National Park Service
U.S. Department of the Interior

Arches National Park
Utah

Salt Wash Rehabilitation Project

ENVIRONMENTAL ASSESSMENT

December 2017

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PROJECT SUMMARY

The National Park Service is proposing to reduce the flooding, sediment deposition and closures of the Wolfe Ranch/Delicate Arch Viewpoint road by improving the conveyance of water and sediment through Salt Wash, Salt Valley Wash, and Winter Camp Wash through mechanical excavation in Arches National Park (the Park). The current paved roadway, sediment deposition rates, and increase in non-native tamarisk within the washes have compromised the natural flow of storm-water runoff, resulting in frequent flooding and closures of the road.

The proposed project aims to remove sediment from the roadway, culverts, and wash channels, and remove non-native tamarisk species, to ensure access of park visitors to a popular park site, and create a more sustainable and less reactive management approach to the area.

This environmental assessment evaluates two alternatives: a no action alternative (alternative 1) and the proposed action to reduce flooding and closures of the road (alternative 2). Implementation of the proposed action would result in impacts to hydrologic and geomorphologic processes, vegetation, visitor experience, and wilderness character.

This environmental assessment has been prepared in accordance with the *National Environmental Policy Act* and its implementing regulations (40 CFR 1500–1508) and Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2011) and its accompanying handbook (NPS 2015a) to assess the alternatives and their impacts on the environment. In addition, the National Park Service is integrating the NEPA compliance process through coordination with that of Section 106 of the *National Historic Preservation Act of 1966* (54 United States Code 27 306108) to evaluate and describe effects on historic properties.

Note to Reviewers and Respondents:

If you wish to comment on this environmental assessment, please mail comments within 30 days to the address below or post them electronically at https://parkplanning.nps.gov/saltwashproject. Before including your address, phone number, email address, or other personal identifying information in your comment, you should be aware that your entire comment, including your personal identifying information, may be made publicly available at any time. While you can ask in your comment to withhold your personal identifying information from public review, the National Park Service cannot guarantee that it will be able to do so.

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CONTENTS

FIGURES

TABLES

APPENDIX

CHAPTER 1: PURPOSE AND NEED

PURPOSE AND NEED FOR ACTION

The National Park Service is proposing to reduce the flooding, sediment deposition and closure of the Wolfe Ranch/Delicate Arch Viewpoint road by improving the conveyance of water and sediment through Salt Wash, Salt Valley Wash, and Winter Camp Wash through mechanical excavation in Arches National Park (the Park). The current paved roadway, sediment deposition rates, and increase in non-native tamarisk (*Tamarix chinensis*) within the washes have compromised the natural flow of storm-water runoff, resulting in frequent flooding and closures of the road. Road closures can extend beyond a flooding event in order to accommodate the removal of sediment deposited on the road by the floods. In recent years, the annual number of road closures and the average length of closure times have increased (Table 1). The proposed project aims to remove sediment from the roadway, culverts, and wash channels, and remove non-native tamarisk species, to ensure access of park visitors to a popular park site, and create a more sustainable and less reactive management approach to the area.

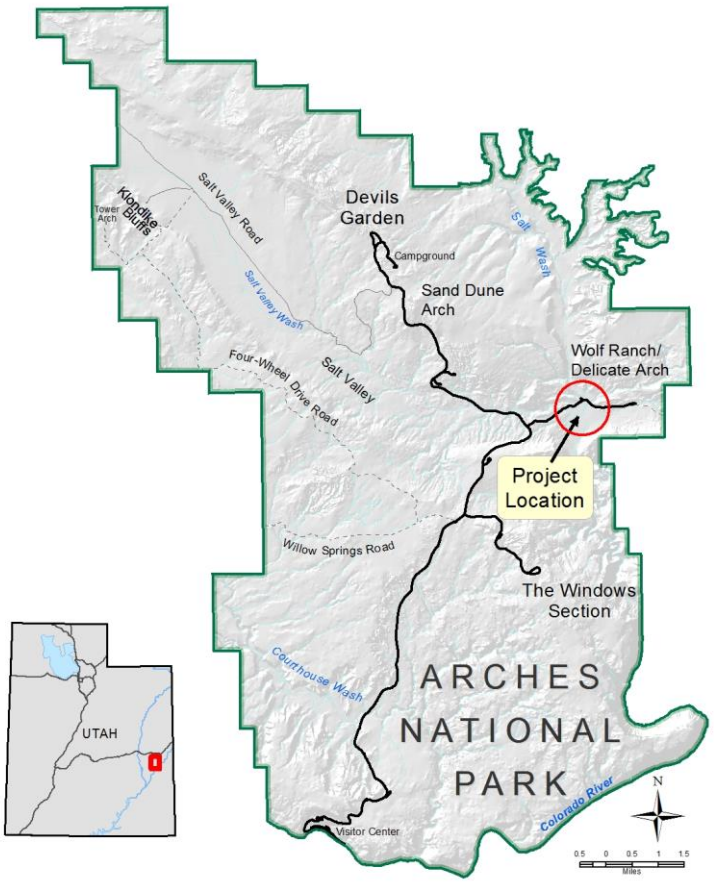

FIGURE 1. PROJECT LOCATIONS FOR WASH CONSTRUCTION AND ASSOCIATED ACTIVITIES AT ARCHES NATIONAL PARK.

TABLE 1. ROAD CLOSURES OF WOLFE RANCH/DELICATE ARCH VIEWPOINT ROAD

Year	Number of days closed (total)	Average road closure duration
2013	6	2 days
2014	19	3 days
2015	24	3 days
2016	34	4 days

Mechanical excavation of the three washes is necessary to improve access of park visitors to a popular park site, improve conveyance of water and sediment flow in the three washes, and create a more sustainable and less reactive management approach to the area. In recent years, the Park has investigated other options as this has been a long-term issue. The proposed action in this EA is necessary to address the immediate need for a management strategy that goes beyond the reactive activities the park is currently taking and has taken in the past. Monitoring data gathered as part of the proposed action will help inform longer term solutions for issues of flooding and road closures at this location.

The proposed action is supported by NPS *Management Policies* 2006 (section 4.1.5., Restoration of Natural Systems) which states parks will reestablish natural processes that have been impacted by "…human disturbances including the introduction of exotic species;… changes to hydrologic patterns and sediment transport; the accelerations of erosion and sedimentation; and the disruption of natural processes."

This environmental assessment has been prepared in accordance with the *National Environmental Policy Act* and its implementing regulations (40 CFR 1500–1508) and Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making* (NPS 2011) and its accompanying handbook (NPS 2015a) to assess the alternatives and their impacts on the environment. In addition, the National Park Service is integrating the NEPA compliance process through coordination with that of Section 106 of the *National Historic Preservation Act of 1966* (54 United States Code 27 306108) to evaluate and describe effects on historic properties.

BACKGROUND/SITE DESCRIPTION

Wolfe Ranch / Delicate Arch Viewpoint road crosses three washes over a distance of about 0.6 miles (1.0 kilometer): Salt Valley Wash to the west, Salt Wash in the center, and Winter Camp Wash to the east (Figure 2). All three washes have been subject to flooding and contribute to sediment transport. Both Salt Valley Wash and Winter Camp Wash are ephemeral drainages, flowing only in response to rainfall. Salt Wash, the largest of the three drainages, has large segments with perennial flow.

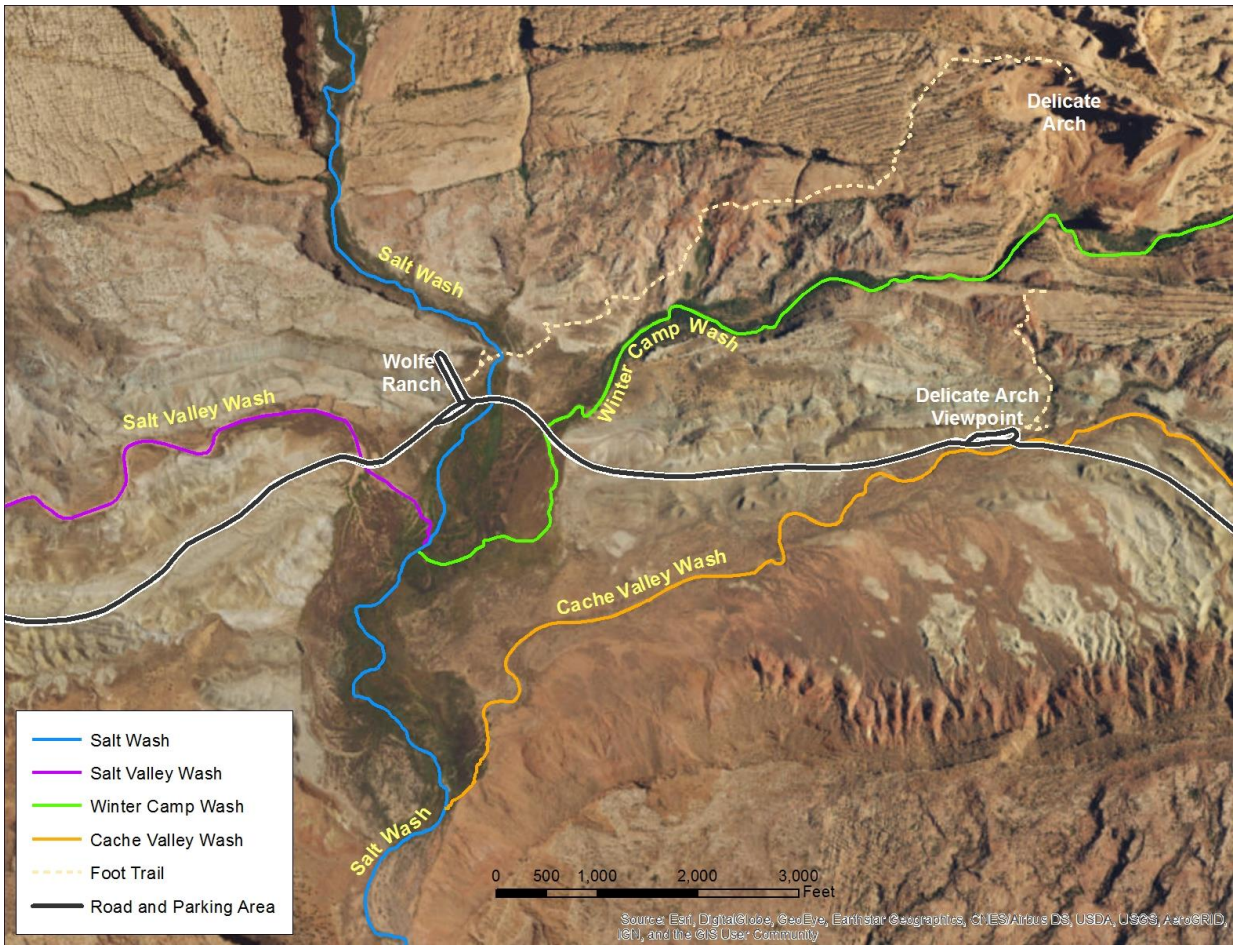

FIGURE 2. GOOGLE EARTH 2014 IMAGE SHOWING THE DELICATE ARCH ROAD WHERE IT CROSSES SALT VALLEY WASH, SALT WASH, AND WINTER CAMP WASH.

The original dirt and gravel Wolfe Ranch / Delicate Arch Viewpoint road alignment left Salt Valley Wash as a low water crossing. Due to the frequency of road closures caused by flash floods, the Park made efforts to alleviate the problem. Between 1993 and 1995, the road grade was elevated, a 26-foot wide asphalt surfaced road was constructed, and two 30 inch diameter culverts were installed from the main park road to the Wolfe Ranch parking area. In total, between the 1960s and 2009, 15 culverts (from 24" diameter to 3' X 6' cell box culverts) have been installed at the three wash crossings along the road. Since then, channel and floodplain aggradation (deposition of material by water) has rendered all of the culverts completely buried or non-functional.

The confluence of the three drainages forms an elongated valley that is accumulating sediment. Aerial imagery indicates that as recently as the 1970s, Salt Wash maintained a single-thread channel which meandered through the area of the road crossings and downstream through the valley (Figure 3). Currently, Salt Wash and its immediate tributaries form a braided system with shifting channels downstream from the crossing area and a single-thread channel no longer exists. This braided reach has become inundated with thick riparian vegetation dominated by non-native tamarisk shrubs (*Tamarix* sp.). The channel regains a single-thread, meandering form about 660 yards (600 meter) downstream from the crossing area (Figures 2 and 3).

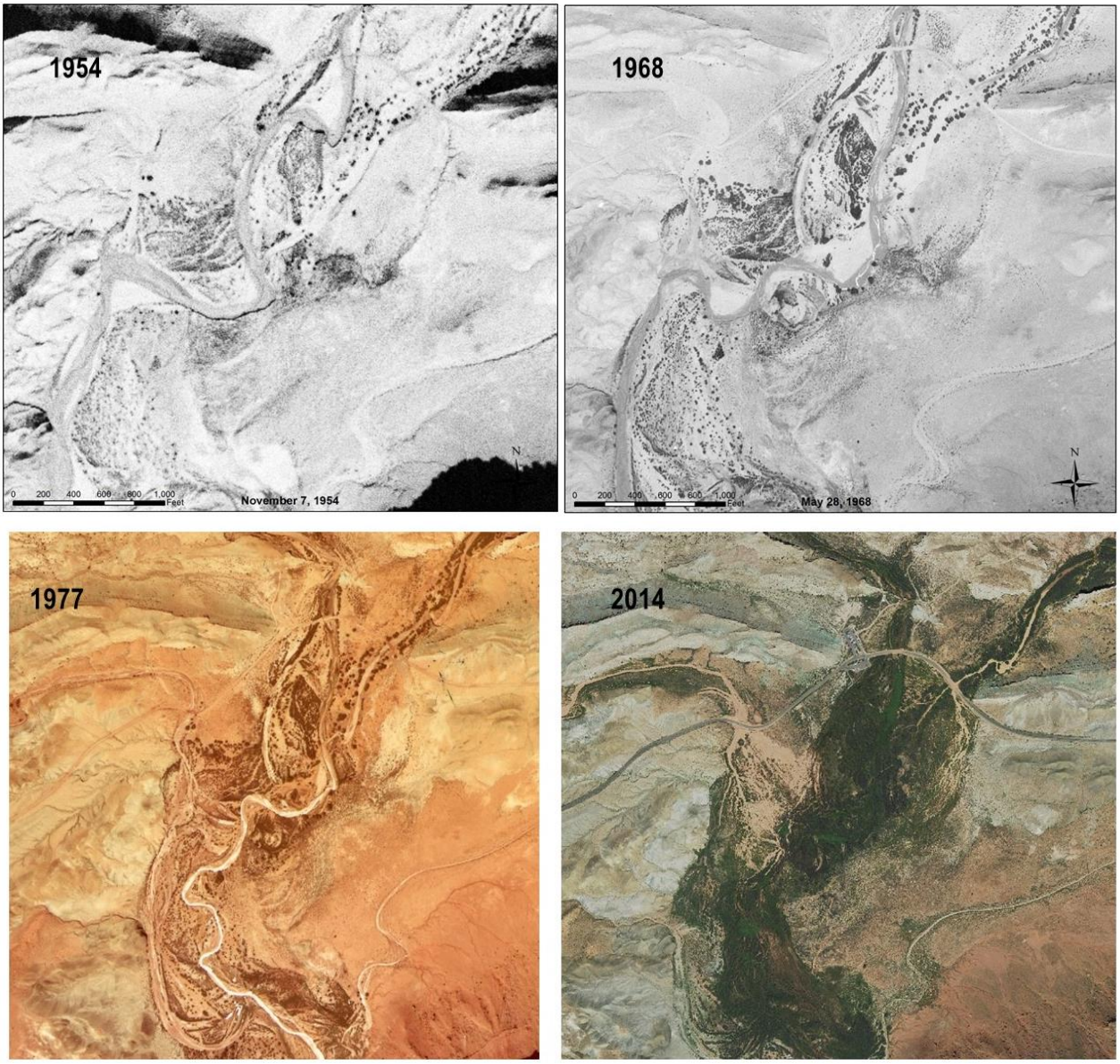

FIGURE 3. AERIAL IMAGERY FROM 1954, 1968, 1977 AND 2014 SHOWING THE CHANGES IN WASH FLOW AND INCREASE IN TAMARISK.

The combination of sediment accumulation at and below the road crossings coupled with the establishment of tamarisk has resulted in complete loss of a favorable downstream gradient, which leads to further sediment aggradation and deteriorating flow. With no action, the crossing area at the roadway will continue to be problematic and result in traffic disruptions, road closures, and potential hazards to visitors, such as strandings on the east side of the road or cars or visitors trapped in floodwaters (Figure 4). According to the 2014 U.S. National Climate Assessment, increases in the frequency and intensity of extreme precipitation events are projected for all U.S. regions, with the region around Arches National Park projected to increase 40-50% (Melillo et al., 2014, Kunkel et al., 2013). Thus, episodic flood events and their associated impacts will likely increase at Arches based on these projections, exacerbating the problems of flooding and road closures in this location.

FIGURE 4. A FLOOD EVENT IN 2013 LEFT DOZENS OF VISITORS STRANDED BETWEEN DELICATE ARCH AND DELICATE ARCH VIEWPOINT PARKING AREAS AT THE WINTER CAMP WASH ROAD CROSSING.

ISSUES AND IMPACT TOPICS RETAINED FOR DETAILED ANALYSIS

The following issues and resource topics associated with the rehabilitation of the three washes were identified during internal scoping. Resource topics identified below are discussed and analyzed in "Chapter 3: Affected Environment and Environmental Consequences."

Issue: The rehabilitation of the three washes through removal of the existing palustrine scrub-shrub wetland (dominated by non-native tamarisk), and excavating and re-contouring the riverine wetlands (wash channels) with heavy equipment would alter the damaged geomorphology of the riverine wetland systems. The proposed action has the potential to restore hydrologic and geomorphological processes and affect native and non-native vegetation.

Issue: Construction activities to rehabilitate Salt Wash, Salt Valley Wash, and Winter Camp Wash would degrade wilderness character by allowing the use of mechanized equipment within recommended wilderness. The proposed project is located within recommended wilderness which is managed as designated wilderness. Construction activity with mechanized equipment is a prohibited activity in wilderness as stated in the 1964 *Wilderness Act.* Prohibited uses within wilderness degrade wilderness character. The use of heavy equipment, construction noise, parking and staging areas, and the physical re-contouring of the project site would have short-term negative impacts to wilderness. However, there would be long-term beneficial effects to wilderness character from the restoration of pre-disturbance hydrologic, geomorphologic, and wetland processes and habitats. Complete removal of the invasive tamarisk shrubs' root structures in the project area is necessary to achieve the desired restoration of natural quality over the long term. Removal of the root structure and establishment of the natural wash channels without the use of mechanized equipment was determined to be infeasible through a minimum requirement analysis

using the Minimum Requirement Decision Guide in accordance with the *Wilderness Act* and section 6.3.5. of NPS *Management Policies* 2006. Utilization of less obtrusive and non-prohibited tools would not achieve the desired restoration of natural quality and would over the long term require additional impacts to wilderness qualities in order to maintain the natural processes of the Salt Wash.

Issue: Flooding and closure of the Wolfe Ranch / Delicate Arch Viewpoint road would continue without the excavation of the washes. This would be to the detriment to the Park's visitors. The road conditions would continue to necessitate road closures resulting in limited access to visitors to see Delicate Arch, one of the Park's most popular destinations. Wolfe Ranch / Delicate Arch Viewpoint road provides the only access to the Wolfe Ranch Historic District, the trailhead to Delicate Arch, and Delicate Arch Viewpoint; the only ADA-accessible viewpoint of Delicate Arch. Closures of the road have the potential to last for several days. In 2016, the average length of closure was four days (Table 1).

Construction of the proposed project would include the use of heavy equipment, resulting in noise from construction, and visible staging and parking areas. These activities would have visual and audio impacts to visitors. Current management practices and the proposed action would both affect visitor experience.

