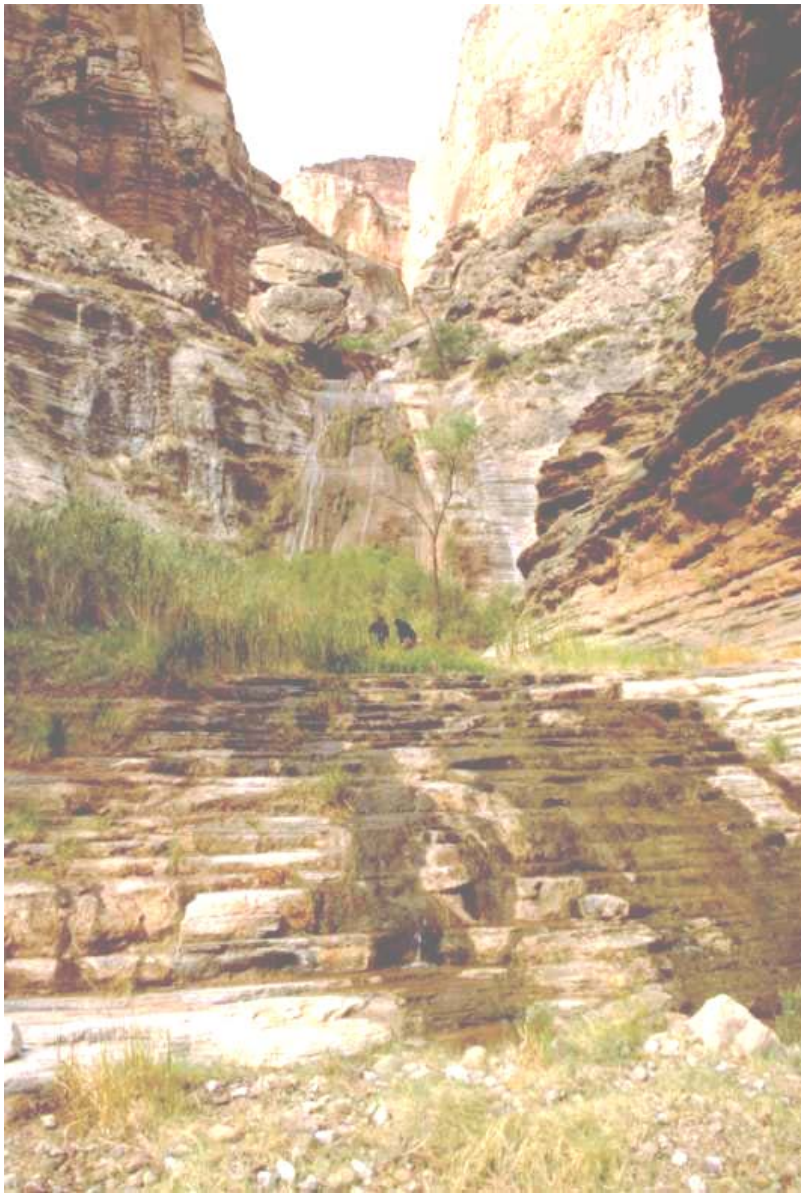
Environmental Assessment / Assessment of Effect

February 2002



Tamarisk Management and Tributary Restoration

Grand Canyon National Park • Arizona

Tamarisk Management and Tributary Restoration

Summary

Tamarisk (*Tamarix sp*.), commonly known as salt cedar, is an exotic (nonnative) shrub or tree that grows in dense stands along rivers and streams across the West. Tamarisk reached the Grand Canyon area during the late 1920s and early 1930s, becoming a dominant riparian zone species along the Colorado River in 1963 following completion of Glen Canyon Dam. These prolific nonnative shrubs displace native vegetation and animals, alter soil salinity, affect water quality and increase fire frequency. Once established in an area, it typically spreads and persists. Preliminary surveys conducted in 157 Grand Canyon National Park side canyons indicate that tamarisk is in the early stages of invading tributaries from the main river corridor. Arresting the tamarisk spread from the river into side canyons is desirable while control is still feasible. No action was considered as one alternative. One action alternative was considered. Alternative B includes the use of mechanical removal, lance injection of Garlon, hack and squirt method, cut stump method and basal bark application of Garlon herbicide. The environmental consequences of each of these alternatives were evaluated. The impacts to natural resources (soils and biotic communities, threatened and endangered species, vegetation, water quality and wetlands, and wildlife), cultural resources (ethnographic resources, traditional cultural properties, archaeological and historic resources and cultural landscapes), wilderness and visitor resources were analyzed.

Public Comment

If you wish to comment on the environmental assessment, you may mail comments to the name and address below. This environmental assessment will be on public review for 30 days; comments are due by April 1, 2002. Our practice is to make comments, including names and home addresses of respondents, available for public review during regular business hours. Individual respondents may request that we withhold their home address from the record, which we will honor to the extent allowable by law. There also may be circumstances in which we would withhold from the record a respondent's identity, as allowable by law. If you wish us to withhold your name and/or address, you must state this prominently at the beginning of your comment(s). We will make all submissions from organizations or businesses, and from individuals identifying themselves as representatives or officials of organizations or businesses, available for public inspection in their entirety.

Please Address Comments to:

Joseph F. Alston, Superintendent,

ATTN: Sara White, Compliance Officer

Grand Canyon National Park

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1. Purpose and Need

Introduction

This Environmental Assessment (EA) / Assessment of Effect (AEF) is prepared in accordance with regulations of the Council on Environmental Policy Act (CEQ) (40 CFR 1500 et seq.) and part 516 of the U.S. Department of the Interior's Departmental Manual (516 DM). The National Environmental Policy Act (NEPA) is the basic national charter for environmental protection; among other actions it calls for examination of impacts on components of effected ecosystems. Section 106 of the National Historic Preservation Act of 1966 (as amended through 2000) mandates that Federal agencies take into account the effects of their actions on properties listed or eligible for listing in the National Register. Grand Canyon National Park is using this EA / AEF to meet its obligations under Section 106, in accordance with the Advisory Council on Historic Preservation's regulations implementing Section 106 (36 CFR 800.8, *Coordination With the National Environmental Policy Act*).

This EA/AEF discloses the planning and decision-making process and potential environmental consequences of the alternatives. The analysis of environmental consequences was prepared to adequately understand the consequences of the impacts of the proposed action and to involve the public and other agencies in the decision-making process. In implementing this proposal, the NPS will comply with all applicable laws and executive orders.

Appropriate Federal, state, and local agencies have been contacted for input, review, and permitting in coordination with legislative and executive requirements.

Purpose and Need

The National Park Service (NPS) proposes to eradicate tamarisk in side canyons, tributaries, developed areas, and springs above the pre-dam water level in Grand Canyon National Park (GCNP). The purpose of the Tamarisk Management and Tributary Restoration project is to restore more natural conditions and prevent any further loss or degradation of the existing native biota in side canyons along the Colorado River within Grand Canyon National Park. A second purpose of this EA/AEF is to determine the appropriate minimum requirements for accomplishing this project in the park's proposed wilderness.

Tamarisk (*Tamarix sp.*), commonly known as salt cedar, is an exotic (nonnative) shrub or tree that grows in dense stands along rivers and streams in the West. Tamarisk, introduced to the U.S. in the 19th century as an erosion control agent, spread through the West and caused major changes to natural environments. Tamarisk reached the Grand Canyon area during the late 1920s and early 1930s, becoming a dominant riparian zone species along the Colorado River in 1963 following completion of Glen Canyon Dam. The impacts caused by tamarisk in the Southwest are well documented (See Reference Section). These prolific nonnative shrubs displace native vegetation and animals, alter soil salinity, and increase fire frequency. Salt cedar is an aggressive competitor, often developing monoculture stands and lowering water tables which can negatively affect wildlife and native vegetative communities (Duncan 1996). In many areas, it occupies previously open spaces and is adapted to a wide range of environmental conditions. Once established in an area, it typically spreads and persists.

Distinctive soil types, vegetation, and hydrologic conditions characterize riparian areas that provide biologically diverse and productive ecosystems. In the Southwest, riparian areas account for less than 2% of the land, yet over 65% of Southwestern wildlife depend on riparian habitats. Grand Canyon National Park contains some of the nation's remaining pristine desert riparian areas.

Preliminary surveys conducted in 157 Grand Canyon National Park side canyons indicate that tamarisk is in the early stages of invading tributaries from the main river corridor. Arresting the tamarisk spread from the river into side canyons is desirable while control is still feasible. This project would allow native vegetation to reestablish and regain dominant status without nonnative plant aggression. Follow up removal and monitoring of treated locations will help ensure native vegetation reestablishment. Tamarisk removal from park developed areas and rim locations would eliminate a potential seed source for further invasion and spread into the canyon.

Public scoping for this project was formally initiated on March 1, 2001 with the release of a press release and public scoping letter. The letter was sent to 325 individuals, agencies and organizations. The letter solicited the public's concerns, viewpoints, and comments regarding the planning and implementation of the proposed project. On March 5, 2001, a follow-up letter was sent to surrounding tribal governments. The summary of public comments is included in Appendix B – Public Scoping. The primary concerns and/or issues regarded the use of pesticides, the impacts of the project on wilderness and natural resources, employee safety, and impacts from follow-up monitoring and maintenance. All of the comments were taken into account during the development of alternatives and have been addressed in the project design.

Laws, National Park Service policies, regulations, and planning documents that call for and guide this project are listed in the Reference section.

Project Goals

- To restore and preserve natural conditions in side canyons along the Colorado River within Grand Canyon National Park by eradicating nonnative tamarisk.

- To protect wilderness character and value by implementing actions that have the least impact on wilderness resources and that accomplish project goals.

- To protect and preserve cultural resources by implementing actions that have the least impact on cultural resources and that accomplish project goals.

- To improve riparian community composition and structure, enhancing fish and wildlife habitat.

- To ensure employee and visitor safety during project implementation.

Project Objectives

The specific quantifiable objectives of this project are to:

- Reduce tamarisk cover by 95% within project areas in Grand Canyon National Park over the next five years.

- Detect a 5% change in total vegetative cover, with a 95% confidence interval, in all tamarisk removal sites within the next five years.

These objectives would be valid for Phases I and II of the project and would be re-evaluated prior to the initiation of Phase III of the project.

Overview

Beginning in fall, 2002 and continuing for five years, this project would use a combination of methods to control the tamarisk that are gradually increasing in side canyons. Management efforts would occur in side canyons, tributaries, and springs above the pre-dam water level. These areas, within proposed

wilderness, have been least impacted by human activities and have the most intact natural plant communities. Due to tamarisk dominance and abundance below pre-dam water level in the main corridor, the park will not focus control efforts there at this time. After control is complete in side canyons, the park may re-evaluate the potential for tamarisk control in the main corridor. While this project focuses primarily on inner-canyon tamarisk removal, control actions would also occur in rim developed areas. The NPS would evaluate the results of the project in five years.

Project Location

Grand Canyon National Park, designated a World Heritage Site because of its international value, is one of the most popular tourist destinations in America. It is located in the southwestern Untied States on the Colorado Plateau in Coconino and Mojave Counties, Arizona (Figure 1).

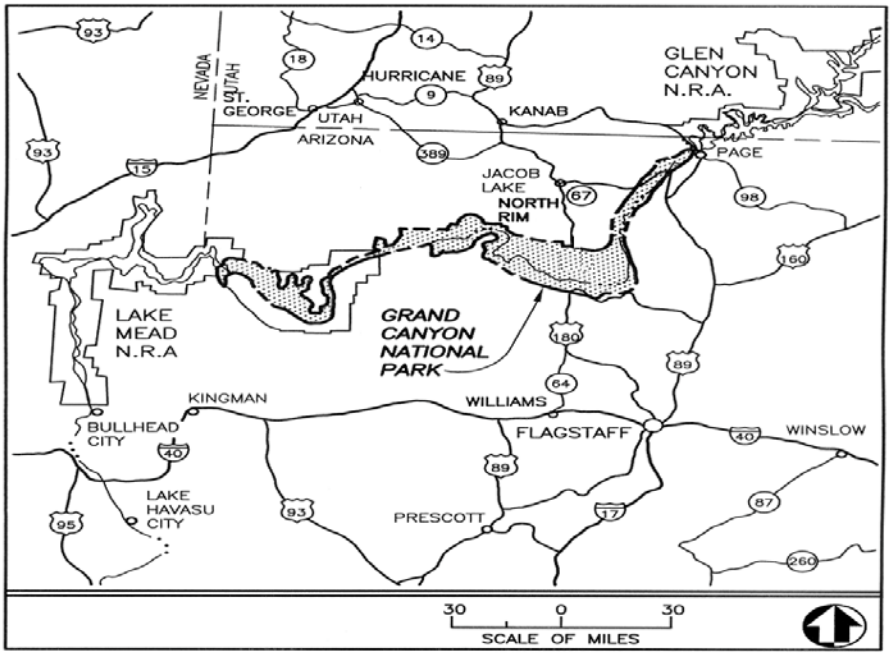

Figure 1. Grand Canyon National Park and Vicinity Map

Grand Canyon National Park encompasses 1,218,376 acres, which makes it one of the largest protected areas on the Colorado Plateau. The park is bounded on the north by the Kaibab National Forest and the Bureau of Land Management Arizona Strip District; on the east by the Navajo Reservation and Glen Canyon National Recreation Area; on the south by the Kaibab National Forest and the Hualapai and Havasupai Reservations; and on the west by the upper reaches of Lake Mead National Recreation Area.

Impact Topics Discussed

Grand Canyon National Park began surveying side canyons and tributaries for tamarisk in 1998. To date, surveys have been completed in 157 side canyons, tributaries and the South Rim Village area. Survey data determines the feasibility of tamarisk control in those areas and provides the public with an accurate representation of this project's scope. Park resource managers determined that the project would be feasible if implemented in a timely fashion. The formal project planning process was initiated

in 2000. An interdisciplinary team (IDT) was formed and met first on November 1, 2000. The IDT consists of Technical Area Specialists in biology, outdoor recreation, revegetation, exotic plant species management, hydrology, geology, archeology, botany, wilderness management, geographic information systems, and natural and cultural resource compliance. The IDT discussed issues and evaluated potential impacts.

The park initiated consultation with surrounding tribal governments on October 30, 2000. A letter soliciting tribal concerns about the proposed project was sent to eight tribal governments: Havasupai Tribe, Hopi Tribe, Hualapai Tribe, Kaibab Band of Paiute Indians, Navajo Nation, Pueblo of Zuni, Paiute Indian Tribe of Utah, and San Juan Southern Paiute Indians. Initial comments were received and incorporated into the planning process. On March 5, 2001, a follow-up letter was sent to the tribal governments including an invitation to meet on March 12, 2001. Follow-up phone calls were made to the tribes. The primary objectives of the meeting were to involve tribal representatives as part of the project interdisciplinary team and to determine concerns prior to drafting the EA/AEF. On April 17, 2001, a follow-up letter summarizing the March 12, 2001 meeting was sent to tribal governments.

Tribal representatives are supportive of this project. Many similar projects are underway on tribal lands, and tribes have offered their technical specialists to provide guidance on methods used for this project. The park aims to develop partnerships with tribal representatives throughout this project. The NPS would acquire annual permits to work on tribal lands, and would only implement the project on tribal lands with a tribal representative on site or with tribal consent.

On March 1, 2001 a press release and public scoping letter initiated public involvement according to NEPA requirements. Comments, issues and concerns identified by the public, park staff, and other agencies during the 30-day scoping process are included in this environmental analysis.

Once overall issues and concerns were identified, alternatives and mitigation measures were formulated. Impact topics were selected for detailed analysis based on substantive issues, environmental statues, regulations, executive orders, and NPS Management Policies, 2001. The following impact topics were selected for detailed analysis.

Natural Resources

The Federal and state Endangered Species Acts (and associated legislation), Clean Water Act, Clean Air Act, and National Environmental Policy Act require that any Federal undertaking examine effects on natural resources. In addition, National Park Service management policies and natural resource management guidelines call for natural resource consideration in planning proposals. Significant park natural resources exist and could be affected by implementation of an alternative. This project would occur over a large area with very diverse resources. The following natural resource topics will be analyzed in this document.

Soils and Biotic Communities

Soil compaction may occur during control efforts, primarily from human trampling. Access to certain sites may impact biotic communities (i.e. microbiotic soils). Potential erosion may result from control efforts. Tamarisk eradication would also alter soil qualities, primarily through removal of salt deposition caused by tamarisk trees. Proposed activities have potential to impact the soil resource; therefore, this topic will be analyzed further.

Threatened, Endangered and Sensitive Species

The U.S. Fish and Wildlife Service (USFWS) has determined that eight Federally or state listed proposed, threatened, or endangered plant species and 14 Federally listed proposed, threatened, or

endangered wildlife species may occur or have habitat in the Grand Canyon area, Coconino County. The full species lists are included in Chapter Three, Affected Environments. The proposed alternatives may have adverse or beneficial impacts to some of these species; therefore, this topic will be analyzed further.

Vegetation

There may be impacts to vegetation during control efforts, primarily from human trampling. Tamarisk eradication would also affect vegetation composition and structure in project areas. Garlon 3a and 4 should not affect non-target plant species, particularly since selective application methods would be used for tamarisk control. However, since proposed activities have potential to impact the overall vegetative communities in project areas, this topic will be analyzed further.

Water quality and Wetlands

The NPS seeks to restore, maintain, and enhance the quality of all park surface and ground waters consistent with the 1972 Federal Water Pollution Control Act, as amended, and other applicable Federal, state, and local laws and regulations. Soils, hydrology, and vegetation typical of a wetland environment classify jurisdictional wetlands. Executive Order 11990 requires Federal agencies to avoid impacts on wetlands where possible. Wetlands exist in or near the proposed project areas. There are potential positive benefits to water quality and wetlands from this project, such as increased surface flows following tamarisk eradication. The proposed project and control methods could also negatively affect water quality. Therefore, these topics will be analyzed further.

Wildlife

Many resident and migratory wildlife species inhabit the park, including 90 mammals, 290 birds, 60 reptiles and amphibians, and 25 fish. Common mammals occurring in riparian habitat and side canyons include: mule deer, bighorn sheep, beaver, coyotes, ringtails, spotted skunks, bats, and rodents. These species, as well as many others, depend on riparian habitats directly or indirectly for food, cover, and nesting. The proposed project could potentially disturb or displace wildlife. Although many of the animals in the project areas are habituated to some level of disturbance and human activity, this project could impact wildlife populations. Therefore, this topic will be analyzed further.

Cultural Resources

The NPS is mandated to preserve and protect cultural resources through the Organic Act of August 25, 1916 and through specific legislation such as the Antiquities Act of 1906, the National Environmental Policy Act of 1969 (as amended), the National Historic Preservation Act of 1966 (as amended through 2000), NPS Management Policies of 2001, the Cultural Resource Management Guideline (DO-28), and the Advisory Council on Historic Preservation's implementing regulations regarding "Protection of Historic Properties" (36 CFR 800).

Cultural resources include: ethnographic resources, Traditional Cultural Properties, archaeological and historical resources and cultural landscapes. These resources will be considered in this document to fulfill the park's legal responsibilities, as noted in the above paragraph. Further, previous research has illustrated that these types of resources do exist throughout the Canyon, therefore, they could have the potential to be affected by the proposed project.

Below are brief descriptions of the types of cultural resources that will be analyzed in this document:

Ethnographic resources

Are defined by the NPS as any "site, structure, object, landscape, or natural resource feature assigned traditional, legendary, religious, subsistence, or other significance in the cultural system of a group traditionally associated with it" (DO-28).

Traditional Cultural Property (TCP)

Is generally defined as one that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that (a) are rooted in that community's history, and (b) are important in maintaining the continuing cultural identity of the community.

Archaeological and Historical Resources

Are defined as any material remains or physical evidence of past human life or activities which are of archaeological or historical interest, including the record of the effects of human activities on the environment. They are capable of revealing scientific or humanistic information through archaeological or historical research.

Cultural Landscapes

Are defined as geographical areas, including both cultural and natural resources and the wildlife or domestic animals therein, associated with a historic event, activity, or person or exhibiting other cultural or aesthetic values.

Wilderness Resources

The NPS is mandated to preserve and protect wilderness resources through the Wilderness Act of 1964; Director's Order 41, Wilderness Management; NPS Management Policies, 2001; the GCNP General Management Plan, and the GCNP Resource Management Plan. Grand Canyon National Park contains of over one million acres (90% of the park) of primitive lands proposed for wilderness designation. According to NPS policy, these areas must be managed as wilderness. GCNP wilderness management seeks to provide outstanding opportunities for solitude or a primitive and unconfined type of recreation, and the opportunity for connection with the out-of-doors.

Wilderness

In addition to an absence of human-produced structures and roads, wilderness is also defined by its visual, audio and social characteristics. The Wilderness Minimum Requirement Analysis for this project is attached as Appendix C. The purpose of the analysis is to minimize impacts on wilderness character and resources. During the development of alternatives, wilderness was a primary consideration. Since most of this project will occur in proposed wilderness, this topic will be discussed further in this document.

Visitor Experience

The park's proposed wilderness offers visitors outstanding opportunities for solitude, inspiration, remoteness, experiencing natural conditions, and primitive recreation. Protection of the visitor experience is a high priority in all park management zones including wilderness. Proposed tamarisk

management efforts could impact park visitors; therefore, this topic will be analyzed further in this document.

Issue Topics Dismissed form Further Consideration

NPS specialists, public scoping, and other Federal, state, and local agencies identified issues and concerns regarding this project. Issues and concerns were grouped into distinct topics to facilitate analysis of environmental consequences. This distillation allows for a standardized comparison between alternatives. Topics were identified on the basis of Federal laws, regulations, and orders; NPS Management Policies, 2001; and NPS knowledge of limited or easily impacted resources. The rationale for dismissing specific topics from further consideration follows.

Air Quality

Clean Air Act, as amended (42 USC 7401 et seq.), provides direction for air quality. GCNP is designated a Class I area. Maximum allowable increases (increments) of sulfur dioxide (SO_2), particulate matter (TSP), and nitrogen oxides (No_x) beyond baseline concentrations established for Class I areas cannot be exceeded. The Act also sets a national goal to restore natural visibility to Class I areas. Section 118 of the Clean Air Act requires all Federal facilities to comply with existing Federal, state, and local air pollution control laws and regulations. This project would have negligible, if any, effects on park air quality. Therefore, this topic will not be analyzed.

Employee and Visitor Health and Safety

The NPS is concerned about public health and safety. Proposed actions would have negligible, if any, effects on the health or safety of park visitors. For more detailed information about the potential effects of Garlon 3a and Garlon 4 on humans, refer to USDA (1992) and SERA (1996). Both documents contain detailed analysis of toxicity, exposure, and reference dose for each of the products. The in depth analysis of the products contained in those documents reveal that the proposed use of these herbicides would result in negligible, if any, impacts to human health and safety. A safety plan, reviewed by the park's safety officer and approved by the Director of the Science Center, will be prepared for this project and include background information on the potential hazards during project implementation. The plan will also include detailed information on pesticide exposure, heat and cold related illnesses, lightning, flash floods, Africanized honeybees and animal bites. For each of these categories, detailed information, Standard Operating Procedures (SOPs), and safe operating procedures will be identified. Employees will be trained in the identification of Africanized honeybees and will provided with standardized procedures that would be followed should a nest be located in a project area. Procedures will also be established for evacuation of campsites along the river if Africanized honeybees are located. All applicable NPS SOPs for work in backcountry areas will be included in the safety plan. For all project implementation tasks, appropriate Job Hazard Analyses will be included. Each Job Hazard Analysis will be reviewed and approved by the Director of the Science Center. The complete safety plan would be reviewed with all workers prior to project implementation. These mitigation measures would ensure employee and visitor safety; therefore, this topic will not be analyzed.

Environmental Justice

Executive Order 12898, *General Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires all Federal agencies to incorporate environmental justice into their missions by identifying and addressing disproportionately high and adverse human health or environmental effects of their programs and policies on minorities and low-income populations and

communities. The proposed action would not have health or environmental effects on minorities or low-income populations or communities as defined in the Environmental Protection Agency's *Environmental Justice Guidance* (1998). Therefore, environmental justice will not be analyzed.

Floodplains

Executive Order 11988, Floodplain Management, requires an examination of impact to floodplains. The 2001 NPS Management Policies; Director's Order 2, Park Planning; Director's Order 12, Conservation Planning, Environmental Impact Analysis, and Decision Making; and the 1995 GCNP General Management Plan provide guidelines on developments proposed in floodplains. Executive Order 11988 requires all Federal agencies to avoid construction in the 100-year floodplain unless no other practical alternative exists. This project does not propose any construction, and there would be either no impacts or negligible impacts to park floodplains. Therefore, this topic was eliminated.

Geology and Topography

No major earthmoving or blasting activities are proposed that would impact the geologic processes or features or cause substantial alteration of topography. Therefore, this topic was eliminated.

Park Operations

Park operations would not be affected by this project. Therefore, this topic will not be analyzed as an impact.

