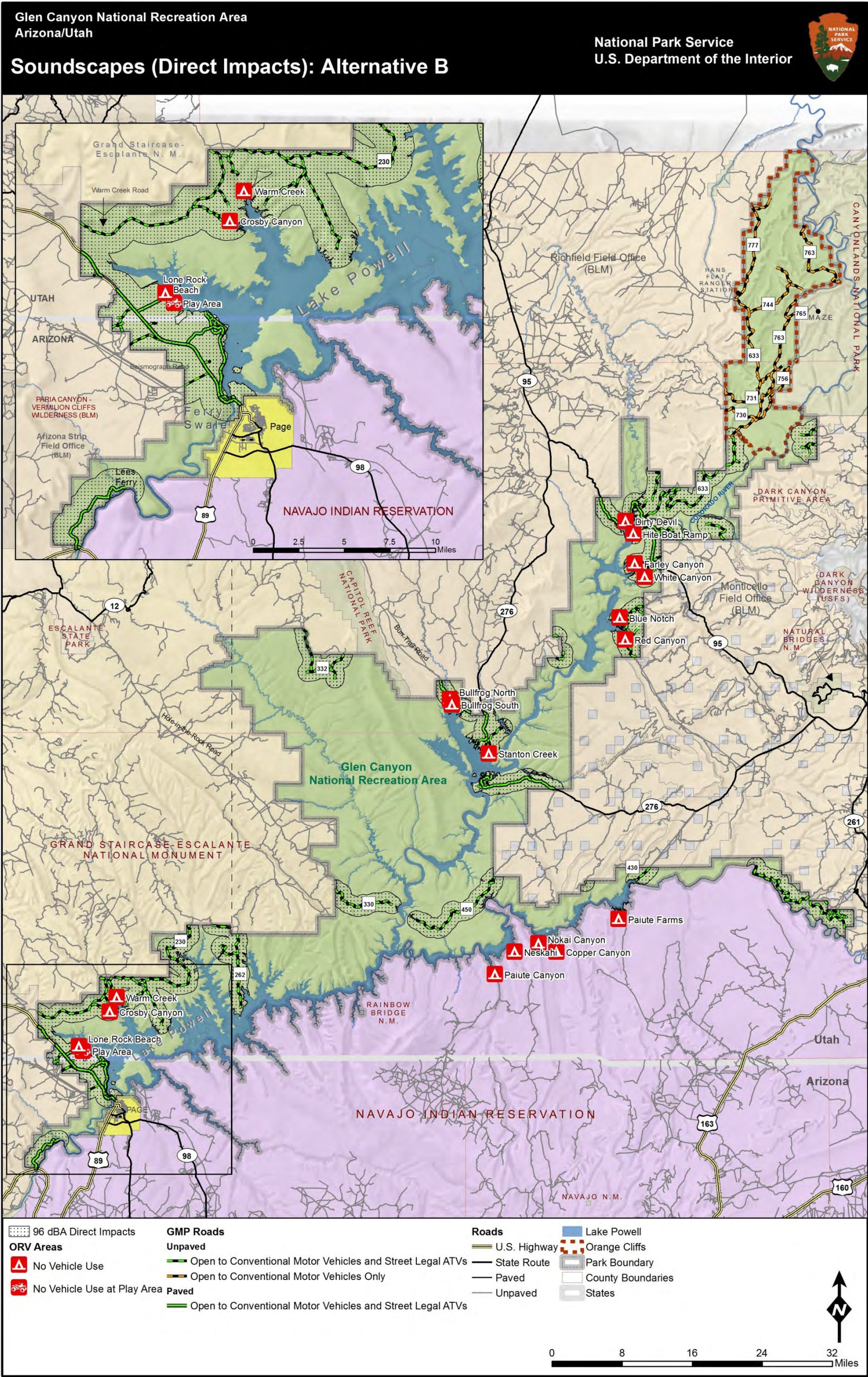


FIGURE 32A: DIRECT IMPACTS ON THE SOUNDSCAPE FROM ALTERNATIVE B