ISSUES DISMISSED FROM DETAILED ANALYSIS

The following issues were initially considered but were ultimately dismissed from detailed analysis. These issues are described below with the reason(s) why further analysis was not warranted.

Air Quality

The Clean Air Act of 1963 (42 U.S.C. 7401 *et seq.*) was established to promote the public health and welfare by protecting and enhancing the nation's air quality. The act establishes specific programs that provide special protection for air resources and air quality related values associated with National Park Service units. Section 118 of the Clean Air Act requires a park unit to meet all federal, state, and local air pollution standards. Arches National Park is designated as a Class I air quality area under the Clean Air Act. The Clean Air Act provides that the federal land manager has an affirmative responsibility to protect air quality related values (including visibility, plants, animals, soils, water quality, cultural resources, and visitor health) from adverse pollution impacts.

Construction activities such as hauling materials and operating heavy equipment could result in temporary increases of vehicle exhaust, emissions, and fugitive dust in the general project area. Any exhaust, emissions, and fugitive dust generated from construction activities would be temporary and localized and would likely dissipate rapidly because air stagnation at Arches National Park is rare. Overall, the project could result in a negligible degradation of local air quality, and such effects would be temporary, lasting only the duration of construction over the two to three winters the project is to occur. The Class I air quality designation for Arches National Park would not be affected by the proposal; the proposed actions are therefore consistent with §1.4.7.1 of NPS *Management Policies* 2006. Because any adverse impacts on air quality from the proposed action would be short-term and localized, this topic is dismissed from further analysis in this document.

Aquatic Species

In order to restore a natural flow to Salt Wash, the only interrupted perennial wash in the project area, mechanical equipment would be used to remove sediment. This work would disturb aquatic species. A fish and amphibian study was conducted in 2015 within Salt Wash to document the presence, spatial distribution, and general abundance of native and non-native fish, amphibians, and crayfish species (NPS 2015b). Seven species of fish were captured: red shiner (*Cyprinella lutrensis*, 320), sand shiner (*Notropis stramineus*, 279), plains killifish (*Fundulus zebrinus*, 231), fathead minnow (*Pimephales promelas*, 207), green sunfish (*Lepomis cyanellus*, 70), black bullhead (*Ameiurus melas*, 9), and speckled dace (*Rhynichthys osculus*, 3). Of the 1,119 individual fish captured during the survey, only three native fish, all speckled dace, were caught. Non-native fish represented 99.7% of the observed fish community. Only one species of amphibian; the non-native American bullfrog (*Lithobates catesbeianus*) was observed during the study. As of 2015, non-native crayfish were not found in Salt Wash.

Historic riverine and riparian habitat changes, likely due to commercial beaver trapping and cattle grazing, led to an increase in the magnitude and frequency of high flow events, introducing non-native species into the area (NPS 2015b). Changes in river geomorphology in response to large flood events led to loss of native fish and amphibian habitat, causing a decrease in the abundance and distribution of native aquatic species. The subsequent invasion of the remaining aquatic habitats by non-native fish, bullfrogs and crayfish led to the virtual extirpation of native fish and amphibians in the Park. Intense competition and predation in the presence of highly abundant non-native species now creates an insurmountable barrier to natural recolonization by native fish and amphibians, even as habitat quality improves with the increase in beavers and beaver dams within the Park.

The proposed project, including the use of heavy equipment within the interrupted perennial Salt Wash, will have direct, adverse impacts on approximately 6,650 linear feet of perennial flow that could provide aquatic species habitat. This represents 12% of the approximate perennial flow in Salt Wash (54,790 linear feet) and 6.5% of the approximate perennial flow in the Park (102,546 linear feet). Therefore, the proposed action will directly and adversely impact up to 6.5% of the total area of potential, suitable habitat for aquatic species in Arches. These impacts may displace aquatic species in the short-term (lasting only during the 2 year construction schedule), but once project activities have concluded, aquatic species should naturally recolonize and reestablish in the affected areas of Salt Wash. Because the proposed action would not result in any unacceptable impacts to aquatic species due to the minor extent of potential habitat affected and due to the predominance of non-native species, and their ability to rebound from disturbances and spread rapidly, this topic is dismissed from further analysis in this document.

Biological Soil Crusts

Biological soil crusts consist of cyanobacteria, lichens, and mosses that form an intricate web of filaments that increase soil stability and rainfall infiltration, fix nitrogen in the soil, and protect the soil surface from wind and water erosion. Over 90% of the project area has been mapped as the same soil type, 110--Bowington-Radnik-Patterfield complex, 0 to 6 percent slopes. These are sandy, alluvial soils characteristic of floodplain-steps (USDA 2010). They are less likely to support well-developed biological soil crusts because they are less aggregated and less stable. In the proposed Salt Wash project area, the landscape and soil

properties are currently degraded, and do not support biological soil crusts in most of the project area. If construction activities disturb or remove soil crusts within the project area, it would only affect <1% of biological soil crust cover in Arches and so would not result in substantial impacts to soil crusts, given the high quality and well-established biological soil crusts that exist throughout the Park. The desired natural conditions of the three washes would not support biological soil crusts, and therefore any removal of biological soil crusts is not of critical importance and this topic is dismissed from further analysis in this document.

Cultural Resources

The National Park Service categorizes cultural resources as archeological resources, cultural landscapes, structures, museum objects, and ethnographic resources in order to focus attention on the management requirements of historic property types under Section 106 the *National Historic Preservation Act of 1966* (NHPA) (54 United States Code 306108). The range of alternatives considered in this environmental assessment includes options to mechanically excavate the three wash channels and deposit sediment within the Park. These activities would have the potential to disturb a range of historic property types if present within the area of potential effects (APE) unless future design efforts are modified, or conditions are imposed, to avoid such effects. Identification of cultural resources and assessment of project effects is required by the provisions contained within the NHPA and the National Park Service has consulted with the Utah State Historic Preservation Office (SHPO) and traditionally associated Native American tribes.

The APE for the Salt Wash drainage channels was previously surveyed for cultural resources (Berry 1975) resulting in the documentation and nomination of the Wolfe Ranch Historical District (National Register Information System ID: 75000167). The district comprises three primary historic structures (Joseph 1997) along with ancillary constructed and natural landscape elements (McDonald 1999, and National Park Service 2002b) identified as contributing features adding to the property's significance and historical integrity. The boundary of the Wolfe Ranch Historical District abuts the northern portion of the project area where tamarisk removal will occur within a limited area of Salt Wash on the upstream side of the access road. Tamarisk removal will be restricted to the active channel of the wash avoiding all of the structures and constructed features, while also having a beneficial effect on the natural landscape features by reestablishing natural conditions consistent with the historic setting of the district. The proposed action would therefore not adversely affect the historic structures or cultural landscape features contributing to the historical significance of the district.

Additional cultural resources inventory was completed for the area of potential effects (APE) (Baker and Knudson 2017) as those areas were identified for project staging, sediment deposition and contouring, or any other type of activity having the potential to impact properties eligible for listing on the National Register. Cultural resources identified in the APE were documented and evaluated for historical and/or traditional religious and cultural significance in consultation with the Utah SHPO and associated Native American tribes. Any effects to identified properties will be avoided through modification of project activities or the inclusion of conditions to avoid such effects. The potential for undisturbed cultural material to occur within this area of active floodplain is low, although redeposited material may be present. To avoid or minimize effects to previously undocumented cultural resources, mitigation measures will include archeological monitoring during ground disturbing activities within the Salt Wash, Salt Valley Wash, and Winter Camp Wash drainage channels

in accordance with the Archeological Monitoring and Inadvertent Discovery Plan prepared for this undertaking (Baker 2017). The proposed action is, therefore, not expected to adversely affect archeological resources within the project area.

The proposed action is expected to have little to no impact on ethnographic resources. The presence of ethnographically significant plant and mineral resources and culturally important viewscapes have been identified within the project area (Stoffle et al. 2016), which may be immediately disturbed by the proposed action, but will experience a long-term beneficial effect by reestablishing conditions conducive to natural processes and native vegetation populations.

Consultation with the Utah SHPO and traditionally associated Native American tribes concerning the degree of potential impacts and mitigation measures for this undertaking resulted in concurrence with the agency's determination of 'No Adverse Effect" and the adequacy of mitigation measures to avoid, minimize, or mitigate impacts to known and previously unidentified cultural resources. For these above reasons, cultural resources have been dismissed from detailed analysis.

Environmental Justice

The Department of the Interior requires its bureaus to specifically discuss and evaluate the impacts of their actions on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risk of the decision (NPS 2015a). The implementation of the alternatives would not result in any identifiable adverse human health effects and this environmental assessment demonstrates there would be no significant environmental impact at all. Because access to Park sites would continue to be available for use by all visitors and staff regardless of race or income, and the construction workforces would not be hired based on their race or income, the proposed action would not have disproportionate health or environmental effects on minorities or low-income populations or communities.

Indian Trust Resources and Sacred Sites

The Department of the Interior requires its bureaus to explicitly consider the effects of its actions on Indian trust resources in environmental documents (NPS 2015a). The federal Indian trust responsibility is a legally enforceable obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the mandates of federal laws with respect to Native American tribes. Departmental planning also requires that any anticipated effects on Indian scared sites are explicitly addressed in environmental documents (NPS 2015a). Indian sacred sites include any delineated location on Federal land that is identified by an Indian Tribe, or Indian individual determined to be an appropriate authoritative representative of an Indian religion, as sacred by virtue of its established religious significance to, or ceremonial use by, any Indian religion. Executive Order 13007 directs federal land managing agencies to (1) accommodate access to and ceremonial use of American Indian sacred sites by Indian religious practitioners, and (2) avoid adversely affecting the physical integrity of such sacred sites.

The proposed action is expected to have no impact on Indian trust resources and Indian sacred sites. There are no Indian Trust resources located in the project area, and the lands

comprising the national park are not held in trust by the Secretary of the Interior for the benefit of Indians due to their status as Indians. Consultation with traditionally associated Tribes provided no further information on the existence of any Indian sacred sites in the project area.

Migratory Bird Species

The *Bald and Golden Eagle Protection Act* (16 U.S.C. 668-668d) and the *Migratory Bird Treaty Act* (16 U.S.C. 703-712) serve to protect bald and golden eagles, and other migratory birds from human disturbances. Some of the eagles and migratory birds observed using the project area include golden eagles (*Aquila chrysaetos*), yellow-rumped warblers (*Setophaga coronate*), lazuli buntings (*Passerina amoena*), northern shrikes (*Lanius excubitor*), Cooper's hawks (*Accipiter cooperii*), and northern harriers (*Circus cyaneus*). The project area is in close proximity to a highly visited, and subsequently noisy, area used by park visitors. Transient bird species that use this area for migration, cover, foraging, or nesting have most likely habituated to these noises and disturbances. Construction-related noises and disturbances may be louder and more disruptive to transient bird species, as they are not the typical noises and disturbances they have habituated to; however, these adverse impacts are expected to be temporary and last only the length of the 2-year construction period. The bulk of the project work would occur in the winter months (November to March), and impacts to migratory birds should be minimal as many bird species will not be in the area. Project work that continues into spring months could deter migratory birds from using the area during construction times. For this reason, time-of-year restrictions for construction activities have been placed to mitigate potential impacts to these species by restricting project work to winter and early spring months, avoiding disturbances during critical nesting months. Time-of-year restrictions for migratory birds is from April 1 to August 31, and for nesting raptors time-of-year restrictions is from January 1 to August 31. The mechanical removal of tamarisk could have adverse impacts on migratory birds even after construction activities have concluded by reducing habitat. However, the habitat is already degraded (80% of the tamarisk is dead or dying), and there is higher quality habitat elsewhere in the Park, including just upstream and downstream of the project area. The lack of habitat is expected to be temporary as native shrubs reestablish after the tamarisk are removed.

Historically, eagles and migratory raptors including Golden Eagles and Red-tailed Hawks (*Buteo jamaicensis*) have nested on cliff faces at Arches National Park. A systematic nesting survey confirmed that a Golden Eagle nest was occupied on a cliff face near the project area in spring of 2017. Reoccupation of the nest by Golden Eagles in the 2018 nesting season is likely; this overlaps with the project timeline. Golden Eagles are generally less tolerant of disturbances; however, disturbances within already altered environments may be less disruptive than disturbances would be in unaltered habitats (USFWS 2002). Time-of-year restrictions (January 1 to August 31) for all construction activities occurring within a half mile buffer of the occupied Golden Eagle nest (Chapter 2, Figure 10), and surveys to document changes in raptor populations during and following construction, would mitigate potential impacts to the eagles, as listed under mitigation measures in Chapter 2. Time-of-year restrictions for construction activities, currently degraded habitat, nest surveys, and a half mile buffer from nesting raptors, will help ensure there are no significant impacts to migratory bird species. For these above reasons, migratory bird species have been dismissed from detailed analysis.

Threatened and Endangered Species

The *Endangered Species Act of 1973*, NPS *Management Policies 2006*, and Director's Order 77, *Natural Resources Management Guidelines*, require the National Park Service to examine the impacts on federal candidate species, as well as state-listed threatened, endangered, candidate, rare, declining, and sensitive species (NPS 2006). The southwestern willow flycatcher (*Empidonax traillii extimus*) is a federally listed endangered bird species, and although it is not currently known to nest within the Park, suitable habitat may exist within the Park. Southwestern willow flycatchers require dense riparian habitats (cottonwood/willow) with pools or standing water nearby, and have adapted to using tamarisk thickets for migration, foraging, and nesting. Mechanical removal of tamarisk could have an adverse impact on southwestern willow flycatcher by reducing potential, suitable habitat (NPS 2009). The project area, and specifically the live cover of tamarisk, was assessed May 2, 2017 by a park wildlife biologist. Tamarisk mortality was observed to be 80% and has rendered the project site non-habitat for this species. After an informal consultation with USFWS, they concurred that since the habitat is currently assessed as unsuitable and the proposed action is not likely to adversely affect the species, the EA can proceed without formal consultation or surveying.

Wetlands

Section 404 of the *Clean Water Act* regulates activities in wetlands. Executive Order 11990: *Protection of Wetlands*, directs all federal agencies to avoid, to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alterative. Consistent with Executive Order 11990 and Director's Order 77-1, the National Park Service has adopted a goal of "no net loss of wetlands" (NPS 2002a). The proposed project is considered an action designed to restore degraded wetland, stream, riparian, and other aquatic habitats according to the NPS Director's Order 77-1; Procedural Manual #77-1: Wetland Protection Section 4.2.1.9. Therefore, the project is exempt from having to complete a Wetland Statement of Findings or any other requirements for compliance with DO #77-1. The restoration of the geomorphology of the streams systems to pre-disturbance conditions, removal of the dominant wetland non-native plant (tamarisk), removal of excess sediment (accumulated as a result of road reconstruction and other factors), and creation of channels that work with the location of the existing culverts will result in the restoration of riverine and palustrine scrub-shrub wetland hydrologic regimes and habitat conditions. Therefore, a statement of findings for wetlands will not be prepared for this project.

Salt Wash is a perennial wash that holds water throughout the year. The flow of the wash has become stagnant due to the increased sediment deposition from the road and from the establishment of tamarisk trees (Figure 5). In addition, the culverts in this area are non-functioning and blocked by sediment and debris. The proposed project would restore hydrologic flow in this area by removing sediment from the culverts and the wash to reestablish a gradient that would allow the flow of water and sediment downstream. The construction activities would have temporary impacts to the turbidity of the water. Any impacts from construction activities within Salt Wash are not expected to be critical to the protection of wetland resources within the Park, as impacts would be short-term and not permanent. For these above reasons, wetlands have been dismissed from detailed analysis.

FIGURE 5. STAGNANT FLOWS IN SALT WASH

Wildlife and Wildlife Habitat

In addition to eagles and migratory birds, wildlife observed to frequent the project area includes mule deer (*Odocoileus hemionus*), beaver (*Castor canadensis*), and many smaller mammals like jackrabbits (*Lepus saxatilis*), cottontail rabbits (*Sylvilagus floridanus*), pack rats (*Neotoma* spp.), and occasionally bighorn sheep (*Ovis canadensis*), black bear (*Ursus americanus*), and mountain lions (*Puma concolor*). These animals may use the project area as a migration corridor, or for lodging, cover, foraging, and fawning. Project work could deter wildlife from using the area during construction times; however, wildlife impacts are expected to be reduced by implementing time-of-year restrictions (April 1 to August 31) already put in place to mitigate disturbances to migratory birds. The mechanical removal of tamarisk and incidental excavation of other streamside native vegetation could have adverse impacts on some wildlife species after construction activities have concluded by reducing potential habitat, particularly the cover that tall tamarisk shrubs provide for a variety of wildlife species and the food and lodging materials that coyote willow shrubs provide for beavers. The habitat alteration is expected to be temporary as native shrubs reestablish over the following years after tamarisk shrubs are removed. With 80% of the tamarisk in the project area already dead or dying, Park ecologists believe that this is a degraded habitat with more favorable and critical habitats existing elsewhere in the Park, including just upstream and downstream of the project area. Additionally, tall shrublands of greasewood and basin big sagebrush occur adjacent to the project area and will remain undisturbed and continue to provide important habitat for wildlife both during and after construction. For these above reasons, wildlife and wildlife habitat have been dismissed from detailed analysis.

CHAPTER 2: ALTERNATIVES

This chapter describes alternatives for reducing flooding and road closures of Wolfe Ranch/ Delicate Arch Viewpoint road. The alternatives were developed by soliciting input from National Park Service employees at Arches National Park, Canyonlands National Park, and Intermountain Regional staff, and present a range of reasonable and feasible approaches that meet the purpose and need for action.

This chapter also addresses alternatives that were initially considered but dismissed from detailed analysis, identifies the National Park Service preferred alternative, and lists mitigation measures.

ALTERNATIVE 1- NO ACTION- CONTINUATION OF CURRENT MANAGEMENT PRACTICES

Under the no-action alternative, the Park would continue to close the roads and perform reactive maintenance when storm-waters flood and deposit sediment on Wolfe Ranch / Delicate Arch Viewpoint road. When road closures are necessary, access to Delicate Arch Viewpoint and parking lot, the only ADA accessible location to view Delicate Arch, will be unavailable for visitors. When flash floods occur, some visitors may be stranded on the east side of the washes and park resources, such as boats and road graders, may be utilized to provide visitor assistance. Park staff duties would continue to be altered in response to flooding events resulting in decreased time spent on normal day-to-day responsibilities. Road closures may be required to remove sediment from the road and wait for flood waters to recede, and it may be several days before the roads are again accessible to the public. In 2016, road closures due to flooding lasted four days on average, and are expected to increase based on trends in past years (Chapter 1, Table 1).

Park staff would continue annual herbicide treatments of noxious weeds that occur on the roadsides and only high-priority non-native species would continue to be removed from the washes. “High-priority non-native species” are described in Section 2.4 of the 2009 *Exotic Plant Management Plan*, which outlines a "Decision-making Tool" with a set of five decision trees to guide exotic species management priorities. With limited resources available for managing exotic plants infestations, the Park uses this framework to decide priorities for exotic species treatments. Generally, tamarisk is not a high priority species because it is so widespread and difficult to remove, but depending on its site-specific impacts, it can be. For instance, tamarisk removal has occurred along the Colorado and Green rivers annually to enhance visitor access and provide fuel reduction near camp areas.

ALTERNATIVE 2 –REDUCTION OF FLOODING AND ROAD CLOSURES THROUGH WASH EXCAVATION (SALT WASH PROJECT) (PROPOSED ACTION AND NPS PREFFERED ALTERNATIVE)

The National Park Service is proposing to improve the conveyance of water and sediment through Salt Wash, Salt Valley Wash, and Winter Camp Wash in Arches National Park to reduce flooding impacts. The purpose of the Salt Wash Rehabilitation Project is to reduce the

flooding, sediment deposition, and closures of the Wolfe Ranch/Delicate Arch Viewpoint road (Figure 6). The alluvial fan has evolved into an unnatural state due to the paved road acting as a dam, and the invasive shrub tamarisk blocking normal sediment transport within the three washes. Road closures can extend beyond a flooding event in order to accommodate the removal of sediment deposited on the road by the floods. In recent years, the annual number of road closures, and the average number of days a closure lasts, has increased (Chapter 1, Table 1).