Prime and Unique Farmlands

In August 1980, the Council on Environmental Quality (CEQ) directed that Federal agencies must assess the effects of their actions on farmland soils classified by the U.S. Department of Agriculture's Natural Resources Conservation Service (NRCS) as prime or unique. Prime or unique farmland is defined as soil that particularly produces general crops such as common foods, forage, fiber, and oil seed; unique farmland produces specialty crops such as fruits, vegetables, and nuts. According to NRCS, none of the soils in the project area are classified as prime and unique farmlands. Therefore, the topic of prime and unique farmlands was dismissed.

Socioeconomic Environment

The proposed action would neither change local and regional land use nor impact local businesses or other agencies. Due to the remote location, difficulty and regulation of access to project areas, impacts to other entities would not occur. Therefore, socioeconomic environment will not be addressed as an impact topic

Soundscape

The NPS is mandated by Director's Order 47 to articulate National Park Service operational policies that will require, to the fullest extent practicable, the protection, maintenance, or restoration of the natural soundscape resource in a condition unimpaired by inappropriate or excessive noise sources. Natural sounds are intrinsic elements of the environment that are often associated with parks and park purposes. They are inherent components of "the scenery and the natural and historic objects and the wildlife" protected by the NPS Organic Act. Natural sounds are vital to the natural functioning of many parks and may provide indicators of the health of various ecosystems. Intrusive sounds are of concern to the NPS because they sometimes impede the Service's ability to accomplish its mission. Motorized boats or equipment (e.g. chainsaws) would not be utilized for this project. This project would have negligible, if any, measurable effects on the soundscape. Therefore, this topic will not be analyzed.

2 . Alternatives Considered

Introduction

Grand Canyon National Park developed the following alternatives from key issues and objectives noted in Chapter One. The No Action Alternative evaluates the existing situation and trend and serves as a baseline for comparing the action alternative. This chapter describes one management alternative. Under CEQ guidance, reasonable alternatives are those "that are practical or feasible from the technical and economic standpoint and using common sense, rather than simply desirable from the standpoint of the applicant…" In developing alternatives, some actions were considered and dismissed; these are summarized at chapter's end.

Alternative A - No Action

Under this alternative no tamarisk control would be attempted. The present trend of increasing numbers, ages, and distribution of nonnative tamarisk will continue. This trend has been well-documented in riparian areas throughout the southwest. This alternative would not allow for the preservation of high quality desert riparian ecosystems found within the Park. Should the No Action alternative be selected, the NPS would respond to future needs and conditions associated with tamarisk control and tributary restoration without major actions or any changes. Grand Canyon National Park will thus violate Federal and state laws and policies regarding noxious plant removal.

Alternative B - Action / Preferred Alternative

The preferred alternative is the National Park Service preferred alternative (and is the proposed undertaking for §106 compliance) and defines the rationale for the action in terms of resource protection and management, visitor and operational use, costs, and other applicable factors. All actions described in the preferred alternative are consistent with the approved 1995 Grand Canyon National Park General Management Plan, related park documents, NPS guidelines and policies, and all other laws and regulations.

Under this alternative, a combination of methods would be used including mechanical, chemical, cultural (i.e. seeding), and several relatively new control methods. The method selected would be site specific and determined by the restoration biologist or project leader, i.e., adaptive. The majority of the saplings and mature trees would be left on site to decompose, providing wildlife habitat.

Manual Removal

Seedlings in washes, streambeds, and non-sensitive areas would be manually removed. In addition to hand pulling, leverage devices (weed wrenches™) would be used for slightly larger seedlings and saplings to ensure that the entire root system is removed. Hand tools, including picks, pulaskis, and shovels may be used to loosen the soil surrounding the larger plants and then the entire root system would be removed.

Garlon Lance Injection

The lance injector has proven highly effective in controlling woody plant species in Hawaii. The lance is a three- to four-foot long tool with four chambers. Small herbicide capsules (approximately ¾" long by ¼" in diameter) are placed inside the chambers, the lance is placed against the trunk of the tree, and as the top of the lance is pushed, the chamber opens and a capsule is inserted into the tree. The number

of capsules inserted into the tree is based on the trunk's diameter. The overall effectiveness of this method on tamarisk has not been determined, but is a method the park would use if proven effective. Direct herbicide injection into the tree would eliminate the possibility of chemical spillage. It would also be safer for the applicators since there is less likelihood of herbicide contact. This method would be used on large saplings and mature trees. Since the lance must be held at 45 degrees to the trunk, it would be difficult to use as the sole method in dense stands.

Hack and Squirt Method

With this method, a hatchet or tree girdler (similar to a small saw) is used to cut downward into the water-conducting tissue (phloem) of standing trees. The herbicide mixture is then directly applied into the cut with a hand-pressurized sprayer (and fine spray nozzle) or 12cc syringe. On larger trees, two or more cuts would be necessary. The cuts would be made at about one to two meters above the ground. This method would be used in areas with scattered individual mature trees; it would be difficult to use as the sole method in dense stands.

Cut Stump Method

Tree trunks are cut near ground level with handsaws and then stumps are sprayed with Garlon mixed with a penetrating agent (oil) or water. The mixture is absorbed by the plant's phloem and transported to the root; if the herbicide mixture is applied quickly (2-10 minutes), 90-95% control is possible. Pressurized hand or backpack sprayers allow precision herbicide application with minimum overspray or drift risk. This method would be used on a limited number of larger trees in dense stands and for smaller trees where manual removal would cause extensive soil disturbance.

Basal Bark Application

The entire stem is treated with Garlon from near ground level up for about 30-38 centimeters. The chemical is applied with a backpack sprayer or hand held pressurized sprayer, both of which have small nozzles with coarse spray settings that allow for direct spraying with minimal drift or overspray. A paintbrush may also be used for small sapling application. This method is much less labor intensive, but is less effective on mature trees and would be used for smaller saplings and some seedlings. It is effective on trees up to one year and three meters tall.

Under this alternative, native species restoration would be used in Phase III and in certain areas in Phase II, primarily in somewhat dense tamarisk stands.

The following specific measures would apply to all methods used in this alternative:

- Every attempt would be made to dispose of debris to minimize visual impact (i.e. off trail, out of the drainage).
- Empty herbicide capsules would be removed from trees in the year following treatment.
- Cut stumps would be hidden from view to the extent possible.
- Soil would be tamped where manual removal is used to help minimize establishment of other invasive exotic species and to minimize visual impact.
- When the hack and squirt method is used, tree cuts would be made on tree sides least visible to backcountry users.
- If pruning is necessary, a minimal number of branches would be cut to minimize visual impact.

Items Applicable to Action Alternative

Herbicide Use Approval

The NPS maintains strict control over pesticide use on national park lands. NPS Management Policies state that "proposed pest management activities must be conducted according to the IPM process prescribed in Director's Order #77-7: Integrated Pest Management. Integrated Pest Management is defined as "a decision-making process that coordinates knowledge of pest biology, the environment, and available technology to prevent unacceptable levels of pest damage, by cost-effective means, while posing the least possible risk to people, resources, and the environment." The pesticide use approval process requires that each park request permission to use pesticides; these requests must be renewed annually. The Colorado Plateau Cluster IPM coordinator approves or denies pesticide use per project based on established NPS guidelines. A pesticide use approval form for Garlon (triclopyr) for park tamarisk control was submitted April 24, 2001 and approved May 10, 2001. The park is required to keep accurate records about the amount of chemical used and the total acreage to which it is applied. Computerized records are submitted to the regional office on an annual basis.

Herbicide Mixture

Extensive research has shown that the following Garlon mixtures provide successful tamarisk control: Garlon 4 mixed with 25% JLB Oil Plus (Brewer International, which is a 100% blend of natural vegetable oils plus limonene penetrant) or Garlon 3A combined in a 50% water mixture. Garlon 3A would be used on trees near standing water. These mixtures would be used under all action alternatives. Neither of these herbicide mixtures would be applied directly to standing water. See Appendix D, Garlon 3A and Garlon 4.

Project Participants

NPS staff would lead all eradication efforts on site during implementation. In keeping with wilderness management practices, participants would be kept to the minimum necessary to accomplish project objectives. It is anticipated that four boats and 12-16 participants would be the minimum necessary for each river trip. This includes 3 boatmen, 1 cook, 1 trip leader/ boatman, 2 project leaders, 1 archaeologist, 1 wildlife biologist, and 3 to 7 work members. Specialists, including the boatmen and cook, would also be available as work crew members. The maximum number of trip participants would be 16 and would include additional specialists and tribal representatives that would also serve as workers.

Project Implementation

The project would begin in spring or fall of 2002 and continue for five years. Three project phases, developed from preliminary tamarisk surveys begun by the NPS in 1998, are detailed in Tables 1-3, Project Implementation Phase Tables (Appendix A).

During the surveys, tamarisk were divided into the following categories to determine project logistics and feasibility:

- **Seedling** Newly emerged plants up to 1 meter tall
- **Sapling** Less than 5cm diameter at the base of the trunk

- **Mature** Greater than 5cm diameter at the base of the trunk or with multiple branching at the base of the trunk

Project Monitoring

A long-term monitoring system, including vegetation transects and photo points, would be installed to monitor vegetative change over time. Vegetation transects would also provide baseline data for project areas. A monitoring plan has been prepared for Phase I of this project and the plan will be expanded to include Phase II and III project locations. For Phase I, transect data will be collected in at least 25% (16 tributaries) of the project area, which should provide an adequate measure of change in vegetation cover percentages. The location selection process was randomly done and the tributaries were stratified based on initial survey data. The stratification was to ensure that an adequate sample of canyons with greater then 50 tamarisk and less than or equal to 50 tamarisk was represented in the overall design.

Line transects with the point intercept method will be used to measure vegetation cover. The transects are 50 meters long, with a point read every 0.5 meters. A total of 100 hits will be recorded for each transect. Transects would be read every year for two years following eradication, and then every other year for a minimum of 10 years. Global Positioning System (GPS) unit will be used to locate the start and end points of each transect, and photographs will be taken from both points. Photopoints will also be installed in all of the project areas and a GPS reading will be taken from each photopoint. Several views will be taken from each photopoint. A map of all photopoint and transect locations will be produced. Data will be analyzed to determine project success.

Follow-up Maintenance

Follow-up maintenance would be necessary to ensure project success. Maintenance would primarily involve manually pulling seedlings. Re-treating some saplings and mature trees with Garlon may be necessary. Based on other tamarisk management projects in the southwest, an average of 15% of the sapling and mature trees would need to be re-treated.

Additional General Mitigation Measures Applicable to Preferred Alternative

Cultural Resources

Should presently unidentified archeological resources be discovered during project implementation, work in that location would stop until the resources are properly recorded by an NPS archeologist and evaluated under National Register of Historic Places eligibility criteria in consultation with the Arizona State Historic Preservation Officer (SHPO) and tribes as appropriate. If the resources are determined eligible, appropriate measures would be implemented either to avoid resource impacts or to mitigate disturbance. In compliance with the Native American Graves Protection and Repatriation Act of 1990 (NAGPRA), the NPS would also notify and consult affiliated tribal representatives for proper treatment of human remains, funerary and sacred objects should these be discovered. All workers would be informed of penalties for illegally collecting artifacts or intentionally damaging any archaeological or historic property in the vicinity. To the extent possible, a park archeologist would be on site during project implementation. In addition, tribal representatives would be invited to coordinate project implementation in locations of concern. Tribal members are participants on the project's interdisciplinary team (IDT). Therefore tribal consultation has been, and will continue to be, performed throughout the implementation and development of this program.

Education

Park staff would develop a site bulletin on project objectives and methods. Bulletins will be made available to affected backcountry users, including boaters and hikers. Postings could also be made on electronic discussion databases and the Park's web page.

Exotic Vegetation and Noxious Weeds

During project implementation, additional invasive plant species would be mapped with a GPS unit, and the park's Restoration Biologist would be notified. If exotic plant species are found in project areas, all workers clothing and footwear and all tools and equipment will be cleaned at the project site to ensure that seeds or propagules are not transported to new locations.

Herbicide Application and Employee Safety

Garlon is a general use herbicide, and pesticide certification is not required for application. However, the park has adopted the policy of having trained and certified applicators on site during projects involving herbicides. At least one person per project location would be a certified applicator. Additional project personnel may apply the product under the certified applicator's supervision. Arizona State pesticide application certification, including herbicide training and safety, is renewed annually. All project participants would receive herbicide training from the project leader. Project participants would understand and abide by the established Personal Protective Equipment (PPE) requirements and rules outlined in the safety plan. Rubber gloves, long sleeve shirts, and goggles are part of the PPE necessary for this project. A job hazard analysis (JHA) for exotic plant removal and herbicide application has already been prepared and would be reviewed with all project participants.

All information and instructions on the herbicide label would be strictly followed. All herbicide containers would show the product label and would be leak- and spill resistant. All application equipment and chemicals would be stored in sealed ammunition cans or large silver boxes during transport on rafts, and all storage containers would have the product's specimen label and the Material Safety Data Sheet (MSDS) clearly displayed underneath a waterproof plastic sheet. The MSDS contains fire and explosive hazard data, environmental and disposal information, health hazard data, handling precautions, and first aid information. All trip participants would review the MSDS with the project leader and understand first aid instructions described on the MSDS. A hazardous material (haz-mat) and safety plan would be developed and reviewed by the Park's environmental protection specialist and safety officer and approved by the Director of the Science Center prior to project implementation. All herbicide and application equipment would be stored separately from food and personal items. Additional ammunition cans for disposal of used PPE (such as gloves, goggles, etc.) and herbicide containers would be included.

According to Arizona's Department of Environmental Quality (ADEQ), Crystal Creek and Chuar Creek are listed as exceeding state surface water quality standards for arsenic and are designated as impaired on the 303(d) list. Rubber boots and any additional PPE proposed by ADEQ would be required for project participants working in these areas.

Leave No Trace Procedures

All project participants would receive instruction on *Leave No Trace* procedures before working in the park's proposed wilderness. These procedures would apply to camping etiquette and project implementation. See Appendix C.

Native Plant Restoration

Active native species restoration may be used in project areas listed in Phase III and some project areas listed in Phase II (refer to Appendix A - Project Implementation Phase Tables). Restoration would occur immediately after or within one year of herbicide treatment. All restoration efforts would use site-adapted native seed and/or plants. Restoration would seek to restore the natural conditions prior to tamarisk arrival and to prevent tamarisk re-invasion. Active restoration would include the collection of seed and/or cuttings from native plants in the project area. Any seed spreading or planting of cuttings would seek to replicate the composition and structure of the native plant communities. Extensive monitoring and maintenance would be conducted in these areas to ensure project success.

Soil Compaction and Biotic Community Disturbance

To minimize soil compaction, the following mitigation measures would be incorporated into all action alternatives:

- The minimum number of workers necessary to complete the work would be used.
- The project leader would determine the access route that would cause minimal disturbance to sensitive soils and vegetation. Access to areas would use existing game and hiking trails wherever possible. If no trails exist, the project leader would determine whether single or multiple paths would be used to access the project site.
- The minimum number of trips to sensitive areas would be conducted for follow-up maintenance and monitoring.

Special Status Species

The following mitigation measures would be incorporated into all action alternatives:

The proposed project would include provisions for the discovery of previously unknown or undiscovered threatened, endangered, or special status species. These provisions require the cessation of project activities until park staff evaluates the project impact on the discovery and conducts additional Section 7 consultation with the U.S. Fish and Wildlife Service.

All project participants would be informed about special status species and what actions should occur if a special status species is encountered.

To the extent possible, a wildlife biologist and botanist would be on site during project implementation.

Tool Safety

All project participants would receive tool safety training and would be required to use the appropriate PPE for each assigned task. The tools would be kept in appropriate storage locations at all times.

Transportation

From a practical standpoint, the majority of project locations are accessible only from the Colorado River. Oar-powered rafts (14-foot minimum) would be the sole transportation to project sites. The use of mechanized vehicles is not necessary to accomplish project objectives (Refer to Appendix C, Wilderness Minimum Requirement Analysis).

Visitor Experience

To minimize visitor experience impacts, a project schedule would be provided to all river groups that launch during the project timeframe. The schedule would alert visitors to the potential of encountering work groups, and allow visitors to avoid contact. The project schedule would also be provided to backpackers through the park's backcountry office and Park web site. During project implementation, to the greatest extent possible, less desirable campsites would be used to minimize contact with other backcountry users. In some situations, campsites may have to be shared with other user groups; however, visitors would have had the opportunity to avoid this by using the provided schedule. NPS staff would provide educational and informational messages to any groups encountered during project implementation. A project "Site Bulletin" would be developed and could be provided to interested parties.

Water Quality

To minimize potential impacts to water quality, best management practices (BMP) would be used to minimize any potential sediment delivery to streams. BMPs include minimizing impacts to steep slopes by leaving standing vegetation on steep slopes or placing cut branches on steep slopes; using the minimum number of workers in areas with steep slopes or fragile soils; and applying native grass seed to steep slopes to help stabilize soils. Herbicide application would not affect turbidity; however, workers in the project areas may. According to the Arizona Department of Environmental Quality, Havasu Creek is currently listed as exceeding turbidity standards.

White Water Rafting Safety Training

All project participants would receive standard NPS white-water personal safety training, and would be provided with and required to use Personal Flotation Devices (PFD) at all times while on boats.

Wilderness

A Minimum Requirement Analysis has been prepared and is included as Appendix C. This analysis would guide actions and alternatives selected for project implementation. The implementation would be using the minimum tool and the mitigation measures described in this section (i.e. education, Leave No Trace, restoration, disbursement of project schedules) to ensure conditions and values inherent in wilderness are maintained or enhanced.

Wildlife

The proposed project would be conducted outside of breeding seasons for the majority of park wildlife species in order to minimize impacts on productivity. Foot traffic (which can cause erosion, vegetation trampling, soil compaction, and be harmful to small animals, such as amphibians found in tributary habitats) in the removal areas would be kept to a minimum by only using the minimum number of people necessary for the removal work and by keeping their trips to a minimum. Under the preferred alternative, traffic would be less because trees are left in place and do not have to be removed from the drainages. This would also increase habitat for small mammals and cavity dwelling birds and bats.

Alternatives Considered, but Dismissed

Fire

The use of fire to control tamarisk has been repeatedly found to be ineffective when used as the sole control method. Tamarisk shows a remarkable ability to recover from this activity and it is a fire-adapted

species. Fire used with follow up herbicide application has proven effective in many areas with dense stands. The majority of tamarisk in Phases I and II is not found in dense thickets, but as scattered individuals with some randomly dispersed dense populations. Controlled burning would not be effective for this distribution and was not considered as an option. The tamarisk populations in Phase III are composed of some dense thickets; however, the proposed methods would provide control without the cost and safety factors associated with controlled burns in remote tributaries and side canyons.

Cutting without Herbicide Application

Cutting large tamarisk trees without herbicide application has proven ineffective. Tamarisk shows a remarkable ability to recover from this technique. Extensive long-term follow up would be necessary. Refer to Carpenter and Murray 1998 for a list of references and summary of tamarisk eradication work, methods, and successes. This technique was not considered viable.

Chainsaw Use

Since most project areas are within proposed wilderness, and since chainsaw use was not proposed to complete project objectives, it was not considered.

Biological Agents

The U.S. Department of Agriculture's Agricultural Research Service (ARS) is currently evaluating use of biological agents to control tamarisk. The ARS has initiated and coordinated the release and study of Asian leaf beetles (*Diorhabda elongata*) in Nevada, California, Texas, Colorado and Wyoming. Biological control is expected to slowly reduce tamarisk populations and allow beneficial plant and animal species to reestablish in severely infested areas. Tamarisk populations in Phases I and II do not contain dense stands of tamarisk where biological control agents are usually most effective; therefore, this technique would not be effective for tamarisk control in the proposed project areas. At this time, this method has not been proven and was not considered a viable alternative. However, the Park may consider the use of this method in the future, especially for addressing tamarisk populations associated with the main river corridor.

Use of Only Cut-Stump Method and Basal Bark Application Methods

The first draft of this document contained the use of the above two mentioned control methods as a separate alternative. These are the methods most commonly used for tamarisk control in the Southwest. Reviewers of the first draft concluded that this alternative was not different enough from the current action alternative to warrant a separate alternative. Also, the use of this method would have produced a significant number of stumps in the project areas. Based on the initial scoping comments, a few individuals objected to the presence of a large number of cut stumps in the project areas. With this alternative, a large amount of debris would have to be removed from the project areas, which would decrease wildlife habitat, increase the erosion potential of steep slopes, and cause additional soil compaction when the brush is hauled out of the drainages. While these are the most commonly used control methods, this was removed from consideration as an alternative due to the potential impacts and also the incorporation of initial scoping comments into the development of the project alternatives.

Comparison of Alternatives

The following section summarizes the alternatives by proposed activities and impacts. Table 2-1 summarizes the proposed management methods and Table 2-2 summarizes all of the proposed activities, which are described in detail under each alternative. Table 2-3 summarizes the impacts of the alternatives by impact topics that are described in detail in Chapter 4 Environmental Consequences.

Table 2-4 summarizes the methods proposed under each alternative to ensure that project goals are met.

Table 2-1 Comparison of Proposed Management Methods

Proposed Activity	Alternatives	
	A	B
Manual Removal	None	Extensive for seedlings and some saplings
Garlon Lance Injection	None	Used for saplings and mature trees
Hack and Squirt Method	None	Used for saplings and mature trees
Cut Stump Method	None	Limited use for saplings and mature trees
Basal Bark Application	None	Limited use for smaller saplings and some seedlings
Native species restoration	None	Used in areas with dense tamarisk stands

Table 2-2: Comparison of Proposed Activities

Action	**Alternative A** **No Action**	**Alternative B** **Action Alternative**
Proposal	*Nonnative tamarisk management and tributary restoration would not occur.*	*Tamarisk management and tributary restoration in 157 side canyons, springs of the Colorado River in Grand Canyon National Park (some developed areas would be included in the management process).*
Duration and Season	N/A	Project work would begin, if approved through the NEPA /NHPA process, in fall 2002. The project is expected to last five years with monitoring and maintenance continuing for an additional five years. Work would be accomplished in off-season months: March, September, October, and November. Time spent at each site is anticipated to be one day/site, perhaps longer in Phases II and III.
Location	N/A	Some work would be done in the South Rim developed area, but most project areas are located in Grand Canyon side canyons and springs. Refer to Tables 1, 2, and 3 for specific locations (Appendix A).
Wilderness	No changes to wilderness from control activities.	The project, in respect to wilderness values and character, proposes use of non-motorized equipment and non-mechanical transport. Instead oar-powered rafts and hand tools would be used to access sites and accomplish work. Leave No Trace (LNT) principles would be practiced throughout the project by all crewmembers. In all methods, debris, cut stumps, girdling marks, and pruning would be done in a manner that would minimize visual impact. Impingement on visitor experience would be addressed by notifying hikers and river runners in advance when workers might be encountered in the canyon; work trips would use less-desirable beaches as campsites.
Methods and Techniques	None will be used	Tamarisk control would be accomplished with a combination of methods including manual removal (hand pulling and weed wrench), herbicide lance injection, hack and squirt, cut stump, basal bark herbicide application. In the lance injection, hack and squirt, and basal bark herbicide techniques intact trees would be left standing to decompose over time. Debris would be moved from the immediate site and disbursed.
Tools	None	Tools would include oar-powered rafts, gloved hands, weed wrenches, rock picks, pulaskis, shovels, hatchets, tree girdlers, small hand saws, hand-held GPS units and lance injectors.
Herbicides and Application Methods	None	Garlon 3A and Garlon 4 Lance injectors use a four-foot-long hand-held device to implant a small (3/4”) metal capsule into the stem of larger trees. These capsules would not be visible and would be removed the year after application.

Action	Alternative A No Action	Alternative B Action Alternative
Proposal	*Nonnative tamarisk management and tributary restoration would not occur.*	*Tamarisk management and tributary restoration in 157 side canyons, springs of the Colorado River in Grand Canyon National Park (some developed areas would be included in the management process).*
Herbicides and Application Methods continued		Hand-pressurized and backpack sprayers, and 12cc syringes are used in hack and squirt, cut stump, and basal bark herbicide applications. Small, coarse-spray nozzles would allow very selective application, eliminating herbicide drift. Application would be highly controlled and plant specific. Herbicide containers are leak and spill proof and would be doubly secured in sealed ammunition cans. Application equipment (gloves, etc.) and empty containers would be properly disposed and sealed in ammunition cans.
Restoration		Site-adapted plant materials collected from near each project location would be used for revegetation efforts.
Work Crews		Workers would be kept to the minimum number necessary to accomplish work. In this case, 12-16 consisting of three boatmen, one trip leader/boatman, one cook, two project leaders, one archaeologist, one wildlife biologist, and three to seven work party members. All trip participants would accomplish control and restoration work. All workers would be trained herbicide applicators.

