Lake Mead

National Recreation Area
National Park Service
U.S. Department of the Interior

ENVIRONMENTAL ASSESSMENT FOR AN EXOTIC PLANT MANAGEMENT PLAN

Clark County, Nevada
Mohave County, Arizona

November 2010

Executive Summary

The National Park Service (NPS) is considering the implementation of a comprehensive exotic plant management plan at Lake Mead National Recreation Area (NRA or Park). The goal of the exotic plant management plan is to maintain native plant communities by preventing and removing exotic plants using an integrated approach that maximizes the effectiveness of the action while minimizing the undesirable impacts of the exotic plant and the management action.

This action is needed to avoid, minimize, and mitigate the impacts of exotic plants on park resources. Exotic plants enter the park by various means. Seeds and plant parts are brought into the parks by wildlife, wind, water, and humans. Fast-growing exotic plants encroach from populations established outside park boundaries, particularly from the surrounding urban areas. Once inside park boundaries, the most aggressive of these species can quickly spread into disturbed as well as undisturbed areas where they often cause irreparable damage to natural resources.

This environmental assessment has been prepared to evaluate two alternatives:

- No Action: Continue Project-based Exotic Plant Management Actions, and
- Proposed Action: Implement a Comprehensive Exotic Plant Management Plan

Under the No Action Alternative, exotic plant management activities would continue on a project-by-project basis. Such projects may be undertaken by the National Park Service, by interagency organizations, or by various cooperators. Such projects would continue to be "ad hoc" - - that is, done in response to a specific situation or problem without considering wider or longer-term issues. As such, most projects focus on site-led priorities, such as removal of exotic plants in springs or rare plant habitats, early detection and eradication of exotic plants along vector corridors, and weed prevention measures incorporated into a construction contract. Such project-based exotic plant management efforts are limited in geographic scope and duration and have thus far been categorically excluded from the requirements of the National Environmental Policy Act.

The Proposed Action is to implement a comprehensive exotic plant management plan that would serve to direct exotic plant management activities undertaken by the NPS and cooperators over the next twenty years. The plan would prescribe specific integrated pest management strategies and actions to address prevention of new exotic plant invasions, early detection and eradication of incipient exotic plant populations, and containment and control of established populations. The plan would also include standardized data management protocols, a monitoring strategy, and research priorities. All of these strategies and actions would also conform to the concept of adaptive management, whereby the Park is continually learning from experience and improving the effectiveness and efficiency of its exotic plant management effort. Exotic plant species would be systematically evaluated and prioritized to determine those species that potentially pose the most risk to park values. Sites would be prioritized based on relative vulnerability to exotic plant invasion and/or impact to park values (e.g rare plant communities, recreation sites, springs, etc). These weed-led and site-led priorities would serve to focus exotic plant management efforts on

managing those species that pose the most harm and protecting those high value sites that are most vulnerable to invasion. This environmental assessment would serve as the programmatic compliance document for all routine and on-going exotic plant management activities; the release of new biological control agents and the use of aerial herbicide application would require separate compliance. The Proposed Action is also the agency's preferred alternative and the environmentally preferred alternative.

Impact topics considered in detail in this environmental assessment include: Geology and Soils, Vegetation, Wildlife, Special Status Species, Water Resources, Wilderness, Cultural Resources, Visual Resources, Park Operations, Safety and Visitor Use and Experience, Socioeconomics, and Adjacent Lands.

Analysis of environmental consequences found similar impacts of both alternatives, although the Proposed Action has greater long-term benefits due to increased effectiveness and efficiency gained through a programmatic approach to exotic plant management. Furthermore, the Proposed Action includes specific best management practices, standard operating procedures, and other administrative tools which serve to minimize risks to the environment and people while improving the effectiveness of the treatment or management action. Neither of the alternatives considered would result in impairment to park resources or unacceptable impacts.

A press release announcing a 30-day public review period for the environmental assessment is sent to various federal and state agencies, individuals, businesses, organizations, and media outlets on the park's mailing list. Notification is also published on the Lake Mead NRA website (http://www.nps.gov/lame) and on the NPS Planning, Environment, and Public Comment website at http://parkplanning.nps.gov.

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I. Introduction

The National Park Service (NPS) is considering the implementation of a comprehensive exotic plant management program at Lake Mead National Recreation Area (Lake Mead NRA or Park). Lake Mead NRA is situated in southeastern Nevada and northwestern Arizona and encompasses lands around Lake Mead and Lake Mohave (Figure 1). The NPS has prepared this environmental assessment (EA) in accordance with the National Environmental Policy Act (NEPA) of 1969, regulations of the Council of Environmental Quality's *Regulations for Implementing the National Environmental Policy Act* (1993), and NPS *Director's Order 12: Conservation Planning, Environmental Impact and Decision Making* (2000).