FIGURE 6. FLOODING-INDUCED ROAD CLOSURES, LIKE THIS ONE IN OCTOBER 2015, ARE INCREASING IN FREQUENCY AND DURATION.

Under alternative 2, the Park would improve the natural conveyance of water and sediment through Salt Valley Wash, Salt Wash and Winter Camp Wash through the removal of tamarisk, mechanical excavation of wash channels, and exposure of buried culverts. The proposed improvements to the channels would use the 1968 historical channel paths which are straighter than the current channels that turn just below the road (Figure 7). The linear or gently arcing channels will maintain a higher flow velocity and not deposit sediment as soon as a sharply curved channel would. Channels with sharp turns deposit more sediment into the bank areas (in this case, the sharp turns are in front of the previous main Salt Valley and Winter Camp Wash channels).

The historic channel courses are based upon aerial photo interpretation of stream channel alignment prior to tamarisk invasion (Chapter 1, Figure 3). These channels are visible from current aerial photos, but do not normally flow during storm events due to sediment blocking the channel path (from 1 foot to as much as 6 feet of depth). Much of the sediment build up is due to tamarisk shrubs and their dense root networks, which have stabilized the accumulating sediments in place. Some sediment build up is a result of park operations involving plowing sediment from the road and piling it along the road edge, and previous channel excavation work that deposited sediment to a distance of 300 feet from the road crossing. This has resulted in a rerouting of the normal channel.

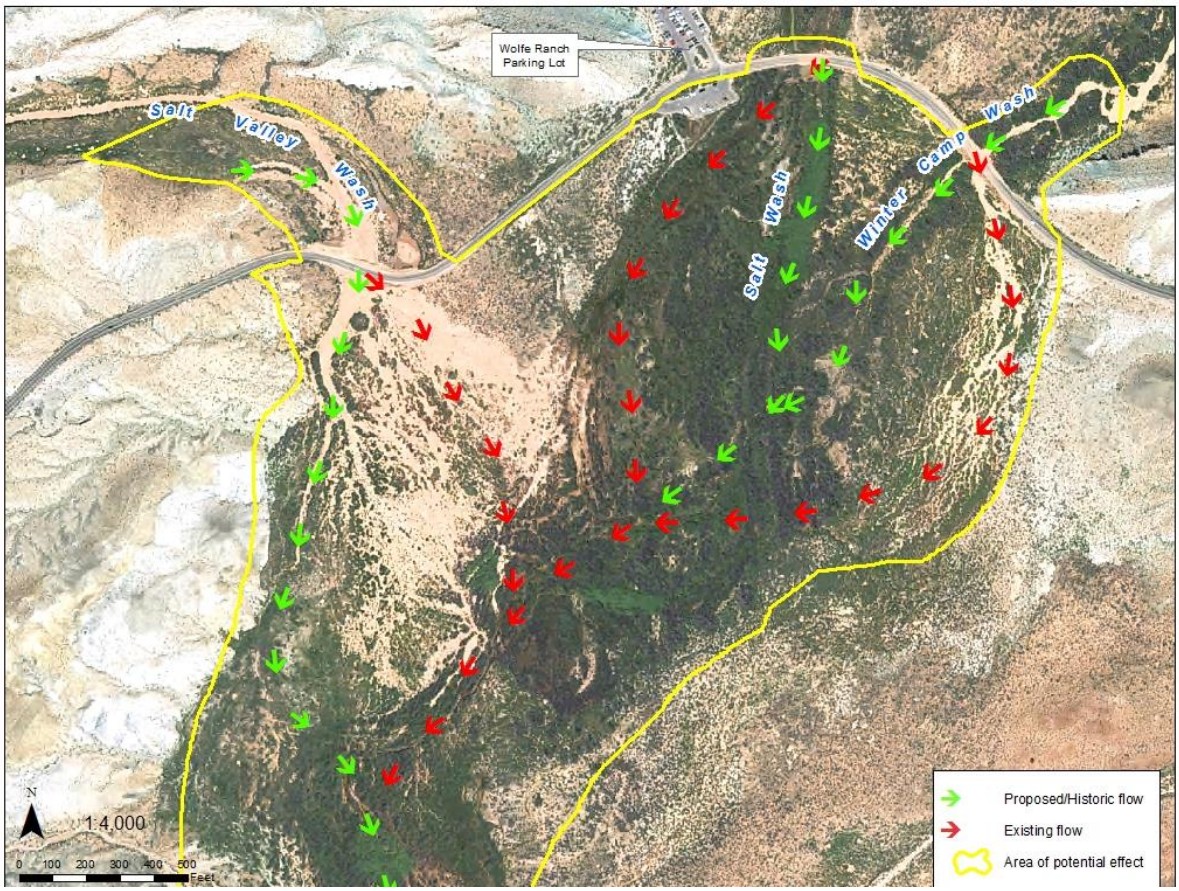

FIGURE 7. HISTORICAL AND PROPOSED CHANNEL FLOWS

Current LIDAR (Light Detection and Ranging) data was used to find the lowest existing channel elevations, and make reasonable path alignments for the ephemeral washes, Salt Valley and Winter Camp (Figure 8). LIDAR is a surveying method that measures elevation. Each storm event creates a slightly different runoff condition, based upon the storm intensity and duration and how much sediment is carried into the confluence area. Removing the tamarisk will allow a wider (up to 90 feet wide) channel, with smaller meandering channels within the wide channel.

The project would last a total of five years: two years of construction (removal of tamarisk and excavation of the three wash channels) and three years of monitoring and continued removal of sediment from the culverts and within the washes to 300 feet on either side of the road, if needed. The total project area is 160 acres and extends up to 500 feet north of the road near the washes, with the vast majority of the excavation occurring south of the road (Figure 9). Of those 160 acres, approximately 115 acres are infested with tamarisk shrubs of varying densities. A total of approximately 54 acres of non-native tamarisk would be removed comprising 33 percent of the total project area. The construction part of the project would have two phases: removal of tamarisk, then re-channeling the three washes and cleaning out the culverts. This would be during the first two years. The Park would utilize an excavator with a specialized attachment (grapple) to remove tamarisk trees, including as much of the roots as possible. Tamarisk would be temporarily stockpiled in a chipping area within the project boundary but outside of the wilderness boundary (Appendix A). Tamarisk would be chipped on-site, with brush piles being moved through the chipper on a weekly basis. Stumps and chips would be hauled to a landfill outside of the Park for disposal on a weekly basis.

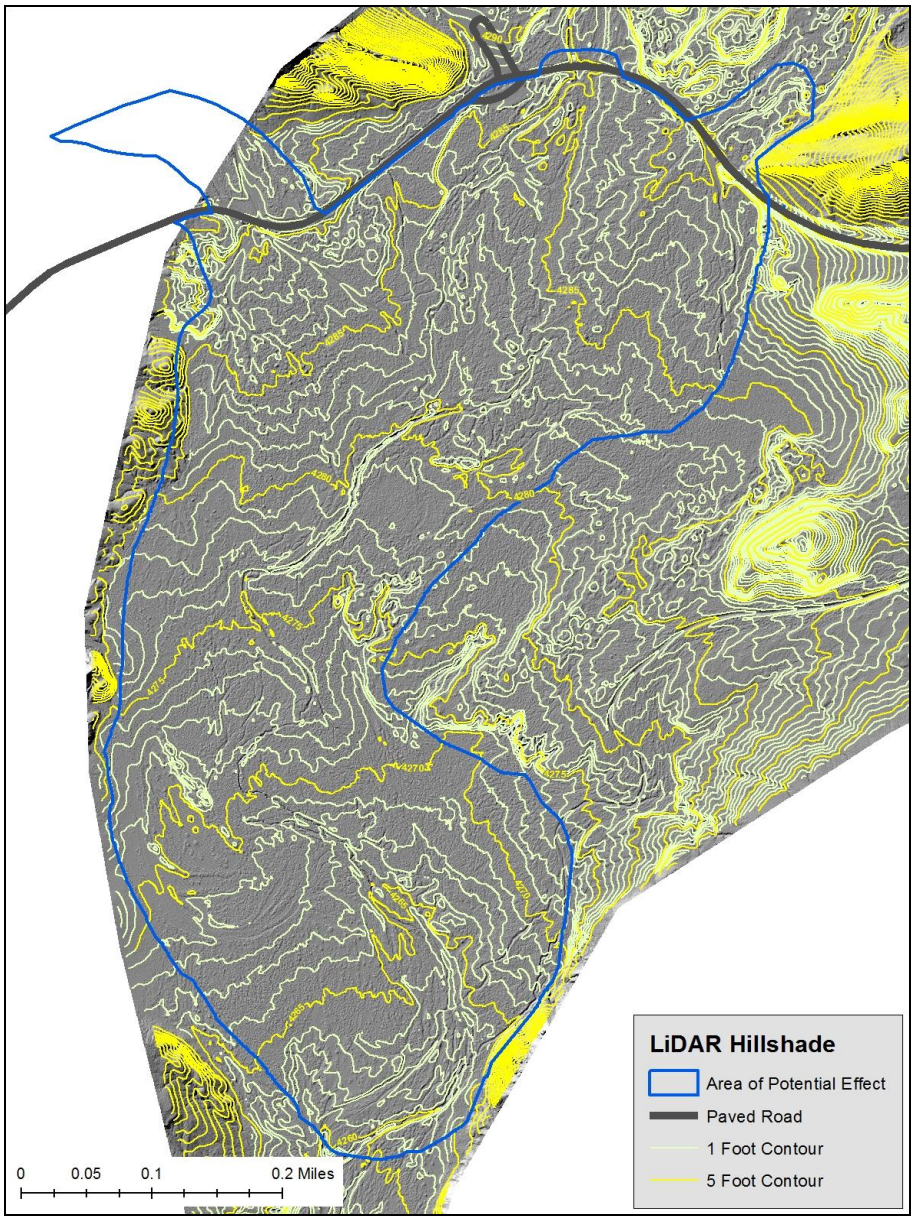

FIGURE 8. LIDAR OF PROPOSED PROJECT SITE

Once removal of tamarisk is completed, Park staff would excavate the three washes with heavy equipment including large front end loaders, road graders, and dump trucks to reestablish a proper gradient that supports the natural flow of water and sediment. An excavator and water truck with hose attachment would be used to clear the culverts of sediment and debris.

Preliminary cross section designs for the washes vary from about 30 feet wide at Winter Camp Wash to 90 feet wide at Salt Wash with final depths between 1 and 3 feet. Final design may vary depending on the current existing channel and on-the-ground constrictions. Recently acquired LIDAR data of the area would allow a detailed gradient analysis, facilitate the design of efficient channels, as well as develop cut and fill volumes. Channel parameters would be carefully evaluated and selected to ensure adequate conveyance of water and

sediment. These analyses may include hydraulic modeling with the support of the National Park Service's Water Resources Division.

Salt Valley Wash, Salt Wash, and Winter Camp Wash would have sediment removed from 2,200 linear feet, 4,900 linear feet, and 2,250 linear feet down gradient along the wash channels, respectively. Approximately 29,000 cubic yards of sediment would be removed from the three channels, and deposited within the project area of potential affect (Figure 9).

Sediment would be placed at identified locations within the project area, simultaneous with the excavation of the washes, referred to as "sediment deposit sites." These sediment deposit sites would complement the landscape and not interfere with the regraded wash channels, and would be created using the same equipment used to remove sediment from the washes (Figure 9). Moving and piling sediment from the washes to nearby identified deposit sites is the most efficient method for completing the re-channelization of the washes. This method would be used to minimize impacts from construction-related activities to visitors and wilderness character by decreasing the amount of time and equipment needed to complete the project. Additional surveys prior to sediment placement would help ensure natural and cultural resources are not being affected by the deposits. If sensitive resources are discovered, additional compliance may occur to analyze new site specific locations.

Sediment deposit sites would include erosion control mitigations, such as silt fencing, erosion mats, and/or soil stabilization polymers. These measures would be used to minimize aeolian (wind driven) erosion and help stabilize sediment so new vegetation can establish. Silt fencing and/or erosion mats would not be permanent installations in wilderness, and would be removed once vegetation is established or by the end of the five year project. Sediment deposit sites would be seeded with an upland, native seed mix to promote native plant revegetation. The sediment deposit sites in the project wash area would eliminate the need for landfill disposition and retain the sediment as part of the geologic resources of Arches National Park.

Alternative 2 construction phase would be completed over two years dependent on time-of-year restrictions and weather. Construction would be allowed into the third year if unforeseen circumstances inhibit the Park from completing the construction of the washes in two years. However, this would not change the overall total project timeline of five years. Time-of-year restrictions for migratory birds and wildlife is from April 1 to August 31, and for nesting raptors the restriction is from January 1 to August 31. Construction activities in the three washes would occur from September 1 up until April 1, as long as it is outside of the raptor nesting area buffer (Figure 10). In the raptor nesting area, construction would be allowed from September 1 to January 1. All construction activities would be during the day. Night construction would not occur and the use of flood lights would not be necessary.

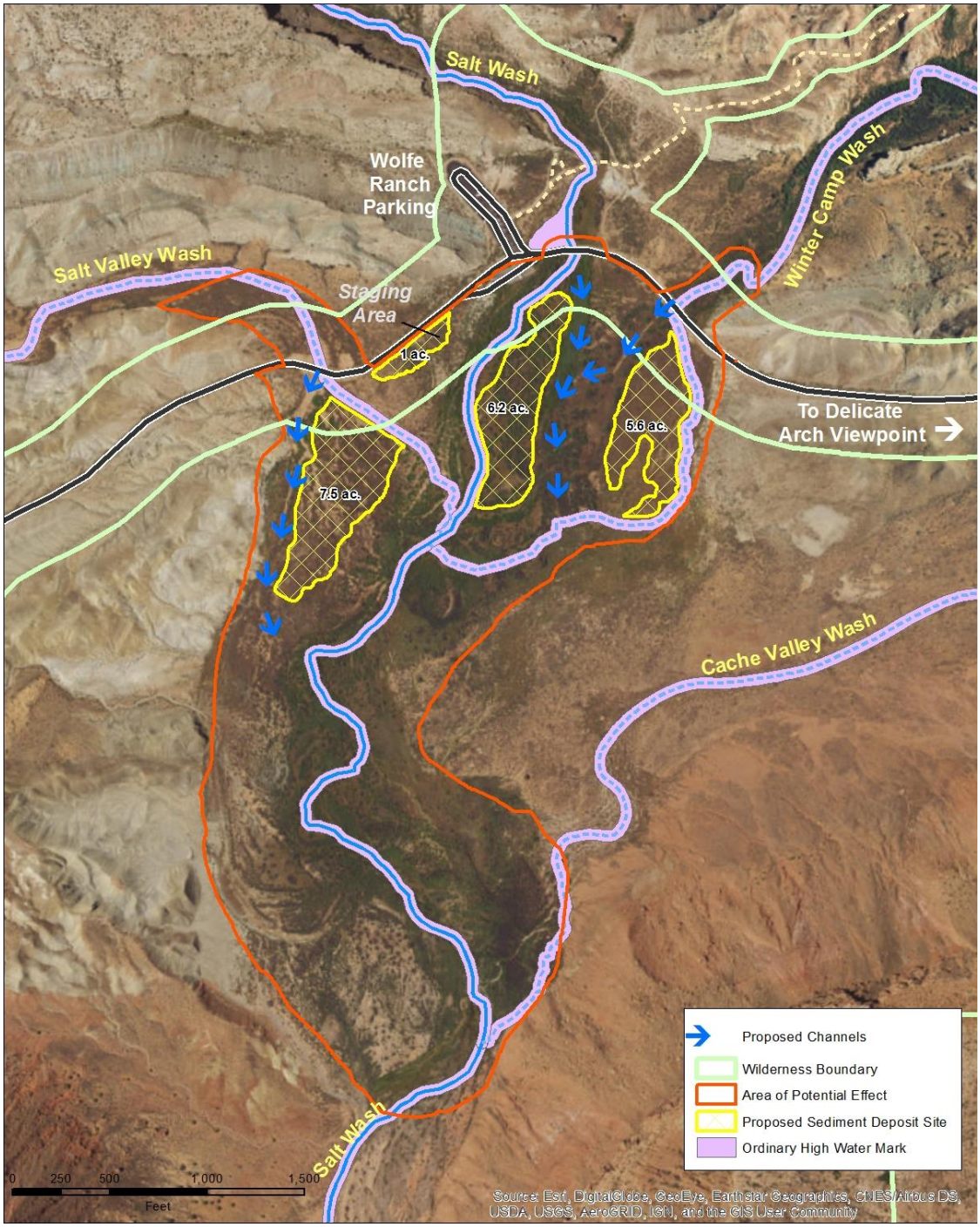

FIGURE 9. AREA OF POTENTIAL EFFECT AND PROPOSED SEDIMENT DEPOSIT SITES

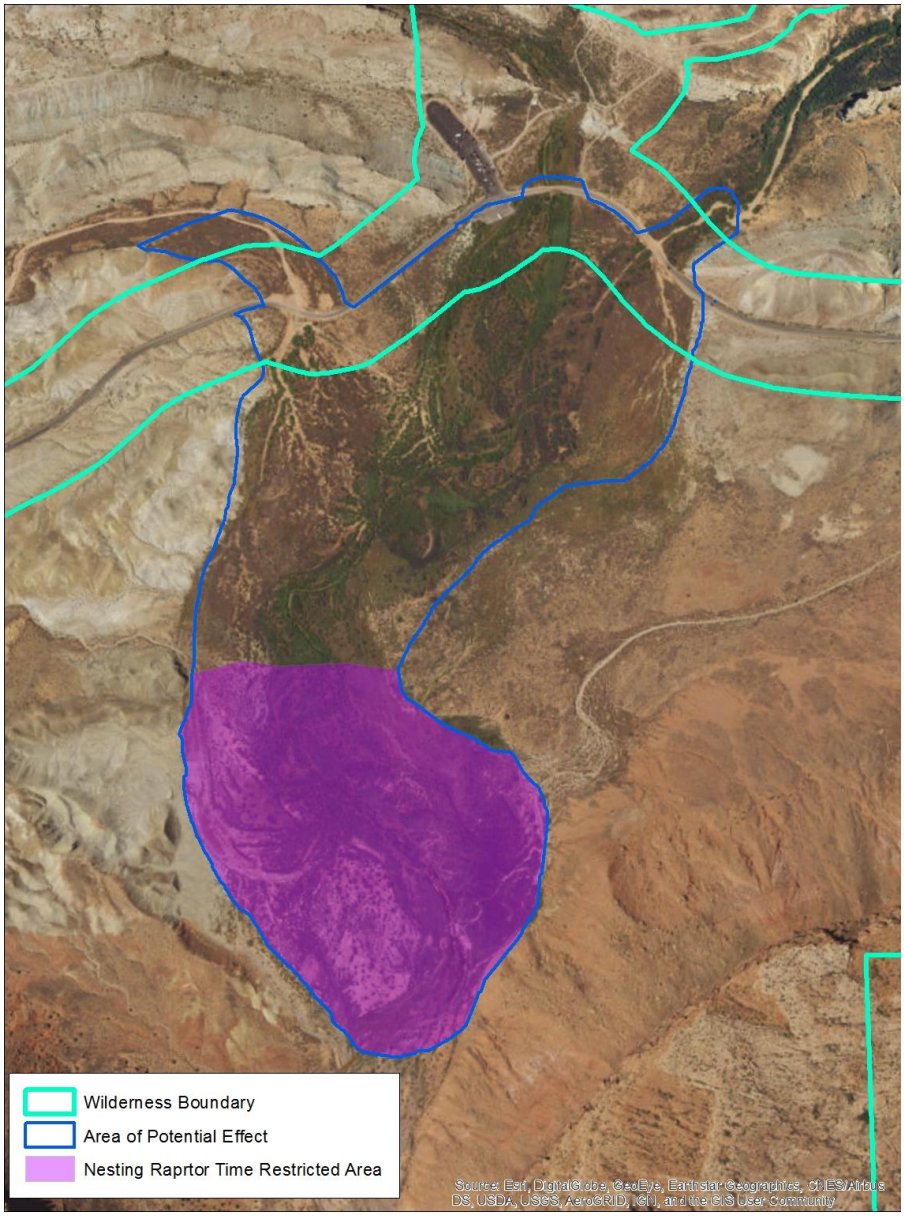

FIGURE 10. TIME-OF-YEAR RESTRICTION FOR NESTING RAPTORS WOULD BE IMPOSED FROM JANUARY 1 TO AUGUST 31 FOR A HALF MILE BUFFER (IN PURPLE) AROUND THE EXISTING RAPTOR NEST.