Table 2-3: Summary Comparison of Alternatives and Impacts

	Alternative A **No Action**	**Alternative B** **Action Alternative**
Soils and Biotic Communities	Indirect, long-term, negligible to minor impact s to soil characteristics such as salinity No new direct impacts to soils and biotic communities.	Negligible to minor direct impacts to biotic communities on localized basis Possible long-term adverse impact to biotic communities in few project areas Short-term, negligible impact to soils or biotic communities on established trails and in majority of project areas Short-term, minor impact to soils from loosening roots Long-term, minor to moderate beneficial decrease in soil salinity and improvement of soil characteristics
Threatened, Endangered and Sensitive Species	No direct impact on the 21 listed plant, aquatic, mammal, and reptile species and three bird species that occur in vicinity of the park Long-term, minor to moderate, beneficial or adverse impacts on southwestern willow flycatcher habitat Long-term, negligible to minor, adverse or beneficial impacts on Kanab ambersnail populations Long-term, negligible to minor beneficial impacts on the survival of remaining species	Short-term, negligible if any direct or indirect effect on the 21 listed plant, aquatic, mammal, and reptile species and three bird species that occur in vicinity of the park Negligible to minor impact to southwestern willow flycatchers May affect – is not likely to adversely affect determination by initial consultation with FWS
Vegetation	No direct impacts to vegetation due to tamarisk removal Long-term, minor to moderate, adverse, indirect and direct impacts to native vegetation due to continued persistence and spread of tamarisk	Short-term, negligible to minor adverse impact to non-target vegetation from trampling Long-term, minor to moderate, beneficial impact to native vegetation through tamarisk removal
Wetlands and Water Quality	No direct impacts to water quality or wetlands Long-term, minor to moderate decrease in water quantity due to increasing use by tamarisk and long-term increase in salt secretion Long-term, minor to moderate, adverse impacts to wetlands	Short-term, negligible to minor adverse impacts from increasing sedimentation and nutrients in water Long-term, minor adverse impact to water temperature; however, this is a return to natural conditions Long-term, minor to moderate improvement in water quantity due to decreased use by tamarisk and long-term decrease in salt secretion Long-term, minor to moderate beneficial impacts to wetlands through restoration Short-term, negligible if any, impacts to water quality due to use of Garlon
Wildlife	No new, direct, adverse impacts to wildlife Long-term, minor to moderate adverse impacts to the many wildlife species utilizing side canyons and tributaries as tamarisk continues to spread and persist Long-term, minor to moderate, beneficial impacts and uses of tamarisk for some species would continue under this alternative	Short-term, negligible to minor impact to aquatic organisms, amphibians and some wildlife species due to increased sedimentation and trampling Minor, direct or indirect, adverse impact on aquatic organisms due to removal of overstory Long-term, beneficial, minor impacts for some species through use of debris as cover Indirect, minor to moderate adverse impacts to species that utilize tamarisk in side canyons Short-term negligible, direct impacts to wildlife species that depend on tamarisk for nesting and habitat Short-term negligible impact to wildlife from herbicide Long-term, moderate beneficial impacts to wildlife once tamarisk is removed

	Alternative A No Action	Alternative B Action Alternative
Ethnographic Resources and Traditional Cultural Properties	No known direct impacts Potential indirect impacts as tamarisk continues to spread	Possible impacts to tribes affiliated with Grand Canyon due to possible disturbance of ethnographic areas and Traditional Cultural Properties. Tribal representatives participate as members of the Tamarisk IDT, and will work closely with GCNP to avoid impacts Long-term beneficial impacts as native species recover
Archaeological and Historical Resources and Cultural Landscapes	No known direct impacts Potential long-term adverse impacts as tamarisk continues to spread and persist	Possible destabilization of terraces and resulting erosion No adverse impacts since no known archaeological and historical resources are found near treatment sites. In case of discovery, an archaeologist will accompany all trips
Wilderness	No new direct adverse impacts Long-term, minor to moderate, indirect adverse impacts to wilderness character, influence and natural conditions and processes due to tamarisk encroachment and persistence	Short-term, minor and localized impacts through disturbance of soils and vegetation Long-term, minor to moderate indirect beneficial impacts to ecosystem diversity and sustainability
Wilderness Visitor Experience	No new direct adverse impact on visitor experience due to management efforts Indirect, long-term, minor to moderate, impacts on wilderness experience due to diminished natural conditions	Short-term, negligible to minor adverse impacts to visitors encountering river trips and workers Short-term, minor visual evidence of work—girdling, cut stumps, debris piles Long-term, minor to moderate, indirect beneficial impacts to ecosystem diversity and sustainability, and thus to visitor experience

Table 2-4: Methods Each Alternative Uses to Ensure Each Goal Is Met

Goal	**Alternative A** **No Action**	**Alternative B, Preferred** **Combination of Methods**
To restore and preserve natural conditions and preserve existing natural conditions in side canyons along the Colorado River within Grand Canyon National Park by eradicating nonnative tamarisk.	Objective not met by the No Action alternative.	The control of nonnative tamarisk that is invading side canyons and tributaries while its still feasible will allow natural systems to recover. Native plant and animal species will return to areas now dominated by tamarisk. In some areas, active revegetation may be necessary to speed up the recovery process.
To protect wilderness character and value by implementing actions that have the least impact on wilderness resources and that accomplish project goals.	The No Action alternative protects wilderness character and values by not implementing actions that could damage qualities like solitude and the chance for a remote and primitive type of recreation. However, taking no action would not accomplish the other project objectives.	Although implementation activities may disrupt wilderness values like solitude and remoteness, every action will be taken to mitigate wilderness impacts through the use of the appropriate minimum tool and action. Wilderness character will be protected in the long run and more natural conditions, as called for in the Wilderness Act, will return.
To protect and preserve cultural resources by implementing actions that have the least impact on cultural resources and that accomplish project goals.	The No Action alternative protects cultural resources by not implementing actions that could cause damage. However, taking no action may not allow the park to preserve riparian areas, seeps and springs that are part of the cultural landscape and possess inherent value.	Alternative B enlists tribal representatives and park archaeologists in project design and implementation to ensure activities do not impact cultural sites.
To improve riparian community composition and structure, enhancing fish and wildlife habitat.	Objective not met by Alternative A, No Action	Alternative B would result in a long-term improvement of riparian plant communities. The delay in alteration of community structure (i.e. standing dead trees) would coincide with a delay in the enhancement of native fish and wildlife habitat. There would be minimal displacement of wildlife with this alternative.
To ensure employee and visitor safety during project implementation.	Not applicable under this alternative.	Every attempt will be made to protect employees from harm. A safety plan, a job hazard analysis, standard operating procedures will be completed before project implementation. All participants will receive white-water safety and herbicide application training,

Environmentally Preferred Alternative

Environmentally preferable is defined as "the alternative that will promote national environmental policy as expressed in the National Environmental Policy Act §101." Section 101 of the National Environmental Policy Act states that "…it is the continuing responsibility of the Federal Government to … (1) fulfill the responsibilities of each generation as trustee of the environment for succeeding generations; (2) assure for all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings; (3) attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences; (4) preserve important historic, cultural, and natural aspects of our national heritage, and maintain, wherever possible, an environment which supports diversity, and variety of individual choice; (5) achieve a balance between population and resource use which will permit high standards of living and a wide sharing of life's amenities; and (6) enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources." The environmentally preferable alternative for this EA is based on these national environmental policy goals.

Alternative A, the No Action Alternative, represents current conditions and management direction for proposed project areas. Although Alternative A would provide the greatest cultural resources protection, this alternative would not result in the same level of natural resources protection and preservation as would the action alternative.

Alternative B, the Preferred Alternative strives to integrate the following GCNP General Management Plan objectives:

- Preserve and protect park genetic integrity and species composition, consistent with natural ecosystem processes.

- To the maximum extent possible, restore altered ecosystems to their natural conditions. In managing naturalized ecosystems, ensure preservation of native components through active management of nonnative components and processes.

Alternative B also meets the natural resource objective from the park's Resource Management Plan:

- Preserve park natural genetic integrity and species composition consistent with ecosystem processes, including the elimination of nonnative plant and animal species wherever possible.

Through use of an Integrated Pest Management (IPM) approach, Alternative B realizes the above objectives and promotes the most comprehensive protection and enhancement of natural and wilderness resources in park tributaries, side canyons, springs above pre-dam water level, and developed areas.

The environmentally preferred alternative is Alternative B because it surpasses the other alternatives in realizing the full range of national environmental policy goals as stated in §101 of the National Environmental Policy Act. Although other alternatives may achieve greater levels of protection for cultural resources, natural resources, and/or visitor experiences, Alternative B provides a high level of protection for natural and cultural resources while concurrently attaining the widest range of neutral and beneficial uses of the environment without degradation, maintains an environment that supports diversity and variety of individual choice and, integrates resource protection with an appropriate range of visitor uses.

3. Affected Environment

The Council on Environmental Quality (CEQ) regulations, which implement the National Environmental Policy Act, requires that all NEPA documents "succinctly describe the environment of the area(s) to be affected or created by alternative under consideration (1502.15)." The purpose of this chapter is to give the reader a general understanding of the environment affected for each of the impact topics that will be analyzed in this document.

Natural Resources

Soils and Biotic Communities

The geologic history of the Grand Canyon includes rocks as old as 2 billion years. An extensive sequence of rocks and layers can been seen throughout the park. The oldest rocks are granites, gneisses and schists, which are well-exposed in the inner gorge. These landforms are seen as steep canyon walls with little soil development. A variety of sedimentary formations and igneous layers have been laid down and can be observed throughout the canyon. The reader is referred to the extensive literature on the geology of Grand Canyon for further detail on the park's geology.

The Natural Resources Conservation Service (NRCS) initiated a soil survey of Grand Canyon National Park in May 1998. Only general descriptions are available for soils in tributaries and side canyons at this time, primarily due to the extensive diversity of soil types and parent material throughout the canyon. In general, inner canyon soil textures consist of sandy loam, sands, silts, or loamy sands. Most soil types erode very easily and regenerate relatively slowly. Tributary soils typically contain rock fragments—from boulders to gravel—low clay amounts, segregated calcium carbonate, and organic matter. The amount of gravelly streambed alluvium, and sandy or silty soil and cobbles depends on the location relative to the stream channel. Typical pH is 7.8 to 8.4. In areas with perennial water, there is generally more organic matter and lower pH. Thick sedges, grasses, forbs and shrubs significantly contribute to the organic content of soils near streams, seeps and springs. Where tamarisk is present, soils are more saline.

Slope soils are relatively fragile and include biotic communities (i.e. microbiotic soil crusts) that play a major role in preventing erosion, cycling nutrients, and providing sites for seed germination and plant growth. In some areas these crusts represent a large percentage of the living ground cover. Footprints not only impact crust functions, but remain visible due to slow crust regeneration.

Threatened, Endangered and Sensitive Species

Under the Endangered Species Act of 1973, as amended (16 USC 1531 et seq.), the park is required to consult with the U.S. Fish and Wildlife Service prior to the planning or initiation of any park project. Consultation was initiated on December 15, 2000, and included the 63 side canyons listed in Phase I of the proposed project. Additional consultation will be required for the remaining Phases.

Plants

The U.S. Fish and Wildlife Service (USFWS) has determined that eight Federally or state listed proposed, threatened, or endangered plant species may occur or have habitat in the Grand Canyon area, Coconino County. These species are:

- Brady pincushion cactus (*Pediocactus bradyi*) Endangered

- Navajo sedge (*Carex specuicola*) Threatened
- San Francisco peaks groundsel (*Senecio franciscanus*) Threatened
- Sentry milk-vetch (*Astragalus cremnophylax* var. *cremnophyla*) Endangered
- Siler pincushion cactus (*Pediocactus sileri*) Threatened
- Welshes milkweed (*Asclepias welshii*) Threatened
- Arizona cliffrose (*Purshia subintegra*) Endangered
- Jones' cycladenia (*Cycladenia humilis* var. *jonesii*) Threatened

The above Federal and state listed species do not exist at the proposed tamarisk management locations. However, during project implementation, project participants much be able to identify these species and should have know where these species are known to occur in the Park.

Wildlife

The U.S. Fish and Wildlife Service has determined that 14 Federally listed proposed, threatened, or endangered wildlife species may occur or have habitat in the Grand Canyon area, Coconino County. These species are:

- Kanab ambersnail (*Oxyloma haydeni kanabensis*) Endangered
- Humpback chub (*Gila cypha*) Endangered
- Bonytail chub (*Gila elegans*) Endangered
- Virgin River chub (*Gila seminuda*) Endangered
- Razorback sucker (*Xyrauchen texanus*) Endangered
- Woundfin (*Plagopterus argentissimus*) Endangered
- Little Colorado spinedace (*Lepidomeda vittata*) Threatened
- Southwestern willow flycatcher (*Empidonax traillii extimus*) Endangered
- Bald eagle (*Haliaeetus leucocephalus*) Threatened
- Mexican spotted owl (*Strix occidentalis lucida*) Threatened
- Hualapai Mexican vole (*Microtus mexicanus hualpaiensis*) Endangered
- Black-footed ferret (*Mustela nigripes*) Endangered
- Yuma clapper rail (*Rallus longirostris yumanensis*) Endangered
- California condor (*Gymnogyps californianus*) Experimental population (treated as threatened)

- Desert tortoise (*Gopherus agassizii – xerobates*) Threatened
  (Mojave population)

In Arizona, the northern leopard frog, *Rana pipiens,* is a Candidate Species for the State List of Threatened Wildlife (Arizona Game and Fish Department, 1988). The state has also placed the species in its "Wildlife of Special Concern" category with a state ranking of S3, which is defined as "rather rare throughout a fairly wide range". It is also listed as Category 3 on the Navajo Nation Endangered Species List. It is not federally listed at this time. During herpetofaunal inventories in consecutive years (1999-2001), an amphibian search documented three sites where leopard frog tadpoles were observed and verified. Both are areas of high visitor use (Grand Canyon National Park Science Center, unpublished data), and none of the sites are in the proposed project areas. However, project participants should be able to identify this species and understand the potential habitat.

One formerly listed species, American peregrine falcon (*Falco peregrinus anatum*), and one formerly proposed species, northern goshawk (*Accipiter gentillis*), occur in the park but are not on the U.S. List of Threatened and Endangered Species. These species are not known to nest in the riparian areas in the Park's tributaries.

Listed fish species that still occur within the main stem of the Colorado River include: Humpback chub (*Gila cypha*), endangered*,* and the Razorback sucker (*Xyrauchen texanus*), endangered. The Humpback chub is known to spawn in the Little Colorado River. Further consultation with the USFWS may be required prior to any management actions in that area.

The California condor (*Gymnogyps californianus*) is an experimental population. In National Parks, experimental populations are treated as a threatened species. Occasionally, during the late fall and winter months, condors will scavenge along the river corridor and some side canyon areas. They also may perch or roost for the night.

In the Environmental Assessment for the establishment of a wild population of Kanab ambersnails (*Oxyloma haydeni kanabensis* Pilsbry) within GCNP, eleven sites were listed as optimum or desirable in biological and environmental conditions (USFWS 1998). Populations of the Kanab ambersnails have been established at Lower Deer Creek Spring, Upper Elves Chasm, and Key Hole Springs.

The willow flycatcher is a neotropical migrant that breeds across much of North America. The southwestern willow flycatcher's (*Empidonax traillii extimus*) breeding range includes southern California, Arizona, New Mexico, western Texas, southwestern Colorado, southern portions of Nevada and Utah, and extreme northwestern Mexico. During the breeding season, the species occurs in riparian habitats where dense growth of willow (*Salix* sp.), Baccharis, arrowweed (*Tesseria* sp.), and tamarisk occur, sometimes with a scattered overstory of cottonwood (*Populus* sp.) (Unitt 1987, Federal Register, 1997). The southwestern race has decreased substantially in numbers in the past several decades. This reduction is attributable primarily to a loss of riparian habitat and secondarily to brood parasitism by Brown-headed Cowbirds (*Molothrus ater*). In Arizona, the Southwestern willow flycatcher is rare and a riparian obligate (Sogge et al. 1997). The breeding population of Southwestern willow flycatcher in Grand Canyon is localized and small. Since 1982, the average number of nests has been less than two, and nests have been found only in the Colorado River corridor. Critical habitat is restricted to the main corridor, from river mile 39 downstream to river mile 71.5; the boundaries also include areas within the 100-year floodplain (Federal Register, 1997). There are no historic records of southwestern willow flycatcher breeding in the tributaries of the Colorado River in Grand Canyon.

After the initial consultation, the USFWS recommended a few changes, primarily to protect the southwestern willow flycatcher, and the recommendations have been incorporated into the proposed action by the NPS. Standard survey protocol must be completed in each of the tributaries containing potentially suitable habitat for the southwestern willow flycatcher, including but not limited to Shinumu Canyon, Tapeats Canyon, Deer Creek Canyon, Havasu Canyon, Kanab Canyon, Spring Canyon and

Three Springs Canyon. These areas are included in Phase III of the proposed project along with Upper Carbon Canyon and the Lower Little Colorado River, which may also contain potentially suitable habitat. The park would consult with the USFWS after completion of full survey protocol in those areas. No vegetation removal may occur in tributaries with potentially suitable southwestern willow flycatcher habitat, as defined by USFWS, unless surveys have been completed within the year of the proposed actions. No habitat can be removed where migrant or breeding flycatchers are detected until further consultation with the USFWS is completed.

With the adoption of these changes, the USFWS concurred with the "may affect, is not likely to adversely affect" determination for the first phase of this project. The NPS will continue to maintain contact with the USFWS to ensure compliance with Endangered Species Act Regulations.

Vegetation

High species diversity, high species density, and high productivity generally characterize riparian areas. Continuous interactions occur among riparian, aquatic, and upland terrestrial ecosystems through exchanges of energy, nutrients, and species. Warren et. al. (1982) provide the following description:

> "Riparian woodlands (or forest) characterized by cottonwood-willow associations are primarily restricted to the larger perennial streams and drainages of the Colorado Plateau region of northern Arizona. The great biological importance and floristic diversity of these cottonwood-willow riparian forests is disproportionate to their limited total area…. Riparian scrub usually occurs along ephemeral or intermittent watercourses (such as desert arroyos), or in narrow canyons which are periodically scoured by floods. Riparian scrub communities are characterized by a broad continuum of vegetative associations that range from mesic vegetation types to xeric growth along desert arroyos (Brown, et al, 1980). These arroyos often contain water only one day or less each year and the resulting vegetation is commonly composed of a mixture of facultative riparian species and upland species. This is in contrast to mesic species, which are generally absent from the surrounding uplands…. Side canyons throughout the park with perennial water support riparian vegetation characterized by cottonwood (*Populus fremontii*) and willow (*Salix* spp.) which is generally very similar to that found in similar situations throughout northern Arizona (Phillips and Phillips, 1979)…."

Each dry wash, spring, seep, or stream has a different association of species, depending on environmental features including elevation, permanence of water, substrate, frequency of flooding, and colonization (Warren, et al. 1982). Riparian vegetation typically occurs in small, discrete stands or patches. The floristic diversity in wetland and riparian composition is highly variable, but is extremely high when compared to the upland vegetation. Typical stands may consist of broad-leaved deciduous trees in the overstory, with a mixture of shrubs and grasses in the understory. Species typical of drainages with perennial water sources are:

- Fremont cottonwood (*Populus fremontii*)
- Brickellia (*Brickellia longifolia*)
- Catclaw acacia (*Acacia gregii*)
- Apache plume (*Fallugia paradoxa*)
- Willow (*Salix exigua*, *Salix goodingii*)
- Monkey flower (*Mimulus cardinalis*)
- Mequite (*Prosopis glandulosa*)
- Emory baccharis (*Baccharis emoryi*)

Species typical of drainages with dry washes or intermittent water are:

- Catclaw acacia (*Acacia gregii*)
- Baccharis (*Baccharis* spp.)

- ♣ Snakeweed (*Gutierrezia sarothrae*)
- ♣ Apache plume (*Fallugia paradoxa*)
- ♣ Mormon tea (Ephedra spp.)
- ♣ Four-wing saltbush (Atriplex canescens)
- ♣ Fremont cottonwood (*Populus fremontii*)
- ♣ Skunkbush (*Rhus trilobata*)
- ♣ Red-bud (*Cercis occidentalis*)
- ♣ Utah agave (*Agave utahensis*)

Upland species, described below, are also present in these dry or intermittent washes. Trees and shrubs tend to be scattered, but may also form dense thickets. Species composition varies depending on moisture availability, elevation, and geographic location in the canyon. Within the park, tamarisk occurs in the majority of the side canyon and tributaries; however, the distribution and density is highly variable. Refer to Appendix A – Project Implementation Phase Tables for detailed information about tamarisk numbers in each tributary or side canyon.

The vegetation surrounding the tributaries is generally from desertscrub communities, which are composed of plant species from three of the four North American desert floras. The Sonoran desertscrub has the highest diversity of species. A two-season rainfall regime and lack of freezing temperatures characterizes the Sonoran desert (Warren, et al. 1982). The Mojave desertscrub has higher local species diversity, but is primarily dominated by shrubs; it is characterized by winter rains and the absence of freezing temperatures (Warren, et al. 1982). The Great Basin desert receives more winter rain than the Mojave, and frequently has severe winter freezes and the lowest diversity of the three (Warren, et al. 1982).

The Great Basin desertscrub is dominated by big sagebrush (*Artemisia tridentata*) rabbitbrush (*Chrysothamnus* spp.), Mormon tea (*Ephedra* spp.) and a variety of perennial grasses. These associations are typically found in the lower portion of the canyon and comprise the vegetation surrounding some of the middle and lower tributaries. Typical Mojave desert species include blackbrush (*Coleogyne ramosissima*), turpentine broom (*Thamnosma montana*), bladder sage (*Salazaria mexicana*), and other species. The Sonoran desert species include brittle bush (*Encelia farinosa),* catclaw acacia (*Acacia greggii),* ocotillo (*Fouquieria splendens*) and desert willow (*Chilopsis linearis*). Sonoran associations occur in the lower portion of the canyons, and many of these species can grow directly in drainages that are not frequently scoured.

For more information and more complete lists of species, please refer to Phillips et al. (1987) and Warren et al. (1982).

Water Quality and Wetlands

Water quality throughout Grand Canyon National Park is considered to be good and generally above state and Federal standards in the majority of the tributaries, seeps and springs. Water quality degradation exists in areas of high visitor use. Surveys have identified the presence of *Giardia lamblia* and fecal coliform, thereby limiting direct consumption by humans without filtration. Lava Canyon is listed as exceeding the acceptable arsenic levels. High water quality is critical for survival and health of species associated with riparian and aquatic ecosystems.

Wetlands and riparian areas are relatively rare in this desert landscape. Wetlands are ecologically productive habitats that support a rich array of plant and animal life. Wetlands sustain a great variety of hydrologic and ecological functions vital to ecosystem integrity. These functions include flood abatement, sediment retention, groundwater recharge, nutrient capture, and high levels of plant and animal diversity. Modification of even small wetland areas may produce effects that are proportionally greater than elsewhere in an ecosystem. Refer to the Vegetation section above for lists of plant species associated with wetland or riparian environments.

Under Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers issues permits for discharge of dredged or fill material into "waters of the United States" (33 Code of Federal Regulations). Wetlands are a subset of United States waters and receive jurisdictional protection under Section 404 of the Clean Water Act. United States waters (also regulated under Section 404 of the Clean Water Act) include features such as streams, rivers, bays, lakes, inlets, mudflats, washes, sloughs, sand flats, territorial seas, tributaries, and impoundments.

Wildlife

Riparian habitats exist along many park tributaries. These areas support diverse and abundant wildlife assemblages, and provide critical habitat for many species. Many resident and migratory wildlife species inhabit the park, including 90 mammals, 290 birds, 60 reptiles and amphibians, and 25 fish. Common mammals occurring in riparian habitat and side canyons include: mule deer, bighorn sheep, beaver, coyotes, ringtails, spotted skunks, bats, and rodents. The majority of the animals that occur in the project areas are habituated to some level of disturbance and human activity.

Most animal species that inhabit the inner canyon depend on riparian areas directly or indirectly for food and cover during at least part of their annual cycles. Several species of birds are known to nest in tamarisk in the Grand Canyon, including mourning dove, long-eared owl, black-chinned hummingbird, southwestern willow flycatcher, Bell's vireo, Bewick's wren, phainopepla, bushtit, Lucy's warbler, yellow warbler, yellow-breasted chat, blue grosbeak, brown-headed cowbird, hooded oriole, lesser goldfinch, and house finch. Seventeen bat species have been detected foraging for insects over tamarisk patches. Peregrine falcons have been observed foraging on bats and small birds that utilize tamarisk patches. Many insect species are known to utilize tamarisk.

Side canyons are important places for amphibians, including northern leopard frogs, red-spotted and Woodhouse toads, and canyon tree frogs, particularly during their breeding season. These amphibians utilize spring and summer rains for egg production. Tadpoles and young can be found July through September.

Cultural Resources

Cultural resources are defined as aspects of cultural systems valued by or significantly representative of a culture or that contains significant information about a culture. A cultural resource may be a tangible entity or a cultural practice. Tangible cultural resources are categorized as districts, sites, buildings, structures, and objects for the National Register of Historic Places and as archaeological resources, cultural landscapes, structures, museum objects, and ethnographic resources for NPS management purposes. (DO-28 179-180). Within the affected environment of this project, cultural resources representing ethnographic, traditional cultural properties, archaeological, historical, and cultural landscapes have been identified.