The EA evaluates the No Action Alternative and one action alternative. The alternatives analyzed are: No Action: Continue Project-based Exotic Plant Management Actions and Proposed Action: Implement a Comprehensive Exotic Plant Management Plan. Also included is a discussion of alternatives that have been ruled out and justifications for their elimination. The EA analyzes impacts of the alternatives on the human and natural environment. It outlines project alternatives, describes existing conditions in the project area, and analyzes the effects of each project alternative on the environment.

1.1 Purpose and Need for an Exotic Plant Management Plan

The goal of the Exotic Plant Management Plan is to maintain native plant communities by preventing and removing exotic plants using an integrated approach that maximizes the effectiveness of the action while minimizing the undesirable impacts of the exotic plant and the management action. An exotic plant is a specific type of vegetation that is not native to the region in which it is growing, and may also be called alien plants or non-native plants. Exotic plant management is a key component of the parks efforts to maintain, and restore if needed, native plant communities and ecological processes for the purpose of protecting the integrity of the park's terrestrial and aquatic ecosystems.

This plan, in concert with the park's wilderness management planning efforts, further addresses exotic plant management within wilderness areas. There are 185,051 acres of designated wilderness, and approximately 212,900 acres of proposed, potential, and suitable wilderness within Lake Mead NRA. Active exotic plant management within wilderness areas is needed to protect indigenous species and sustain natural ecosystems in the name of preserving wilderness character. While exotic plant management is an essential component of wilderness stewardship and necessary for the administration of the area as wilderness it is imperative that the tools and techniques used to complete the objectives have minimal effect on the wilderness character. The minimum requirement concept (fully outlined in Appendix C) would be utilized for wilderness areas to determine suitability of project work and ensure non-degradation of wilderness character.

This action is needed to avoid, minimize, and mitigate the impacts of exotic plants on park resources. Exotic plants enter the park by various means. Seeds and plant parts are brought into

the park by wildlife, wind, water, and humans. Fast-growing exotic plants encroach from populations established outside park boundaries, particularly from the surrounding urban areas. Once inside park boundaries, the most aggressive of these species can quickly spread into disturbed as well as undisturbed areas. These invasive plants often cause irreparable damage to natural resources. The ecological balance of plants, animals, soil, and water achieved over many thousands of years is destroyed. As native plants are displaced, wildlife populations that rely on the plants for food and shelter also decline. Exotic plants may reduce or deplete water levels, or alter runoff patterns and watershed processes, thus diminishing both the land and water quality. Some exotic plants release toxic chemicals into the soil or harbor diseases, increasing the stress on native plants. Some nitrogen-fixing exotic plants increase soil fertility, allowing other exotic plants to outcompete plants that have evolved in the nutrient-poor native soils. Exotic plants that interbreed with native plant species can contaminate native gene pools. The growth and spread of exotic plants can also change fire frequency, size, and intensity, resulting in an altered ecosystem.

Threats from exotic plants continue to increase as the opportunity for new species or at least new seed sources of other species continues to increase with the increase in development in the Las Vegas Valley. Las Vegas Wash carries the stormwater and wastewater effluent directly from the urban environments to Las Vegas to Lake Mead, which also carries seed and propagules into the park. There is also the potential for invasion from river flows that feed Lake Mead, specifically Virgin River, Muddy River, Upper Colorado River, and Meadow Valley Wash. Boats also serve as vectors for the transport of exotic plants, specifically aquatic exotic plants.

The park has initiated several new exotic plant management projects in recent years in response to the increased priority placed on exotic plant management in the NPS and the increased opportunities to fund such efforts through internal and external funding sources. The Lake Mead Exotic Plant Management Team focuses on treatment of high priority exotic plant populations in several desert parks. There are also on-going park operations that contribute to exotic plant management in various ways, including the native plant nursery which provides native plants to restore sites that have been degraded by exotic plants, the interpretation program which seeks to educate park visitors and the surrounding communities about the parks native resources, and the compliance program which analyzes proposed projects for potential impacts to native plant communities. Most of these programs have been categorically excluded under NEPA due to their minor adverse impacts which are more than compensated for by the beneficial effects to the environment.

While these project-based efforts and contributing programs have been individually successful their effectiveness could be magnified if they were integrated into a comprehensive exotic plant management program and implemented programmatically under an Exotic Plant Management Plan. Additionally, development of such a plan would provide comprehensive guidance and documentation for project managers and cooperators, provide a context for systematic evaluation and adaptive management, facilitate the transfer of information to the public and our partners, improve fiscal accountability by focusing on species and/or places where efforts yield the most benefit, enhance the effectiveness of the program by providing the required environmental analysis of more aggressive control measures, improve efficiency by identifying and eliminating

redundancies between program elements, and finally, lay a course for the future by identifying additional program elements that are needed to achieve the parks exotic plant management goal. Routine and on-going exotic plant management activities are considered programmatically in this environmental assessment; separate compliance documents would be required to release a biological control agent or to use aerial herbicide application.