For three years after the project is completed, the Park would monitor for flooding-induced closures of the road and monitor the hydrologic flow in the channels. If flooding-induced road closures begin to increase and sediment build-up begins to act as a dam, the Park would remove sediment and debris from the culverts and re-excavate the three channels up to 300 feet from the road, outside of the wilderness boundary. If maintenance or re-excavation within the channels is necessary beyond the wilderness boundary or after five years, longer-term solutions will be explored that address issues of flooding and road closures, using monitoring data from Table 2 to inform the long-term solutions. The proper NEPA compliance would be completed, as needed. Any maintenance of the culverts after the five years would be conducted under an existing programmatic Categorical Exclusion by the Park.

Sediment removed from the culverts and wash channels during the three years after project construction would be placed within the sediment deposit sites, in portions that fall outside of the wilderness boundary (Figure 9). Sediment removed after five years would be hauled to a landfill outside of the Park for disposal. Tamarisk seedlings and re-sprouts would be treated with an herbicide (or cut and sprayed for larger shrubs) in accordance with the Park's *Exotic Plant Management Plan* (NPS, 2009a).

Monitoring the success of the project would be based on indicators such as decreased road closures and less frequent flooding events. Monitoring data would be used to determine if vegetation and hydraulic conditions are moving toward or away from desired conditions, and would be evaluated to determine the reason(s) for the observed conditions. This information would be used to inform future alternatives and decisions regarding the conveyance and flooding issues in this area. The proposed monitoring program is presented in Table 2.

TABLE 2. MONITORING SCHEDULE

Monitoring Type	By Occurrence	Every Six Months	Annual
Flood events	X		
Road closures (number and duration)	X		
Sediment accumulation in culverts	X		X
Tamarisk regrowth		X	
Native plant revegetation		X	
Channel width, depth, and gradient			X
Soil stability in sediment deposit sites			X
Photo Points			X

Monitoring Components

Flood Events. Flood events would be tracked by individual occurrence to develop a record of frequency and seasonality. When possible, estimates of flow (cubic feet per second [cfs]) would be developed, based on channel width and reconstructed depth of flow.

Road Closures. The park would continue the current practice of recording the number and duration of road closures to determine whether the project is meeting intended goals of reducing road closures.

Sediment Accumulation in Culverts. After each flood event, sediment accumulation in culverts would be recorded (approximate depth and volume), and summed on an annual basis.

Tamarisk Regrowth. Semi-annual surveys of the project area would be conducted to determine the extent of tamarisk regrowth and development of treatment strategies, if

needed. The Park's *Exotic Plant Management Plan* identifies several treatment strategies for tamarisk (NPS, 2009a).

Native Plant Revegetation. Semi-annual surveys of the project area would be conducted, concurrent with the tamarisk monitoring, to determine the extent of passive native revegetation (e.g. coyote willow, common reed, Baltic rush, soft-stem bulrush) and development of strategies to enhance native vegetation restoration, if needed. Although native revegetation is not a priority in this project, data collected concurrently with tamarisk monitoring may help inform future management decisions elsewhere in the Park.

Channel Width, Depth and Gradient. Measurement of channel conditions would be conducted annually. Width and depth would be measured at one to two transects within the separate sections of each wash (Salt Valley, Salt, and Winter Camp), and at two to five transects below the confluence of the three washes. Channel gradient would be measured in each of the separate washes and in the combined wash below the confluence. Monitoring data would be incorporated into a database to develop an understanding of how the system changes over time. Data may be collected using standard survey equipment or remote sensing technology such as LIDAR, or a combination. Specific monitoring protocols would be developed with the assistance of the National Park Service's Water Resources Division.

Soil Stability in Sediment Deposit Sites. Monitoring would include the condition of silt fences and the extent and rate of establishment of new vegetation. Vegetation monitoring would include prevalent species, including non-native exotic species that will be targeted for control. This monitoring would be conducted concurrently with the tamarisk and native vegetation monitoring described above.

Photo Points. Two to four photo points would be selected to provide an overall comprehensive visual record of system response to the project. Photos would be taken annually.

The proposed monitoring schedule will allow the Park to ensure the project is effective, and identify any necessary follow up actions within the five year project span. Any follow up actions beyond five years or inside of wilderness will require the proper NEPA compliance. Information gathered as part of this monitoring effort will help inform future management decisions related to issues of flooding and road closures in this area.
The implementation of alternative 2 is supported by NPS *Management Policies* 2006 (section 4.1.5., Restoration of Natural Systems). The proposed action would improve natural processes that have been impacted by human disturbances, in particular, the introduction of non-native vegetation and changes to hydrologic patterns from the construction of the road.

The proposed actions would occur in recommended wilderness and a Minimum Requirements Analysis would be completed prior to the completion of this NEPA process, in accordance with the *Wilderness Act* and section 6.3.5. of NPS *Management Policies* 2006.

The Park would apply through the Utah Division of Water Rights and the US Army Corps of Engineers for the appropriate stream alteration permits needed in order to implement the proposed project.

ALTERNATIVES AND ALTERNATIVE ELEMENTS CONSIDERED BUT DISMISSED

During internal scoping, the following alternatives were considered and dismissed from further analysis in this environmental assessment.

Remove Culverts and Return This Section of Delicate Arch Road to a Low Water Crossing

This alternative would conflict with the management strategies identified for Delicate Arch in the Park's General Management Plan that supports visitation to the area. In addition, prior to 1994, the Wolfe Ranch / Delicate Arch Viewpoint road was a low water crossing, and flooding events and safety issues led the Park to raise and pave the roadway. Reestablishing the road as a low water crossing would create a condition similar to that time period with flooding events often leading to road closures. This alternative would not meet the project objectives of reducing road closures due to flooding events.

Partial Rehabilitation of One or Two Washes Instead of All Three Washes

The three washes converge into the same alluvial fan south of the road and contribute to sediment deposition onto roadways during flooding events. Partial excavation would not resolve the purpose and need for taking action and would not reduce the amount of flooding or road closures.

Relocate Road Below Alluvial Fan and Install Bridges

This alternative would relocate the road to an area that is less affected by the wash drainages and alluvial fan. However, total relocation of the road is economically infeasible and would have too great of an environmental impact, such as permanent negative impacts to undisturbed areas managed as wilderness.

Remove Tamarisk using a Controlled Burn and Perform Wash Excavation and all other Project Activities in One Season of Work

A controlled burn of tamarisk does not meet the purpose and need of the plan because it leaves root systems intact which will inhibit the excavation and re-contouring of the wash channels. Tamarisk is fire-adapted and recovers more quickly than native species after a burn because it sprouts vigorously from the root crown; therefore, burning tamarisk would be an ineffective means of tamarisk treatment over the long term. Additionally, it would be difficult to contain the impacts of a controlled burn on native vegetation in the project area, which is interwoven with tamarisk thickets. Controlled burns of wildland areas involve the additional impact of fire line construction. The selected alternative and grapple excavation of tamarisk will allow for more targeted treatment of tamarisk and would have fewer incidental, adverse impacts on native vegetation than a controlled burn is likely to have.

Partial Removal of Tamarisk and Perform Wash Excavation and all other Project Activities in One Season of Work

A partial removal of tamarisk leaves the wash banks stabilized and does not meet the purpose and need of the plan in that it does not facilitate the excavation and re-contouring of the three washes to improve the flow of water and sediment. An additional benefit of the project is that it meets other stated park goals; it is supported by NPS Management Policies 2006 (section 4.1.5., Restoration of Natural Systems), which states that parks will reestablish natural processes that have been impacted by "…human disturbances including the introduction of exotic species;… changes to hydrologic patterns and sediment transport; the accelerations of erosion and sedimentation; and the disruption of natural processes" and by Executive Order 13112, February 3, 1999, which directs all agencies in the Executive Branch to: "take steps to prevent the introduction of invasive species, detect and respond rapidly to and control populations of such species, and provide for restoration of native species and habitat." Partial tamarisk removal does not meet these goals.

Relocate Chipping Operation to Balanced Rock Boneyard

This alternative element would relocate the tamarisk chipping operation to the Balanced Rock boneyard, a park maintenance yard that is more shielded from view of park visitors than the project area. This alternative was considered to mitigate the sight and sound impacts to visitors hiking within wilderness on the Delicate Arch trail, one of the most highly visited trails in the Park. However, relocation (by means of dump truck loads carrying whole tamarisk trees) would have additional sight and sound impacts to visitors traveling on Park roads, visiting Balanced Rock, and picnicking at the Balanced Rock picnic area. Three to four truckloads of tamarisk shrubs would be required for every one truckload of chipped material, increasing fuel costs, staff time, traffic on Park roads, and greenhouse gas emissions. Transporting exotic plant material could result in spreading exotic plant seeds to undisturbed areas of the Park, requiring longer-term efforts by Park exotic plant management teams. Sight and sound impacts from chipping operations to visitors hiking to Delicate Arch are instead addressed under mitigation measures.

MITIGATION MEASURES

The following mitigation measures would be implemented as part of the National Park Service's preferred alternative. An appropriate level of monitoring would be implemented throughout any construction activities to help ensure that protective measures are properly in place and are achieving their intended results. These include:

AIR QUALITY

- Fugitive dust generated by construction activities on roadways will be controlled by spraying water on the roads, if necessary.
- Inspection will be used to confirm equipment has properly functioning mufflers.

CULTURAL RESOURCES

- All project personnel will be informed of the procedures to follow in the event of post-review and inadvertent discoveries, as well as the penalties for intentionally damaging historic properties or illegally collecting archeological resources.
- Procedures will be established for notifying and updating the archeological monitor on the schedule of ground disturbing activities.
- Project personnel will coordinate with the archeological monitor to develop and implement resource protection procedures, including installation of temporary barriers. The archeological monitor will be present during installation of temporary barriers and will periodically inspect to ensure that barriers are effective and that resources are not being impacted.
- Archeological monitoring through periodic and regular inspections by a professionally qualified archeologist will be conducted during all ground disturbing activities within the project area.
- If any previously unidentified cultural resources are discovered during construction activities, the procedures outlined in the Archeological Monitoring and Inadvertent Discovery Plan (Baker 2017) prepared for this undertaking will be followed.

SOUNDSCAPES

- To reduce noise, chippers and grapple models with low noise ratings or noise dampening treatments will be selected and all efforts will be made to use chippers and grapple models with lower maximum noise levels.
- To reduce noise (and visual) impacts at sensitive visitor or wildlife locations, chipping operations will be timed to lessen impacts as much as possible (using available data to optimize days of the week, times of day, and continuous vs. non-continuous chipping operations).
- To minimize sights and sounds of project activities on visitors within wilderness, wood chipping activities will be located out of view from the Delicate Arch trail, as determined by the Viewshed Analysis (Appendix A).
- Reduced power operation, equipment models known to produce lower noise levels, and equipment of only the necessary size and power to do the job effectively (not oversized) will be used.
- Operation that minimizes the need for rearward motion and operating backup alarms will be used.

- Quieter backup alarms that meet regulatory requirements, e.g. manually adjustable, ambient-sensitive, or broadband alarms will be used; or no alarm if an observer directs the vehicle's rearward motion (Reid et al. 2013).

VEGETATION AND SOILS

- Repeated post-treatment of exotic vegetation species to ensure efficacy of exotic vegetation removal. Methods may include the use of loppers, hand saws, chain saws, and National Park Service approved herbicides. All exotic vegetation treatments would be covered by the Park's existing *Exotic Plant Management Plan* (NPS 2009).
- Restoration actions at sediment deposit sites to mitigate soil erosion and establish native perennial vegetation, such as the application of soil stabilization products (i.e. silt fencing, erosion mats, and/or soil stabilization polymers) and planting of native seeds.
- Vehicles and tools must be cleaned thoroughly before entering the Park to avoid the possibility of bringing exotic plant seed or material into the park.
- Loads of tamarisk debris or wood chips will be covered when leaving the project area, in order to minimize spread of windblown seeds from noxious weeds known to occur in the project area.
- Access routes to tamarisk removal and sediment deposition sites will be chosen and flagged to minimize impacts to native species and soils and confine construction activities as much as possible.
- On-site monitoring by a professionally qualified environmental monitor will be conducted during key phases of construction activities (including the onsets of tamarisk removal, when re-channelization is proceeding downstream, and the onsets of sediment deposition) to help minimize impacts to natural resources and deal with unforeseen situations. This work may include flagging areas or patches of native vegetation to avoid, marking access routes, and salvaging native plants for revegetation efforts.
- The chipping area will be raked clean of all chips and other plant debris and will be treated by exotic vegetation management teams post-construction activities."

VISITOR USE AND EXPERIENCE, PUBLIC HEALTH AND SAFETY

- Signs, alerts, press releases, and notifications will be issued to inform visitors prior to and throughout the duration of construction activities.
- Construction zones will be identified (i.e. flagging, fencing, etc.) to prevent visitors from entering unknowingly.
- Construction materials staging will be restricted to areas that will neither impede vehicle traffic of visitors, contractors, or park staff.

WATER QUALITY

- To minimize possible petrochemical leaks from construction equipment, the contractor would have a spill plan, regularly monitor and check construction equipment to identify, and repair any leaks.
- A fuel/lubricant spill absorption kit will be in place to address potential land and water spills and leaks.
- All fueling and oil servicing will be done in designated stagings area, at least 100 feet from a wash, and best management practices will be implemented to ensure no pollutants enter the washes.

- Sediment removal from the wash channels will involve the clean excavation method of scooping sediment out of the wash channels to minimize sediment discharge and erosion.
- Standard erosion control measures will be used such as silt fences, sand bags, wattles, and/or soil contouring to minimize any potential soil erosion and minimize debris accumulation in the washes.

WILDLIFE (INCLUDING NESTING RAPTORS AND MIGRATORY BIRDS)

- Time-of-year restrictions will be imposed from April 1 to August 31 for federally and state-listed, and migratory birds.
- Time-of-year restrictions will be imposed from January 1 to August 31 for nesting raptors only within the project area that is a half mile from the located nest (see Figure 10).
- Systematic surveys will be conducted by resource management staff for nesting migratory bird species.
- A professionally qualified wildlife monitor will be required for all channel excavation work that will occur in perennial reaches of Salt Wash and/or will result in the destruction of a beaver dam to minimize adverse impacts to beavers and other wildlife.

CHAPTER 3- AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This chapter describes and analyzes the resource topics and potential environmental consequences that may occur as a result of implementing any of the alternatives. Resource topics described and analyzed in this chapter include hydrologic and geomorphologic processes, vegetation, visitor experience, and wilderness character.

In accordance with the Council on Environmental Quality (CEQ) regulations, direct, indirect, and cumulative impacts are described (40 CFR 1502.16) and the impacts are assessed in terms of context and intensity (40 CFR 1508.27). Where appropriate, mitigating measures for adverse impacts are also described and incorporated into the evaluation of impacts.

ANALYZING CUMULATIVE IMPACTS

Cumulative impacts are defined as "the impact on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions, regardless of what agency or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

Cumulative impacts are determined for each resource topic by combining the impacts of the alterative being analyzed and other past, present, and reasonably foreseeable actions that also would result in beneficial or adverse impacts. Cumulative impacts are considered for both the no action and the preferred alternative. The geographic scope for the cumulative impacts analyses is primarily specific to areas within the project boundary polygon, but also includes the larger delta area and areas north of the paved road to where the three canyons narrow, including the Delicate Arch/Wolfe Ranch parking lot. The temporal scope is 10-15 years, but also includes earlier projects. Projects considered in the cumulative impact analysis and the potentially affected resource are described and identified below.

Past Actions

- 1992-1995
  The Wolfe Ranch / Delicate Arch Viewpoint road was paved and widened, the road grade was elevated, the Wolfe Ranch parking lot was expanded and paved, a bus parking lot was added on the south side of the road, two 30" culverts were installed at Salt Valley Wash road crossing, three 3' X 6' box culverts and one 24" culvert were installed at Salt Wash road crossing, and two 3' X 6' box culverts were installed at Winter Camp Wash road crossing.
- 1999
  Sediment was removed from box culverts in Winter Camp Wash and Salt Wash, which had completely silted in. Sediment removal work in the Salt Wash channel occurred 25 feet upstream and downstream of the road crossing. Sediment removal work in the Winter Camp Wash channel occurred 25 feet upstream and 150 downstream of the road crossing, where 3-4 feet of sand was removed and the wash was tapered for flow.
- 2001
  Rip rap was repaired and silted-in culverts were cleaned out in Salt Valley Wash.

- 2006
  Section 404 permit was obtained by the Park for all three washes. All culverts were cleaned out. Rip rap was repaired in Salt Valley Wash, and new rip rap was added. Sediment was removed from Salt Valley Wash 200 feet upstream and downstream of the road crossing and a previous ditch line was reestablished 50 feet upstream and 100 feet downstream of the culverts. Sediment was removed from the Winter Camp Wash channel 50 feet upstream and 150 feet downstream of the road crossing. Sediment was removed to a depth of approximately 3 feet below existing grade and tamarisk shrubs growing within the channel were removed. Most of the sediment was hauled to the Balanced Rock boneyard; some of the sediment was placed on wash sides.
- 2008
  The Wolfe Ranch / Delicate Arch Viewpoint road was chip sealed.
- 2009
  Five bigger squash culverts (49" x 33") were installed at the Salt Valley Wash road crossing, replacing the two smaller culverts.
- 2009-2011
  Ongoing maintenance was conducted to clean out the culverts in Salt Valley Wash.
- 2011
  Sediment was removed up to 300 feet upstream of the road in Salt Valley Wash. Section 404 permit expired.
- 2013
  Drainage maintenance work was performed just south of the Delicate Arch/Wolfe Ranch bus parking area. This included brush removal and bulldozer work in smaller drainages to create a "V" ditch of 6' X 10'. All work occurred within 300 feet of the road. Additionally, culverts associated with these smaller channels were cleaned out.
- 2015
  Delicate Arch/Wolfe Ranch parking area was expanded (capacity more than doubled) and a new cut-off trench was constructed to channel run-off water away from or around the parking lot.

Present Actions

- Present actions include road maintenance in reaction to sediment deposition on the road following flood events. Roads are cleared of sediment and sediment is deposited along road edges. Road closures following flood events are common and increasing in frequency and duration.

HYDROLOGIC AND GEOMORPHOLOGIC PROCESSES

Affected Environment

Hydrologic and geomorphologic processes have been altered from a more natural state to a degraded state due to the human activities in the area, specifically, the road is an obstruction and hindrance to water and sediment flow. The combination of the sediment accumulation at and below the three wash crossings with the road coupled with the establishment of tamarisk, has resulted in complete loss of a favorable downstream gradient, which has led to further sediment aggradation and deteriorating conditions. In addition, all 15 culverts that have been installed at the three wash crossings between the 1960s and 2009 are non-functional. The

frequency and magnitude of over-road flow and sediment deposition events both appear to be increasing with time due to the repeated deposition and floodplain aggradation.