Ethnographic Resources and Traditional Cultural Properties

Ethnographic resources are defined by the NPS as any "site, structure, object, landscape, or natural resource feature assigned traditional, legendary, religious, subsistence, or other significant in the cultural system of a group traditionally associated with it" (Director's Order 28, Cultural Resource Management Guideline). Grand Canyon National Park lands are traditionally affiliated with the following Indian tribes: Havasupai, Hopi, Hualapai, Kaibab-Paiute, Navajo Nation, Paiute Indians Utah, Pueblo of Zuni, White Mountain Apache and San Juan Southern Paiutes (Ferguson 1998; Hart 1995; Hualapai Tribe 1993; Roberts, et al. 1995 ; Stevens 1996; Stoffle, et al. 1996). Ethnographic resources may occur in the proposed project areas based on the findings of these reports.

A **Traditional Cultural Property** (TCP) is generally defined as one that is eligible for inclusion in the National Register of Historic Places because of its association with cultural practices or beliefs of a living community that are rooted in that community's history, and are important in maintaining the continuing cultural identity of the community. Traditional cultural values are often central to the way a community or group defines itself, and maintaining such values is often vital to maintaining the group's sense of identity and self-respect. Properties to which traditional cultural value is ascribed often take on this kind of vital significance, so that any damage to or infringement upon them is perceived to be deeply offensive to, and even destructive of, the group that values them.

Such places may not necessarily come to light through archaeological, historical, or architectural surveys. The existence and significance of such locations often can be ascertained only through interviews with knowledgeable area users or through other forms of ethnographic research (Ferguson 1998; Hart 1995; Hualapai Tribe 1993; Roberts et al. 1995; Stevens 1996; Stoffle et al. 1996). The subtlety with which the significance of such locations may be expressed makes it easy to ignore them; on the other hand, it makes it difficult to distinguish between those properties having real significance and those whose significance is questionable. As a result of the Glen Canyon Dam Final Environmental Impact Statement, TCPs were identified along the Colorado River corridor by the various tribes culturally affiliated to the Canyon (FEIS 1994). Due to the significance and confidentiality of these TCPs to each individual tribe, it is imperative to continue tribal involvement during the development and implementation of this project, as the exact locations of these areas may not be readily available to the Park.

Archaeological and Historical Resources and Cultural Landscapes

Archaeological and Historical resources are defined as any material remains or physical evidence of past human life or activities which are of archeological or historical interest. This also includes the effects of human activities on the environment. These materials are capable of revealing scientific or humanistic information through research.

Cultural traditions (as evidenced by these archaeological and historical resources) begin in the Canyon with the Archaic peoples (2,500 BC) and continues through the Puebloan and Cohonina peoples (AD 500-1200), the Cerbat tradition (AD 1300-1700), and Paiute groups (possibly Archaic through historic times). Apachean occupation of the Grand Canyon region is documented by the late 17th century and use by numerous groups continues to the present. Historic Anglo-American use of the area began in 1869 with the first attempt to explore the Colorado River and subsequent exploration and economic exploitation.

As a result of an Environmental Impact Statement for the Operation of Glen Canyon Dam, an intensive survey of the river corridor area (from Glen Canyon Dam to Separation Canyon) was completed. A total of 478 prehistoric and historic sites were located in the river corridor, many representing uses by Puebloan people including the Hopi and Zuni, Pai and Paiute, and Navajo and Anglo-Americans. Anglo-American historic resources in the corridor total 71 sites or components and represent use between 1869 and 1940.

Three hundred twenty six sites have been determined eligible for inclusion on the National Register of Historic Places as contributing elements to the Grand Canyon River Corridor Historic District. The remaining sites were ineligible or were not evaluated. Ninety-eight sites near proposed project areas are National Register eligible; however, these sites are not located in drainages where tamarisk control would occur. Refer to Appendix E for Archaeological Resource Tables (*NOTE – this information is not available to the general public; however, it was compiled and provided to the surrounding tribes and State Historic Preservation Officer (SHPO) for review*).

Cultural landscapes are defined as a geographic area, including both cultural and natural resources, and the wildlife or domestic animals therein, associated with a historic event, activity, or person, or exhibiting other cultural or aesthetic values. There are 4 general types of cultural landscapes, not mutually exclusive; historic site, historic designed landscape, historic vernacular landscape, and ethnographic landscape (DO-28: 179). Within the project area, there are no historic designed landscapes documented, however, historic sites, vernacular landscapes and ethnographic landscapes may exit.

Wilderness and Visitor Resources

The NPS is mandated to preserve and protect wilderness resources through the Wilderness Act of 1964; Director's Order 41, Wilderness Management; NPS Management Policies, 2001; the GCNP General Management Plan, and the GCNP Resource Management Plan. GCNP wilderness management seeks to provide outstanding opportunities for solitude or a primitive and unconfined type of recreation, and the opportunity for connection with an undisturbed nature, rather than an unnatural one.

Wilderness

Approximately 1.1 million acres in Grand Canyon National Park are proposed for wilderness designation, and the majority of proposed project areas are within the proposed wilderness. NPS Management Policies 2001 require the park service manage proposed wilderness as wilderness until Congress addresses designation through legislative action. In managing wilderness, the NPS adheres to the "minimum requirement" standard as expressed in Section 4c of the Wilderness Act:

Except as specifically provided for in this Act, and subject to existing private rights, there shall be no commercial enterprise and no permanent road within any wilderness area designated by this Act and, except as necessary to meet the minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area) there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure of installation within any such area.

NPS Management Policies state that:

…superintendents will apply the minimum requirement concept to the context of wilderness management planning, as well as to all other administrative practices, proposed special uses, scientific activities, and equipment use in wilderness. When determining minimum requirement, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resources or character is unavoidable, only those actions that preserve wilderness character and/or have localized short-term adverse impacts will be acceptable.

The minimum requirement concept, described above, guides all management actions, including research, in wilderness and is intended to minimize impacts on wilderness character and resources. NPS Management Policies state that "the minimum requirement concept will be applied as a two - step process that determines:

Whether the proposed management action is appropriate or necessary for administration of the area as wilderness and does not pose a significant impact to wilderness resources and character; and

The techniques and types of equipment needed to ensure that impact to wilderness resource and character is minimized."

A Minimum Requirement Analysis has been completed for this project and is included as Appendix C.

Wilderness values include naturalness, ecological, geological, or other features of scientific, educational, scenic, or historical interest. Noticeable imprints of humans can effect wilderness character.

Visitor Experience

Grand Canyon visitation in 2000 was 4,816,599 people. Canyon recreation activities include hiking, backpacking, camping, viewing (nature, wildlife, cultural sites, canyon vistas, and astronomy), white-water rafting, mule rides (limited to three trails), photography, painting, and enjoying wilderness settings or solitude. In general, about 22% of the public visit during the spring, 48% during the summer, 22% during the fall, and 8% during winter. Approximately 80% of visitors stay above the rims (GRCA Visitor Use Statistics, updated June 2001). In 2000, there were 36,800 backcountry users (not including river use), with approximately 45% of these visiting park wilderness areas. Average group size is 3.3 people, and the most popular time for wilderness backpacking is in the spring and fall months. In 2000, total river recreation use was approximately 23,000 people. About 90%of recreational use occurs between May through September (2000 Backcountry Use Statistics on file, Science Center).

The majority of the project areas are in proposed wilderness with access only by foot or by raft from the Colorado River. This project would be implemented during March, September, October, and November, which would minimize potential impacts to river users. Many project areas receive limited visitation particularly during the off-peak season. During March, September and October, backcountry camping is popular recreational activity. Many of the project areas would be difficult to access as a hiker, but there is a high potential for encounters in a limited number of areas. For example, Tanner, Hance, Monument and Hermit Creeks are popular destinations from the South Rim. The chance for backcountry users encountering the work crews (particularly at campsites along the river) is high during the popular months. Mitigation measures described in each alternative would minimize impacts to wilderness users.

4. Environmental Consequences

Introduction

This section analyzes the consequences of the alternatives for tamarisk management and tributary restoration, and provides a basis for comparing alternatives. The section is divided into Natural, Cultural, and Wilderness/Visitor Use Resources and then further divided into the issue topics.

Cumulative Impacts

A cumulative impact is defined in regulations developed by the Council on Environmental Quality, 40 CFR 1508.7. as “the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions.” Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time. Therefore, it is necessary to identify other ongoing or foreseeable future actions within the project vicinity in Grand Canyon National Park. For this analysis, foreseeable future actions were considered to be actions that could occur in side canyons, tributaries, and springs above the pre-dam high water within the next five years which currently have funding or for which funding is being sought. This would

include actions that occur in these areas outside park boundaries. Foreseeable future actions that might occur are:

- **Treatment of noxious and invasive weeds on the Coconino and Kaibab National Forests.** The "Proposed Action for the Integrated Treatment of Noxious and Invasive Weeds on the Coconino, Kaibab and Prescott National Forests" was published in the Federal Register in June 2001. The U.S. Forest Service is currently drafting an Environmental Impact Statement for the proposed action which includes annual treatments of noxious weeds on a range of infestations from an estimated 2,000 acres per year to a projected 10,000 acres per year across the three forests. The proposed action includes containment or control of 1,450 acres of tamarisk in the Kanab Creek drainage. Coordination of efforts would be needed to ensure success. Kanab Creek is listed in Phase III of this GCNP EA and initiation of park efforts would be delayed until partnerships could be formed.

- **Treatment of additional noxious and invasive weeds within Grand Canyon National Park.** Control of several other high priority exotic plant species may be initiated in the future within the project vicinity. The control of Russian olive, Russian thistle, and tree of heaven may occur in the project vicinity. The mapping of the distribution of these species is currently underway. Only a few scattered individuals are known to occur in the park, and they only occur along the Colorado River. Tree of heaven is only known to occur in Kanab Creek. Russian thistle is distribution is still being determined. The distribution of other priority exotic species is limited to the beaches and riparian areas in the mainstem of the Colorado River and would not be considered as part of this project vicinity.

- **Treatment of tamarisk on tribal lands**. Several tamarisk eradication projects are currently underway on tribal lands. Additional projects are planned for tribal lands in the same tributaries and side canyons as this GCNP proposed project. Coordination of efforts would be needed to ensure success. The inclusion of tribes on the Interdisciplinary Team (IDT) for this project has that ensured communication and information sharing would occur in the future.

- **Treatment of tamarisk on Bureau of Land Management lands**. The Arizona Strip Field Office has been inventorying its riparian resources since the early 1990s. Monitoring plots are established in Kanab Creek and the Paria River, and trends are being observed over time. Any tamarisk management efforts in those areas would have to be coordinated and partnerships formed with BLM staff to ensure success.

- **Treatment of tamarisk in Glen Canyon Recreation Area**. The riparian restoration and tamarisk eradication project at Lees Ferry would not directly add to the cumulative effects of this project since that area is located in the primary river corridor. However, information generated from that project may help determine and direct revegetation efforts in dense tamarisk stands in this project.

Foreseeable future actions in park developed areas were not considered as contributing to the project's cumulative impacts. No other additional restoration or management actions are planned in the park's tributaries and side canyons at this time. Additional disturbed land restoration activities are currently limited to the beaches along the mainstem of the Colorado River in the park and would not contribute to the cumulative impacts of this project. Trail maintenance projects proposed for the next decade would also not contribute to the cumulative impacts of this project since there are very few sections of trail in the tributaries and project areas. The NPS does recognize that park natural and cultural ecosystems are part of the greater Colorado Plateau ecosystem and would strive to integrate this project into other plateau planning and restoration efforts.

Impairment

In addition to determining the environmental consequences of the preferred and other alternatives, National Park Service policy (*Management Policies 2001*) requires analysis of potential effects to determine whether or not actions would impair park resources.

The fundamental purpose of the national park system, established in the Organic Act and reaffirmed by the General Authorities Act, as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek ways to avoid, or to minimize to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the National Park Service the management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of the park, as long as the impact does not constitute impairment of the affected resources and values. Although Congress has given the National Park Service the management discretion to allow certain impacts within parks, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible National Park Service manager, would harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute an impairment. An impact would be more likely to constitute an impairment to the extent that it affects a resource or value whose conservation is:

- necessary to fulfill specific purposes identified in the establishing legislation or proclamation of the park;
- key to the natural or cultural integrity of the park;
- identified as a goal in the park's general management plan or other relevant NPS planning document.

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others operating in the park. A determination on impairment is made for every impact topic in each alternative.

Natural Resources

The Federal and state Endangered Species Acts (and associated legislation), Clean Water Act, Clean Air Act, and National Environmental Policy Act require that any Federal undertaking examine effects on natural resources. In addition, National Park Service management policies and natural resource management guidelines call for natural resource consideration in planning proposals. Significant park natural resources exist and could be affected by implementation of an alternative. This project would occur over a large area with very diverse resources. For the purposes of this document, general descriptions and analyses will be used.

Methodology

This impact analysis and conclusions for this section are based on park staff knowledge of resources and project areas, review of existing literature and park studies, information provided by experts in the National Park Service, other agencies, tribal governments, and professional judgements.

Direct effects are defined as those that occur at the same time and place as the action. For example, a direct impact of tamarisk control in a drainage could be soil compaction around tamarisk.

Indirect effects are those that are spatially removed from the activity or occur later in time but are considered likely in the foreseeable future. For example, re-establishment of native plant species in the project areas may be an indirect effect.

Definitions

Natural resources impact analyses will use these terms to describe impact intensity:

Negligible a change not measurable or perceptible; or one confined to a small area (i.e. project area)

Minor a change which, if measurable, would be localized

Moderate a clearly detectable and measurable change with localized impact

Major a substantial, highly noticeable, and measurable impact

The following duration definitions characterize impacts:

Short-term occur during implementation, primarily due to tamarisk control-related activities

Long-term extends past implementation and would likely have permanent resource effects

Natural Resources

Soils and Biotic Communities

Impacts of Alternative A – No Action

Impact Analysis

The No Action alternative would maintain the existing conditions of soils and biotic communities. Some minor impacts to soils and biotic communities currently exist in the proposed project areas due to human and wildlife use of the areas; these impacts include soil compaction from human and wildlife use. The No Action alternative would not change these existing negligible to minor impacts to soils and biotic communities and is not expected to result in any additional impact to soils and biotic communities due to trampling or compaction. However, soil salinity would increase over time due to tamarisk deposition.

Cumulative Effects

There would be no new cumulative impacts to soils and biotic communities. However, soil salinity would continue to increase due to tamarisk deposition; this effect may be amplified as tamarisk continues to colonize and populations expand. Reasonable foreseeable future actions such as the continued increase in backcountry and river use, have the potential to disturb soils and biotic communities in the project areas. No new trails are proposed in the project areas, but cyclic maintenance of short lengths of already existing trails in the project area could impact soils. The cumulative effect of the no-action alternative on the proposed project areas, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of negligible to minor intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

The No Action alternative would not produce any direct impacts to soils and biotic communities. This alternative may result in indirect, long-term, negligible to minor impacts to soil characteristics such as salinity. The cumulative effect of the no-action alternative on the proposed project areas, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of negligible to minor intensity.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

Slope soils are relatively fragile and include biotic communities (i.e. microbiotic soil crusts) that play a major role in preventing erosion, cycling nutrients, and providing sites for seed germination and plant growth. In some areas these crusts represent a large percentage of the living ground cover. Footprints not only impact crust functions, but remain visible due to slow crust regeneration. Minor direct impacts to biotic communities in certain areas would occur, primarily from workers accessing the site. For example, to access Cranberry Canyon one must climb the downstream slope without a defined trail. While it is possible to walk on hard surfaces for a while, certain segments require walking on microbiotic soils which may lead to a long-term impact to soil resources. Access to the majority of areas is along drainages or on established trails where a short-term, negligible, adverse impact may occur.

Where small handpicks, shovels, pulaskis or weed wrenches are used to loosen soils around plant roots, a short-term, minor, direct soil impact would occur. The majority of seedlings are found in active drainages where soils are accustomed to disturbance. In areas near seeps and springs, manual removal impact may be moderate. In areas with sensitive soils, vegetation, or other resources manual removal would not be used to minimize impact. In those areas, lance injection, cut stump, or basal bark application would be used. Following removal, soils would be tamped into place to minimize further disturbance.

In soil environments, the ester and amine salts formations associated with triclopyr rapidly neutralize into a relatively non-toxic salt that is degraded by soil microorganisms (EXTOXNET 1996). Soil triclopyr levels after selective herbicide treatments would have a negligible to minor, direct or indirect effect on soils.

An indirect effect of Alternative B would be improved soil characteristics due to tamarisk removal. Salt deposition would be halted and soils would, over time, recover their normal pH and chemical composition. This effect would be minor to moderate, depending on the extent of the tamarisk in the area.

Cumulative Effects

Most project areas are in drainages, washes and side canyons for which there are currently no other proposed GCNP actions that would add to the effects this alternative would have on the soil resource. Reasonable foreseeable future actions, such as the continued increase in backcountry and river use, have the potential to disturb soils and biotic communities in the project areas. No new trails are proposed in the project areas, but cyclic maintenance of short lengths of already existing trails in the project area could impact soils. Follow-up maintenance and monitoring over the duration of this project would add to direct effects of this alternative on soils. The cumulative effect of the preferred alternative

in the proposed project areas, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of negligible to minor intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

Impacts from management activities may have a negligible to minor direct impacts on biotic communities on an extremely localized basis, primarily in access routes to a few project sites. Due to the fragility of microbiotic crusts, impacts could be long-term due to the crust's long recovery time. Most project access would cause negligible impacts to biotic communities. Alternative B would have a short-term, minor, adverse impact to the majority of soils in project areas, primarily due to soil compaction from worker presence but also due to soil disturbance during manual removal efforts. There would be a long-term, minor to moderate beneficial improvement in soil characteristics such as pH and salinity due to tamarisk removal. The cumulative effect of the preferred alternative in the proposed project areas, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of negligible to minor intensity.

Threatened, Endangered and Sensitive Species

Impacts of Alternative A – No Action

Impact Analysis

The Federal and state listed plant species are not known to exist in the proposed project areas. This determination is based on specific knowledge of the areas, knowledge of the species in question, and professional judgement. As no tamarisk control activities would occur, and no known populations are known to exist in the project areas, there would be no direct change in the status of threatened, endangered or sensitive plant species. Should any new locations of these plant species be detected in the project areas, the continued spread of tamarisk could have a long-term, minor to moderate impact on the survival of these populations.

The U.S. Fish and Wildlife Service has determined that 14 Federally listed proposed, threatened, or endangered wildlife species may occur or have habitat in the Grand Canyon area, Coconino County. The majority of the listed species are not known to occur in project areas. Occasionally, during the late fall and winter months, California condors (*Gymnogyps californianus*) will scavenge along the river corridor and some side canyon areas. They also may perch or roost for the night, and they may utilize the larger tamarisk trees. The No Action alternative would allow for this; however, the use of tamarisk in side canyons has not been documented.

In 1998, new wild populations of Kanab ambersnails were translocated to three locations within GCNP: Key Hole Spring, Upper Elves Chasm, and Lower Deer Creek (USFS 1998). Tamarisk do not currently exist in these areas, but the colonization and spread of tamarisk into these areas could cause increases in salinity which could have potential long-term, negligible to minor impacts to these populations. Should tamarisk spread into these areas, the shade provided by tamarisk may provide minor, beneficial impacts to the populations.

Southwestern willow flycatchers are known to utilize dense tamarisk stands for nesting and breeding. While this is not the preferred habitat, the use of thickets has been documented. The continued spread, colonization, and dominance of tamarisk could provide long-term suitable habitat for the endangered

southwestern willow flycatcher. The spread of tamarisk could also alter the floristic composition of remaining native habitat that would be preferred by the flycatchers.

Cumulative Effects

Should the California condor population expand and further disburse in the future, the birds may utilize side canyons as roosts and perches. While they are not currently known to utilize tamarisk, they may in the future. Under that scenario, which has not been documented, the continued spread of tamarisk could produce beneficial impacts.

Additional surveys for leopard frogs will be completed in the spring of 2002. If any new populations are identified, tamarisk spread in those areas could potentially impact the populations, primarily through additional shading. However, increase salinity could produce negative impacts to leopard frogs.

Future tamarisk spread in Lower Deer Creek Spring, Upper Elves Chasm, and Key Hole Springs (Kanab ambersnail establishment sites) has the potential to beneficially impact new populations of Kanab ambersnail through and increase in shade. However, Kanab ambersnails are not known to utilize tamarisk; should tamarisk colonize these areas and outcompete other vegetation, there could be a negative impact on the snails. Populations may negatively be impacted through increase salinity.

Cyclic maintenance of trails and inventorying and monitoring of archaeological sites will continue to occur in the inner canyon; these activities have a negligible effect on the park's threatened, endangered or sensitive species. The cumulative effect of the No Action alternative on the park's threatened, endangered and sensitive species, in combination with other past, present, and reasonably foreseeable future actions in the inner canyon, would be negligible to minor.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

The No Action alternative would not directly affect any threatened, endangered or sensitive species. The continued spread of tamarisk could have long-term, minor to moderate, beneficial or adverse impacts on southwestern willow flycatcher habitat. Likewise, the continued spread of tamarisk into Kanab ambersnail could produce long-term, negligible to minor, adverse or beneficial impacts on Kanab ambersnail populations. For the remaining species, the continued spread of tamarisk could have long-term, minor to moderate impacts on the survival of the populations. The cumulative effect of the No Action alternative on the park's threatened, endangered and sensitive species, in combination with other past, present, and reasonably foreseeable future actions in the inner canyon, would be negligible to minor.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

The Federal and state listed plant species are not known to exist in the proposed project areas. This determination is based on specific knowledge of the areas, knowledge of the species in question, and professional judgement. The U.S. Fish and Wildlife Service concurs that there would be no effect on any of the Federal or state listed plant species under the proposed action alternative.

During herpetofaunal inventories in consecutive years (1999-2001), an amphibian search documented three sites where leopard frog tadpoles were observed and verified. Both are areas of high visitor use

(Grand Canyon National Park Science Center, unpublished data), and none of the sites are in the proposed project areas; therefore, this action alternative would have no known impacts on established populations of leopard frogs.

One formerly listed species, American peregrine falcon (*Falco peregrinus anatum*), and one formerly proposed species, northern goshawk (*Accipiter gentillis*), occur in the park but are not on the U.S. List of Threatened and Endangered Species. This project would not impact these species.

Indirectly and cumulatively, triclopyr, the preferred herbicide for use in this project, has little if any potential to accumulate in aquatic organisms and is practically nontoxic to fish, invertebrates and mammals. The selective herbicide application methods used under this alternative would minimize any potential effects, which overall would be short-term and negligible. The project would not affect habitat considered critical for spawning or breeding of any of the listed species.

Occasionally, during the late fall and winter months, California condors (*Gymnogyps californianus*) will scavenge along the river corridor and some side canyon areas. They also may perch or roost for the night. Should the condors scavenge, perch or roost in areas of project implementation, all activity by the project crew would cease until the time that birds disperse and leave the immediate vicinity. With this mitigation measure in place, there should be no impact to the park's experimental population.

In the draft EA for the establishment of a wild population of Kanab ambersnails (*Oxyloma haydeni kanabensis* Pilsbry) within GCNP, eleven sites in are listed as optimum or desirable in biological and environmental conditions (USFWS 1998). The preferred alternative included the establishment of populations at Lower Deer Creek Spring, Upper Elves Chasm, and Key Hole Springs; tamarisk is not currently known to occur in these areas; therefore, there would be no direct effect on the populations from this alternative.

The tributaries that contain potentially suitable habitat for the southwestern willow flycatcher include, but are not limited to Shinumu Canyon, Tapeats Canyon, Deer Creek Canyon, Havasu Canyon, Kanab Canyon, Spring Canyon and Three Springs Canyon. These areas are included in Phase III of the proposed project along with Upper Carbon Canyon and the Lower Little Colorado River, which may also contain potentially suitable habitat based on initial Habitat Assessments completed in 1999. The park would have to consult with the USFWS after the completion of full survey protocol in these areas and would not proceed with any removal efforts until consultation is completed. If additional potential habitat is detected in other areas, consultation will need to be completed prior to any tamarisk management. With the adoption of these changes, the USFWS concurred with the "may affect, is not likely to adversely affect" determination for this project. The NPS will continue to maintain contact with the USFWS to ensure compliance with Endangered Species Act Regulations.

The preferred alternative, based on initial consultation with the USFWS, would have negligible to minor impacts on any of the park's threatened, endangered or sensitive species.

Cumulative Effects

Should the California condor population expand and further disburse in the future, the birds may utilize side canyons as roosts and perches. While they are not currently known to utilize tamarisk, they may in the future. However, condors would probably seek out larger willow and cottonwood trees prior to the use of tamarisk. Additional surveys for leopard frogs will be completed in the spring of 2002. If any new populations are identified, tamarisk management in those areas could potentially impact the populations, primarily through trampling. If new populations are identified, additional consultation with USFWS would be necessary. Since tamarisk management actions would not occur during the breeding season of the leopard frogs, there should be no impacts to any newly discovered populations.