1.2 Goals and Objectives of the Lake Mead NRA Exotic Plant Management Plan

- Vegetation Program Goal: Maintain, and restore if needed, native plant communities and ecological processes for the purpose of protecting the integrity of the park's terrestrial and aquatic ecosystems, thus reducing their vulnerability to invasion.

- Exotic Plant Management Goal: Maintain native plant communities by preventing and removing exotic plants using an integrated approach that maximizes the effectiveness of the action while minimizing the undesirable impacts.

  - Objective 1: Operate the Exotic Plant Management Program within a framework of adaptive management where research and monitoring are used to systematically evaluate actions and outcomes for the purpose of improving future management actions.

  - Objective 2: Proactively prevent the introduction and/or expansion of new exotic plant species.

  - Objective 3: Actively detect and eradicate incipient exotic plant populations.

  - Objective 4: Contain and, if possible, eradicate established exotic plant populations.

- Wilderness Management Goal: Maintain native plant communities and ecological processes for the purpose of long-term protection and preservation of wilderness character under a principle of non-degradation.

1.3 Project Location

This programmatic plan would encompass all of the area administered by the National Park Service in Lake Mead National Recreation Area. The Park includes two reservoirs (Lakes Mead and Mohave) along 140 miles of the lower Colorado River from the southern tip of Nevada to the northwest corner of Arizona. It contains portions of Clark County, Nevada, and Mohave County, Arizona (Figure 1).

Lake Mead NRA is bounded on the north by the town of Overton, Nevada, the Virgin Mountains, and the Shivwits Plateau; on the east by Grand Canyon National Park and land administered by the Bureau of Land Management (BLM); on the south by Bullhead City,

Arizona, and Laughlin, Nevada; and on the west by Boulder City, Nevada, the Eldorado Mountains, and the Newberry Mountains. The Park is generally associated with the city of Las Vegas, Nevada, which lies approximately 20 miles to the northwest (Figure 2). Lake Mead NRA is located in one of the fastest growing regions of the United States. The park visitation is approximately 9 million annually.

The Park contains approximately 1.5 million acres, of which 1,484,159 acres are in federal ownership administered by the NPS and 12,568 are nonfederal lands. An additional 4,488 acres surrounding Hoover and Davis Dams are administered by the Bureau of Reclamation. Lake Mead NRA is the fourth largest unit of the national park system outside the state of Alaska. Federal acreage divided by state reflects 60% of the park is located in Arizona and 40% is located in Nevada. There are nine designated wilderness areas in Lake Mead NRA totaling 185,051 acres. In addition, the park has an additional 212,900 acres of proposed, potential, and suitable wilderness.

The upland areas within the park are rugged with deep canyons, dry washes, sheer cliffs, and mountains. The vegetation is primarily composed of communities typical of the Mojave Desert, with some species and plant assemblages typical of the surrounding Sonoran Desert and Great Basin Desert. Within Lake Mead NRA major vegetation types, generally arranged from low elevation to high elevation, include lowland riparian shrubland or woodland (often dominated by non-native saltcedar), creosote bursage shrubland, desert grassland, blackbrush shrubland, Joshua tree woodland, and pinyon-juniper woodland. Over the low desert area, rainfall is typically less than 5 inches a year and may be slightly higher at higher elevations. Precipitation typically falls as winter rain and late summer thunderstorms associated with the southwestern monsoonal flow. However, precipitation is highly variable, with significantly above average rainfall in some years (such as 2004-05) and below average rainfall in most years. Winters are mild, and summers are very hot. Soils are typically low in organic matter. For most plant species, water is the limiting factor for growth and reproduction.