Salt Valley Wash. The western most ephemeral drainage, Salt Valley Wash (Chapter 1, Figure 2), has the best hydrologic function of the three wash crossings and is somewhat capable of passing incoming water and sediment under the prevailing conditions. However, the crossing does not perform as designed, and is suffering structurally as a result. The asphalt surface, which serves as a low-water-crossing during times of discharge, is undercut and eroded on the downstream side. Even though Salt Valley Wash is passing sediment and water, runoff events will continue to erode away the road surface and likely compromise the crossing at some time. The road was originally constructed as a dirt road with low water crossings, but would flood and impact visitation. Since it was paved in 1994, the road has restricted the flow of Salt Valley Wash, due to inadequate culverts under the road. The water velocity has slowed dramatically as it crosses the road, causing the stream to deposit large amounts of sediment on the road and just downstream. In 2009, larger culverts were added under the road, but because of the extremely large volume of sediment accumulation on the downstream side, there was no clear channel, and the stream quickly filled in the culverts and continued to back up over the road. Another factor in the loss of a clear downstream channel is the widespread growth of tamarisk within the channel and flood plain. The tamarisk shrubs have grown into the channel, and in numerous locations completely block the channel.

Salt Wash. Salt Wash, the middle crossing, is the largest drainage of the three, and the only one with perennial flow (Chapter 1, Figure 2). This catchment drains over 150 square miles (240 square km) and has formed a prominent valley both up and downstream of the crossing. The perennial flow has supported sub-irrigation and an extensive woody and herbaceous riparian community, much of it composed of tamarisk. The combination of the aggradation and vegetation establishment has led to extremely poor flow conveyance conditions, and there is little downstream flow. Aerial imagery from the middle of last century indicates that the historical Salt Wash channel was a well-developed meandering stream with a relatively constant channel width of between 33 to 66 feet (Chapter 1, Figure 3). The decrease of water and sediment flow has resulted in ponding of water and mud on the road during most of the year and often contributes to the need for road closures. Road closures can extend beyond a flooding event in order to accommodate the removal of sediment deposited on the road by flooding events. In recent years, the annual number of road closures, and the average number of days a closure lasts, has increased (Chapter 1, Table 1). In 2016, the road was closed for 34 days, and it is expected to surpass that number in 2017. In the winter of 2017, the road was closed at Salt Wash due to standing water and mud on the road for over 4 months.

Winter Camp Wash. Winter Camp Wash is the eastern most of the three drainages (Chapter 1, Figure 2). The primary issue with this crossing is extreme sediment aggradation that has resulted in sediment management issues, and frequent road closures. The culvert passage has completely filled and currently functions as a low water crossing. This crossing however, does not pass sediment, and the downstream channel and floodplain have aggraded substantially, currently providing little to no hydrologic flow. There is sufficient downstream gradient to provide both flow and sediment conveyance; however, the adverse grade in the accumulation area is hindering that flow. The project would improve the Winter Camp Wash drainage at the Delicate Arch Road crossing so that access to Delicate Arch Viewpoint can remain open for visitor use. Invasive tamarisk plants that are blocking the channel and choking the floodplain would be removed from the Winter Camp alluvial fan.

Floodplains. Executive Order 11988 *Floodplain Management* directs all federal agencies to avoid construction within the 100-year floodplain unless no other practicable alternative exists. The National Park Service manages floodplains to preserve floodplain values, minimize the potential hazards of flooding, and comply with law (NPS 2006), as directed in Director's Order 77-2 *Floodplain Management* (NPS 2003).

The project area is within a 100-year floodplain. The improvement of the hydrologic flow of water and sediment in the project area is considered an action that preserves floodplain values and decreases potential flooding hazards, and is therefore construction which is allowed to occur in the floodplain. Potential physical changes to the floodplain within the project area will be analyzed in the context of hydrologic and geomorphologic processes because hydrologic and geomorphologic processes are part in parcel to floodplains.

Alternative 1- No Action- Continuation of Current Management Practices

The natural flow of water and sediment would not be improved, resulting in continued aggradation of sediment in the three washes and over the road. Hydrologic and geomorphologic processes would continue to degrade further from a natural desired condition. The hydrologic process of transporting sediment and water during rainfall events in Salt Wash, Salt Valley Wash, and Winter Camp Wash would continue to be slow due to a shallow gradient, resulting in ever increasing sediment aggradation and more flooding-induced road closures. The increase in sediment build-up further leads to a shallower gradient, contributing to a negative feedback loop of degrading hydrologic processes. Without the transport of sediment and water down the three washes, the geomorphologic features of the washes are compromised. The insufficient hydrologic and geomorphologic processes in-turn support denser vegetation growth within the washes, particularly non-native tamarisk, trapping sediment in the washes and further compounding the current undesirable condition. According to the 2014 U.S. National Climate Assessment, increases in the frequency and intensity of extreme precipitation events are projected for all U.S. Regions, with the region around Arches National Park projected to increase 40-50% (Melillo et al., 2014, Kunkel et al., 2013). Thus, episodic flood events and their associated impacts will likely increase at Arches based on these projections, leading to more flooding-induced road closures and increasing sediment deposition on the road and in the wash channels and culverts.

Cumulative Impacts. Past actions including removing low water crossings, paving the road, installing culverts, and performing minor wash excavations have contributed to sediment aggradation and the overall degradation of hydrologic processes. These past actions when combined with impacts resulting from Alternative 1 [No Action], would likely lead to worsening degradations of hydrologic and geomorphologic processes, increased undercutting of the road, and an increase in non-native vegetation, which is outcompeting native vegetation across most of the project area. Tamarisk would continue to trap sediment within the washes, further hindering natural hydrologic processes. Therefore, considering the impacts to hydrologic and geomorphologic processes from Alternative 1 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is adverse and long-term.

Alternative 2- Proposed Action- Reduction of Flooding and Road Closures Through Wash Excavation (Salt Wash Project) (NPS Preferred Alternative)

Under alternative 2, the natural flow of water and sediment would be improved, resulting in a condition that supports hydrologic and geomorphologic processes. Mechanical excavation of the three washes, including upstream of the road (500 feet in Salt Valley Wash, 50 feet in Salt Wash, and 500 feet in Winter Camp Wash), would reestablish a steeper gradient, allowing for the movement of sediment and water during rainfall events, and reducing flooding-induced road closures and sediment deposition on the road. This would support geomorphologic processes, such as weathering of rocks and soils, and erosion of sediments downstream. These processes are an important natural component of the landscape, and support the ecological resiliency of the Park's ecosystems. Resiliency provides for a robust ecosystem that can recover more quickly from human and natural disturbances.

It is unknown how long the excavated gradient and beneficial impacts to hydrologic and geomorphologic processes would last. As long as the proper gradient is maintained for water and sediment to flow downstream, the project would be successful and keep the road from flooding or sediment aggradation from occurring. It is believed by NPS Water Resources scientists that the natural flow of water through the washes, and functioning culverts should be able to maintain a sufficient downstream gradient. However, it is still uncertain how long these effects will last, especially when considering future climate projections showing 40-50% increases in the frequency and intensity of extreme precipitation events and their associated impacts across this region (Melillo et al., 2014, Kunkel et al., 2013).

Cumulative Impacts. Past actions as described in the No Action Alternative have contributed to sediment aggradation and the overall degradation of hydrologic processes. The preferred alternative [Alternative 2] would decrease the adverse impacts of past, present, and future actions by improving the conveyance of water and sediment under the road, establishing a sufficient downstream gradient for sediment transport, and removing or substantially reducing the cover of tamarisk, allowing a wider channel to establish and native vegetation to recolonize the project area. Therefore, considering the impacts to hydrologic and geomorphologic processes from Alternative 2 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is beneficial but of unknown duration.

VEGETATION

Affected Environment

According to NPS 2006 *Management Policies*, "Native species are defined as all species that have occurred or now occur as a result of natural processes on lands designated as units of the national park system. 'Exotic species' are those species that occupy or could occupy park lands directly or indirectly as the result of deliberate or accidental human activities. Exotic species are also commonly referred as a non-native, alien, or invasive species. Because an exotic species did not evolve in concert with the species native to the place, the exotic species is not a natural component of the natural ecosystem at that place."

Native vegetation occurs within the project area but current conditions are of a degraded quality, and native species are out-competed by non-native species over most of the project area. Some native vegetation occurs within the tamarisk removal area, with the wettest areas containing scattered patches of coyote willow (*Salix exigua*) and common reed (*Phragmites australis*), as well as Baltic rush (*Juncus arcticus*), cattails (*Typha latifolia*), alkali muhly (*Muhlenbergia asperifolia*), and Soft-stem bulrush (*Scirpus validus*) (Coles et al. 2009). On the drier terraces, scattered shrubs of rubber rabbitbrush (*Chrysothamnus nauseosus*), Basin big sage (*Artemisia tridenta ssp. tridentata*), saltbush (*Atriplex canescens*), and greasewood (*Sarcobatus vermiculatus*) occur in gaps between the tamarisk. A patchy understory of desert saltgrass (*Distichlis spicata*) is found beneath some of the tamarisk, and sand dropseed (*Sporobolus cryptandrus*) is a common native grass scattered throughout the project area (Coles et al. 2009). Greasewood and Basin big sage dominate most of the higher ground just outside the project area, with a grassy understory of alkali sacaton (*Sporobolus airoides*) and James' galletta (*Hilaria jamesii*), and well-developed biological soil crusts in some areas. Other areas within the tamarisk removal area are dominated by weedy, salt-loving native plants like Torrey's seepweed (*Suaeda torreyana var. torreyana*) and Iodine bush (*Allenrolfia occidentalis*), and non-native herbaceous species including cheatgrass (*Bromus tectorum*), Russian thistle (*Salsola sp.*), and Russian knapweed (*Centaurea repens*).

Approximately 80% of the project area is dominated by exotic or non-native vegetation, according to the 2009 vegetation map of Arches (Coles et al. 2009). 115 acres are mapped and classified as tamarisk shrublands and 14 acres are mapped and classified as non-native, annual herbaceous vegetation. Arches National Park has an estimated 92 non-native plant species (including unconfirmed and probably present species), which make up about 12% of all vascular plant species currently identified for the Park. In 2003-2004, the Northern Colorado Plateau Inventory and Monitoring program mapped and quantified non-native plant populations at Arches. According to their mapping efforts, 748 acres in Arches are infested with exotic or non-native plant species, which is about 1% of Park lands (Dewey and Anderson 2005). Tamarisk (*Tamarix chinensis*) is a non-native tall shrub or tree common to riparian areas of the Park, and is listed as a Class 3 (Containment) noxious weed on the Utah State Noxious Weed List (UDAF 2017). Controlling tamarisk was the first priority identified for non-native plant management in Arches National Park; however, control efforts have been limited due to treatment difficulty and the widespread distribution of tamarisk. In addition to tamarisk, scattered populations of other exotic species that are a high priority for control are known to occur in the project area. Russian knapweed (*Centaurea repens*) and small populations of Canada thistle (*Cirsium arvense)* are found often mixed with tamarisk, but vegetation management teams have been unable to effectively treat these stands due to impenetrable tamarisk thickets. Other non-native species not targeted for control due to their widespread distribution are also found in the project area. These include ubiquitous cheatgrass (*Bromus tectorum*) and Russian thistle (*Salsola sp.)*, neither of which are officially listed as noxious weeds for the state of Utah and both are more typical of upland environments.

Executive Order #13112 (Invasive Species) was signed in 1999, "…to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause…" Currently, Park vegetation management teams map and monitor non-native plant populations using GPS technology as part of their field efforts focused on treatment and control of non-native species. This provides the Park with valuable data about distribution of and changes in target non-native plant populations, including early detection of newly-introduced species.

Section 2.4 of the *Exotic Plant Management Plan* (NPS 2009) for Southeast Group parks prioritizes non-native species for treatment based on their potential impact on park resources and potential for control. Tamarisk was identified as a priority for treatment in eight locations within Arches, including just upstream of the project area; however, it is less commonly targeted for treatment because it is so widespread and difficult to remove. Tamarisk removal is prioritized for areas where healthy stands of native woody vegetation (such as cottonwood and willow) are present, with the objective of protecting and expanding these stands. Targeted tamarisk treatments have occurred in Arches using volunteer groups and regional Exotic Plant Management Teams, focused mainly on the Courthouse Wash riparian corridor. No tamarisk treatments have occurred in the project area to date.

In addition to manual and chemical tamarisk treatments, biological control is now a tool for tamarisk management. Tamarisk leaf beetles (*Diorhabda carinulata*) were initially released in Grand County, Utah in 2004 and spread to areas within the Park by 2007 (Robinson and Higgs 2013). An estimated 80% of the tamarisk in the project area has been defoliated, weakened, or killed by the tamarisk leaf beetle. While the beetles are effective at weakening or even killing established tamarisk, the trees are left standing in large, dead masses with root systems intact. Even with the high die-back of tamarisk trees in the project area, the trees are still trapping sediment in the washes and inhibiting flow in the wash channels, compounding the degradation of hydrologic and geomorphologic processes. Furthermore, dead tamarisk contributes to fuel loading in the area and increased danger of wildfire occurrence.

Alternative 1- No Action- Continuation of Current Management Practices

Under Alternative 1, incidental removal of or disturbances to native vegetation would not occur. Native vegetation would continue to be out-competed by non-native species across much of the project area. Tamarisk shrubs would not be removed, resulting in continued aggradation of sediment in the three washes and over the road. Without the transport of sediment and water down the three washes, the geomorphologic features of the washes are compromised. The insufficient sediment movement in-turn supports denser vegetation growth within the washes, particularly non-native tamarisk, which further traps sediment in the washes and compounds the current undesirable condition. The *natural* quality of wilderness character would be degraded because the area would continue to be dominated by tamarisk and other non-native species, which would continue to out-compete native species. The wildlife habitat characteristics of the area would continue to be degraded due to the high cover of non-native vegetation and the high mortality of tamarisk shrubs across the project area. The fuel loads from dead and dying tamarisk would continue to pose a wildfire threat to the native plant communities in the area that are not fire-adapted.

Cumulative Impacts. Past actions including removing low water crossings, paving the road, installing culverts, and performing minor wash excavations have contributed to the overall degradation of hydrologic processes, which in turn has supported an increase in non-native vegetation, primarily tamarisk. These past actions, when combined with impacts resulting from Alternative 1 [No Action] would likely lead to worsening degradations of hydrologic and geomorphologic processes and an increase in non-native vegetation. Therefore, considering the impacts to vegetation from Alternative 1 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is adverse and long-term.

Alternative 2- Proposed Action- Reduction of Flooding and Road Closures Through Wash Excavation (Salt Wash Project) (NPS Preferred Alternative)

Under alternative 2, some native vegetation would be disturbed or incidentally removed during tamarisk removal and channel contouring. Across the project area, twenty-five acres are mapped as greasewood shrublands and 6 acres are mapped as saltbush shrublands (Coles et al. 2009). These shrublands are outside of the tamarisk removal area but some portion of them will be impacted as a result of accessibility constraints (heavy machinery gaining access from the road to tamarisk-dominated areas). As a percentage of park native vegetation community cover, project activities have the potential to directly or indirectly, adversely impact up to 2.2% of greasewood shrublands in the Park and <1% of saltbush shrublands in the Park. Additionally, small patches of mesic, native vegetation are mosaicked with tamarisk shrublands as narrow bands adjacent to perennial water courses. Up to 12 acres of the 115 acres mapped as tamarisk may be dominated by coyote willow, common reed, Baltic rush, softstem bulrush, cattails, saltgrass, and/or alkali muhly. Channel contouring and tamarisk removal have the potential to directly and adversely impact up to 7% of the native, riparian shrub and herbaceous vegetation cover in the Park. However, the majority of impacts would be to native plant species with extensive rhizomatous root systems (such common reed, coyote willow, and desert saltgrass); these impacts would be short-term, as rhizomatous plants will rebound quickly from disturbance as long as parts of stands are left undisturbed and some roots and stems are left intact. Other native plant species may not rebound as easily; therefore, mitigations would be imposed to minimize impacts to native plants by defining access routes and temporarily fencing or flagging pockets of native plants for machinery to avoid. Therefore, it is anticipated that much fewer than 7% of the total cover of native riparian shrub and herbaceous vegetation in the Park would be adversely impacted over the long term.

Under Alternative 2, up to 115 acres of tamarisk would be mechanically removed by the roots, eliminating approximately 36% of the total acreage of tamarisk mapped Parkwide (excluding tamarisk found along the Colorado River on the Park boundary). This would have beneficial impacts on native plant populations in the project area, which are currently outcompeted by tamarisk and other non-native species. It would reduce fuel loads and wildfire threat to native species. It would open up areas currently infested with Russian knapweed for better treatment access by park vegetation management teams. The *natural* quality of wilderness character would be improved as native species recolonize the area and non-native species' populations are diminished. It would be a benefit to wildlife habitat over the long-term as native vegetation rebounds and reestablishes in the area.

Activities associated with channel contouring and sediment deposition would negatively affect the plants that are directly driven over and buried by these deposits. Soil disturbing activities often favor non-native vegetation that is adapted to disturbance. The channel reconstruction project will disturb soils and vegetation in areas where the seed bank likely includes a high proportion of exotic species. The potential to spread non-native seed is high, particularly to the proposed sediment deposit sites. Sediment deposit sites were intentionally selected in areas currently degraded and dominated by weedy or non-native plant species, to lessen these impacts. Strategically depositing sediment over weedy sites could benefit native vegetation by burying the existing exotics and providing a favorable substrate for sand-loving native plants such as sand sage (*Artemisia filifolia*), sand dropseed (*Sporobolus cryptandrus*),

ricegrass (*Achnatherum hymenoides*), globemallow (*Sphaeralcea* sp.) and evening primrose (*Oenothera* sp.). Park vegetation management teams will work to mitigate adverse impacts by repeatedly treating exotic vegetation to ensure the efficacy of the exotic vegetation removal and the successful establishment of native vegetation communities.

While disturbances from tamarisk removal and channel contouring, and the associated incidental removal of native vegetation from the three washes, will be a negative impact to native plants in the short term, this area comprises only 7% of the Park's native, riparian shrub and herbaceous vegetation and is not critical for the riparian vegetation resources or the natural, wilderness character of the Park. Over the long term, the proposed action will greatly benefit native vegetation by reducing competition from this aggressive exotic species (tamarisk) and this degraded riparian system should achieve higher diversity and cover of native plant species once tamarisk is removed.

Cumulative Impacts. Past actions as described in the No Action Alternative have contributed to the overall degradation of hydrologic processes, which in turn has supported an increase in non-native vegetation, primarily tamarisk. The preferred alternative [Alternative 2] would decrease the adverse impacts of past, present, and future actions by removing or substantially reducing the cover of tamarisk, allowing a wider channel to establish and improving the natural flow of water and sediment. Removal of tamarisk and post-treatment of the re-sprouts and other targeted exotic species on the sediment deposit sites would help facilitate native plant re-vegetation across the project area. Mitigation measures would be imposed to protect stands of native vegetation from construction activities as much as possible. Additionally, reseeding and revegetation efforts, where feasible, would aid in the restoration of native plant communities across the project area. Therefore, considering the impacts to vegetation from Alternative 2 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is beneficial and long-term.

VISITOR EXPERIENCE

Affected Environment

Arches National Park is a popular year-round destination for people visiting from around the world and offers a variety of recreational experiences. According to the Arches National Park Statistics (NPS 2016) and park staff, the Park has hosted over one million visitors annually since 2010 (Table 3). While the park is visited year-round, there is a distinct peak season that occurs between March and November. The Park is considered a drive-through park where a typical visit is less than four hours.

TABLE 3. VISITATION TO ARCHES NATIONAL PARK, PARK STATISTICS

Year	Recreation Visitors
2010	1,014,405
2011	1,040,758
2012	1,070,577
2013	1,082,866

2014	1,284,767
2015	1,399,247
2016	1,585,718

The project area includes the visitor access roads for Delicate Arch, Wolfe Ranch Historic District, Delicate Arch Viewpoint and associated parking lots. Delicate Arch is one of the primary locations park visitors visit. Daily visitation during the peak season is more than 2,000 people. The current degraded conditions of the culverts under the road have led to a low water crossing. Most intermittent flood events cause Wolfe Ranch / Delicate Arch Viewpoint road to flood and trap visitors on the east side of the road until the water level recedes. Park staff often has to provide assistance to visitors attempting to cross back safely. Once the water recedes, the amount of sediment deposited on the road surface requires heavy equipment for removal prior to reopening the road. Road closures can last several days, resulting in the inability for some visitors to see Delicate Arch.