Future tamarisk management in Lower Deer Creek Spring, Upper Elves Chasm, and Key Hole Springs (Kanab ambersnail establishment sites) has the potential to impact new populations of Kanab

ambersnail through shade removal, trampling or salinity changes. However, coordination of actions and consultation with the USFWS would minimize any potential impacts. Cyclic maintenance of trails and inventorying and monitoring of archaeological sites will continue to occur in the inner canyon; these activities have a negligible to minor effect on the park's threatened, endangered or sensitive species. The cumulative effect of the preferred alternative on the park's threatened, endangered and sensitive species, in combination with other past, present, and reasonably foreseeable future actions in the inner canyon, would be negligible to minor.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

The proposed action would have short-term, negligible to minor effect on the 21 listed plant, aquatic, mammal, and reptile species, and the three birds, bald eagle, Mexican spotted owl, California condor, that occur in the vicinity of Grand Canyon National Park. The initial Biological Assessment for Phase I project sites, which the USFWS concurred with, stated that there would be *NO EFFECT* on these species under this alternative. The overall conclusion of the initial consultation with the USFWS on the southwestern willow flycatcher, was that the proposed action *MAY AFFECT – IS NOT LIKELY TO ADVERSELY AFFECT* the species. With mitigation measures in place and continued contact and consultation with the USFWS for the additional phases, this action alternative would have short-term, negligible, if any, direct or indirect impacts to any of the park's listed species. The cumulative effect of the preferred alternative on the park's threatened, endangered and sensitive species, in combination with other past, present, and reasonably foreseeable future actions in the inner canyon, would be negligible to minor.

Vegetation

Impacts of Alternative A – No Action

Impact Analysis

The No Action alternative would maintain the existing vegetation communities and trends. There would be no direct impacts to vegetation from implementing this alternative. However, there would continue to be long-term, minor to moderate, adverse impacts to vegetation under this alternative as tamarisk populations continue to spread and dominate some of the proposed project areas. This trend has been observed in numerous riparian areas throughout the southwestern United States. A constant source of seed would remain available in the park's side canyons and tributaries. Tamarisk can exclude and outcompete native plant species for valuable resources such as nutrients and water.

Cumulative Effects

There would be no new cumulative impacts to vegetation under this alternative. There are no additional foreseeable past, present or future impacts to vegetation (by humans or park management) in the park's side canyons and tributaries that would add to the impacts on native vegetation. As tamarisk populations continue to spread into tributaries and side canyons, a constant seed source would be maintained in those areas; this source of seed would continue to expand in the future. Natural processes, such as flash flooding, are part of the natural system in these areas and would continue to occur, unpredictably, in the future. It should be noted that a large flash flood has the potential to remove the majority of the vegetation in a tributary (i.e. Stone Creek flood of 1999). While this is not a human caused impact, it can reset the process of plant succession and colonization. If the seed source for tamarisk remains in the tributaries, the seedlings of this species could establish, dominate, and

outcompete the native species. Past, present and future human and wildlife use of the tributaries and water sources causes trampling and impacts to the native vegetation and may contribute to the alteration of plant communities through disturbance and the importation of other exotic plant species' seeds. The cumulative effect of the No Action alternative on the park's vegetation, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, and of minor to moderate intensity in the majority of the proposed project areas.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

Under this alternative, there would not be any direct impacts to vegetation due to tamarisk removal. There would continue to be adverse, long-term, minor to moderate, direct and indirect impacts to native plant communities and vegetation under this alternative. The cumulative effect of the No Action alternative on the park's vegetation, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, and of minor to moderate intensity in the majority of the proposed project areas.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

During control efforts, vegetation in the project areas may be trampled as workers access tamarisk to implement control actions and to monitor the project. Having the fewest workers in the area at any time would minimize these direct impacts; however, a short-term, minor, direct adverse impact would still occur. The follow up maintenance and monitoring of the project areas would add to this impact; however, access would be limited to one visit per year for the more remote sites. Garlon, particularly with selective application, is not known to impact non-target plant species; therefore, the overall impact would be short term and negligible. When manually removing seedlings and saplings, there is the potential to disturb the root system of neighboring plants. This impact would be localized, short term, and minor. Particularly since very selective control methods would be used, overall impacts to non-target plant species would be negligible to minor, localized, and short-term.

Nonnative tamarisk can outcompete native plant species and create an environment in which they cannot regenerate; under this alternative, tamarisk would be removed from the project areas. Once tamarisk has died and the seed source is removed, native plant species would recover and colonize, which is an indirect, long-term beneficial impact under this alternative. In areas with a limited number of tamarisk trees, it may not be currently competing with or dominating the native species; however, even in those areas, the unnatural, exotic seed source would be removed, which is a short and long-term, minor, beneficial impact. Community structure and composition would be directly altered with the implementation of this alternative, a minor to moderate short-term impact, but in the long-term would return to a natural state. The majority of sapling and mature tamarisk would be left in place to die under this preferred alternative; therefore, the recovery of native plant communities may be delayed a few years. The tamarisk canopy would remain for a few years in some areas, limiting the light and ability of native species to colonize the areas. For the project areas with dense tamarisk patches (a few in Phase II and all of Phase III areas), active revegetation methods would be employed. This method would have direct, beneficial, moderate, long and short-term impacts on the recovery of native plant communities.

This alternative would also increase the potential fire hazard in the project areas, particularly those with dense stands. If a fire were to ignite, there is a potential for minor to moderate, short-term or long-term, direct adverse impacts to the native vegetation.

Cumulative Effects

Follow-up maintenance and monitoring would add to negative effects of this alternative on vegetation. The majority of project areas are in drainages, washes and side canyons for which there are currently no proposed actions that would add to the effects this alternative would have on vegetation. However, if the BLM, USFS or tribes initiate control actions in these drainages outside park boundaries, there could be additional impacts. Impacts from trampling would remain negligible to minor under this scenario. Past, present and future human and wildlife use of the tributaries and water sources causes trampling and impacts to the native vegetation and may contribute to the alteration of plant communities through disturbance and the importation of other exotic plant species' seeds. In combination with other past, present and reasonably foreseeable future actions, the cumulative effect of this action alternative would range in intensity from negligible to moderate.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

There would be short-term, negligible to minor, adverse impacts to non-target vegetation from methods used in this alternative. There would also be long-term, minor to moderate, beneficial impacts to native vegetation from tamarisk removal (Refer to Carpenter and Murray 1998 for additional references). In combination with other past, present and reasonably foreseeable future actions, the cumulative effect of this action alternative would range in intensity from negligible to moderate, adverse and beneficial.

Water Quality and Wetlands

Impacts of Alternative A – No Action

Impact Analysis

There would be no new impacts to water quality or wetlands as a result of the No Action alternative. However, tamarisk populations would continue to spread, which could produce indirect and direct long-term impacts to water quality and wetlands. Tamarisk usurps valuable water and can eliminate wetland ecosystems over time. The rate of spread and the loss of water are difficult to predict, however, this trend is well documented in the literature and would be considered an adverse impact of minor to moderate intensity. The diversity of wetland flora and fauna would be diminished as tamarisk dominates the system. In addition, salts would continue to be exuded from tamarisk leaves and deposited into the water. This alters water quality, and may produce a long-term, minor effect on the wetland vegetation.

In most areas, tamarisk is found only directly in the stream and wash channels. However, in some locations, tamarisk may be aiding in stabilizing the banks. Under this alternative, tamarisk would continue to stabilize banks. During flood events, the presence of tamarisk may actually decrease the amount of short-term sedimentation added to the system. This beneficial impact of tamarisk would continue. However, during severe flood events, even tamarisk is washed downstream as the stream or wash channel is altered. This is part of the natural events in many of the canyon's tributaries, and the stability produced by tamarisk could actually be considered an unnatural part of the system.

Cumulative Effects

Water quality may be altered as salts are exuded from tamarisk leaves and may be deposited into the water. The trend of increased tamarisk thickets would have long-term effects on these resources and may actually deplete the entire wetland resource in some areas. Human use and presence in some of the project areas can disturb wetland ecosystems and result in direct impacts to water quality. Depending on the type of water source (i.e. small pools with little recharge or large streams with flowing water), and the extent of the use of the source by park visitors, water quality may decline in the future. These water sources are often necessary for drinking water for backcountry hikers, and many of the larger sources are used by backpackers and river runners for swimming and/or soaking. The cumulative effect of the No Action alternative on water quality and wetlands in the majority of the project areas, in combination with other past, present and reasonable foreseeable future actions, would be adverse, long term, and of minor intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

Since this alternative would not implement control efforts, there are no direct impacts to water quality or wetlands. Under this alternative, tamarisk populations would not be controlled; therefore, they would continue to spread and impact sensitive wetland areas resulting in long-term, minor to moderate adverse impacts. This trend is well documented in the literature (refer to Carpenter and Murray 1998 for additional references), and has been observed in numerous riparian areas throughout the southwestern United States. The cumulative effects of this alternative on water quality and wetlands, in combination with other past, present and reasonably foreseeable future actions, would be adverse, long term, and of minor to moderate intensity.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

Water quality elements that affect aquatic ecosystems include water temperature, dissolved oxygen, suspended sediment, nutrients, and chemical pollutants. There may be short-term, direct, increases in sedimentation in project areas. For manual removal of seedlings and saplings, there is soil disturbance that could affect sedimentation levels directly and also contribute to short-term, increases in nutrients in water bodies in project areas. In areas with dense tamarisk cover, the ultimate removal of the overstory (once the trees have died) could result in an increase in water temperature. However, the increase should correspond with natural water temperature level prior to tamarisk encroachment. For all of these impacts, the intensity would be negligible to minor. There would be a beneficial, indirect increase in water quantity and wetland health over time as the tamarisk is removed from the systems.

In most areas, tamarisk is found only directly in the stream and wash channels. However, in some locations, tamarisk may be aiding in stabilizing the banks. Under this alternative, tamarisk would continue to stabilize banks for a few years as a combination of control methods are used. During flood events, the presence of tamarisk as standing dead may actually decrease the amount of short-term sedimentation added to the system. This beneficial impact, although it may be considered unnatural, would continue for a few years until the tamarisk trees fall over or are removed from the system through flooding.

Tamarisk removal will aid in the restoration of natural wetland environments. Many of the native wetland plant species require water and cannot compete with the extensive root system of tamarisk for

this valuable resource. Some of these plant species are not able to grow in the saline soil environment that is produced by tamarisk. After removal, native plant species will be able to re-establish in wetland environments and natural wetland cycles will be restored. This is a long-term, beneficial, minor to moderate impact under this alternative.

This alternative proposes the use of triclopyr (Garlon 3A and 4) to control tamarisk. The use of any chemical near water sources creates a direct and indirect risk of chemical pollution. The U.S. Forest Service conducted extensive research into the properties and risks involved with the use of this chemical (Refer to USDA 1992 and USDA 1998). Leaching rates of Garlon are low and should not impact water quality in project areas (negligible if any impact); the ester and amine salt formations associated with triclopyr rapidly neutralize into relatively non-toxic salts and are degraded by soil microorganisms. Herbicide application would be done selectively under this alternative, which would minimize the chance of chemical pollutants through spillage (refer to mitigation measures discussed earlier in this chapter). Garlon 3A is recommended for direct use near water and would be used in place of Garlon 4 when application is in or near sensitive water bodies. See Appendix D, Garlon 3A and Garlon 4.

Cumulative Effects

If extensive follow-up maintenance is required, the impacts described above may be increased. The impacts may also increase if additional tamarisk management efforts are implemented outside of park boundaries in the future. Until control actions are implemented in each project area, water quality may continue to be altered as salts are exuded from tamarisk leaves and may be deposited into the water. Human and wildlife use and presence in some of the project areas can disturb wetland ecosystems and result in direct impacts to water quality. Depending on the type of water source (i.e. small pools with little recharge or large streams with flowing water), and the extent of the use of the source by park visitors, water quality may decline in the future. These water sources are often necessary for drinking water for backcountry hikers, and many of the larger sources are used by backpackers and river runners for swimming and/or soaking. The cumulative effect of this action alternative on water quality and wetlands in the majority of the project areas, in combination with other past, present and reasonable foreseeable future actions, would be adverse, long term, and of minor intensity. However, there would also be beneficial long term effects, of minor to moderate intensity, on both of these resources should this alternative be implemented.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

There may be overall short-term, negligible to minor, adverse water quality impacts under this alternative. The impact of increased water temperature may be a long-term, minor adverse impact since it would not be realized until the overstory tamarisk fall over or are washed downstream. There would also be long-term, minor to moderate beneficial water quality and wetland impacts under this alternative since tamarisk would no longer usurp the majority of the water and nutrient resources in the area. The wetland functions would be restored over the long-term. There would be short-term, negligible, impacts to water quality due to the use of Garlon. The cumulative effect of this action alternative on water quality and wetlands in the majority of the project areas, in combination with other past, present and reasonable foreseeable future actions, would be adverse, long term, and of minor intensity.

Wildlife

Impacts of Alternative A – No Action

Impact Analysis

There would be no direct impacts to wildlife with this alternative. However, there could be numerous indirect effects through the spread of tamarisk in the proposed project areas. Tamarisk usurps valuable water and can eliminate aquatic ecosystems over time. Many wildlife species depend on this resource in the desert environment of the inner canyon. There may also be a net loss of native habitat for species such as neotropical migrants, aquatic organisms and mammal species. This would be a direct, long-term, minor to moderate impact. Some wildlife species, such as bats, small birds, and many insect species may rely on tamarisk for foraging and habitat; under this alternative, the tamarisk patches would be preserved or would expand, which could provide a continued long-term, beneficial use for these species.

Cumulative Effects

There would be no new direct cumulative impacts under the No Action alternative. However, the trend of increased tamarisk thickets would have long-term negative effects on some wildlife species and beneficial effects for others. Human visitation would continue to increase in some of the proposed project areas, which can have a minor adverse effect on wildlife species, the majority of which are habituated to some level of disturbance and human activity. The cumulative effect of this No Action alternative on wildlife in the majority of the project areas, in combination with other past, present and reasonable foreseeable future actions, would be adverse and beneficial, long term, and of minor to moderate intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

Since this alternative would not implement control efforts, there are no direct, adverse impacts to wildlife. The loss of native vegetation due to encroachment of tamarisk may result in the net loss of habitat and subsequent loss of neotropical migrants and declines or alterations in other mammal, insect, and aquatic organism communities. This would be a long-term, minor to moderate, adverse impact. The beneficial impacts and uses of tamarisk for some species would continue under this alternative. The cumulative effect of this No Action alternative on wildlife in the majority of the project areas, in combination with other past, present and reasonable foreseeable future actions, would be adverse and beneficial, long term, and of minor to moderate intensity.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

There may be short-term direct sedimentation increases in project areas. Manual removal of seedlings and some saplings creates soil disturbance that could affect sedimentation levels directly and also contribute to short-term nutrient increases in water bodies in project areas. The use of lance injection, hack and squirt, cut stump method and basal bark herbicide applications for saplings and mature trees would minimize this impact; however, manual removal of seedlings is a major component of this alternative. Increased sedimentation may produce a short-term negligible adverse impact to aquatic organisms. The removal of overstory vegetation would result in a direct increase in water temperature, which may have a minor direct or indirect impact on aquatic organisms. This impact would be

minimized under this alternative since the maturity of the overstory would remain in place and fall over time. The majority of the debris would be left on site to decompose, which would also provide long-term, beneficial, minor impacts for some species as it would provide habitat and cover.

Direct and indirect negative, negligible to minor impacts to amphibians may be incurred by walking through the pools and streams that contain their eggs, tadpoles, and young. Disturbances caused by walking through areas where toads and frogs are found range from stirring up sediment in the water, trampling eggs, tadpoles, and young, disrupting their foraging efforts, and adding sunscreen and other contaminants to the water.

There may be an indirect, minor to moderate adverse impacts to species that utilize the tamarisk in side canyons. These include insects and animals that consume the insects, such as birds, bats, and lizards. Future monitoring efforts would be needed to analyze the rate of recovery of native flora species following removal of tamarisk and the displacement of small mammals, birds, bats, and herpetofaunal while the native vegetation recovers. Peregrine falcons and other birds that forage on bats and small birds that utilize tamarisk patches may be adversely impacted; however, due to the dominance and presence of tamarisk in the primary river corridor, this impact would be considered negligible to minor. Several bird species are known to nest in tamarisk in the Grand Canyon; the removal of tamarisk would cause short-term, minor impacts to these species. Since the control work would be completed outside of the breeding season, the impacts would be considered negligible. Some birds may continue to nest in the standing tamarisk trees, however, as the trees die, they would not provide suitable cover; this may produce adverse, minor to moderate, impacts on those species during the breeding season following the control work.

Extensive toxicity tests and literature searches have been completed on potential effects of triclopyr (EXTOXNET 1996, SERA 1996, USDA 1992 and USDA 1998). Toxicity tests on birds and mammals suggest that triclopyr has a low order of acute oral toxicity. The toxicity of triclopyr to fish and aquatic invertebrates is relatively well characterized. Some aquatic insects may be more sensitive than other aquatic animals (SERA 1996). Indirectly and cumulatively, triclopyr has little if any potential to accumulate in aquatic organisms and is practically nontoxic to fish and invertebrates. The selective herbicide application methods used under this alternative would minimize any potential effect, which would be classified as negligible to minor.

Beneficial impacts would include the restoration of native flora species that may have a positive impact on the retention of the population of southwestern willow flycatchers and neotropical migrants, and many native insect and mammal species. Tamarisk currently usurps valuable water from riparian areas, seeps and springs. Following the removal of tamarisk from these systems, water levels would increase in some areas, restoring this valuable resource that wildlife depend on in the park's desert environments.

Cumulative Effects

If extensive follow-up maintenance is required, the impacts described above may be increased. The impacts may also increase if additional tamarisk management efforts are implemented outside of park boundaries in the future. Triclopyr rapidly breaks-down to non-toxic substances and would pose a negligible cumulative effect to wildlife. Human visitation would continue to increase in some of the proposed project areas, which can have a minor adverse effect on wildlife species, the majority of which are habituated to some level of disturbance and human activity. The cumulative effect of this action alternative on wildlife in the majority of the project areas, in combination with other past, present and reasonable foreseeable future actions, would be adverse and beneficial, long term, and of minor to moderate intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand

Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

There would be long-term beneficial impacts to the majority of wildlife species once tamarisk is removed and native vegetation recovers. There may be short-term minor adverse impacts to some wildlife species, primarily due to trampling during control efforts. There may be short-term negligible adverse impacts to wildlife species that depend on tamarisk for nesting and habitat. Since the majority of the tamarisk trees would be left standing to die, the wildlife species utilizing tamarisk during project implementation would not be immediately displaced. The cumulative effect of this action alternative on wildlife in the majority of the project areas, in combination with other past, present and reasonable foreseeable future actions, would be adverse and beneficial, long term, and of minor to moderate intensity.

Cultural Resources

Cultural resources are defined as aspects of cultural systems valued by or significantly representative of a culture or that contains significant information about a culture. A cultural resource may be a tangible entity or a cultural practice. Tangible cultural resources are categorized as districts, sites, buildings, structures, and objects for the National Register of Historic Places and as archaeological resources, cultural landscapes, structures, museum objects, and ethnographic resources for NPS management purposes (DO-28 179-180). Within the affected environment of this project, cultural resources representing ethnographic, traditional cultural properties, archaeological, historical, and cultural landscapes have been identified.

Methodology

Cultural resources will be analyzed following the National Historic Preservation Act of 1966 (as amended through 2000) and its implementing regulations 36 CFR 800. The National Historic Preservation Act requires agencies to take into account the effects of their actions on properties listed or eligible for listing on the National Register of Historic Places. The process begins with identification and evaluation of cultural resources for National Register eligibility, followed by assessment of effect on those eligible resources, and concluding after consultation. If an action could change the characteristics that qualify the resource for inclusion on the National Register, it is considered to have an effect. **No historic properties affected** means that no cultural resources are effected. **No adverse effect** means there could be an effect, but the effect would not be harmful to those characteristics that qualify the resource for inclusion on the National Register. **Adverse effect** means the effect could diminish the integrity of the characteristics that qualify the resource for the National Register.

Definitions

The following will be used to describe cultural resource impacts for the Tamarisk Management and Tributary Restoration project:

Negligible	The impact is at the lower levels of detection; for National Register properties, there is no change in any character-defining features of the resource (no adverse effect).
Minor	The impact is slight, but detectable (no adverse effect).
Moderate	The impact is readily apparent; for National Register properties, the effect would not be harmful to those characteristics that qualify the property for inclusion on the National Register (no adverse effect).

Major — The impact is severely adverse or exceptionally beneficial; for National Register properties, the effect would be harmful to character-defining features of the National Register site (adverse effect).

Ethnographic Resources and Traditional Cultural Properties

Impacts of Alternative A – No Action

Impact Analysis

The No Action alternative would have no direct adverse effect on TCPs and ethnographic resources. Inventories of ethnographic resources were conducted for the Glen Canyon Dam Environmental Impact Statement (FEIS 1994). If no action were taken, the ethnographic resources and traditional cultural properties would be left as they are; no direct impacts would occur. However, as time passes, and nothing is done with tamarisk growth, indirect impacts could occur throughout the canyon at these resources. For example, the spread of tamarisk could disturb collection areas and native riparian areas, and wane spring ecosystems.

Cumulative Effects

No long-term cumulative effects are anticipated with this action. However, the trend of increased tamarisk thickets could have long-term negative effects on some ethnographic resources and TCPs. Reasonably foreseeable future actions include the continued use and negligible degradation of these areas by park visitors. These impacts, coupled with the impacts of the No Action alternative, would be adverse, of minor overall intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), Grand Canyon National Park concludes that the No Action alternative would have *no adverse effect* on the ethnographic resources, including traditional cultural properties.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

Ethnographic and TCP documents produced as a result of the Glen Canyon Dam FEIS (1994) indicate that these resource types would not be effected directly by the proposed project. Mitigative measures would involve tribal members culturally affiliated with Grand Canyon. Because they are IDT participants there is confidence the proposed work would not have an adverse effect on any sensitive locations. Indirectly, springs and collection areas, may be modified. For example, there could be an increase in water quantity and wetland health over time as the tamarisk is eradicated. An additional benefit is that once tamarisk have died, native plant species would recover and colonize. Furthermore, access to these sensitive areas may be more direct and less of a safety hazard. For example, walking through tamarisk thickets is difficult for visitors of all ages, especially the elderly. Tamarisk removal may benefit access by tribal members culturally affiliated with Grand Canyon.

Cumulative Effects

The actual removal of the tamarisk will primarily occur in the drainage areas. There is no anticipation of removing tamarisk from, or proximal to areas where ethnographic resources or TCPs exist and any indirect impacts that may occur, as discussed in the above paragraph, could be beneficial to the resources. Therefore, long-term cumulative effects would be negligible to minor (no adverse effect).

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), Grand Canyon National Park concludes that the implementation of Alternative B would have *no adverse effect* on the ethnographic resources, including traditional cultural properties.

Archaeological and Historical Resources and Cultural Landscapes

Impacts of Alternative A – No Action

Impact Analysis

If the No Action alternative were applied, cultural landscapes and historical and archaeological properties would remain in their similar state and there would be a no adverse effect. However, throughout the years as tamarisk populations expand to the higher terraces where archaeological and historical resources are located, disturbance to the resources may occur. This type of disturbance may cause displacement of structures and artifacts (due to root disturbance), resulting in loss of information and inaccurate documentation.

Cumulative Effects

There are no long-term cumulative effects to these resources from this alternative. However, as mentioned above, if tamarisks are not removed they may expand to areas where archaeological and historical resources exist. This expansion would create misrepresentation of the archaeological record due to overgrowth and root disturbance.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), Grand Canyon National Park concludes that the No Action alternative would have *no adverse effect* on archeological and historic resources.

Impacts of Alternative B - Preferred Alternative

Impact Analysis

The impact of this alternative is at the lower levels of detection. For National Register properties, there is no short- or long-term change in any character-defining features of the resource (no adverse effect) because the disturbance would be concentrated in the drainages and not on the terraces where archaeological and historical materials are identified. In some instances removal of tamarisk may destabilize a dune, causing bank slump. In this case, it is possible that, through time, the destabilization of the dunes could cause destabilization of the terraces behind the dunes, where archaeological and historical sites are located. However, through monitoring effects reestablishment of native species would curtail this type of bank erosion. An archaeologist will accompany each tamarisk management expedition. Because of this involvement, there is confidence that mitigation measures would include avoidance and appropriate documentation of any inadvertent discoveries. If during implementation of the project previously unknown archeological resources are discovered, all work in the immediate vicinity of the discovery would be halted until the resources could be identified and documented and an appropriate mitigation strategy developed in consultation with the state historic preservation officer and associated tribes, as necessary.

Cumulative Effects

The actual removal of the tamarisk will primarily occur in the drainage areas. There is no anticipation of removing tamarisk from, or proximal to terraces where archaeological and/or historical sites, or cultural landscapes are situated. If there would be long-term cumulative effects, such as described in the paragraph above, it is anticipated that they would be negligible to minor (no adverse effect).

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

After applying the Advisory Council on Historic Preservation's criteria of adverse effects (36 CFR Part 800.5, *Assessment of Adverse Effects*), Grand Canyon National Park concludes that the implementation of Alternative B would have *no adverse effect* on archeological and historic resources.

Wilderness and Visitor Resources

The NPS is mandated to preserve and protect wilderness resources through the Wilderness Act of 1964; Director's Order 41, Wilderness Management; NPS Management Policies, 2001; the GCNP General Management Plan, and the GCNP Resource Management Plan. GCNP wilderness management seeks to provide outstanding opportunities for solitude or a primitive and unconfined type of recreation, and the opportunity for connection with an undisturbed nature, rather than an unnatural one. The analysis of impacts to wilderness and visitor resources will use the same methodology as those used in the natural resource analysis section.