Figure 1. Region Map

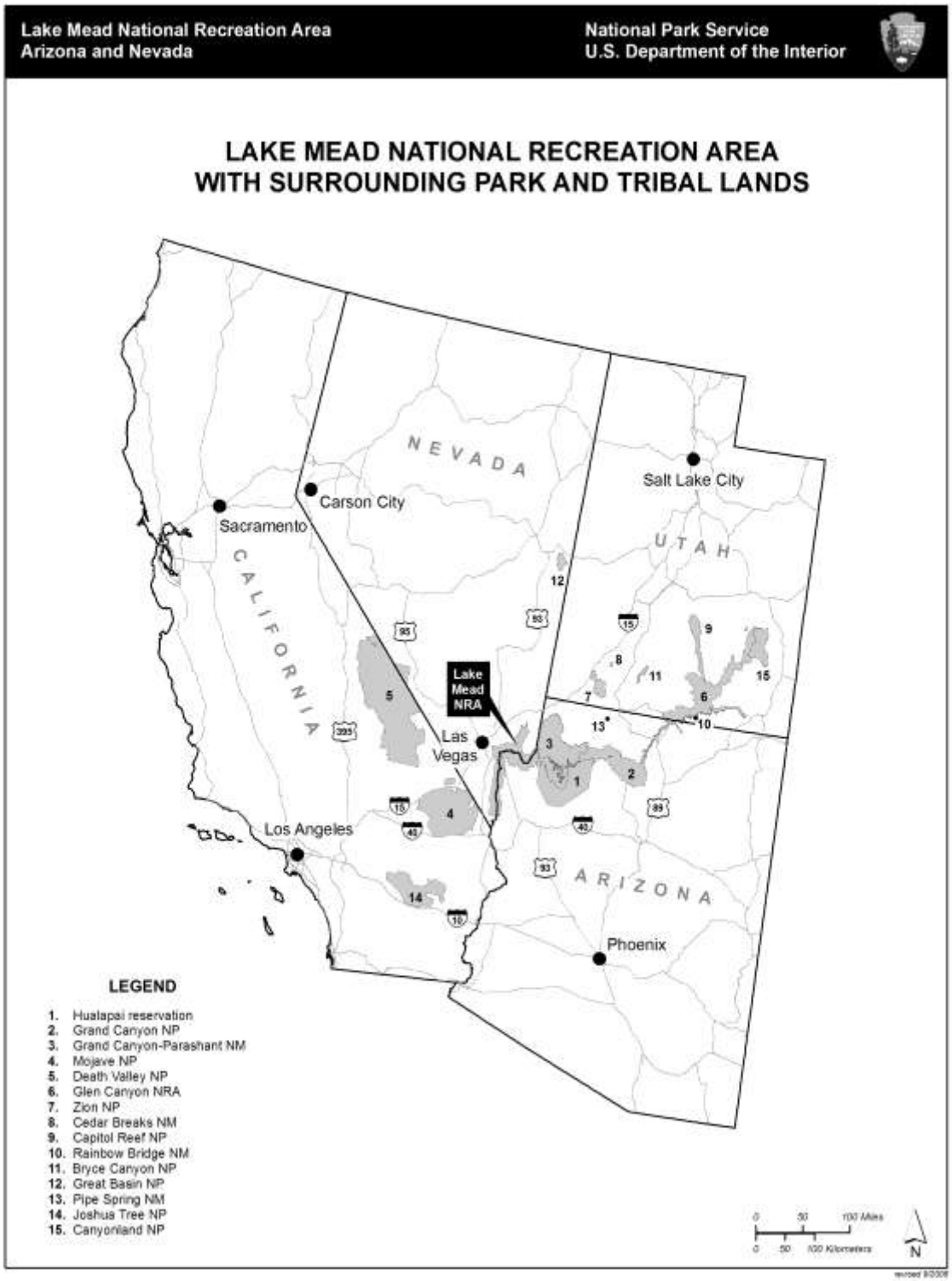
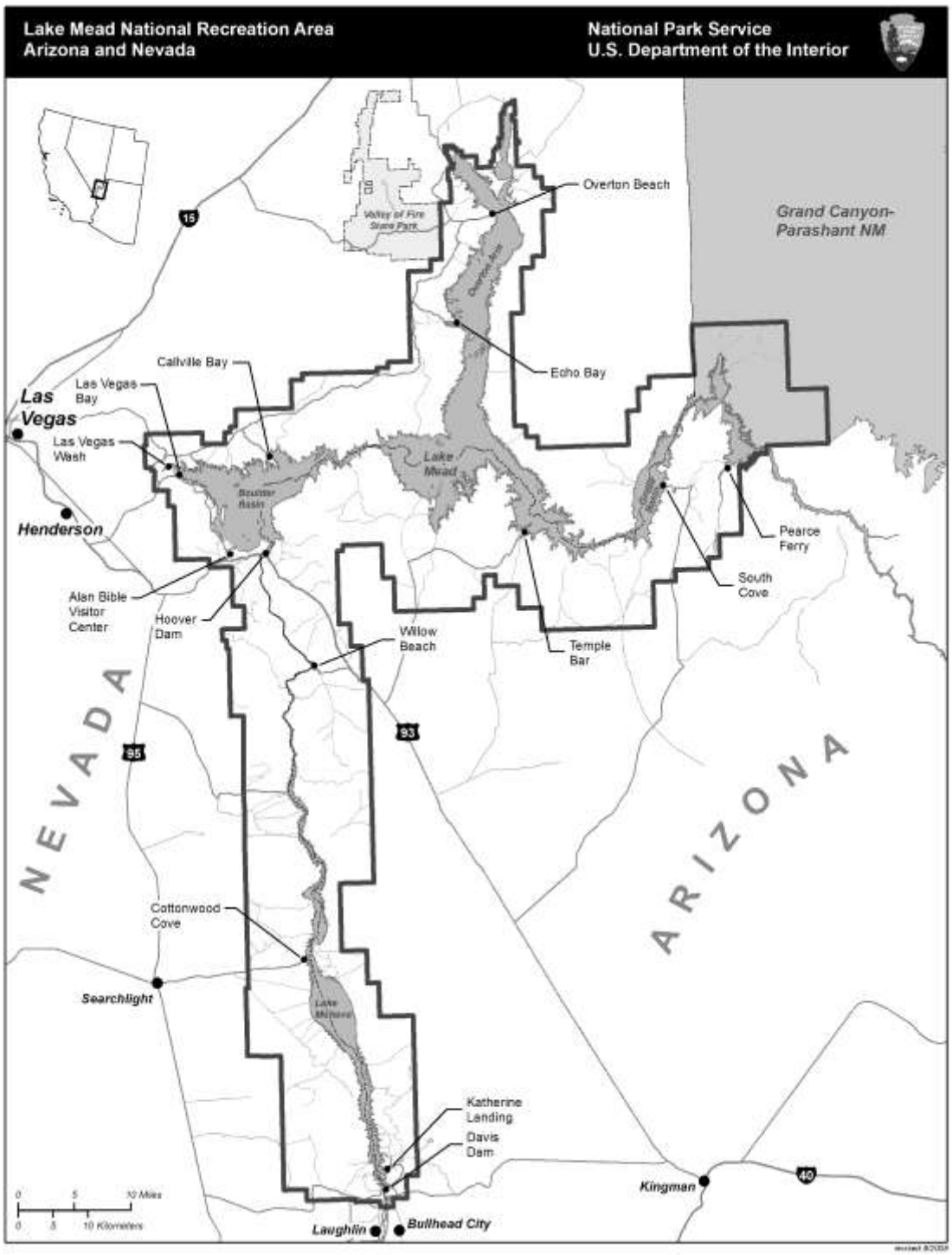