The project area contains a variety of resources, including popular visitor access sites. The acoustic environment, or soundscape, is described by the ambient sound level, a measure of the soundscape which varies continuously with time. Sound levels vary according to source intensity, distance, and a variety of other factors. In order to provide the reader with some context and a better understanding of the sound levels in this document, Table 4 lists sound levels for common sounds and some which may be found in parks.

TABLE 4. COMMON PARK SOUND LEVELS (NPS, 2009B)

Park Sound Sources	Common Sound Sources	Level (dBA)
Volcano crater (HALE)	Human breathing at 3m	10
Leaves rustling (CANY)	Whispering	20
Crickets at 5m (ZION)	Residential area at night	40
Conversation at 5m (WHMI)	Busy restaurant	60
Snowcoach at 30m (YELL)	Curbside of busy street	80
Thunder (ARCH)	Jackhammer at 2m	100
Military jet at 100m AGL(YUCH)	Train horn at 1m	120

SOUND LEVEL IS EXPRESSED ON A LOGARITHMIC SCALE IN UNITS OF A-WEIGHTED DECIBELS (DBA).

To describe the variation of sound levels with time, averages and other statistical metrics are used. Examples include the 10th percentile (L_{50}, sound level exceeded 90% of the time), the 90th percentile (L_{10}, sound level exceeded 10% of the time), and the median (L_{50}, sound level exceeded 50% of the time). Other common metric are the minimum sound level (L_{min}), the maximum sound level (L_{max}), and the equivalent-continuous sound level (L_{eq}).

There is no measured ambient sound level data in the project area; however, ambient data was measured in 2003 at two similar sites, ARCH003 and ARCH005 (Ambrose et al. 2009 and Ambrose 2017). ARCH003 was located in a front country site above and behind park housing near the Visitor Center. ARCH005 was located in Courthouse Wash, a riparian corridor dominated by invasive tamarisk, similar to the project site, approximately 100 m (328 feet) from the main entry road. The sound levels at highly trafficked visitor areas near the project area, e.g. Delicate Arch trailheads, are expected to be generally higher than ARCH005 and lower than ARCH003, as shown in Table 5. So, a visitor would normally experience noise levels on the Wolfe Ranch / Delicate Arch Viewpoint road and at the Delicate Arch trailhead

parking lot between 10 and 80 dBAs (a human breathing 3 meters away and a busy street curbside) (Table 4).

TABLE 5. DAYTIME (0700-1900) AMBIENT SOUND LEVELS (in dBA)

Site	L_{min}	L_{max}	L_{eq}	L_{10}	L_{50}	L_{90}
ARCH003	20.7	80.5	54.2	55.8	49.9	44.7
ARCH005	18.2	60.6	40.0	42.3	34.8	29.8

To estimate locations that visitors would see construction activities from the Delicate Arch Trail, a viewshed analysis was conducted using six sample locations (Appendix A). There are some locations on the trail that visitors would not be able to see the construction activities, but each sample site has a view of part of the project APE.

Alternative 1- No Action- Continuation of Current Management Practices

With no action, the crossing area at the roadway will continue to be problematic during and after flood events and result in traffic disruptions, road closures, and potential hazards to visitors, including strandings on the east side of the road or cars or visitors trapped in floodwaters (see Figure 4). Visitors may need additional park staff assistance to cross. Visitor experience would continue to be negatively affected by the flooding and closure of Wolfe Ranch/ Delicate Arch Viewpoint road by limiting access to view Delicate Arch and blocking access to the Delicate Arch Viewpoint parking lot, further congesting the heavily used parking lot at Wolfe Ranch. Noise from construction vehicles clearing the blocked roadway would occur every time sediment needs to be removed from the road.

Cumulative Impacts. Past actions including removing low water crossings, paving the road, installing culverts, and performing minor wash excavations have contributed to flooding-induced road closures and their associated effects on visitors. The expansion of the Wolfe Ranch / Delicate Arch parking area in 2014 has accommodated higher levels of visitor use, increasing the number of people potentially affected by flooding-induced road closures. These past actions when combined with impacts resulting from Alternative 1 [No Action], would likely lead to increased flooding-induced road closures, longer road closures, and increased numbers of visitors affected by road closures. Therefore, considering the impacts to visitor experience from Alternative 1 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is adverse and long-term.

Alternative 2- Proposed Action- Reduction of Flooding and Road Closures Through Wash Excavation (Salt Wash Project) (NPS Preferred Alternative)

Visitor experience would ultimately be improved with the implementation of alternative 2. During construction activities, visitors' experiences would be affected by construction noise and the visual impacts of having heavy equipment near the Wolfe Ranch / Delicate Arch Viewpoint road and parking lot. Construction activities are anticipated to occur daily, over two winters for three to five months each, depending on construction locations near the nesting raptor area (Chapter 2, Figure 10). Construction may be extended into a third year, if

necessary. Construction activities will occur during winter months, when visitation numbers are lowest at Arches National Park.

After construction, visitor experience would improve at the Wolfe Ranch and Delicate Arch locations, with the decrease in flooding events leading to road closures. Visitors would no longer have to alter their itineraries due to road closures, or become stranded on the east side of the washes and require assistance from park staff. Noise from vehicles removing sediment from the road after flooding events would decrease, resulting in benefits to visitor experience in the long-term. The parking lot at the end of the road would be accessible for visitors to view Delicate Arch year-round.

For visitors, construction noise will attenuate with distance, diminishing for people as they move away from construction sites. Topography, like intervening hills and rock formations, may block and further reduce construction noise. In order to understand construction noise impacts, sound levels are predicted using simplified line-of-sight distance and atmospheric absorption assumptions (Table 6).

TABLE 6. PREDICTED CONSTRUCTION NOISE LEVELS

Equipment Description	Acoustical Use Factor (%)	Lmax @ 50 ft (dBA, slow)	Est. Lmax @200 ft (dBA)	Est. Lmax @ 800 ft (dBA)
Wood Chipper[1]	20	89	77	64
Backhoe[2]	40	78	66	53
Dump Truck[2]	40	76	64	51
Excavator[2]	40	81	69	56
Front End Loader[2]	40	79	67	54
Grapple (on backhoe)[2]	40	87	75	62
Scraper[2]	40	84	72	59

[1] – (NYSDEC 2001)
[2] – (FHWA 2006)

The total noise level at a given location will depend on what combination of equipment is being operated at a given time, as well as individual distances and other site-specific conditions. Mitigations would greatly reduce the impacted area. Assuming line-of-sight (non-obstructed) propagation of sound from source to receiver, if the noise level from equipment is reduced so it occurs at 200 feet rather than 800 feet, the ground area affected by that level (or higher) will have been reduced from approximately 46 acres to 3 acres. In general, the greatest noise impacts are predicted to occur from an operating wood chipper and grapple (tamarisk removal equipment).

Visitors will see and hear the construction activities in the three washes, particularly while driving past the three washes, parking in the parking lots, and beginning their hike at the trailhead for Delicate Arch. From certain view points on the Delicate Arch trail, visitors will be able to see and hear the construction equipment in the washes. However, the farther away a visitor is from the construction site, the less noise and visual impacts there would be.

If additional work to help maintain the washes is needed within the first five years of the project, impacts to visitor experience would be similar to those described above. However, these impacts would be expected to be much less in duration and intensity, as any maintenance activity would not be as extensive as the original Salt Wash Project.

Cumulative Impacts. Past actions as described in the No Action Alternative have contributed to flooding-induced road closures and their associated effects on visitors. The expansion of the Wolfe Ranch / Delicate Arch parking area has accommodated higher levels of visitor use, increasing the number of people potentially affected by flooding-induced road closures. The preferred alternative [Alternative 2] would decrease the adverse impacts of past, present, and future actions by improving the conveyance of water and sediment under the road and reducing the number of flooding-induced road closures. While the preferred alternative [Alternative 2] may result in direct, adverse impacts to visitor experience, particularly the visual and noise impacts associated with construction activities, these impacts would be minor, localized and short-term, affecting only those visitors at the Wolfe Ranch/Delicate Arch parking area or along the Delicate Arch trail during the months of construction. Therefore, considering the impacts to visitor experience from Alternative 2 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is beneficial but of unknown duration.

WILDERNESS CHARACTER

Affected Environment

The 1964 Wilderness Act mandates the preservation of wilderness character and the National Park Service uses the interagency wilderness character framework *Keeping It Wild* (Landres et al. 2008) and *Keeping It Wild 2* (Landres et al. 2015) to assess the impacts of proposed management alternatives on wilderness character. This framework describes wilderness character as "the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands. These ideals combine to form a complex and subtle set of relationships among the land, its management, its users, and the meanings people associate with wilderness."

Arches National Park preserves 76,679 acres of high desert on the Colorado Plateau in the canyon country of southeastern Utah. The park was first established as a national monument in 1929, and later became a national park in 1971. In 1974, 39,690 acres of the park were recommended to Congress for wilderness designation with 28,560 acres of potential wilderness addition. Since that time, the expiration of mineral leases, acquisition of former private lands, designation of the Wolfe Ranch National Historic District, changes in the road system, and the addition of Lost Spring Canyon in 1998, has nearly doubled the total acreage of the Arches wilderness recommendation. The current recommended wilderness is more or less defined by park roads. The wilderness boundary is set back 300 feet from the centerlines of major roads and 150 feet from the centerlines of other roads, except where topographical features proved more logical boundaries. The total acreage for recommended wilderness is 73,310 acres; over 96% of the park's total area (Figure 11).

The proposed project to reduce flooding and road closures by improving natural conveyance in the three washes occurs almost completely in recommended wilderness except for the 300 foot buffer from Wolfe Ranch / Delicate Arch Viewpoint road. Wilderness character is currently degraded in the project site due to noise from visitors, non-native vegetation, and loss of natural processes within the washes.

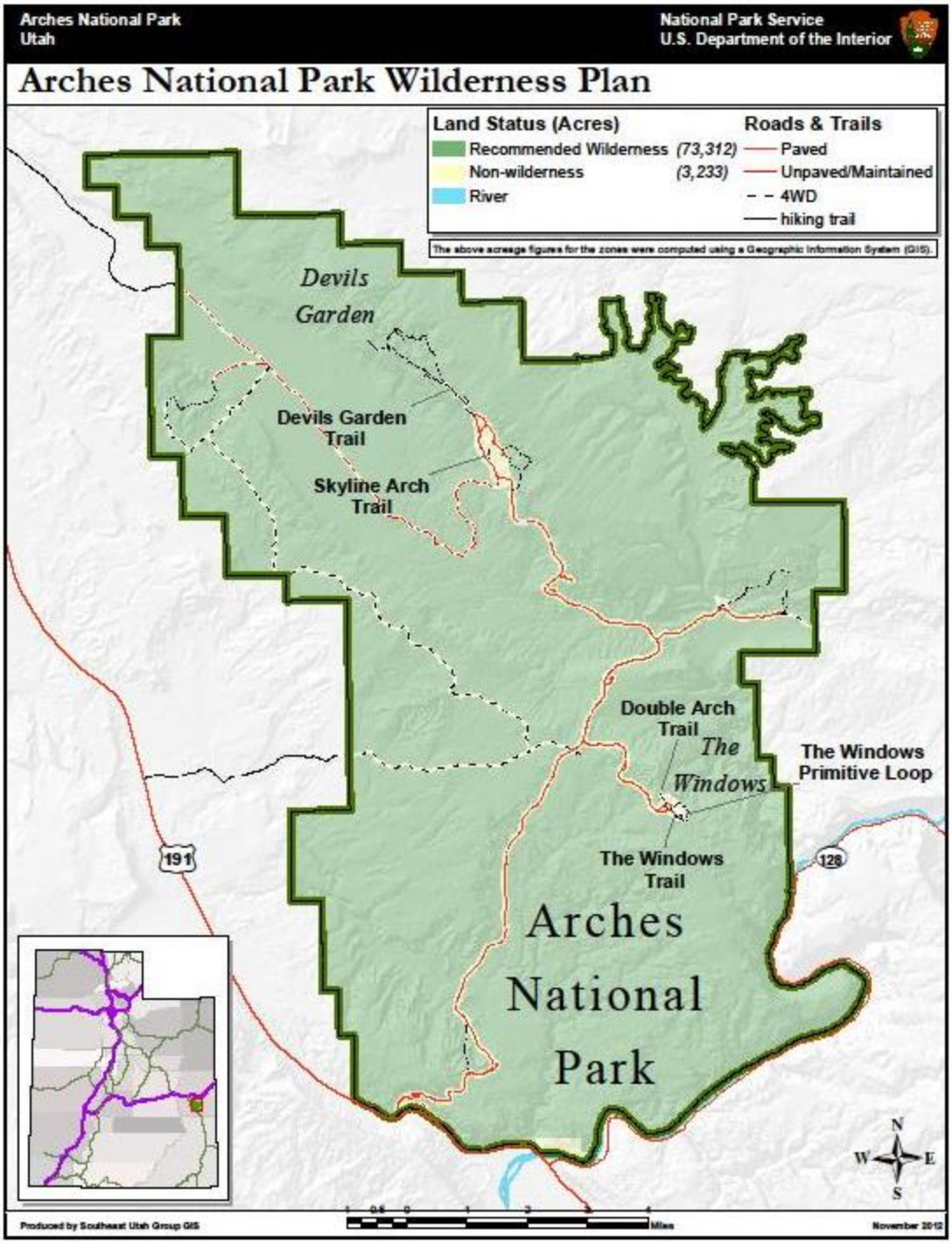

FIGURE 11. RECOMMENDED WILDERNESS FOR ARCHES NATIONAL PARK (OVER 96% OF TOTAL PARK AREA)

Wilderness Character Qualities. The five qualities that contribute to wilderness character are untrammeled, natural, undeveloped, opportunities for solitude or primitive and unconfined types of recreation, and other features of value. These qualities are summarized below from the 2013 Arches National Park Wilderness Building Blocks character narrative and report.

Untrammeled Quality. The *Wilderness Act* states that wilderness is "an area where the earth and its community of life are untrammeled by man" that "generally appears to have been affected primarily for the forces of nature." Therefore wilderness is essentially unhindered and free from the actions of modern human control or manipulation.

Native Americans have occupied and interacted with the landscape for more than 10,000 years. Throughout this time, people managed, manipulated, and co-adapted to their environment in order to maximize return on subsistence strategies such as hunting, horticulture, and agriculture. This traditional ecological knowledge was gained over thousands of years and resulted in the development of sustainable adaptive strategies that maximized the carrying capacity of the land. In more recent times, local ranchers drove cattle across the landscape, disrupting the native vegetation and soils, and contributing to erosion and exotic plant species introductions. Despite these historic and prehistoric environmental alterations, the modern Arches wilderness is largely unrestrained and unmanipulated. Whenever possible, natural processes are relied upon to maintain native plant and animal species. Wildlife populations range free within the boundaries of the wilderness. Waterways flow freely and vegetation prospers and succumbs to the fluctuations of drought and monsoon.

Actions that control or manipulate certain aspects of the environment within the wilderness often degrade the untrammeled quality but may be necessary for preserving other qualities of wilderness character. For example, the natural quality of the Courthouse Wash and Salt Wash corridors are compromised by the spread of exotic plants, including tamarisk. Other invasive plants threaten the wilderness's upland regions. Arches National Park's *Exotic Plant Management Plan* (NPS 2009) and grasslands restoration program both aim to restore natural habitat and protect native species, but the physical actions associated with the programs in wilderness temporarily degrade the untrammeled quality of wilderness.

Natural Quality. The *Wilderness Act* states that wilderness is "protected and managed so as to preserve its natural conditions." This quality aims to preserve native species, patterns, and ecological and evolutionary processes, and to understand and learn from natural systems. The natural quality is degraded by such things as the loss of native species and the alteration of ecological processes.

The natural quiet of the Arches wilderness belies the wealth of life within. Lush riparian areas, ephemeral pools, dry arroyos, mixed grasslands, and large expanses of bare rock support a surprising diversity of plants and animals. Biological soil crust occupies the area between desert vegetation. Although seemingly insignificant, this crust is essential to desert life. It stabilizes soil, reduces susceptibility to wind and water erosion, contributes to nutrient cycling, and consequently promotes plant life throughout the landscape.

Many anthropogenically-centered factors threaten the natural quality. Air, noise, and water pollution, the introduction of non-native species, and the alteration of ecological and other natural processes have a significant impact on natural resources.

Non-native plant infestations have altered the area's ecology, including tamarisk, which has significantly altered the environment within the project area. The establishment of tamarisk in the project area has contributed to sediment accumulation in the washes, which has resulted in a complete loss of a natural downstream gradient, degrading the natural processes of sediment and water transport.

Undeveloped Quality. The *Wilderness Act* defines wilderness as "an area of primeval character and influence, without permanent improvements or human habitation. . .where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable."

The imprint of modern man is evident but isolated within the boundaries of the Arches wilderness. Development is limited to resource protection, a natural gas pipeline right-of-way, scientific research, past historical uses, and signs and rock cairns, which are typically disguised to blend with the landscape and occur only in high traffic areas.

This quality is affected by what are commonly called section 4 (c) prohibited uses- the presence of structures and the use of motor vehicles, motorized equipment, or mechanical transport. Removal of structures and avoiding these prohibited uses preserves or improves this quality. For example, the use of motorized equipment, such as chainsaws, is necessary for the removal of particularly formidable exotic species; but these instances are generally localized and temporary and therefore have a minimal impact on the undeveloped quality of wilderness character. As well, motorized equipment and mechanical transport in the form of helicopters and wheeled litters are used regularly to facilitate emergency rescue operations.

Opportunities for Solitude or Primitive and Unconfined Recreation Quality. The *Wilderness Act* states that wilderness offers "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is primarily about the opportunity for people to experience wilderness, and is influenced by factors that affect these opportunities. It provides for primitive recreation, the use of traditional skills, personal challenge, risk, and self-discovery, and the freedom from constraints of modern life.

Over one million people visit Arches National Park every year. The majority of these visitors never set foot in the wilderness, but exposure to the sights and sounds of this spectacular landscape are nonetheless valuable. The park estimates the average visitor spends only 4-5 hours in the Park (NPS 1989 and RSG 2017). Most visitors are spending time in the front country at viewpoints, parking lots, and on congested trails. For the few who do immerse themselves in this remote and rugged environment, the Arches wilderness offers a variety of opportunities for solitude and self-discovery. Day hiking, rock climbing, and canyoneering are the most common activities in wilderness and a limited number of overnight permits are available in zones outside of the project area.

Wilderness managers can preserve or improve this quality by reducing visitor

encounters, signs of modern civilization, and facilities, and through management restrictions on visitor behavior.

Other Features of Value Quality. The *Wilderness Act* section 2 (c) (4) states that a wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." The fifth quality captures important elements or "features" of a particular wilderness that are not covered by the other four qualities. For Arches National Park, this includes geologic, paleontological, and cultural and historic resources.

Arches, fins, salt structures, balanced rocks, folds, and faults make up the Arches wilderness. The park contains the greatest concentration of natural rock arches anywhere in the world. As well, it is geographically situated in one of the most paleontological rich areas of North America, representing a thick sequence of terrestrial Mesozoic aged rocks from the "Age of Dinosaurs". Hundreds of fossils have been documented within and around the boundaries of the park.

People have been attracted to the region that is the Arches' wilderness for thousands of years. The earliest visitors were hunter-gatherers who migrated into the area about 12,000 years ago at the end of an Ice Age.

Arches National Park is characteristic of the Colorado Plateau ecosystems, providing valuable opportunities for scientific studies of natural and human systems in diverse landscape settings over long periods of time. Collaboration with external partners and engagement in scientific and scholarly activities help maintain Arches' significance in the context of shared landscape values, rapidly changing social and environmental conditions, and the uncertainty of the impacts of management decisions.