Wilderness

Impacts of Alternative A – No Action

Impact Analysis

The No Action alternative would not cause direct impacts on wilderness resources since no implementation actions would occur. However, the Wilderness Act states that wilderness areas will be

managed to preserve natural conditions. Without action, indirect impacts will occur, including loss of wilderness primeval character and influence and natural conditions due to tamarisk encroachment. The continued spread of tamarisk alters natural processes, such as fire frequency and intensity, which should be preserved as part of the park's wilderness.

Cumulative Effects

Over time, adverse indirect effects of the No Action alternative would include loss of riparian habitat and natural conditions and processes in this wilderness area in direct violation of Wilderness Act requirements. This alternative could also impact future tamarisk management projects outside park boundaries since the park would remain a seed source. The cumulative effect of the No Action alternative on the park's wilderness resources, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of minor to moderate intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

Although no direct impacts on wilderness would result from failure to implement management actions, the cumulative impact would include continuing nonnative plant encroachment and ensuing loss of natural conditions. The alternative would have minor to moderate, long-term adverse indirect impacts on wilderness resources, and would leave the NPS out of compliance with laws, NPS policies, and regulations. The cumulative effect of the No Action alternative on the park's wilderness resources, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of minor to moderate intensity.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

Management efforts described in Alternative B would incur direct, short-term, minor, localized impacts including soil and vegetation disturbance, girdled trees, some cut stumps, and scattered debris. These impacts would suggest human management of the project areas; however, this appearance would be short term as native ecosystems and plant communities would recover. A minor, direct, change in community structure would occur as treated plants left in place decay and die. Beneficial impacts include the restoration of natural processes, such as fire frequency, and natural ecosystem structure and function.

Cumulative Effects

Since the project would be implemented in phases, impacts would be spread over a number of years minimizing damage to any one location or to the project areas as a whole. The cumulative effect of this action alternative on the park's wilderness resources, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of minor intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

Although direct adverse impacts would include short-term, minor and localized soil, vegetation and structure disturbance, benefits to the natural environment would include long-term recovery of natural systems and processes. The cumulative effect of this action alternative on the park's wilderness resources, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, of minor intensity.

Visitor Experience

Impacts of Alternative A – No Action

Impact Analysis

There would be no direct impact to visitor experience due to implementation actions under the No Action alternative. However, the continued loss of native riparian and desert scrub plant communities could be considered a negative direct or indirect impact to the visitor's experience of Grand Canyon National Park. The park contains some of the nation's last remaining intact desert riparian ecosystems, and continued loss of these areas due to tamarisk encroachment and dominance would produce long-term, negative, minor to moderate impacts to the experience of backcountry users.

Cumulative Effects

Adverse indirect effects of Alternative A, No Action, could stem from the park's failure to implement tamarisk management actions including the loss of the experience of natural conditions. Other work projects, such as archaeological inventories and trail maintenance, occur in the park's side canyons and tributaries. These activities produce localized, short-term, negligible to minor impacts on the visitor's experience and will continue to occur as part of cyclic maintenance and protection of park resources. The cumulative effect of the No Action alternative, in combination with other past, present, and reasonably foreseeable future actions, would be adverse and of minor to moderate intensity.

Conclusion

The Alternative A, No Action, would have no direct adverse impact on visitor experience due to management efforts. There would be indirect, long-term, minor to moderate adverse impacts to visitor experience of natural conditions should tamarisk be allowed to spread. The cumulative effect of the No Action alternative, in combination with other past, present, and reasonably foreseeable future actions, would be adverse and of minor to moderate intensity.

Impacts of Alternative B – Preferred Alternative

Impact Analysis

Although many project areas are outside heavily visited backcountry areas, some are near primary attraction sites. Management efforts described in Alternative B would incur direct, short-term, minor to moderate, localized impacts to visitors encountering river trips and work crews. Direct short-term, minor, localized visual impacts would occur from evidence of work including soil and vegetation disturbance, girdled trees, some cut stumps, and scattered vegetation.

Mitigation efforts described in Chapter 2 would minimize impacts to visitor experience. Time and native vegetation would lessen visual impacts associated with tamarisk management. Long-term, indirect beneficial impacts such as increased vegetation diversity and movement toward more natural and sustainable ecosystems would also occur.

Cumulative Effects

Since visitors would not come into contact repeatedly or for long periods, no known cumulative impacts would result from the implementation of Alternative B. However, other work projects, such as archaeological inventories and trail maintenance, occur in the park's side canyons and tributaries.

These activities also produce localized, short-term, negligible to minor impacts on the visitor's experience and will continue to occur during the implementation of this project. The cumulative effect of this alternative, in combination with other past, present, and reasonably foreseeable future actions, would be adverse, short-term, and of negligible to minor intensity.

Impairment

Because there would be no major, adverse impacts to a resource or value whose conservation is (1) necessary to fulfill specific purposed identified in the establishing legislation or proclamation of Grand Canyon National Park; (2) key to the natural or cultural integrity of the park; or (3) identified as a goal in the park's General Management Plan or other relevant National Park Service planning documents, there would be no impairment of the park's resources or values.

Conclusion

The implementation of this alternative would produce short-term, negligible to minor adverse impacts to visitor experience and visual resources. Mitigation measures associated with this alternative should minimize impacts. This alternative creates long-term, minor to moderate, beneficial impacts on visitor experience through native riparian vegetation restoration. The cumulative effect of the No Action alternative, in combination with other past, present, and reasonably foreseeable future actions, would be adverse and of minor to moderate intensity.

5. References, Coordination and Consultation

Regulations, Policies and Laws

Current laws and policies require that the following conditions be achieved in the park:

Desired Condition	Source
Federal- and state-listed threatened and endangered species and their habitats are sustained.	Endangered Species Act
Populations of native plant and animal species function in as natural condition as possible except where special management considerations are warranted.	GCNP Resource Management Plan, 1997
Prevent the introduction of exotic species into national park system units, and remove populations of these species that have already become established in parks. All exotic plant and animal species that are not maintained to meet an identified park purpose will be managed, up to and including eradication, if (1) control is prudent and feasible, and (2) the exotic species: • Interferes with natural processes and the perpetuation of natural features, native species or natural habitats; or • Disrupts the genetic integrity of native species; or • Disrupts the accurate presentation of a cultural landscape; or • Damages cultural resources; or • Significantly hampers the management of park or adjacent lands; or • Poses a public health hazard as advised by the U. S. Public Health Service (which includes the Centers for Disease Control and the NPS Public Health Program); or • Creates a hazard to public safety. High priority will be given to managing exotic species that have, or potentially could have, a substantial impact on park resources, and that can reasonably be expected to be successfully controllable. Lower priority will be given to exotic species that have almost no impact on park resources or that probably cannot be successfully controlled. The decision to initiate management should be	NPS Management Policies, 2001

based on a determination that the species is exotic. For species determined to be exotic and where management appears to be feasible and effective, superintendents should (1) evaluate the species' current or potential impact on park resources; (2) develop and implement exotic species management plans according to established planning procedures; (3) consult, as appropriate, with Federal and state agencies; and (4) invite public review and comment, where appropriate. Programs to manage exotic species will be designed to avoid causing significant damage to native species, natural ecological communities, natural ecological processes, cultural resources, and human health and safety.		
"…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…"	*Executive Order # 13112 Invasive Species*	*1999*
Populations of exotic plant and animal species, up to and including eradication, will be undertaken whenever such species threaten park resources of public health…High priority will be given to the management of exotic species that have a substantial impact on park resources and that can reasonably be expected to be successfully controlled.	NPS-77, Natural Resources Management	
"All Federal land and water management agencies within Interior, NOAA, and Defense have authority to control and manage invasive species as well as restore affected area on their lands and waters. This authority arises from the various agency organic acts and other statues that govern management, used, and planning on the lands and waters under their jurisdiction."	National Invasive Species Council Management Plan 2001	
"…except as necessary to meet the minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons in the area) there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, no other form of mechanical transport, and no structure or installation within any such area."	The Wilderness Act 1964	
The plan's management objectives direct the park to restore altered ecosystems to their natural conditions to the maximum extent possible.	GCNP General Management Plan (GMP) 1995	
The plan calls for nonnative plant population monitoring and removal where feasible. Park specialists prioritized exotic plant species management actions using an NPS-approved	Grand Canyon's Resource Management Plan (RMP) 1997	

standard ranking process. Tamarisk removal from tributaries ranked high on the priority list.	
Federal areas are subject to State and local water quality regulations. Grand Canyon National Park must meet Arizona State Water Quality Standards.	Federal Water Pollution Act as amended in 1972. Section 208.
"…executive agencies shall, to the extent permitted by law, restrict the introduction of exotic species into the natural ecosystems on lands and waters which they own, lease, or hold for purposes of administration and shall encourage States, local governments, and private citizens to prevent the introduction of exotic species into natural ecosystems of the United States."	Executive Order 11987 May 24, 1977
Established (1) that archaeological resources on public and Indian lands are protected, (2) permit requirements for resource excavation or removal, (3) civil and criminal penalties for illegal removal of these resources.	The Archaeological Resources Protection Act 1979 (Public Law 96-95)
Archeological sites are protected in an undisturbed condition unless it is determined through formal processes that disturbance or natural deterioration is unavoidable.	National Historic Preservation Act
No management actions may be taken that could adversely effect values that qualify a river for inclusion in the National Wild and Scenic Rivers System.	NPS Management Policies, 2001
Historic properties are inventoried and their significance and integrity are evaluated under National Register criteria. The qualities that contribute to the eligibility for listing or listing of historic properties on the NRHP are protected in accordance with the Secretary of the Interior's Standards (unless it is determined through a formal process that disturbance or natural deterioration is unavoidable).	National Historic Preservation Act; Executive Order 11593; Archeological and Historic Preservation Act; the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; Programmatic Memorandum of Agreement Among the NPS, Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); NPS Management Policies.
All agencies shall consult with tribal governments prior to taking actions that effect Federally recognized tribal governments. These consultations are to be open and candid so that all interested parties may evaluate for themselves the potential impact of relevant proposals. Parks will regularly consult with traditionally associated native Americans regarding planning, management, and operational decisions that effect subsistence activities, sacred materials or places, or other ethnographic resources with which they are historically associated.	American Indian Religious Freedom Act, Presidential Memorandum of April 29, 1994 on Government-to-Government Relations with Tribal Governments, NPS Management Policies.

All agencies shall accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and avoid adversely effecting the physical integrity of these sacred sites.	E.O. 13007 on American Indian Sacred Sites
Other Federal agencies, state and local governments, potentially effected Native American and other communities, interest groups, State Historic Preservation Officer, and the Advisory Council on Historic Preservation will be given opportunities to become informed about and comment on anticipated NPS actions at the earliest practicable time. All agencies shall consult with tribal governments prior to taking actions that effect Federally recognized tribal governments. These consultations are to be open and candid so that all interested parties may evaluate for themselves the potential impact of relevant proposals. Parks will regularly consult with traditionally associated native Americans regarding planning, management, and operational decisions that effect subsistence activities, sacred materials or places, or other ethnographic resources with which they are historically associated.	National Historic Preservation Act, Programmatic Memorandum of Agreement Among the NPS, Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995), Executive Order 11593, American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, E.O. 13007 on American Indian Sacred Sites, Presidential Memorandum of April 29, 1994 on Government-to-Government Relations with Tribal Governments, NPS Management Policies, American Indian Religious Freedom Act, Presidential Memorandum of April 29, 1994 on Government-to-Government Relations with Tribal Governments, NPS Management Policies
The qualities that contribute to the eligibility for listing or listing of historic properties on the NRHP are protected in accordance with the Secretary of the Interior's Standards (unless it is determined through a formal process that disturbance or natural deterioration is unavoidable).	National Historic Preservation Act; Executive Order 11593; Archeological and Historic Preservation Act; the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; Programmatic Memorandum of Agreement Among the NPS, Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); NPS Management Policies 2001.
Archaeological sites are protected in an undisturbed condition unless it is determined through formal processes that disturbance or natural deterioration is unavoidable In those cases where disturbance or deterioration is unavoidable, the site is professionally documented and salvaged. Appropriate cultural anthropological research is conducted in cooperation with park-associated groups.	National Historic Preservation Act; Executive Order 11593; Archeological and Historic Preservation Act; the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation; Programmatic Memorandum of Agreement Among the NPS, Advisory Council on Historic Preservation, and the National Council of State Historic Preservation Officers (1995); NPS Management Policies 2001.
All agencies shall accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners, and avoid adversely effecting the physical integrity of these sacred.	NPS Management Policies 2001 E.O. 13007 on American Indian Sacred Sites NPS Management Policies, E. O. 13007 on American Indian Sacred Sites

NPS general regulations on access to and use of natural and cultural resources in parks will be applied in an informed and balanced manner that is consistent with park purposes and does not unreasonably interfere with native American use of traditional areas or sacred resources and does not result in degradation of park resources.	

Current laws and policies require the analysis of potential effects to determine whether or not actions will impair park resources.

Desired Condition	Source
While Congress has given the Service the management discretion to allow certain impacts in parks, that discretion is limited by the statutory requirement (enforceable by the Federal courts) that the park service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The impairment that is prohibited by the Organic Act and the General Authorities Act is an impact that, in the professional judgment of the responsible NPS manager, will harm the integrity of park resources or values, including the opportunities that otherwise will be present for the enjoyment of those resources or values. Whether an impact meets this definition depends on the particular resources and values that will be effected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts.	NPS Management Policies, 2001
Requires an Environmental Assessment (EA) or Environmental Impact Statement (EIS) for those actions or projects that could adversely effect listed or eligible cultural resources, natural resources, socioeconomic resources, visitors, and traditional cultural resources regardless of National Register eligibility. This EA follows the DO-12 format.	Director's Order-12, Conservation Planning Environmental Impact Analysis and Decision Making
Apply DO-41 to management actions carried out within the framework of a park's general management plan, the Government Performance and Results Act, a park's natural and cultural resources plans, and the park's wilderness management plan. It also states NPS wilderness policies apply regardless of category. Further, The National Park Service will apply the minimum requirement concept to all administrative activities that effect the wilderness resource and character. And lastly, The minimum requirement process will be conducted through appropriate environmental analysis (e.g., environmental	Director's Order-41, Wilderness Preservation and Management 1999

assessment/FONSI, or an environmental impact statement/record of decision. The Minimum Requirement Analysis completed for the Tamarisk Management and Tributary Restoration Project is included as Appendix C.	
Mandated that Federal agencies "…protect and preserve American Indian religious cultural rights and practices." Each Federal agency must undertake consultation on its missions, statutes, regulations, and policies with traditional native American religious leaders.	The American Indian Religious Freedom Act 1978 (Public Law 95-341)
Planning will always seek to avoid harm to cultural resources, and consider the values of traditionally associated groups. To ensure that approaches and alternatives for resource preservation have been identified and considered, planning processes that could effect cultural resources must include cultural resource specialists, traditionally associated peoples, and other stakeholders, and provide them with appropriate notification about opportunities to become involved.	NPS Management Policies, 2001
The goal of cultural resource planning in the national park system is to identify and preserve park cultural resources and provide for their appreciation by the public. It strives to integrate cultural resource concerns into broader NPS planning processes, to avoid or minimize harm to cultural resources, to identify the most appropriate uses for cultural resources, and to determine the ultimate treatment (preservation, rehabilitation, restoration, reconstruction, reproduction) or deliberate neglect or destruction for cultural resources.	DO#28, Cultural Resources Management, 1997

The fundamental purpose of the national park system, established by the Organic Act and reaffirmed by the General Authorities Act as amended, begins with a mandate to conserve park resources and values. National Park Service managers must always seek to avoid or to minimize, to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give National Park Service management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill park purposes as long as the impact does not constitute impairment of the effected resources and values. Although Congress has given the National Park Service management discretion to allow certain impacts in parks, that discretion is limited by the statutory requirement that the National Park Service must leave park resources and values unimpaired, unless a particular law directly and specifically provides otherwise. The prohibited impairment is an impact that, in the professional judgment of the responsible park manager, will harm the integrity of park resources or values, including the opportunities that otherwise will be present for the enjoyment of those resources or values. An impact to any park resource or value may constitute impairment. An impact will be more likely to constitute impairment to the extent it affects a resource or value whose conservation is:

Necessary to fulfill specific purposes identified in the park's establishing legislation or proclamation; Key to the park's natural or cultural integrity or to opportunities for enjoyment; Identified as a goal in the park's general management plan or other relevant NPS planning documents.

Impairment may result from National Park Service activities in managing the park, visitor activities, or activities undertaken by concessioners, contractors, and others. A determination on impairment must be made in the *Environmental Consequences* section of an EA or EIS for each impact topic.

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Consultation/Coordination

Agencies, Tribes, Organizations, Persons Contacted

National Park Service

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Grand Canyon National Park

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R.V. Ward, Wildlife Biologist, Science Center

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National Forest Service

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Other Agencies, Organizations, Tribes, and Individuals

Advisory Council on Historic Preservation

Arizona Department of Environmental Quality

Arizona Department of Game and Fish

Arizona Department of Water Resources

Grand Canyon Wildlands Council

Havasupai Tribe

Hualapai Tribal Council

Kaibab Band of Paiute Indians

Paiute Indian Tribe of Utah

Pueblo of Zuni

San Juan Southern Paiute Tribe

State Historic Preservation Office

The Hopi Tribe

The Hualapai Tribe

The Navajo Nation

U.S. Fish and Wildlife Service

U.S. Forest Service

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List of Scoping Letter and EA / AEF* Recipients

Federal Agencies

Advisory Council on Historic Preservation
Department of Agriculture
- Forest Service
  - Coconino National Forest
  - Coronado National Forest
  - Kaibab National Forest
  - Prescott National Forest
  - Tonto National Forest

Department of Interior
- Bureau of Indian Affairs
- Bureau of Land Management
- Bureau of Reclamation
- National Park Service
  - Albright Training Center
  - Bryce Canyon National Park
  - Denver Service Center
  - Flagstaff Area Parks
  - Glen Canyon National Recreation Area
  - Grand Canyon National Park Library
  - Intermountain Regional Office
  - Lake Mead National Recreation Area
  - Pipe Spring National Monument
  - Southern Arizona Group
  - Sunset Crater, Wupatki, and Walnut Canyon National Monuments
  - Zion National Park

Federal Highway Administration
National Biological Survey
National Trust for Historic Preservation
U.S. Fish and Wildlife Service
U.S. Congress
- Congressman Hayworth
- Congressman Kolbe
- Congressman Pastor
- Congressman Shadegg
- Congressman Stump
- Senator Kyl
- Senator McCain

State and Local Agencies

State of Arizona
Arizona Department of Environmental Quality
- Arizona Department of Water Resources
- Arizona Game and Fish Department
- Arizona State Land Department
- Arizona State Parks
- Arizona State University
- Arizona Department of Transportation

City of Flagstaff
City of Fredonia
Town Council
Public Library
City of Holbrook
Chamber of Commerce
City of Page
Visitor Center
Public Library
City of Phoenix
Phoenix Public Library
City of Sedona
Public Library
City of St. Johns
City of Williams
Visitor Center
Public Library
Coconino County
Grand Canyon School
Northern Arizona University
Online Library
Mojave County
Public Library
University of Arizona

State of Utah

City of Kanab
Public Library
Kane County
Washington County
Public Library

Tribes

Havasupai Tribe
Kaibab Band of Paiute Indians
Paiute Indian Tribe of Utah
Pueblo of Zuni
San Juan Southern Paiute Tribe
The Hopi Tribe
The Hualapai Tribe
The Navajo Nation

Media

Arizona Daily Sun
Arizona Republic
Associated Press
Flagstaff Live
Grand Canyon News
Lake Powell Chronicle
Las Vegas Review Journal
Navajo—Hopi Observer
Northern Arizona Campus Newspaper
Pinyon Press
Santa Ana Register
Southern Utah News
Tusayan Broadcasting Inc.

Individuals

Chamber of Commerce
Flagstaff Public Library
Grand Canyon Community Library
Visitor Center
Organizations
American Whitewater
Arizona State Horseman Association
Arizona Strip Regional Planning Task Force
Arizona Trail Association
Central Arizona Paddlers Club
Earth Law, University of Denver
Five County Association of Governments
Grand Canyon Association
Grand Canyon Environmental Youth Club
Grand Canyon Hikers and Backpackers Asso.
Grand Canyon Improvement Association
Grand Canyon National Park Foundation
Grand Canyon Pioneers
Grand Canyon Private Boaters Association
Grand Canyon River Guides
Grand Canyon River Outfitters Association
Grand Canyon Trust
Grand Canyon Wildlands Council
Grand Canyon Wild West Tours
Kentucky Wolf Information Center
McDowell Sonoran Land Trust
National Air Tour Association
National Parks Conservation Association
Sierra Club, Arizona Office
Sonoran Institute
Southern Utah Wilderness Alliance
Southwest Forest Alliance
The Nature Conservancy
The Wilderness Project
The Wilderness Society

Businesses
AAA Arizona
All Aboard America
Air Grand Canyon
Air Star Helicopters
Aramark Leisure Services, Inc.
Arizona Public Service
AMFAC Parks and Resorts, Inc.
Arizona Raft Adventures, Inc.
Arizona River Runners, Inc.
Auto Bus Tours and Charter
Bramer Tours and Travel
California Charters, Inc.
California USA, Inc.
Canyon Airport Shuttle Service
Canyon Expeditions, Inc.
Canyon Exploration, Inc.
Colorado River and Trail Expeditions, Inc.
Corporate Transportation Tours
Crossroads Adventure USA, Inc.
Delaware North Parks Services
Denure Tours Ltd.
Diamond River Adventures, Inc.
Fast Deer Bus Charters, Inc.
Frontier Tours
Garkane Power
Gannett Fleming, Inc.
Grand Canyon Airlines
Grand Canyon Airport
Grand Canyon Day Hikes
Grand Canyon Management
Grand Canyon Outback Jeep Tours
Grand Canyon Railway
Grand Canyon Steak House
Grand Canyon Squire Inn
Grand Canyon Trail Rides
Hatch River Expeditions, Inc.
High Desert Adventures, Inc.
High Sonoran Adventures
Holiday Inn Express
Indevideo
IMAX
Jacob Lake Lodge
Kenai Helicopters
Knoxville Tours, Inc.
Moki Mac River Expeditions, Inc.
Nava-Hopi Tours, Inc.
OARS, Inc. and Grand Canyon Dories
Outdoors Unlimited
Pacific Coast Sightseeing
Papillon Grand Canyon Helicopters
Paul Revere Transportation
Peek Performance Association
Quality Inn
Red Feather Lodge
Seven Mile Lodge
Scenic Airlines, Inc.
Silverado Stages
Snell and Wilmer
Sky Island Treks
South Rim Travel
The Grand Hotel
The Tusayan Cafe
Tour West, Inc.
U.S. West Communications
Vacation Tours, Inc.
Vaughn's Southwest Custom Tours
Vango, Inc.
Verkamps, Inc.
Vision Air

Canyon Forest Village	We Cook Pizza
Canyoneers, Inc.	Wendys
Casino Fun Express	Western Spirit Cycling
Certified Transportation Systems	
Citizen Auto Stage	
Western River Expeditions, Inc.	

*NOTE: A letter was sent to the above list when the EA/AEF was released; recipients of the letter were advised to contact the park for a copy of the document or visit the park's website. The EA/AEF was sent to all agencies and individuals that requested a copy during the initial scoping period – this list is available upon request.