Figure 2: Park Map



1.4 Legal Guidance and Constraints

1.4.1. Relevant Laws

The stated purpose of the NPS (*Organic Act of 1916*) is to "conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations." Lake Mead NRA was established by law in 1964 for "...the general purpose of public recreation, benefit and use, and in a manner that will preserve, develop, and enhance…the recreation potential, and in a manner that will preserve the scenic, historic, scientific, and other important features of the area…" (Public Law 88-639). The park considers its native plant communities to be important features of the area and thus their preservation, including management of exotic plants that threaten native plant communities, is consistent with the park's establishment as a unit of the National Park System.

The *Plant Protection Act* became law in June 2000 as part of the *Agricultural Risk Protection Act*. The *Plant Protection Act* consolidates all or part of 10 existing U.S. Department of Agriculture plant health laws into one comprehensive law, including the authority to regulate plants, plant products, certain biological control organisms, noxious weeds, and plant pests. The *Plant Quarantine Act*, the *Federal Pest Act*, and the *Federal Noxious Weed Act* are among the 10 statues that the new act replaces. The *Plant Protection Act* is necessary because of the major impact plant pests could have or currently have on the agriculture, environment, economy, and commerce of the United States. The *Plant Protection Act* gives the Secretary of Agriculture (and through delegated authority, the Animal and Plant Health Inspection Service of the U.S. Department of Agriculture) the ability to prohibit or restrict the importation, exportation, and interstate movement of plants, plant products, certain biological control organism, and noxious weeds, and plant pests. The act also authorizes the Animal and Plant Health Inspection Service to regulate "any enemy, antagonist, or competitor used to control a plant pest or noxious weed."

Although the *Plant Protection Act of 2000* superseded and repealed most of the *Federal Noxious Weed Act of 1974*, section 15 (Management of Undesirable Plants on Federal Lands [7 USC 2814]) was retained. Section 15 requires federal land management agencies to develop and establish management programs to control undesirable plants of federal lands under the agencies' jurisdiction. Undesirable plants are those classified under state and federal law as undesirable, noxious, harmful, injurious, or poisonous. The act also requires that federal land management agencies enter into cooperative agreements to coordinate the management of undesirable plant species on federal lands where similar programs are being implemented on state and private lands in the same area. The Secretaries of Agriculture and the Interior must coordinate their respective control, research, and educational efforts relating to noxious weeds.