There are no known cultural resources within the project area. Collaboration with park cultural specialists will occur throughout all planning and project actions. Agency consultation is detailed in the Consultation and Coordination section.

Alternative 1- No Action- Continuation of Current Management Practices

Under Alternative 1 [No Action] the *natural* quality of wilderness character would continue to be degraded. Non-native vegetation combined with sediment accumulation in the washes would continue to alter the natural hydrologic processes within the wilderness. Flooding and associated road closures would continue.

Under this alternative the *untrammeled, undeveloped, opportunities for solitude and primitive and unconfined recreation,* and *other features of value* qualities would be preserved.

Cumulative Impacts. Past actions including removing low water crossings, paving the road, installing culverts, and performing minor wash excavations have contributed to sediment aggradation and the overall degradation of natural (hydrologic and geomorphologic) processes. These past actions when combined with impacts resulting from Alternative 1 [No Action] would likely lead to worsening degradations of natural (hydrologic and

geomorphologic) processes and an increase in non-native vegetation, which is outcompeting native vegetation across most of the project area. Tamarisk would continue to trap sediment within the washes, further hindering natural processes and adding to the degradation of the *natural* wilderness quality. Therefore, considering the impacts to wilderness character from Alternative 1 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is adverse and long-term.

Alternative 2- Proposed Action- Reduction of Flooding and Road Closures Through Wash Excavation (Salt Wash Project) (NPS Preferred Alternative)

Under Alternative 2 [preferred alternative] the *untrammeled* quality of wilderness character would be adversely impacted. Manipulation of the wash channels and removal of tamarisk by mechanical excavation in wilderness would temporarily degrade the untrammeled quality.

The *natural* quality of wilderness character would be improved. Non-native tamarisk has altered the area's ecology and degraded the natural quality in the project area. The presence of tamarisk combined with sediment accumulation in the washes has resulted in complete loss of a natural downstream gradient. Reestablishment of sediment and water transport within the wash channels through mechanical excavation and removal of tamarisk would improve the natural qualities.

The *undeveloped* quality of wilderness would be adversely impacted. The use of motorized machinery to excavate the wash channels and remove tamarisk during the project is a prohibited use in wilderness. Removal of the root structure and establishment of the natural wash channels without the use of mechanized equipment was determined to be infeasible through a minimum requirement analysis using the Minimum Requirement Decision Guide in accordance with the *Wilderness Act* and section 6.3.5. of NPS *Management Policies* 2006. Utilization of less obtrusive and non-prohibited tools would not achieve the desired restoration of natural quality and would over the long term require additional impacts to wilderness qualities in order to maintain the natural processes of the three washes. Temporary installation of silt fencing and/or erosion mats also degrades the undeveloped wilderness quality. The impacts would be short-term, and would last for the duration of construction over the two to three winters the project is to occur. The silt fencing and/or erosion mats would also be short-term, and would last for up to three years after the project work concludes.

The *opportunities for solitude or primitive and unconfined recreation* qualities of wilderness would be adversely impacted. During the project, mechanical activities in the washes would degrade the *opportunities for solitude or primitive and unconfined recreation.* The project area would be closed to the public, but noise and views of operations would be heard and seen by visitors in the wilderness. The impacts from project work would decrease as visitors move farther away from the project site into wilderness.

The *other features of value* quality of wilderness may be degraded or remain preserved. For cultural resources, surveys would be conducted prior to construction. Any cultural resources identified will be documented and evaluated for historical and/or traditional religious and cultural significance in consultation with the Utah SHPO and associated Indian Tribes. Any

effects to identified properties will be avoided through modification of project activities or the inclusion of conditions to avoid such effects.

Upon completion of project activities, impacts to wilderness character directly associated with these activities would cease; however, some activities would result in indirect impacts to wilderness qualities that would last over a longer period of time. After the completion of project work the reestablished channel washes and the sediment deposit sites would show traces of restoration activities that would at first degrade the *untrammeled* and *undeveloped* qualities. Eventually, with the reestablishment of hydrologic and geomorphologic processes, as the washes successfully move water and sediment downstream, and as vegetation returns, there would be improvements to the *untrammeled* and *undeveloped* qualities that would continue to improve from the "re-wilding" of the area (NPS 2004). The *natural* quality would benefit over time as natural processes reestablish. Minimal effects to the *other features of value* quality would be anticipated. There would be no change to cultural resources or changes to cultural resources management after construction activities.

Cumulative Impacts. Past actions as described in the No Action Alternative have contributed the overall degradation of natural (hydrologic and geomorphologic) processes. The preferred alternative [Alternative 2] would decrease the adverse impacts of past, present, and future actions by improving the conveyance of water and sediment under the road and removing or substantially reducing the cover of tamarisk, allowing a wider channel to establish and native vegetation to recolonize the project area. While the preferred alternative [Alternative 2] may result in direct, adverse impacts to the *untrammeled, natural, undeveloped,* and *opportunities for solitude and primitive and unconfined recreation* qualities of wilderness character, these impacts would be minor, localized and short-term, lasting only during the months of project work or for a temporary time after, once installations in wilderness have been removed. Therefore, considering the impacts to wilderness character from Alternative 2 in the context of other past, present, and reasonably foreseeable future actions, the overall cumulative effect is beneficial but of unknown duration.

CHAPTER 4- CONSULTATION AND COORDINATION

This chapter provides a detailed list of the various consultations initiated during the development of the environmental assessment.

LIST OF AGENCIES AND TRIBES CONSULTED

Agency consultation began early in the environmental assessment process to ensure that all relevant agencies are informed of any NPS planning actions. The following agencies and tribes have been consulted:

Agency Consultation

Utah State Historic Preservation Officer
Dead Horse Point State Park
City of Moab, Utah
Grand County, Utah
US Fish and Wildlife Service

Native American Consultation

Hopi Tribe
Kaibab Paiute Tribe
Las Vegas Paiute Tribe
Navajo Nation
Paiute Indian Tribe of Utah
Southern Ute Indian Tribe
Ute Indian Tribe
Ute Mountain Ute Tribe
Pueblo of Zuni

CHAPTER 5: ACRONYMS

American with Disabilities Act	(ADA)
Area of potential effects	(APE)
Code of Federal Regulations	(CFR)
Council on Environmental Quality	(CEQ)
Environmental Assessment	(EA)
Light Detection and Ranging	(LIDAR)
National Environmental Policy Act	(NEPA)
National Historic Preservation Act	(NHPA)
National Park Service	(NPS)
Natural Resources Conservation Service	(NRCS)
State Historic Preservation Office	(SHPO)

CHAPTER 6: REFERENCES

Ambrose, S., and C. Florian.
2009 Acoustic measurements in Arches National Park, Canyonlands National Park, Hovenweep National Monument, and Natural Bridges National Monument, 2000-2007. Report prepared by the Sandhill Company, Castle Valley, UT for the National Park Service Southeast Utah Group.

Ambrose, S. Personal communication. E-mail from Skip Ambrose, Sandhill Company, March
2017 17, 2017 to Randy Stanley, NPS.

Baker, Thann
2017 Archeological Inventory and Inadvertent Discovery Plan for the Salt Wash Rehabilitation Project (PEPC 70534) in Arches National Park, Grand County, Utah. In *Cultural Resources Inventory for the Salt Wash Rehabilitation Project, Arches National Park, Grand County, Utah* by Thann Baker and Clay Knudson, pp. C-1 – C-11. National Park Service, Southeast Utah Group, Moab.

Baker, Thann and Clay Knudson
2017 Cultural Resources Inventory for the Salt Wash Rehabilitation Project, Arches National Park, Grand County, Utah. National Park Service, Southeast Utah Group, Moab.

Bald and Golden Eagle Protection Act of 1940. 16 U.S.C. 668-668c; P.L 86-70,P.L. 87-884,P.L. 92-535,P.L. 95-616; 54 Stat. 250,73 Stat. 143,76 Stat. 1346,86 Stat. 1064,92 Stat. 3114. June 8, 1940.

Berry, Michael S.
1975 An Archaeological Survey of the Northeastern Portion of Arches National Park. Utah Division of State History, Antiquities Section Selected Papers 1(3), Salt Lake City, Utah.

Coles, J., A. Tendick, G. Manis, A. Wight, G. Wakefield, J. Von Loh, and A. Evenden
2009 Vegetation classification and mapping project report, Arches National Park. Natural Resource Technical Report NPS/NCPN/NRTR-2009/253. National Park Service, Fort Collins, Colorado.

Dewey, S. A. and K. A. Andersen
2005 An Inventory of Invasive Non-native Plants in Arches National Park (2003-2004) Final Report. Prepared for the National Park Service, Northern Colorado Plateau Network by Utah State University; Plants, Soils, and Biometeorology; Weed Science Research Project Report No. SD0510A, 31 pp. plus appendices.

Endangered Species Act of 1973, as amended. 16 USC 1531-1544; PL 93-205; Stat. L. 884. Approved December 28, 1973.

Executive Order 11990: *Protection of Wetlands.* May 24, 1977.

Executive Order 11988: *Floodplain Management.* May 24, 1977.

Federal Highway Administration
2006 FHWA Roadway Construction Noise Model User's Guide, DOT-VNTSC-FHWA-05-01. Final Report prepared by the U.S. Department of Transportation, Volpe Center for the Federal Highway Administration, January 2006. Accessible online at https://www.fhwa.dot.gov/environment/noise/construction_noise/rcnm/rcnm.pdf

Johnson, Todd
2012 Transportation Scholar Reports: Occupancy Averages for Parking Lots, 2000-2011 Arches National Park Entrance Station Data, Parking Duration and Occupancy at Secondary Parking Areas in Arches National Park. Arches National Park.

Joseph, Maureen
1997 Cultural Landscape Inventory: Wolfe Ranch Area, Arches National Park. Manuscript on file at Southeast Utah Group Headquarters, Moab, Utah.

Kunkel, K. E., T. R. Karl, D. R. Easterling, K. Redmond, J. Young, X. Yin, and P. Hennon
2013 Probable maximum precipitation and climate change, Geophysical Research Letters, 40, 1402–1408, doi:10.1002/grl.50334.

Landres, P., C. Barns, J.G. Dennis, T. Devine, P. Geissler, C.S. McCasland, L. Merigliano, J. Seastrand, and R. Swain
2008 Keeping It Wild: An interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. General Technical Report RMRS-GTR-212. USDA Forest Service Rocky Mountain Research Station, Fort Collins, CO.

Landres, P., C. Barns, S. Boutcher, P. Dratch, A. Lindholm, L. Merigliano, N. Roeper, and E. Simpson
2015 Keeping It Wild 2: An updated interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. October 2015. General Technical Report MRS-GTR-340. USDA Forest Service Rocky Mountain Research Station, Fort Collins, CO.

McDonald, James R.
1999 Wolfe Ranch Historic Structures Report, Arches National Park. Historic Research Associates, Inc. Manuscript on file at Southeast Utah Group Headquarters, Moab, Utah.

Melillo, Jerry M., Terese (T.C.) Richmond, and Gary W. Yohe, Eds.
2014 Climate Change Impacts in the United States: The Third National Climate Assessment. U.S. Global Change Research Program, 841 pp. doi:10.7930/J0Z31WJ2.

Migratory Bird Treaty Act of 1918. 16 U.S.C. §§ 703–712.

National Environmental Policy Act of 1969, as amended. 42 USC 4321 et seq.; PL 91-190, Sec.

2; 83 Stat. L. 852. January 1, 1970.

National Park Service, US Department of the Interior (NPS)
1989 *General Management Plan*, Arches National Park.
2002a National Park Service Director's Order 77-1: *Wetland Protection*. October 2002.
2002b Cultural Landscapes Inventory: Wolfe Ranch, Arches National Park. Manuscript on file at Southeast Utah Group Headquarters, Moab, Utah.
2003 National Park Service Director's Order 77-2: *Floodplain Management*. September 2003.
2004 National Wilderness Steering Committee. *What Constitutes Appropriate Conservation and Restoration Activities in Wilderness?* Guidance White Paper #2, http://www.wilderness.net/NPS.
2006 *Management Policies 2006*. National Park Service, Washington, D.C.
2009a *Southeast Utah Group Exotic Plant Management Plan*. 2009.
2009b Big Thicket National Preserve: *Acoustical Monitoring Snapshot*. May 2009.
2011 Director's Order 12: *Conservation Planning, Environmental Impact Analysis, and Decision-making*. Washington, DC.
2015a *National Park Service NEPA Handbook*. September 2015.
2015b *Technical Assistance Request 1096: Mitigate threats to native amphibian populations from exotic bullfrogs in Salt Wash and Courthouse Wash, Arches National Park*. Water Resources Division. March 2015.
2016 *Arches National Park Statistics*. Available online at: https://www.nps.gov/arch/learn/management/statistics.htm. Accessed February 9, 2017.

New York State Department of Environmental Conservation
2001 NYSDEC Program Policy: Assessing and Mitigating Noise Impacts, DEP-00-1, February 2, 2001. Accessible online at http://www.dec.ny.gov/docs/permits_ej_operations_pdf/noise2000.pdf

Protection of Historic Properties. 36 CFR Part 800. Final Rule December 12, 2000.

Reid, P. and S. Olson., Rapporteurs
2013 Protecting National Park Soundscapes, by National Academy of Engineering in cooperation with the National Park Service and Volpe Center. National Academies Press, Washington, D.C. Accessible online at: https://www.nap.edu/catalog/18336/protecting-national-park-soundscapes

Resource Systems Group, Inc. (RSG)
2017 Arches National Park Visitor Use Study: Summer, 2016. National Park Service, Fort Collins, Colorado. Report available upon request.

Robinson, Wright and Tim Higgs
2013 Effectiveness of Biocontrol with Tamarisk Beetles (*Diorhabda carinulata*). Powerpoint presentation to the Grand County Council. Accessible online at: http://www.grandcountyutah.net/DocumentCenter/Home/View/1670. Accessed September 12, 2017.

Stoffle, Richard, Evelyn Pickering, Katherine Brooks, Christopher Sittler, and Kathleen Van Vlack
2016 Ethnographic Overview and Assessment of Arches National Park. Prepared for the National Park Service, Project Number UAZDS-415 by the Bureau of Applied Research in Anthropology, School of Anthropology, University of Arizona, Tuscon, Arizona.

United States Department of Agriculture, Natural Resources Conservation Service (NRCS)
2010 Soil Survey of Arches National Park, Utah. Accessible online at http://soils.usda.gov/survey/printed_surveys/.

Utah Department of Agriculture and Food (UDAF)
2017 State of Utah Noxious Weed List. Available online at: https:// http://ag.utah.gov/divs-progs/50-plants-and-pests/hay-grain-seed/599-noxious-weed-list.html. Accessed September 12, 2017.

United States Fish and Wildlife Service (USFWS)
2002 Utah Field Office Guidelines for Raptor Protection from Human and Land Use Disturbances. U.S. Fish and Wildlife Service, Utah Field Office. January 2002.

Wilderness Act of 1964. 16 USC 1131–1136; PL 88-577; 78 Stat. L. 890. September 3, 1964.

APPENDIX A: VIEWSHED ANALYSIS

To better understand the impacts associated with alternative 2 (proposed action and preferred alternative) of the Salt Wash Rehabilitation Project Environmental Assessment, Arches National Park created a viewshed analysis from six sample locations on the Delicate Arch Trail and Delicate Arch Viewpoint Trail. The six sites illustrate what a visitor can see (the view) of the Area of Potential Effect (APE) where construction may be occurring.

Figures A-1 through A-6 highlight the view point location (1 through 6), and the view a person should be able to see shaded in color. Also identified on the maps are the trails, parking areas, and the APE.

From each location, a visitor can see at least part of the APE. The location with the greatest view of the APE is viewpoint 1, the closest location to the APE. The locations with the least views of the APE are viewpoint 4 and 5 on the Delicate Arch Viewpoint Trail. Viewpoint 6 is the farthest location on the Delicate Arch Trail from the Wolfe Ranch parking lot, and the view with the least amount of APE visible along the trail. In general, the farther a visitor is from the APE on the trails, the less they will see of construction activities occurring in the APE. The topography of the area changes along the trails and there may be other locations where the APE is completely blocked.

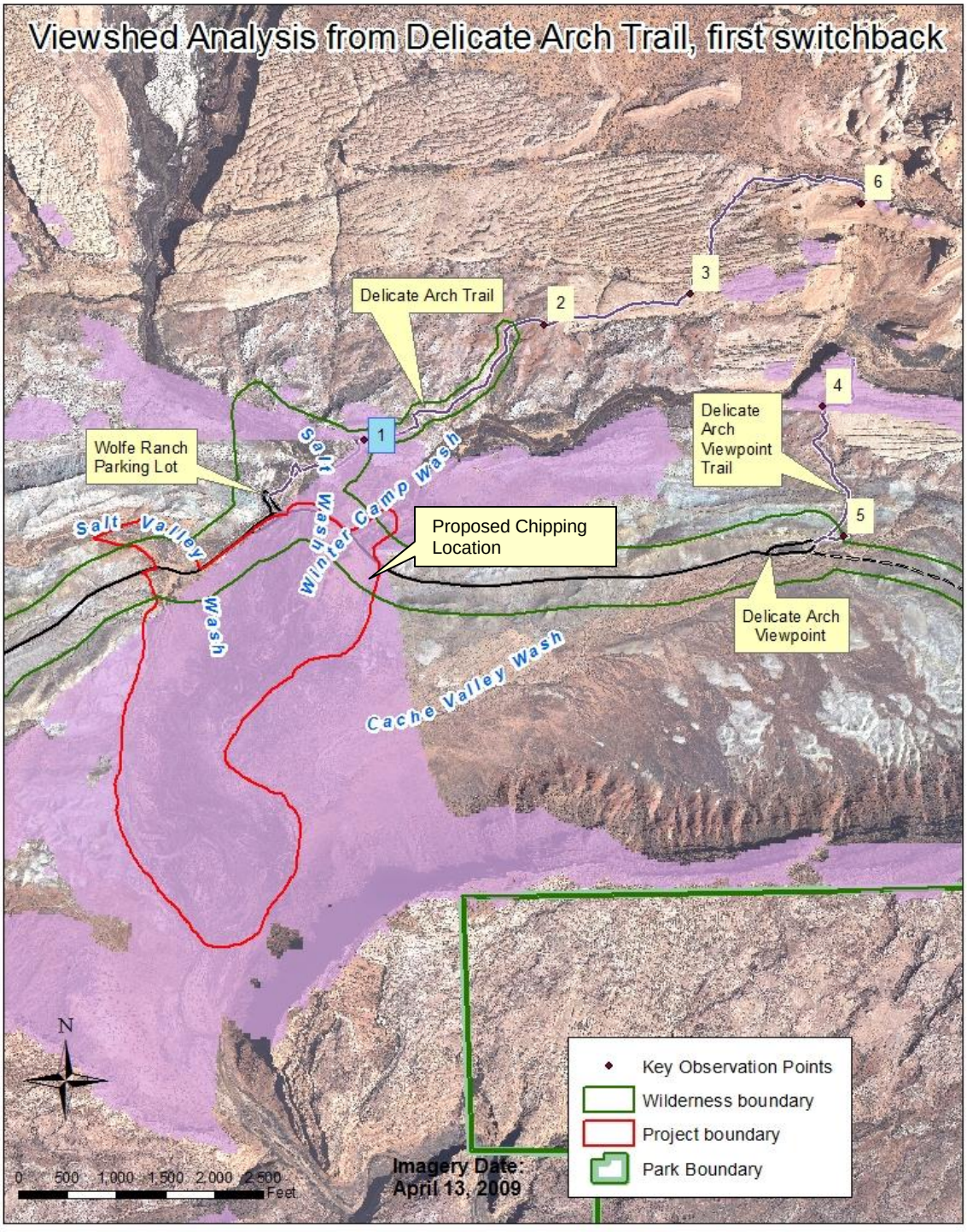

Figure A-1. Viewshed Analysis of Location 1. Location 1 is on the Delicate Arch Trail at the First Switch Back. Pink Shaded Area is the View From that Location.