Appendix A - Project Implementation Phase Tables

Table 1: Phase I Project Work Areas and Survey Status

Tamarisk Management Project

Grand Canyon National Park

Tamarisk Size Breakdown

River Mile	River Side	Canyon	Seedling	Sapling	Mature	TOTAL TARA	SW Willow Flycatcher Habitat Assessment Complete	Archaeological Resources Within 300m *
11	R	Soap Creek	2000	62	10	2072	X	
20.5	R	North Canyon	2	7	16	25	X	
37.7	L	Tatahatso Wash	0	7	1	8	X	
39	R	First redbud alcove	19	8	8	35	X	
39.2	R	Second redbud alcove	0	0	6	6	X	
40.9	R	Buckfarm Canyon	5	5	14	24	X	
41.2	R	Bert's Canyon	0	0	8	8	X	
56.2	R	Kwagunt Creek	8	35	5	48	X	
57.5	R	Malgosa Canyon	0	0	80	80	X	
64.7	R	Carbon Creek	47	49	54	150	X	
65.5	R	Lava Canyon	46	245	161	452	X	
65.7	L	Palisades Creek	0	4	11	15	O	
69.8	R	Basalt Canyon	1000	200	40	1240	X	
74.1	R	74 mile Wash	0	4	0	4	X	
75	R	Escalante Creek	8	19	3	30	X	
75.6	L	75 mile Creek	697	65	14	776	X	
81	R	Vishnu Creek	10000	71	44	10115	X	
84	L	Lonetree Canyon	130	8	21	159	X	
84	R	Clear Creek	2	4	14	20	X	
85	R	85 mile Spring	5	16	5	26	X	
88	R	Lower Bright Angel Creek	1000	131	135	1266	O	
91.6	R	Trinity Creek	30	101	38	169	O	
92.5	L	Salt Creek	0	0	4	4	X	
93.5	L	Monument Creek	87	74	245	406	X	
94	R	94 mile Creek	155	202	238	595	X	
94.9	L	Hermit Creek	230	58	25	313	X	
96.7	L	Boucher Creek	40	100	40	180	X	
99	R	Tuna Creek	487	39	70	596	X	
105	L	Ruby Canyon	6	26	36	68	X	
106	L	Serpentine Canyon	0	10	38	48	X	
107.8	R	Hotauta Canyon	11	20	20	51	X	
107.8	L	South Bass Canyon	3	19	20	42	O	
111	R	Hakatai Canyon	0	0	100	100	O	
112	R	Waltenberg Canyon	12	20	11	43	X	

114.5	L	Garnet Canyon	10	118	25	153	X	
116.5	L	Elves Chasm	1	10	26	37	X	
117	L	Bighorn Wash	100	47	14	161	X	
120	R	Lower Blacktail Canyon	40	0	4	44	X	
120	R	Upper Blacktail Canyon	0	15	16	31	X	
122	R	122 Mile Creek	2	2	10	14	X	
122.7	L	Forster Canyon	16	83	22	121	X	
124.9	L	Fossil Canyon	4	10	25	39	X	
128	R	128 Mile Creek	73	37	110	220	X	
129	L	Specter Chasm	14	35	1	50	X	
130.5	R	Bedrock Canyon	96	200	94	390	X	
131.8	R	Galloway Canyon	10	34	118	162	X	
132	R	Stone Creek	0	2	2	4	O	
133	R	133 Mile Creek	4	17	22	43	X	
138.5	R	Cranberry Canyon	9	24	3	36	X	
139	R	Fishtail Canyon	0	1	7	8	X	
142	R	142 Mile Spring	0	12	2	14	X	
147.8	L	148 Springs	0	0	2	2	X	
147.9	L	Matkatamiba Canyon	500	0	4	504	X	
150	R	150 Mile Canyon	15	14	1	30	X	
152	R	Spring above 152 "Ledges Camp"	19	22	15	56	X	
155	R	Slimey Tick Canyon	158	9	4	171	X	
155.5	R	Last Chance Canyon	32	14	2	48	X	
164.5	R	Tuckup Canyon	0	3	11	14	X	
168	R	Fern Glen Canyon	0	3	1	4	X	
171	R	Stairway Canyon	3	4	4	11	X	
174	R	Cove Canyon - Lower	14	47	74	135	X	
174	R	Cove Canyon - Upper	350	4	7	361	X	
209	R	209 Mile Canyon	350	102	43	495	X	
212	R	Bessies Camp Creek	0	0	15	15	X	
214	R	214 Mile Creek	6	22	14	42	X	

O Southwest willow flycatcher habitat surveys will be completed in these areas before tamarisk control begins.

Table 2: Phase II Project Work Areas and Survey Status

Tamarisk Management Project

Grand Canyon National Park

Tamarisk Size Breakdown

River Mile	River Side	Canyon	Seedling	Sapling	Mature	TOTAL TARA	SW Willow Flycatcher Habitat Assessment Complete	Archaeological Resources Within 300m *
4	L	4 Mile Wash	0	5	6	11	X	
4.5	L	4.5 Mile Wash	0	0	0	0	O	
5	L	5 Mile Wash	unknown	unknown	unknown		O	
5.8	R	6 Mile Wash	0	0	10	10	X	
8	L	Jackass Creek	1	0	4	5	O	
8	R	Badger Canyon	3	18	25	46	O	
12	L	Saltwater Wash	unknown	unknown	unknown		X	
12+	L	Next wash	0	0	0	0	O	
14	L	Tanner Wash	unknown	unknown	unknown		O	
16.4	L	Hot Na Na Wash	unknown	unknown	unknown		O	
17	R	Rider Canyon	4	2	36	42	X	
18	L	18 Mile Wash-upper	0	0	1	1	O	
18	L	18 Mile Wash - lower	4	12	15	31	O	
19	R	19 Mile Canyon	0	0	0	0	X	
22	L	22 Mile Wash	0	0	0	0	O	
24.5	L	24 Mile Wash	0	0	0	0	X	
25	L	25 Mile Wash	0	0	0	0	O	
26	R	Cave Springs Area	unknown	unknown	unknown		O	
26.5	L	Tiger Wash	unknown	unknown	unknown		O	
29.3	L	Shinumo Wash	0	0	0	0	O	
30	L	30 Mile Wash	0	0	0	0	O	
31.6	R	South Canyon	0	0	0	0	O	
31.7	R	Vasey's Paradise	unknown	unknown	unknown		O	
34.8	L	Nautiloid Canyon	0	0	0	0	O	
36.5	R	36.5 Mile wash	65	50	30	145	O	
47.2	R	Saddle Canyon	0	0	0	0	X	
48.5	R	48.5 Mile camp	0	0	0	0	O	
52	R	Nankoweap Canyon	256	298	139	693	O	
58.2	R	Awatubi Canyon	unknown	unknown	unknown		X	
59.8	R	60 Mile Canyon	0	0	0	0	O	
66.8	L	Espejo Creek	0	0	0	0	O	
67	L	Comanche Creek	0	0	0	0	O	

68.5	L	Tanner Canyon	0	1	0	1	O	
69	R	69 Mile Wash	unknown	unknown	unknown		O	
72.3	L	Unkar Creek	1453	668	224	2345	O	
75.8	L	Papago Creek	0	1	0	1	O	
76.6	L	Red Canyon (Hance)	0	0	0	0	O	
77	R	Hance Spring	0	0	0	0	X	
82.8	L	Boulder Creek	unknown	unknown	unknown		O	
89	L	Pipe Creek	1	173	244	418	X	
89	L	Garden Creek					O	
90	L	Horn Creek	0	0	31	31	O	
91.1	R	91 Mile Creek	1	3	4	8	O	
96	R	96 Mile Wash	0	0	0	0	O	
98	R	Crystal Creek	unknown	unknown	unknown		X	
99.5	R	99.5 Mile Wash	unknown	unknown	unknown		O	
100.5	L	Agate Canyon	unknown	unknown	unknown		O	
101	L	Sapphire Canyon	unknown	unknown	unknown		X	
102	L	Turquoise Canyon	unknown	unknown	unknown		O	
102.5	L	102.5 Mile Wash	1	6	4	11	X	
103	L	103 Mile Wash	1	0	3	4	O	
103	R	103 Mile Wash	0	0	0	0	O	
104	R	104 Mile Wash	0	0	6	6	X	
105	R	105 Mile Wash	1	4	3	8	X	
105.8	L	Above Serpentine	2	3	3	8	O	
107.5	R	Above Hotauta	0	2	0	2	O	
110	L	Copper Canyon	19	5	10	34	O	
112	L	112 Mile Wash	0	3	0	3	O	
112.5	R	112.5 Mile Wash	0	4	3	7	O	
119	R	119 Mile Creek	0	0	0	0	X	
127	R	127 Mile Creek	0	0	0	0	X	
130	R	130 Mile Creek	0	8	15	23	X	
134	L	Bonita Creek	0	0	1	1	O	
134.6	R	134.5 mi. - Owl Eyes	0	0	1	1	O	
140	L	140 Mile Canyon	16	0	14	30	X	
143	L	143 Mile Canyon	unknown	unknown	unknown		X	
145.6	L	Olo Canyon	7	7	2	16	O	
152	L	152 Mile Wash "Stairstep Falls"	5	29	6	40	O	
153	L	Sinyala Canyon	unknown	unknown	unknown		O	
157.5	R	Cork Spring Canyon / 1st Chance	unknown	unknown	unknown		O	
164	L	164 Mile Drainage	unknown	unknown	unknown		O	
166.5	L	National Canyon	370	10	18	398	X	
171.6	L	Mohawk Canyon	456	63	18	537	X	

176.5	R	Saddle Horse Canyon	0	0	0	0	X	
177	L	Honga Spring	14	20	10	44	O	
179	L	Prospect Canyon	4	5	2	11	O	
182.5	L	Hell's Hollow	0	0	0	0	O	
182.8	L	Below Hell's Hollow	0	0	0	0	O	
188	R	Whitmore Wash	0	0	5	5	O	
189.8	L	Wash Above 190	0	0	0	0	X	
190.3	L	Wash Below 190	150	9	17	176	X	
192	L	Basalt Cliffs	0	0	2	2	X	
193	L	193 Mile Creek	0	0	0	0	O	
193	R	Boulder Wash	0	0	0	0	O	
194	L	194 Mile Canyon	0	0	0	0	X	
196	L	196 Mile Creek	0	0	0	0	X	
198.5	R	Parashant Wash	unknown	unknown	unknown		O	
205	L	205 Mile Creek	0	0	0	0	O	
206.6	R	Indian Canyon	0	0	0	0	O	
209	L	Granite Park Canyon	301	57	54	412	O	
211.5	R	Fall Canyon	0	0	0	0	O	
217	L	217 Mile Canyon	0	0	0	0	O	
219	R	Trail Canyon	50	25	275	350	X	
220	R	220 Mile Canyon	1	1	0	2	O	
220.5	L	Granite Spring Canyon	0	0	0	0	O	
222	L	222 Mile Canyon	0	0	0	0	O	
225.5	R	225.5 Mile Wash	0	80	5	85	O	
255	R	Salt Creek	0	150	25	175	O	
259.5	R	Burnt Creek	200	200	500	900	O	
274.3	L	Cave Canyon	0	10	20	30	O	

O Tamarisk and southwest willow flycatcher habitat surveys will be completed before tamarisk control work begins.

- Areas that currently do not have tamarisk will continue to be surveyed and control will occur as tamarisk are encountered.

**The archaeological information that was generated for these tables is kept confidential by the Park and is not available for public review.*

Table 3: Phase III Project Work Areas and Survey Status

Tamarisk Management Project

Grand Canyon National Park

Tamarisk Size Breakdown

River Mile	River Side	Canyon	Seedling	Sapling	Mature	TOTAL TARA	SW Willow Flycatcher Habitat Assessment Complete	Archaeological Resources Within 300m *
61.5	L	Lower Little Colorado River	100	200	200	500	X	
64.7	R	Carbon Creek – upper section	47	49	54	150	X	
108.7	R	Shinumo Creek	0	0	6	6		
133.8	R	Tapeats Creek	0	0	0	0		
136.2	R	Deer Creek	0	0	0	0		
143.5	R	Kanab Creek – need to resurvey	unknown	unknown	unknown			
157	L	Havasu Canyon	144	291	51	486	X	
204	R	Spring – need to resurvey	unknown	unknown	unknown		X	
215.7	L	Three Springs – need to resurvey	unknown	unknown	unknown		X	

**The archaeological information that was generated for these tables is kept confidential by the Park and is not available for public review.*

Based on informal consultation with the U.S. Fish and Wildlife Service (USFWS), the above-listed areas may contain southwestern willow flycatcher (SWIFL) "potential suitable habitat." Full SWIFL surveys must be conducted in these areas during the year of proposed control. Surveys must be completed during the breeding season—mid-April through early July. Full survey protocol includes visiting each area five times during the breeding season in the early morning hours. A SWIFL song tape is played by a certified SWIFL biologist and any response indicates SWIFL are using the area for breeding. Full survey information must be provided to the USFWS who will decide if tamarisk management can occur in that area.

Phase III areas have been removed from the list of tributaries proposed for Phase I and II work. Current funding (Arizona Water Protection Fund) does not cover full survey cost; therefore, additional funding is needed to include these areas. During the project, any additional areas that may contain suitable SWIFL habitat would be documented and undergo full surveys.

Appendix B Public Scoping

Informal public involvement has been ongoing since 1998. The formal public involvement and consultation process was initiated in the fall of 2000.

The park initiated consultation with surrounding tribal governments on October 30, 2000. A letter soliciting tribal thoughts and concerns was sent to eight tribal governments. Initial comments were received and incorporated into the planning process.

An interdisciplinary team (IDT) was formed for this project, and the first formal meeting was on November 1, 2000. The IDT consists of Technical Area Specialists in biology, outdoor recreation, revegetation, exotic plant species management, hydrology, geology, archeology, botany, wilderness management, geographic information systems, and natural and cultural resource compliance. Priorities were established, issues discussed and evaluated, and roles in the planning process assigned.

A project planning meeting was held on December 4, 2001. Park compliance staff, Science Center Director, Public Affairs Officer, Restoration Biologist, and Project Manager were in attendance. The commitment to proceeding with the planning process for this project was renewed and the compliance timeline was discussed. Team members began drafting the public scoping letter and press release for the project.

On December 15, 2000, a Biological Assessment was sent to the U.S. Fish and Wildlife Service to initiate the informal consultation process.

On January 25, 2001, the park received written response to the Informal Consultation with the U.S. Fish and Wildlife Service. The responses and suggestions were incorporated into the park's tamarisk management plan and were used to determine the phases of project implementation. With the incorporation of their recommended changes, the U.S. Fish and Wildlife Service determined that no further section 7 consultation is required for Phase I of the proposed project.

On March 1, 2001, a public scoping letter was sent to 325 individuals, agencies and organizations. The letter solicited the public's concerns, viewpoints, and comments regarding the planning and implementation of the proposed project. The scoping period ended on April 1, 2001; however, comments received after that date were also considered.

On March 1, 2001, the park issued a press release entitled "Grand Canyon National Park Initiates General Scoping on Proposed Tamarisk Management Project. The press release stated that the park would accept comments on the project for 30 days. The table below summarizes the public scoping comments that were received.

On March 5, 2001, a follow-up letter was sent to the surrounding tribal governments. The letter included an invitation to an IDT meeting on March 12, 2001. Follow-up phone calls were made to the interested tribes.

The second IDT meeting was held in Flagstaff on March 12, 2001. The primary objectives were to involve the interested tribal representative in the project planning process as part of the project IDT and to determine concerns/issues prior to drafting the EA for the proposed project.

On March 31, 2001, the park presented an overview of the project at the annual Guides Training Seminar in Marble Canyon, Arizona. Comments were solicited and incorporated into the project planning.

On April 10, 2001, park compliance staff met with the project leader to discuss the comments and the project timeline.

On April 17, 2001, a follow-up letter was sent to the surrounding tribal governments. The letter provided a summary of the March 12, 2001 IDT meeting.

On April 26, 2001, the park superintendent sent out a formal response to all parties that commented during the open scoping period.

SYNOPSIS OF COMMENTS	SOURCE(S)	ANALYSIS	ACTION
Pesticide Use			
Can tamarisk removal be done without the use of poison? Is cutting large trees and applying herbicide to stumps the best method? Is cutting and applying herbicide to stump more effective than injection?	Glenn Rink (03/10/01) Sandy Bahr Sierra Club Grand Canyon Chapter (04/01/01)	Manual removal of seedlings and small saplings is effective. Research has shown that Garlon herbicide provides the most effective control for saplings and mature trees; manual removal, cutting or fire is ineffective. Lance injection is relatively new and there is little data about its effectiveness on tamarisk; however, it has been successfully been used on other woody species. The capsules used with the lance contain Garlon, which has been proven effective for tamarisk control. Girdling and injecting herbicide, and basal bark application also produce good control and minimize cutting.	Explain in the draft EA the rational for each control method. Include Parker and Williamson (1996, 2000) information regarding chemical use.
Use pesticide method that reduces risk of spillage.	Sandy Bahr Sierra Club Grand Canyon Chapter (04/01/01)	Project methods proposed will minimize spillage. All proposed methods are selective. With lance injection, the chemical is in a gel, inside the capsule, and there would be no risk of spillage. With all other proposed methods, the Garlon would be mixed with oil or water and there is a higher chance of spillage; however, safety measures would be employed. Standard operating procedures (SOPs) for the transport, mixing and use of herbicide have been prepared.	Implement project safety plan, ADEQ Best Management Practices, and Standard Operating Procedures for herbicide transport and use.
Concern about herbicide's effect on amphibians, fish, other plants, etc.	Jerry Driesens (03/26/01)	If the preferred alternative is selected, herbicide will be directly injected or selectively applied to tamarisk. Extensive research has been done on the effect of Garlon 3a and 4 on non-target species, See appendix D	Use of proposed methods would mitigate this concern. Refer to the USDA 1992 and 2000 references.

Follow Best Management Practices (BMP) to prevent pollution. Protect adjacent water bodies' existing habitat and wildlife from chemical water impairments.	Arizona Department of Environmental Quality (3/28/01)	Conservation practice standards will be implemented.	Implement ADEQ BMPs.
Wilderness			
Since the project occurs in proposed wilderness, a Minimum Requirement Analysis is necessary. Strongly object to use of mechanized devices; chainsaws, power spray equipment, helicopters.	Sandy Bahr Sierra Club Grand Canyon Chapter (04/01/01) Kim Crumbo (03/21/01)	We concur that a Minimum Requirement Analysis is necessary, See Appendix C, Wilderness Minimum Requirement Analysis. Mechanized devices are not proposed as part of this project.	Complete Minimum Requirement Analysis.
Concerned about use of herbicides in wilderness. Wouldn't some other approach be more in line with the minimum tool approach?	Glenn Rink (03/10/01) Rhonda Barbieri (02/05/01)	Herbicides are one component of an Integrated Pest Management program. A combination of manual and chemical treatment provides the most successful control for tamarisk (see Carpenter and Murray 1998). The use of herbicides is not precluded in wilderness areas if determined to be the minimum tool necessary.	Complete Minimum Requirement process to determine whether proposed actions are appropriate for use in project areas.
Ensure that site disturbances are minimized from any heavy equipment used to apply herbicide and remove tamarisk.	Arizona Department of Environmental Quality (3/28/01)	No heavy equipment will be used during this project.	Not applicable.
Natural Resources			
Minimize soil loss in storm water runoff by restoring indigenous vegetation.	Arizona Department of Environmental Quality (03/28/01)	The majority of the project areas listed in Phase I do not have dense stands of mature tamarisk, but rather scattered individual trees. Natural recruitment of indigenous vegetation will occur once tamarisk has been removed. In Phase II and Phase III, restoration of indigenous vegetation is proposed. In addition, use of the lance injection system, basal bark application, and girdle/inject methods will leave vegetation on site to help minimize soil loss.	Use active restoration of native vegetation in areas where dense stands of tamarisk are removed.

USFS lands contain the upper reaches of Kanab Creek that has a dense population of tamarisk ranging from Kanab, Utah to the park boundary. Treatments and results for Kanab Creek may thus be limited.	USDA Forest Service, North Kaibab Ranger District (03/29/01)	Kanab Creek is listed in Phase III of this project, and no control work will occur until 2004 at the earliest. The USFS is currently preparing an EIS for the treatment of noxious and invasive weeds on the Coconino, Kaibab, and Prescott National Forests; tamarisk control in Kanab drainage is one component of the that EIS.	Coordinate control actions with the U.S. Forest Service.
Aren't tamarisk in the main river corridor stabilizing beaches and wouldn't their removal cause erosion?	Jerry Driesens (03/26/01)	Removal of tamarisk trees on beaches in the main corridor is not included in this project.	Not applicable.
Don't tamarisk provide habitat suitable for wildlife?	Jerry Driesens (03/26/01)	Tamarisk is not commonly eaten by native herbivores and the seeds are too small for most birds or rodents. Some bird species do nest or seek cover in tamarisk, but it provides habitat inferior to native vegetation. Many pollinators utilize tamarisk. The proposed management methods would leave treated tamarisk on site to continue to provide habitat until native vegetation returns to the area.	The U.S. Fish and Wildlife Service and Arizona Fish and Game have been consulted. Areas that provide potential habitat for the endangered Southwestern willow flycatcher will require full surveys prior to any control work; these areas are listed in Phase III of this project.
Won't natural flooding remove tamarisk?	Jerry Driesens (03/26/01)	Natural flooding cannot be relied upon for tamarisk control. NPS regulations and policies require that exotic species be managed if control is prudent and feasible and if the species could have a substantial impact on park resources; tamarisk in side canyons and tributaries falls into this category.	Adhere to NPS Management Policies and other regulations and policies listed in this document.
Scope of Project			
Remove tamarisk along the Colorado River.	Pete Chasar 03/02/01 Brian Hefenieder (03/02/01)	Tamarisk control along the Colorado River within the park is not included in this project. The success of this project over the next five years, along with the tamarisk eradication project at Lees Ferry in Glen Canyon NRA will help analyze whether tamarisk control in the main river corridor is desirable and/or feasible.	Continue to focus only on tamarisk populations in tributaries, side canyons and washes for this project. These are areas where control is feasible.

Monitoring			
Reduce tamarisk reoccurrence by monitoring sites and abate tamarisk re-growth; conduct spot treatment and removal as needed.	Arizona Department of Environmental Quality (03/28/01)	The park is committed to follow-up maintenance and monitoring necessary to ensure project success. Vegetative transects are installed in 16 proposed project areas. Transects will be monitored on an annual basis to determine the treatment success. Photo points will be established in each treatment area to monitor vegetation change over time. Each tributary will be visited annually; continuing spot treatments and manual removal will be an integral component of this project.	Describe follow-up maintenance plan and monitoring system.
Concerned about follow -up maintenance and huge seed source.	Jerry Driesens (03/26/01)	One primary seed source for many project areas is the main river corridor. This seed source will not be removed as part of this project. The park is committed to manually removing seedlings in project areas on an annual basis. The main river corridor may be treated at a later date; a separate EA will be written at that time.	Describe follow-up maintenance plan.
Employee Safety			
Note that Chuar and Crystal Creeks, and Pumpkin Spring exceed state surface water quality standards for arsenic.	Arizona Department of Environmental Quality (03/28/01)	Pumpkin Spring is not included in this project. Extensive contact with creek waters will be avoided and additional PPE will be required in those areas. ADEQ will be contacted again to obtain more details about arsenic levels.	Proper worker PPE, including rubber boots, will be required when working in Chuar and Crystal Creeks. Contact ADEQ to determine whether additional actions or Best Management Practices are necessary.
The Paria River exceeds beryllium, selenium, pH, and turbidity standards.	Arizona Department of Environmental Quality (03/28/01)	The Paria River is not included in this project since it is not within GCNP.	Not applicable.
Protect herbicide applicators by strictly following herbicide instructions regarding application, protective equipment, and disposal requirements of the herbicides used.	Arizona Department of Environmental Quality (03/28/01)	The park will follow these recommendations as part of the project Safety Plan.	Prepare project Safety Plan.

Appendix C Wilderness Minimum Requirement Analysis

NPS Director's Order 41: Wilderness Preservation and Management, states:

Application of the Minimum Requirement Concept

> *. . . except as necessary to meet the minimum requirements for the administration of the area for the purpose of this Act (including measures required in emergencies involving the health and safety of persons within the area) there shall be no temporary road, no use of motor vehicles, motorized equipment or motorboats, no landing of aircraft, not other form of mechanical transport, and no structure or installation within any such area.*
> *– The Wilderness Act: Section 4(c)*
>
> *All management decisions affecting wilderness must be consistent with a minimum requirement concept . . . . When determining minimum requirement, the potential disruption of wilderness character and resources will be considered before, and given significantly more weight than, economic efficiency and convenience. If a compromise of wilderness resource or character is unavoidable, only those actions that preserve wilderness character and/or have localized, short-term adverse impacts will be acceptable.*
>
> *– NPS Management Policies: 6.3.5 Minimum Requirement*

The National Park Service will apply the minimum requirement concept to all administrative activities that affect the wilderness resource and character. The application of the minimum requirement concept is intended to minimize impacts on wilderness character and resources and must guide all management actions in wilderness.

Wilderness managers may authorize (using a documented process) the generally prohibited activities or uses listed in Section 4(c) of the Wilderness Act if they are deemed necessary to meet the minimum requirements for the administration of the area as wilderness and where those methods are determined to be the 'minimum tool' for the project. The use of motorized equipment and the establishment of management facilities are specifically prohibited when other reasonable alternatives are available. The minimum requirements process cannot be used to permit roads or inappropriate commercial enterprises within wilderness unless these are authorized by specific legislation.

The minimum requirement concept is to be applied as a two-step process that documents:

(1) A determination as to whether or not a proposed management action is appropriate or necessary for the administration of the areas as wilderness, and does not pose a significant impact to the wilderness resources and character; and,

(2) If the project is appropriate or necessary in wilderness, the selection of the management method (tool) that causes the least amount of impact to the physical resources and experiential qualities (character) of wilderness.

It is important to understand the distinctions between the terms "Minimum Requirement," and "Minimum Tool."

Minimum Requirement is a documented process the NPS will use for the determination of the appropriateness of all actions affecting wilderness.

> Minimum Tool means a use or activity, determined to be necessary to accomplish an essential task, which makes use of the least intrusive tool, equipment, device, force, regulation, or practice that will achieve the wilderness management objective. This is not necessarily the same as the term “primitive tool,” which refers to the actual equipment or methods that make use of the simplest available technology (i.e., hand tools).

Park managers will apply the minimum requirement concept when making all decisions concerning management of the wilderness area. This includes decisions concerning administrative practices, historic properties, proposed special uses, research, and equipment use in wilderness.

Planned administrative actions that may result in an exception to a prohibited use (i.e., chainsaws, aircraft use, radio repeater sites, rock drills, patrol structures, weather stations), or have the potential to impact wilderness resources and values must be consistent with an approved wilderness management plan and be documented in accordance with the park’s minimum requirements process. The minimum requirements process will be conducted through appropriate environmental analysis.