Executive Order 13112 on Invasive Species was signed on February 1999. Section 2 of the Executive Order directs federal agencies to identify actions that may affect the status of invasive species and take action to: prevent the introduction of invasive species, detect and respond rapidly to control populations of such species in a cost-effective and environmentally sound manner, monitor invasive species populations accurately and reliably, provide for restoration of native species and habitat conditions in ecosystems that have been invaded, conduct research on

invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species, and promote public education on invasive species and the means to address them. The National Invasive Species Management Plan is an interagency document developed in support of EO 13112. The 2008-2012 Plan identifies five strategic goals: prevention, early detection and rapid response, control and management, restoration, and organizational collaboration.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and the regulation established by the U.S. Environmental Protection Agency (40 CFR 116-117,195,170-172) serve as primary guidance governing pesticide registration, pesticide use, the training and certification of pesticide applicators, and the criminal and civil penalties associated with misuse of pesticides. *FIFRA* defines the term "pesticide" as (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pests; (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant; and (3) any nitrogen stabilizer. Herbicide is a specific class of pesticide used to treat plants. All pesticides used in the United States must be registered by the U.S. Environmental Protection Agency. Registration ensures that pesticides will be properly labeled, and if used in accordance with specifications, will not cause unreasonable harm to the environment. Pesticide labels include direction for the protection of workers who apply the pesticide and direction for reducing exposure to non-applicators. Violation of these directions constitutes a violation of *FIFRA.* The storage and disposal of most pesticides are also regulated under the act, with specific direction provided on pesticide labels. Enforcement of the act is delegated to individual states. *FIFRA* also gives the U.S. Environmental Protection Agency review authority for biological control agents when they are used to control invasive pests.

NEPA was enacted in 1969 for a simple reason: to make sure that agencies fully consider the environmental costs and benefits of their proposed actions before they make any decision to undertake those actions. The Act and subsequent regulations enacted by the Council on Environmental Quality establish two mechanisms to achieve this stated intent: (1) a requirement that all agencies make a careful, complete, and analytic study of the impacts of any proposal that has the potential to affect the environment, and alternatives to that proposal well before any decisions are made; and (2) the mandate that agencies be diligent in involving any interested or affected members of the public in the NEPA process. The NPS establishes agency policy and procedural requirements for compliance with NEPA in D*irectors Order/Reference Manual #12: Conservation Planning, Environmental Impact Analysis, and Decision-Making.* This environmental assessment is the document prepared in compliance with NEPA and agency procedures to analyze potential impacts that would result from the adoption of an Exotic Plant Management Plan for Lake Mead NRA. Routine and on-going exotic plant management activities are considered in this environmental assessment; additional compliance would be required to introduce new biological control agents and/or conduct aerial herbicide application.

The *Wilderness Act of 1964* established a national wilderness preservation system "administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of

information regarding their use and enjoyment as wilderness (16 USC 1131)." The act defines wilderness as "an area where the earth and its community of life are untrammeled by man, where man himself is a visitor who does not remain." Under Section 4(c) of the *Wilderness Act*, the following activities are generally prohibited in wilderness: commercial enterprises, permanent roads, temporary roads, use of motor vehicles, use of motorized equipment, use of motorboats, landing of aircraft, other form of mechanical transport, structures or installations. There are nine designated wilderness areas in Lake Mead NRA totaling in185,051 acres: Jimbilnan, Pinto Valley, Muddy Mountains, Black Canyon, Eldorado, Ireteba Peaks, Nellis Wash, Spirit Mountain, and Bridge Canyon. Four of these wilderness areas are co-managed with wilderness on adjacent lands administered by the Bureau of Land Management: Muddy Mountains, Eldorado, Ireteba, and Spirit Mountain. There are an additional 212,900 acres of proposed, potential, and suitable wilderness within Lake Mead NRA. Exotic plants are known to occur in some wilderness areas of Lake Mead NRA. Thus treatment of these exotic plants in wilderness is constrained by the requirements of this Act and the NPS policies that implement it. In short, the Act compels managers to act swiftly to eradicate non-native flora to protect the wilderness, but only minimum tools must be used.

Congress passed the *National Historic Preservation Act* of 1966 because "the historical and cultural foundations of the Nation should be preserved as a living part of our community life and development in order to give a sense of orientation to the American people" (16 USC 470b [2]). Section 106 of the Act requires that federal agencies consider the effects of their undertakings on historic properties; that is, those cultural resources eligible for the National Register of Historic Places. Treatment methods proposed to control exotic plants and the presence of exotic plants among historic structures and archaeological sites may have effects on historic properties in the Park and thus require consideration and consultation under this Act.