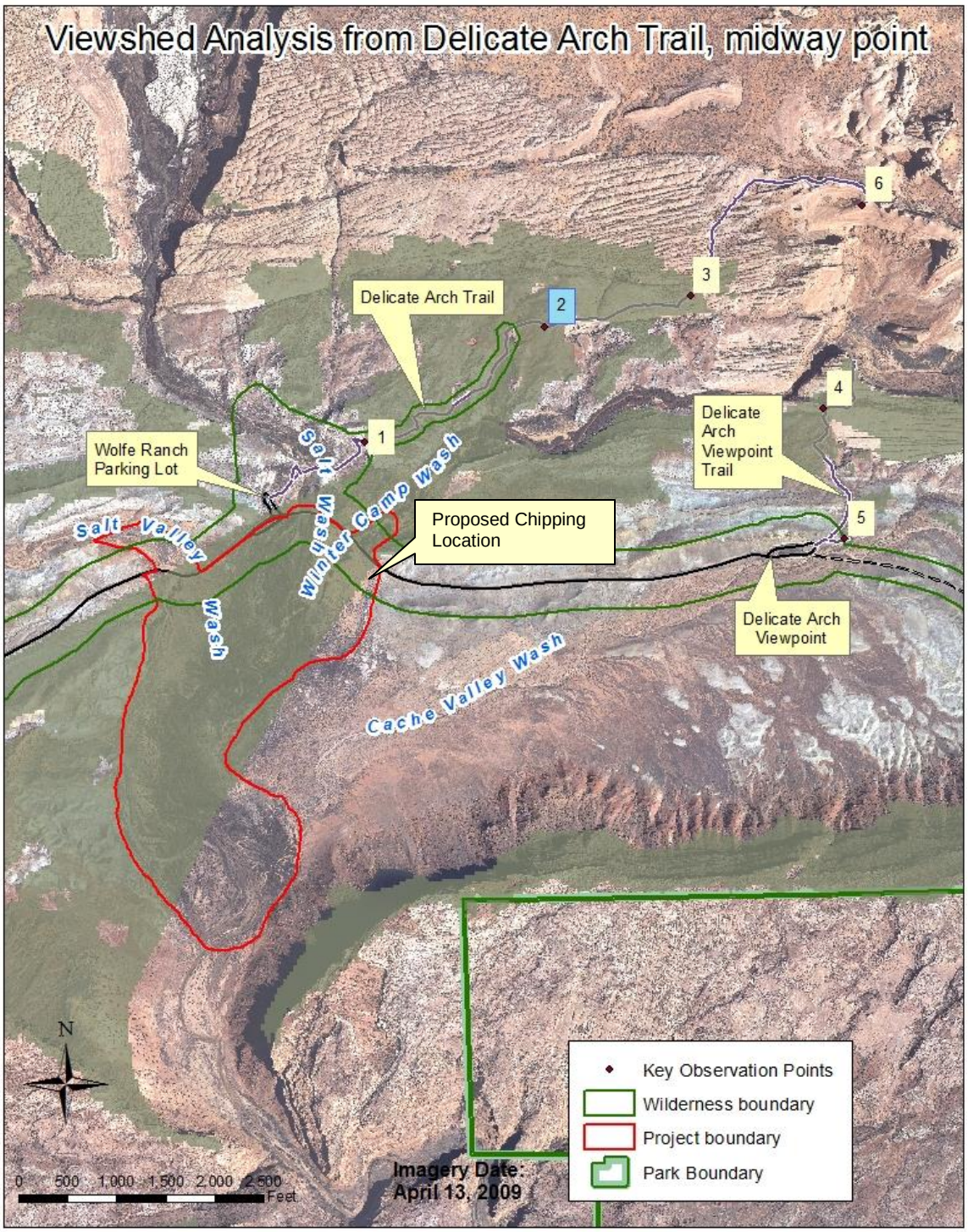

Figure A-2. Viewshed Analysis of Location 2. Location 2 is on the Delicate Arch Trail at the Midway Point. The Green Shaded Area is the View From that Location.

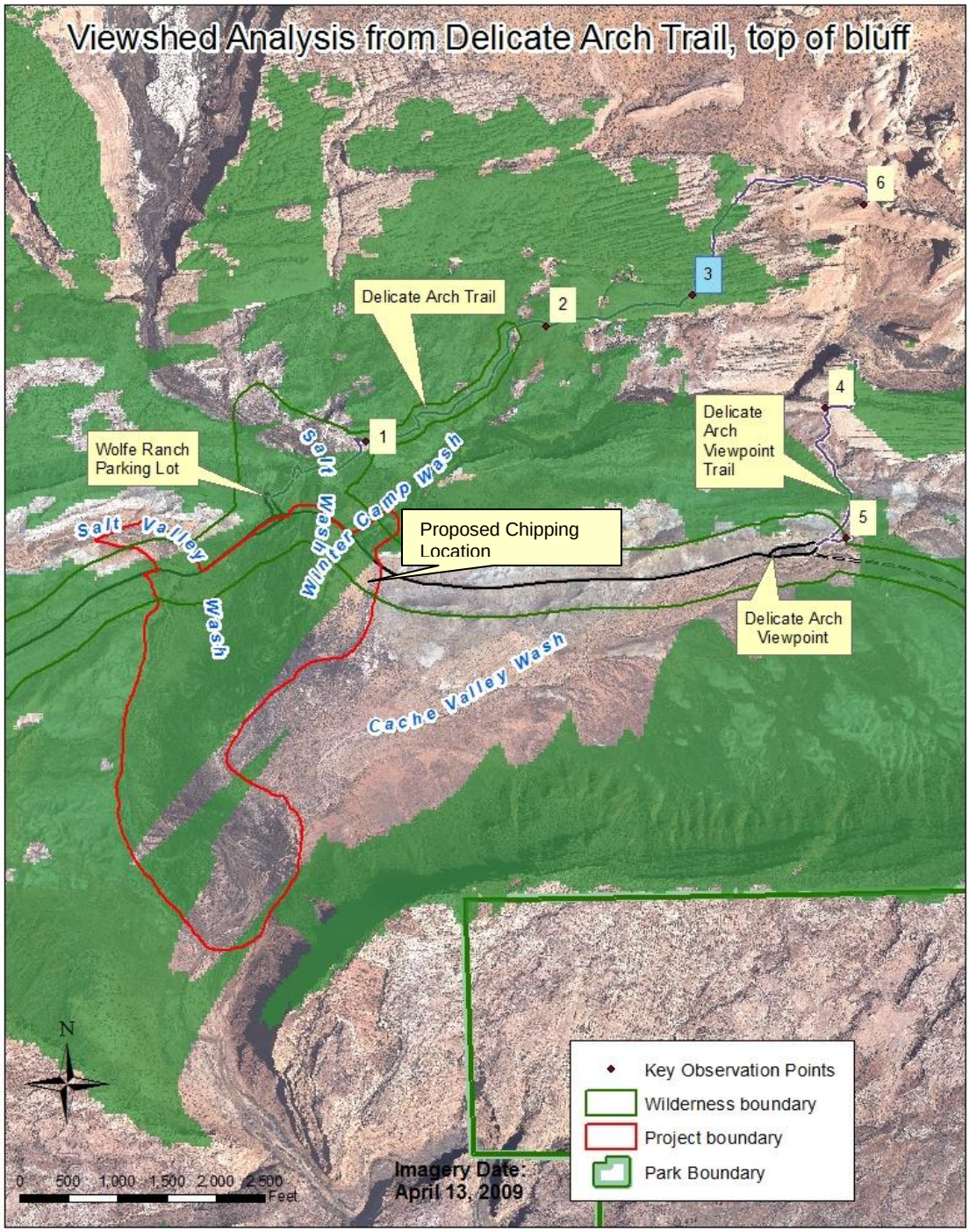

Figure A-3. Viewshed Analysis of Location 3. Location 3 is on the Delicate Arch Trail at the top of a bluff. The green shaded area is the view from that location.

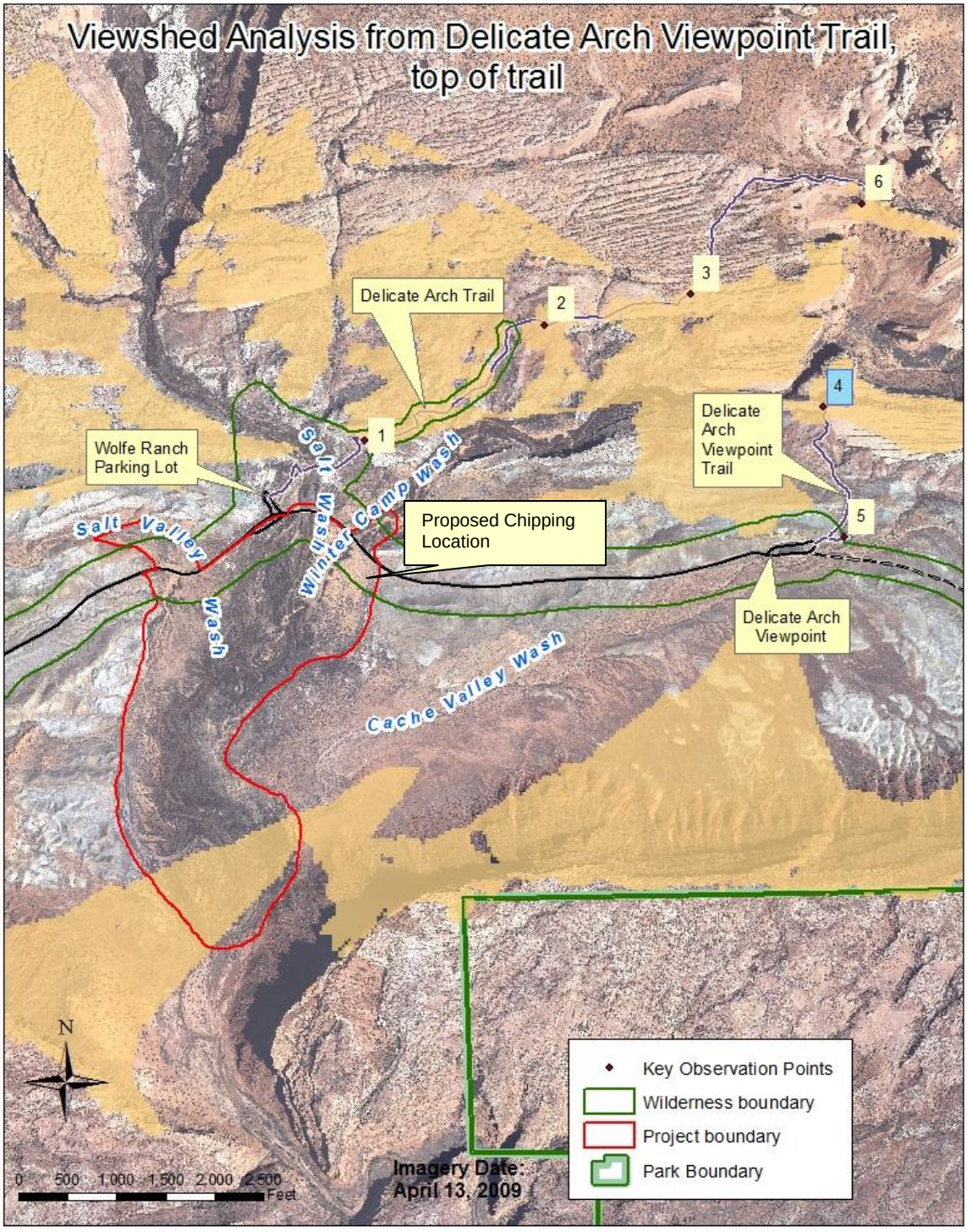

Figure A-4. Viewshed Analysis of Location 4. Location 4 is on the Delicate Arch Viewpoint Trail at theTop of the Trail. The Yellow Shaded Area is the View From that Location.

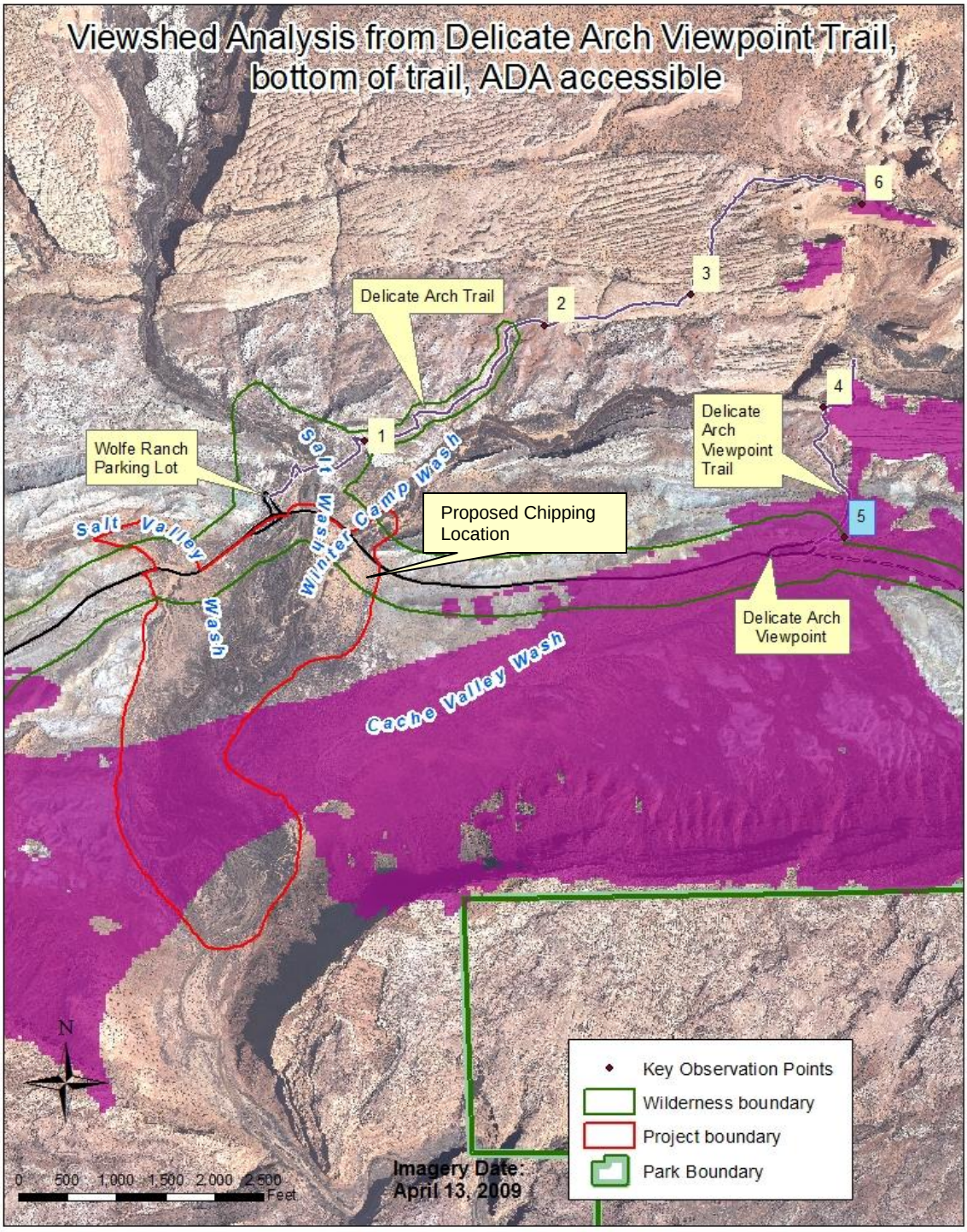

Figure A-5. Viewshed Analysis of Location 5. Location 5 is on the Delicate Arch Viewpoint Trail at the bottom of the trail. The purple shaded area is the view from that location.

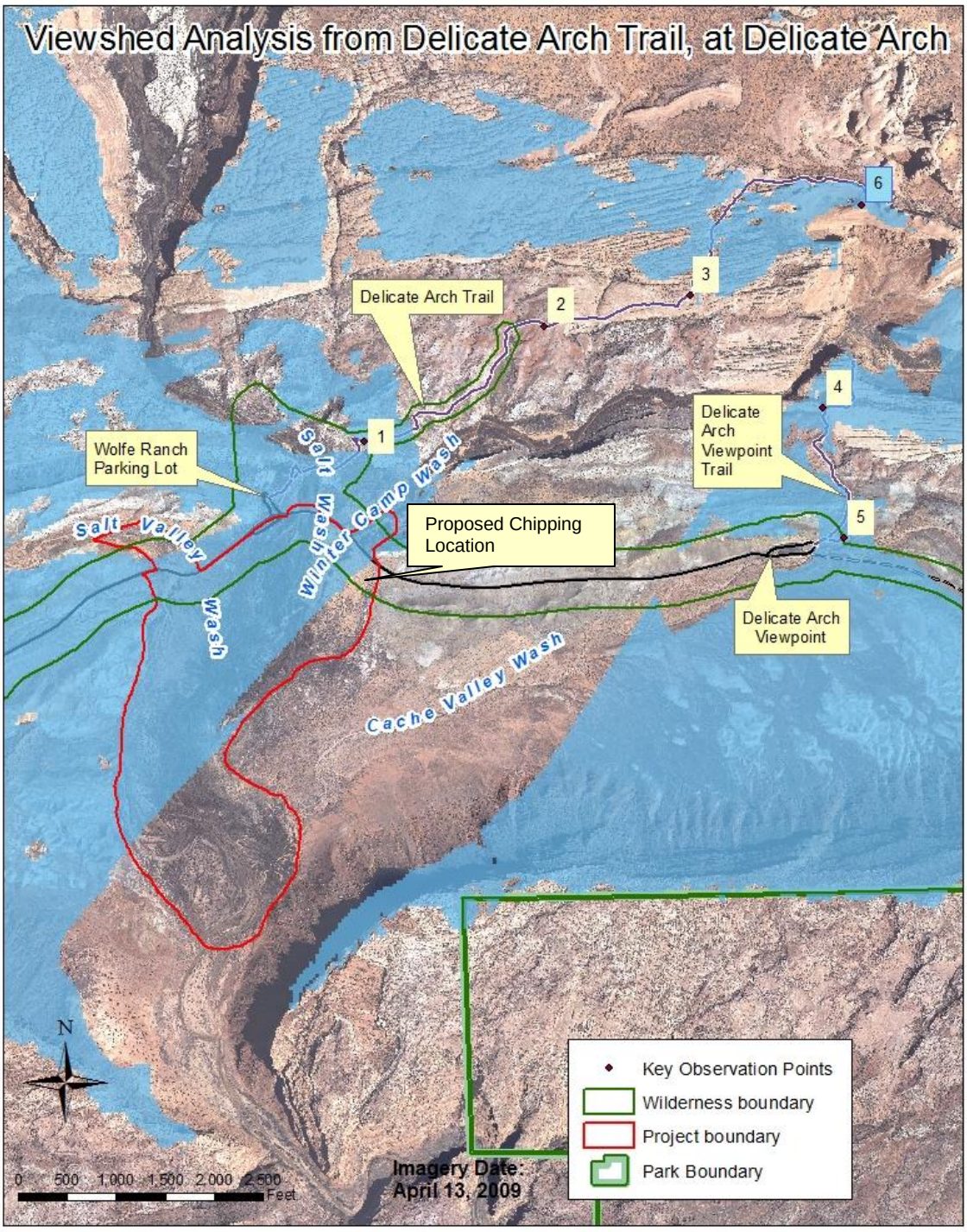

Figure A-6. Viewshed Analysis of Location 6. Location 6 is on the Delicate Arch Trail at Delicate Arch. The blue shaded area is the view from that location.

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering wise use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historic places, and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people. The department also promotes the goals of the Take Pride in America campaign by encouraging stewardship and citizen responsibility for the public lands and promoting citizen participation in their care. The department also has major responsibility for American Indian reservation communities and for people who live in island territories under US administration.

United States Department of the Interior – National Park Service