When determining the minimum requirement for a proposed action, the manager will strive to minimize the extent of adverse impact associated with accomplishing the necessary wilderness objective. The determination as to whether or not an action has an adverse impact on wilderness must consider both the physical resources within wilderness, and wilderness characteristics and values. These characteristics and values include: the wilderness’s primeval character and influence; the preservation of natural conditions (including the lack of man-made noises); cultural resource values, the assurance of outstanding opportunities for solitude; the assurance that the public will be provided with a primitive and unconfined type of recreational experience; and the assurance that wilderness will be preserved and used in an unimpaired condition.

Managers must give appropriate consideration to the aesthetic values of wilderness as well as the physical resource. These factors take precedence over cost or convenience in determining minimum requirement. National parks with wilderness must have a documented process for applying the minimum requirement concept.

The documented process for the Grand Canyon National Park Tamarisk Management and Tributary Restoration EA will follow the minimum requirement process developed by the Arthur Carhart National Wilderness Training Center.

MINIMUM REQUIREMENT DECISION WORKSHEETS

" . . . except as necessary to meet minimum requirements for the administration of the area for the purpose of this Act."

– Wilderness Act, 1964

Minimum Requirement Worksheets for Tamarisk Management in Grand Canyon National Park

STEP 1 - DETERMINING MINIMUM REQUIREMENTS

This flow chart will help assess whether the project is the minimum required action for administration of the area as wilderness. ***T***hese questions will help determine **IF** this action is the **minimum required** action in wilderness.

Guiding Questions

Use the available space or additional sheets as necessary.

Is this an emergency? (i.e., a situation that involves an inescapable urgency and temporary need for speed beyond that available by primitive means, such as fire suppression, health and safety of people, law enforcement efforts involving serious crime or fugitive pursuit, retrieval of the deceased or an immediate aircraft accident investigation.)	**Answer:** **YES:** ☐ **NO: X** **Explain:** Tamarisk removal is not an emergency.
If **Yes**, then: Document rationale for line officer approval using the minimum tool form and proceed with action. If **No**, then: ⇓ *go to next question*	
Does the project or activity conflict with the stated wilderness goals, objectives, and desired future conditions of applicable legislation, policy and management plans?	**Answer:** **YES:** ☐ **NO: X** **Explain:** No, it supports actions required GCNP's General Management Plan, Resource Management Plan, NPS Management Policies, and the Wilderness Act. See Regulations and Policy Section of this EA.
If **Yes**, then: Do not proceed with the proposed project or activity. If **No**, then: ⇓ *go to next question*	

Are there other less intrusive actions that should be tried first? (i.e. signing, visitor education, or information.)	**Answer:**	**YES:** ☐	**NO: X**
	Explain: No, no known efforts other than control/management will work to stop tamarisk invasion.		

If **Yes**, then: Implement other actions using the appropriate process.

If **No**, then: ⇓ *go to next question*

Can this project or activity be accomplished outside of wilderness and still achieve its objectives? (i.e. some group events.)	**Answer:**	**YES:** ☐	**NO: X**
	Explain: Most tamarisk removal sites are within Grand Canyon proposed wilderness.		

If **Yes**, then: Proceed with action outside of wilderness using the appropriate process.

If **No**, then: ⇓ *go to next question*

Is this project or activity subject to valid existing rights? (i.e. a mining claim or right-of-way easement.)	**Answer:**	**YES:** ☐	**NO: X**
	Explain:		

If **Yes**, then: Proceed to minimum tool section of this document, STEP 2.

If **No**, then: ⇓ *go to next question*

Is there a special provision in legislation (the 1964 Wilderness Act or subsequent wilderness legislation), that allows this project or activity? (i.e. maintenance of dams and water storage facilities with motorized equipment and mechanical transport or control of fire, insects and disease.)	**Answer:**	**YES:** ☐	**NO: X**
	Explain:		

If **Yes**, then: The proposed project or activity can be **considered** but is not necessarily required just because it is mentioned in legislation. *Go to Part B, as needed.*

If **No**, then: ⇓ *Proceed to Part B, Responsive Questions*

Minimum Requirements Worksheets

PART B - Determining the Minimum Requirement

Responsive Questions for Minimum Requirements Analysis; if responses indicate potential adverse impacts to wilderness character, evaluate whether or not to proceed with this proposal.

	RESPONSIVE STATEMENT	
EFFECTS ON WILDERNESS CHARACTER		
How does the project or activity benefit the wilderness resource as a whole as opposed to maximizing one resource?	The Tamarisk Management and Tributary Restoration Project seeks to restore the biotic and physical environment that existed before tamarisk introduction; the project thus meets the Wilderness Act requirement of maintaining natural processes.	
If this project or activity were not completed, what would be the beneficial and detrimental effects to the wilderness resource?	Beneficial: Not completing the project lowers the possibility that visitor experience (solitude, primitive recreation) would be impacted in some way; no impacts to natural and cultural resources would occur from implementation activities. Detrimental: If this project is not completed, the park will have lost the chance to stop tamarisk invasion while it was feasible (i.e., low number of individuals just beginning tributary invasion). Increasing tamarisk will have continuing and mounting impacts on natural and cultural resources. See the Environmental Impacts section of this EA.	
How would the project or activity help ensure that human presence is kept to a minimum and that primarily the forces of nature rather than being manipulated by humans affect the area?	Since tamarisk is a direct result of human activities (nonnative plant introduction), its removal would allow natural conditions to prevail.	
How would the project or activity ensure that the wilderness provides outstanding opportunities for solitude or a primitive and unconfined type of recreation? (i.e. does the project or activity contribute to people's sense that they are in a remote place with opportunities for self-discovery, adventure, quietness, connection with nature, freedom, etc.)	The project would indirectly ensure that GCNP wilderness would provide outstanding opportunities for solitude or a primitive and unconfined type of recreation by removing a nonnative element form their experience. Opportunities would increase for connection with a natural "nature," rather than an unnatural one.	
MANAGEMENT SITUATION		
What does your management plan, policy, and legislation say to support proceeding with this project?	Management efforts are called for in the park's General Management and Resource Management Plans. See Regulations and Policies section of Tamarisk Management EA.	
How did you consider wilderness values over convenience, comfort, and political, economic or commercial values while evaluating this project or activity?	Convenience, comfort, political, economic or commercial values were not considered while evaluating this project.	
SHOULD WE PROCEED?	**YES: XX** **Go to Step 2**	**NO:** **Stop**

Minimum Requirements Worksheets

STEP 2 - **DETERMINING MINIMUM TOOL**

These questions will assist in determining the appropriate tool(s) to accomplish the project or proposed activity with the least impact to the wilderness resource.

Develop several approaches to resolve the issue or problem. At a minimum consider the following three methods:	
Alternative 1: An alternative utilizing motorized equipment or mechanized transport	**Alternative B: An alternative using non-motorized equipment and non-mechanized transport.**
Describe the alternatives. Be specific and provide detail. *What is proposed?* *Why is it being proposed in this manner?* *Who is the proponent?* *When will the project take place?* *Where will the project take place?* *How will it be accomplished? (What methods and techniques will be used?)*	
Alt#1: Since neither motorized equipment nor mechanized transport is proposed for use in this tamarisk control project, this column does not apply and will not be analyzed further.	
Alternative B: **Proposed:** Tamarisk management and tributary restoration in 157 side canyons, springs of the Colorado River in Grand Canyon National Park (some developed areas will be included in the process). **Manner:** The project, in respect to wilderness values and character, proposes use of non-motorized equipment and non-mechanized transport. Instead oar-powered rafts and hand tools will be used to access sites and accomplish work. **Proponent**: The project is supported by all levels of management, and will be accomplished by the Science Center's staff and volunteers under the direction of the Revegetation Program Manager. **When**: Project work will begin, if this alternative is approved through the NEPA process, in fall 2001. The project is expected to last five years with monitoring and maintenance continuing for ten years. Work will be accomplished in off-season months: March, September, October, and November. Time spent at each site is anticipated to be one day/site, perhaps longer in Phases II and III. **Place**: Some work will be done in the South Rim developed area, but most project areas are located in Grand Canyon's side canyons and springs. Refer to Tables 1, 2, and 3 (Appendix A) in the Tamarisk Management EA for specific locations. **Methods and Techniques**: Under this alternative (B), a combination of manual removal, Garlon lance injection, hack and squirt, cut stump, basal bark Garlon application, and native vegetation seeding would be used to accomplish control and revegetation.	

Alternative B, Description of Alternative, Continued

Tools would consist of: oar-powered rafts, gloved hands, weed wrenches, rock picks, pulaskis, shovels, hatchets, Garlon 3A and 4, hand-held lance injectors, tree girdlers, pressurized sprayers and GPS units.

Workers will be kept to the minimum number necessary to accomplish work. In this case, 12 to 16 workers—consisting of three boatmen, one trip leader/boatman, one cook, two project leaders, one archaeologist, one wildlife biologist, and three to seven work party members—will all work to accomplish control and restoration work. All workers will also be trained in herbicide application; project leaders will have Arizona state pesticide certification.

Leave No Trace (LNT) principles will be practiced throughout the project by all crewmembers.

Herbicides Garlon 3A and Garlon 4 will be used to eradicate tamarisk during this project. Although chemical application would not be the first method of choice in wilderness, research has shown that management efforts without these herbicides are ineffectual. Application will be highly controlled and plant specific.

Lance injectors are 3 or 4-feet long; they implant a small (3/4") metal capsule into the larger tree trunks. Capsules may be visible, but will be removed the year after application. Syringes are used in hack and squirt, cut stump, and basal bark Garlon application. Fine-spray nozzles will allow very selective application, eliminating herbicide drift.

Herbicide containers are leak and spill proof and will be doubly secure in sealed ammunition cans. Application equipment (gloves, etc.) and empty containers will be properly disposed and sealed in ammunition cans. Herbicide containers will be properly labeled and contain MSDS sheet.

In all methods, debris, cut stumps, girdling marks, capsule injection and pruning will be done in a manner that will minimize visual impact.

Site-adapted seeds and plants will be used for revegetation efforts.

Follow-up monitoring and maintenance trips will employ all of the methods above.

Impingement on visitor experience will be addressed by notifying hikers and river runners in advance when workers might be encountered in the canyon, and work trips will use less-desirable beaches.

Use the following criteria to assess each method (a brief statement should suffice) :

Biophysical effects

Describe the environmental resource issues that would be affected by the project.
Describe any effects this action will have on protecting natural conditions within the regional landscape (i.e., insect, disease, or noxious weed control).
Include both biological and physical effects.

Alternative B

Soils

- Minor, localized impact from hiking and trampling (trees are left standing).
- Possible long-term impact to biotic crusts on very localized basis.
- Short-term, negligible impact on established trails.
- Short-term, minor impact to soils from loosening roots.
- Long-term, minor to moderate beneficial decrease in soil salinity and improvement of other soil characteristics such as pH.

Alternative B, Description of Alternative, Continued

Threatened, Endangered and Sensitive Species

- Short-term, negligible if any effect on the 21 listed plant, aquatic, mammal and retile species, and the tree birds that occur in the vicinity of the park.
- May affect – is not likely to adversely affect – determination for the southwestern willow flycatcher.

Vegetation

- Short-term, negligible to minor impact to non-target vegetation from trampling.
- Long-term, minor to moderate, beneficial impact to native vegetation.
- Long-term impact on community structure (treated trees left standing).

Water Quality and Wetlands

- Short-term, negligible to minor impact from increasing sedimentation and nutrients in water.
- Long-term, moderate improvement in water quantity due to decreased use by tamarisk and long-term decrease in salt secretion (trees left standing).
- Short-term, negligible impact or risk of chemical pollution.
- Long-term, beneficial impacts to wetlands through restoration over time.

Wildlife

- Short-term, minor impact to aquatic organisms and amphibians.
- Short-term, minor impacts to some wildlife species, primarily due to trampling.
- Short-term negligible impacts to wildlife species that depend on tamarisk for nesting and habitat.
- Long-term, moderate beneficial impacts to wildlife once tamarisk removed.
- Short-term negligible impact to wildlife from herbicide.

Social/recreation/experiential effects

Describe how wilderness experience may be affected by the proposed action.
Include effects to recreation use and wilderness character.
Consider the effect the proposed action may have on the public and their opportunity for discovery, surprise, and self-discovery.

Alternative B

Wilderness Character and Visitor Experience

- Short-term negligible to minor adverse impacts to visitors encountering river trips and workers.
- Short-term, minor visual evidence of work—girdling, injected trees, cut stumps, small debris piles.
- Long-term, minor to moderate indirect beneficial impacts to ecosystem diversity and sustainability, and thus to visitor experience.

Societal/political effects

Describe any political considerations (i.e. MOUs, agency agreements, local positions) that may be affected by the proposed action.
Describe relationship of method to applicable laws.

Alternative B, Description of Alternative, Continued

Alternative B

- Possible impacts to tribes affiliated with Grand Canyon due to possible disturbance of ethnographic areas and Traditional Cultural Properties. Tribal representatives participate as members of the Tamarisk IDT, and will work closely with GCNP to avoid impacts.

Health and safety concerns

Describe and consider any health and safety concerns associated with the proposed action.
Consider the types of tools used, training, certifications, and other administrative needs to ensure a safe work environment for employees.
Consider the effect the proposed action may have on the health and safety of the public.

Alternative B

A project safety plan approved by the park safety officer will be prepared. This plan will insure that employees receive training on or information about:

- NPS white-water safety training
- Heat- and cold-related illness
- Lightening
- Flash floods
- Animal bites and stings
- Tool safety and storage
- PPE (personal protection equipment) and instruction (rubber boots, gloves, goggles, etc.)
- Arsenic education
- Appropriate storage of application equipment, herbicides, and disposables

All applicable Standard Operating Procedures will be included in the safety plan.

Job Hazard Analyses will be prepared for each project task and will be reviewed with trip participants.

The Regional Pesticide Use Approval Process has approved all herbicides.

Economic and timing considerations

Describe the costs and timing associated with implementing each alternative
Assess the urgency and potential cumulative effect from this proposal of similar actions.

Alternative B

Cost was not used as a factor to distinguish alternatives nor to consider actions in wilderness.

Although the project is not urgent, the sooner management is begun, the more feasible the project.

Cumulative impacts of similar actions are analyzed in Chapter Four, Environmental Consequences, of the Tamarisk Management and Tributary Restoration EA.

Formulate a preferred action. Be specific and describe in detail below.

The preferred action is Alternative B as described above.

Choose a preferred alternative:

Alternative B is the Park Service preferred alternative.

Further refine the preferred alternative to minimize impacts to wilderness.

Every action has been analysed as to its wilderness impact and procedures have been refined to minimize impacts. See Alternative B above.

What will be the specific operating requirements for the action? Include information on timing, locations, amounts, etc… Be as specific as possible.

See Alternative B above.

What are the maintenance requirements? Describe any ongoing or repeat efforts that will be necessary.

Follow-up maintenance and monitoring trips will continue for up to 10 years. Project logistics will be identical to those described for Alternative B.

What standards and designs will apply?

A project Safety Plan, Standard Operating Procedures, Job Hazard Analyses, Pesticide Use Approval, NEPA, wilderness management, pesticide application certifications, etc.

Develop and describe any mitigation measures that apply.
Leave No Trace principles will apply to all aspects of project work.

Soil, vegetation, water quality, wetland, and wildlife impacts: efforts will be made to walk on durable surfaces, avoid biotic crusts, soil compaction and vegetation trampling, erosion and sedimentation, off-trail and out-of-drainage walking. A revegetation specialist and wildlife biologist will accompany every trip.

Cultural Resources will be protected in every way possible including the presence of an archaeologist on every trip and consultation with affiliated tribal representatives.

Impacts to visitor experience will be mitigated by avoiding encounters whenever possible, the provision of information regarding work project location and timing, visitor information brochures, hiding visual evidence of work (girdled trees, stumps, brush piles, etc.).

See Mitigation Measures section in Chapter 2 of EA for additional details.

What will be provided for monitoring and feedback to strengthen future effects and preventative actions to be taken to help in future efforts?

Monitoring results will be retained by the Science Center Restoration Biologist for review and feedback during the 5 to 10-year project length.

Minimum Requirement Worksheet Signatures

Approvals	Signature	Name	Position	Date
Prepared by:	/s/	Greer K. Chesher	Resource Management Specialist	07/09/01
Revised and Updated by:	/s/	Lori J. Makarick	Restoration Biologist	01/23/02
Recommended by:	/s/	Linda Jalbert	Outdoor Recreation Planner	02/26/02
Recommended by:				
Approved by:				

Leave No Trace Principles of Outdoor Ethics

Plan ahead and prepare

- Travel and camp on durable surfaces
- Dispose of Waste Properly
- Leave What You Find
- Minimize Campfire Impacts
- Respect Wildlife
- Be Considerate of Other Visitors

Plan ahead and prepare

- Know the regulations and special concerns for the area you'll visit.
- Prepare for extreme weather, hazards, and emergencies.
- Schedule your trip to avoid times of high use.
- Visit in small groups. Split larger parties into groups of 4-6.
- Repackage food to minimize waste.
- Use a map and compass to eliminate the use of marking paint, rock cairns or flagging.

Travel and camp on durable surfaces

- Durable surfaces include established trails and campsites, rock, gravel, dry grasses or snow.
- Protect riparian areas by camping at least 200 feet from lakes and streams.
- Good campsites are found, not made. Altering a site is not necessary.
  In popular areas:
- Concentrate use on existing trails and campsites.
- Walk single file in the middle of the trail, even when wet or muddy.
- Keep campsites small. Focus activity in areas where vegetation is absent.
- In pristine areas
- Disperse use to prevent the creation of campsites and trails.
- Avoid places where impacts are just beginning.

Dispose of Waste Properly

- Pack it in, pack it out. Inspect your campsite and rest areas for trash or spilled foods. Pack out all trash, leftover food, and litter.
- Deposit solid human waste in catholes dug 6 to 8 inches deep at least 200 feet from water, camp, and trails. Cover and disguise the cathole when finished.
- Pack out toilet paper and hygiene products.
- To wash yourself or your dishes, carry water 200 feet away from streams or lakes and use small amounts of biodegradable soap. Scatter strained dishwater.

Leave What You Find

- Preserve the past: examine, but do not touch, cultural or historic structures and artifacts.
- Leave rocks, plants and other natural objects as you find them.
- Avoid introducing or transporting non-native species.
- Do not build structures, furniture, or dig trenches.
-

Minimize Campfire Impacts

- Campfires can cause lasting impacts to the backcountry. Use a lightweight stove for cooking and enjoy a candle lantern for light.
- Where fires are permitted, use established fire rings, fire pans, or mound fires.
- Keep fires small. Only use sticks from the ground that can be broken by hand.
- Burn all wood and coals to ash, put out campfires completely, then scatter cool ashes.

Respect Wildlife

- Observe wildlife from a distance. Do not follow or approach them.
- Never feed animals. Feeding wildlife damages their health, alters natural behaviors, and exposes them to predators and other dangers.
- Protect wildlife and your food by storing rations and trash securely.
- Control pets at all times, or leave them at home.
- Avoid wildlife during sensitive times: mating, nesting, raising young, or winter.

Be Considerate of Other Visitors

- Respect other visitors and protect the quality of their experience.
- Be courteous. Yield to other users on the trail.
- Step to the downhill side of the trail when encountering pack stock.
- Take breaks and camp away from trails and other visitors.
- Let nature's sounds prevail. Avoid loud voices and noises.

Appendix D Garlon 3A and Garlon 4

The active ingredient in Garlon 4 is triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid, butoxyethyl ester (BEE). This product is petroleum based. This product has a signal word of Caution. The label indicates it is toxic to fish and should not be directly applied to water, to areas where surface water is present, or to intertidal areas below the mean high watermark. Garlon 4 can be applied to cut stumps, as basal bark treatment or injected directly into the girdled tree to minimize this impact. This application should be done to the wet cambium around the entire stump circumference. Application can be done throughout the year, but control may be reduced if treatment is done during periods of moisture stress. It is best to use an applicator, which can be calibrated to deliver the small amounts of material required. Either a pressurized hand sprayer or backpack pump can be used. This product is not available in capsules for use with the lance injection system.

The active ingredient in Garlon 3A is triclopyr: 3,5,6-trichloro-2-pyridinyloxyacetic acid, triethylamine salt (TEA). This project is aqueous based. This product has a signal word of Danger due to irreversible eye damage. It is not labeled as toxic to fish, but indicates the product should not be directly applied to water, to areas where surface water is present, or to intertidal areas below the mean high watermark. Garlon 3A can be applied to tamarisk by the tree injector method, cut stump treatment, or basal bark application.

Triclopyr is a herbicide that stimulates abnormal tissue proliferation by mimicking natural plant auxins.

It is important to note the two different chemical forms of triclopyr in Garlon 3A and 4 because they have different properties in regard to human and environmental effects. In toxicity tests, reviewed by the EPA, both BEE and TEA are slightly toxic by oral and dermal exposure. They are practically non-toxic by inhalation. Tests indicate that neither causes dermal irritation or sensitization. However, TEA is corrosive to the eyes, which is why it has a signal word of Danger while BEE is only minimally irritating to the eyes. Triclopyr is not considered to be a human carcinogen.

Triclopyr is considered to be somewhat mobile and persistent in soil, but there is a difference between the two chemical forms. BEE has a low soil movement rating due to its low water solubility (23 mg/L) and higher K_{OC} (780). TEA has a high rating for soil movement due to its high water solubility (2,100,000 mg/L) and low K_{OC} (20). The soil half-life is estimated at 46 days. The predominant degradation pathway for triclopyr is photodegradation in water and microbial degradation in soil. Triclopyr can be taken up by the roots and leaves and is readily translocated throughout the plant. The estimated half-life in aboveground drying foliage as in a forestry overstory is two to three months.

A study done by Solomon et al., in a northern Ontario bog lake in a sandy soil area, showed that dissipation of triclopyr from water was rapid and none was detected after day 42. After 15 days, soil levels were below five percent of the original amount applied. Sediment analysis showed that a relatively small, but variable, proportion of pesticide was adsorbed. The dissipation from sediment was slower than in water, but did not indicate persistence that will carry over for long periods of time. Selective application methods were not used in this study.

Stephenson et al., found that triclopyr (Garlon 4E) was moderately persistent in sandy soil at a northern Ontario site. The time to disappearance was not dependent on soil type. Researchers looked at vertical movement in soil and suggested that rainfall in the first several days is probably most significant. However, at all sampling times, 90% or more of the triclopyr was recovered from the upper organic layer. They also concluded that residues in soil due to lateral movement were probably unlikely to be biologically significant. Low levels of triclopyr were detected in runoff water but again are unlikely to be of biological significance. Authors concluded that environmental problems are unlikely as a result of excessive triclopyr persistence and/or mobility in soils typical of northern Ontario forestry areas.

TEA is practically non-toxic-to-slightly-toxic to birds and estuarine/marine invertebrates. It is practically non-toxic to freshwater fish and invertebrates and estuarine/marine invertebrates. BEE is slightly toxic to birds. It is moderately to highly toxic to freshwater fish and estuarine/marine fish and slightly-to-

moderately toxic to freshwater invertebrates. It is highly toxic to estuarine/marine fish. According to the EPA's Re-registration Eligibility Decision (RED) for triclopyr there is concern for chronic risk to mammals and acute risk to fish and non-target plants. However, calculation of acute risk to fish was based on direct application to surface water, which is not a registered use. Also flowing water will allow for rapid dissipation of the product, therefore reducing possible risk to fish. There is some concern over fish toxicity as a result of the metabolite 3,5,6-trichloro-2-pyridinol, and the EPA is requiring further testing by the manufacturer. There appears to be little if any potential for triclopyr to accumulate in aquatic organisms.

Studies done by Wan et al., also indicate that Garlon 3A (BEE) is significantly less toxic to salmonids and rainbow trout than Garlon 4.

Evaluating risk to both humans and the environment is dependent on exposure to and toxicity of the compound. In this project, application would be done by tree injection, basal bark application and by treating cut stumps. Application by injection presents an extremely low exposure potential to both the applicator and the environment. Application by painting stumps or lower bark presents a higher potential for exposure. Wearing proper personal protection equipment can reduce exposure risks to the applicator. Applying the minimal amount needed and allowing time for the pesticide to dry before rainfall can reduce exposure to environmental aspects.

Garlon References

Garlon 4. *Specimen Label*. Dow AgroSciences.

Garlon 4. *Material Safety Data Sheet.* Dow AgroSciences.

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Wan, M.T., et al. "Acute Toxicity to Juvenile Pacific Salmonids of Garlon 3A, Garlon 4, Triclopyr, Triclopyr Ester, and Their Transformation Products: 3,5,6-Trichloro-2-pyridinol and 2-Methoxy-3,5,6-trichloropyridine." 1987. *Bulletin of Environmental and Contamination Toxicology* 39:721-728.

Please refer to Specimen Labels and Material Safety Data Sheets for Garlon 3a and Garlon 4 and the above references for more detailed information.

Appendix E Archaeological Resource Tables

*Site specific archaeological information was compiled for each of the project areas in the three phases of this project. This information is not available for public review. The Park's cultural resource staff confidentially maintain this database.