Section 7 of the *Endangered Species Act* of 1973 requires all federal agencies to ensure that any action authorized, funded, or carried out by the agency will not jeopardize the continued existence of any endangered or threatened species or adversely modify any critical habitat of these species (16 USC 1536[a][2]). Each federal agency must consult with the U.S. Fish and Wildlife Service (or the National Marine Fisheries Service for certain marine and anadromous species) regarding any federal action that may affect a listed species. Numerous endangered or threatened species as well as critical habitat for these species exist in Lake Mead NRA. Pursuant to the Act, plans to control exotic plants must be consistent with the recovery plans for listed species, including the Clark County Multiple Species Habitat Conservation Plan which addresses the conservation of 232 species in Clark County Nevada, including some lands in Lake Mead NRA.

Nevada Revised Statutes Chapter 555: Control of Insects, Pests, and Noxious Weeds requires that every landowner or occupier of lands in Nevada control and/or eradicate noxious weeds. The Nevada Department of Agriculture defines a noxious weed as "any species of plant which is, or is likely to be, detrimental or destructive and difficult to control or eradicate." An invasive plant is declared "noxious" in the State of Nevada after a legislative process is conducted that places the species on the State's Noxious Weed List. These statues also regulate the licensing of pesticide applicators in Nevada. These regulations, with some exceptions where federal law supercedes

state law, generally apply to weeds and weed control efforts on those lands of Lake Mead NRA that are located in Nevada.

Noxious weeds and efforts to control them in the State of Arizona are regulated under *Chapter 2 of Arizona's Revised Statutes, Article 1: Dangerous Plant Pests and Diseases, Article 5: Pesticides, Article 6: Pesticide Control, and Article 6.1 Integrated Pest Management.* The Arizona Department of Agriculture has primary responsibility for administering the State's noxious weed program, including maintaining a list of noxious weed species. The Department regulates listed species, including all viable plant parts (stolons, rhizomes, cuttings and seed, except agricultural, vegetable and ornamental seed for planting purposes). These regulations, with some exceptions where federal law supercedes state law, generally apply to weeds and weed control efforts on those lands of Lake Mead NRA that are located in Arizona.

1.4.2. Relevant Policies

NPS Management Policies (2006) Section 4.4.1.3 defines exotic species as "those species that occupy or could occupy park lands directly or indirectly as a result of deliberate or accidental human activities. Exotic species are also commonly referred to as non-native, alien, or invasive species. Because an exotic species did not evolve in concert with the species native to the place, the exotic species is not a natural component to the natural ecosystem at that place." In section 4.4.4 the policy further defines the legal basis of a exotic plant management program by stating that "exotic species will not be allowed to displace native species if displacement can be prevented" and elaborates in section 4.4.4.2 that all exotic plant and animal species that are not maintained to meet an identified park purpose will be managed – up to and including eradication – (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, or
- creates a hazard to public safety.

Section 4.4.5.2 prescribes that management of exotic species will be based on the use of an integrated pest management program to reduce risks to the public, park resources, and the environment from pests and pest-related management strategies. Integrated pest management is 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. Specific policies exist regarding pesticide use approval, storage, and reporting as well as the use of biological control agents.

Director's Order/Reference Manual 12: Conservation Planning, Environmental Impact Analysis, and Decision-Making (NPS 2001) lays the groundwork for how the NPS complies NEPA. The Order sets forth a planning process for incorporating scientific and technical information and

establishing a solid administrative record for NPS projects and programmatic plans, such as the Lake Mead Exotic Plant Management Plan. The Order requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision makers to understand the implications of those impacts in the short and long term, cumulatively, and in context, based on an understanding and interpretation by resource professionals and specialists. The Order also requires that an analysis of impairment to park resources and values be made as part of the NEPA document.

Management of wilderness in the NPS is guided by *NPS Management Policies* (NPS 2006) and *Director's Order/Reference Manual #41: Wilderness Preservation and Management* (NPS 1999). The Order directs "Potential disruption of wilderness character and resources and applicable safety concerns would 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 have localized, short term adverse impacts would be acceptable." Any prohibited use proposed in wilderness for non-emergency activities must be considered and documented with a wilderness minimum requirement analysis. The wilderness minimum requirement analysis will first include a determination of whether such use is necessary for the administration of the area as wilderness, and if so, would then determine the minimum method or tool that causes the least amount of impact to the physical resources and experiential qualities of wilderness, as well as a discussion of alternatives considered.

1.4.3. Relevant Plans

The park's *Vegetation Management Plan* was completed in December 1992 and includes a chapter on exotic vegetation management; however, this document does not include an environmental analysis as required under the NEPA. The park's *General Management Plan* was completed in 1986 and includes an environmental impact statement, but the scope of analysis for exotic plant management is limited to tamarisk control. The 1999 Lake Mead NRA *Resource Management Plan* and *State of Park Report* (1998) stated that the park should, "Develop a program for the management of exotic species, particularly plant species." Although the report states that over 100 alien species of plants exist in the park, only two plant species were mentioned by name. These two species were saltcedar and red brome. Saltcedar was noted as a significant invasive of riparian and spring systems, and red brome was mentioned as an invader of upland areas. Two additional park-wide plans have been completed in recent years: the *2002 Lake Management Plan and Environmental Impact Statement* as well as the *2005 General Management Plan Amendment to Address Low Water Conditions and Environmental Assessment*. These documents focus on the shoreline and lake surface areas and their analyses of exotic plant management is limited to tamarisk control with very limited discussion of other exotic plant related concerns.

The Clark County Multiple Species Habitat Conservation Plan (MSHCP) was approved by the U.S. Fish and Wildlife Service in 2000. The MSHCP was prepared pursuant to section 10 (a) of the Endangered Species Act (ESA) of 1973, as amended, in support of an application for an incidental take permit for species listed under the ESA. The MSHCP identifies those actions necessary to meet the conservation goals and objectives of the plan for 78 species covered under

the permit, including one species listed as endangered (southwestern willow flycatcher, *Empidonax traillii extimus*), one species listed as threatened (desert tortoise, *Gopherus agassizii*), and two candidate species for Federal listing (relict leopard frog, *Rana onca*, and yellow-billed cuckoo, *Coccyzus americanus*). The MSHCP planning area includes designated critical habitat for the desert tortoise, and proposed designated critical habitat for the flycatcher. The MSHCP also identified 103 evaluation and 51 watch list species that may be considered for inclusion under the permit for future phases of the MSHCP. All unlisted covered species are addressed in the MSHCP as if they were listed, meaning that the conservation measures in the MSHCP for those species would satisfy permit issuance criteria under section 10(a)(1)(B) of the ESA if the species was listed during the term of the permit. A total of 232 species are addressed. Implementation of the conservation measures in the MSHCP is a cooperative effort among many cooperators, including but not limited to the U.S. Fish and Wildlife Service, the Bureau of Land Management, the U.S. Forest Service, the National Park Service, the Department of Defense, Nevada Department of Wildlife, Nevada Department of Forestry, and other Federal and state land managers and regulators. The MSHCP includes species and habitats that occur in Lake Mead NRA that are impacted by exotic plants and might be impacted during weed management activities.

The Clark County MSHCP Weed Management Plan was developed in 2005 to coordinate existing activities and prioritize new projects focusing on weed inventory, eradicate, and monitor weeds in Clark County, Nevada. The Plan is used to comply with the requirements of the U.S. Fish and Wildlife Service for the conservation of species and habitats identified in the MSHCP and reaffirms Clark County's commitment as steward of weed management. In addition, the Weed Management Plan is used to aid in planning and coordination of future weed management activities for MSHCP partner agencies and serves as a standard by which the County measures progress toward the conservation goals identified in the MSHCP. The Weed Management Plan identifies goals and objectives for the management of weeds throughout Clark County, including prevention, detection, assessment/control, and restoration.

1.5 Issues and Impact Topics

Issues are related to potential environmental effects of project alternatives and were identified by the project interdisciplinary team. Once issues were identified, they were used to help formulate the alternatives and mitigation measures. Impact topics based on substantive issues, public and agency scoping, environmental statutes, regulations, and executive orders were selected for detailed analysis. A summary of the impact topics and rationale for their inclusion or dismissal is given below.

1.5.1. Issues and Impact Topics Identified for Further Analysis

The following relevant impact topics are analyzed in the EA:

- Geology and Soils
- Vegetation
- Wildlife
- Special Status Species
- Water Resources

- Wilderness
- Cultural Resources
- Visual Resources
- Park Operations
- Safety and Visitor Use and Experience
- Adjacent Lands

1.5.2. Impact Topics Considered but Dismissed from Further Consideration

The following topics are not further addressed in this document because there are no potential effects to these resources, which are not in the project area or would be imperceptibly impacted.

- Air Quality
- Designated ecologically significant or critical areas
- Wild or scenic rivers
- Wetlands
- Floodplains
- Designated coastal zones
- Indian Trust Resources
- Prime and unique agricultural lands
- Sites on the US Department of the Interior's National Registry of Natural Landmarks
- Sole or principal drinking water aquifers
- Soundscapes
- Socioeconomics

In addition, there are no potential conflicts between the project and land use plans, policies, or controls (including state, local, or Native American) for the project area.

Regarding energy requirements and conservation potential, construction activities would require the increased use of energy for the construction itself and for transporting materials. However, overall, the energy from petroleum products required to implement action alternatives would be insubstantial when viewed in light of production costs and the effect of the national and worldwide petroleum reserves.

There are no potential effects to local or regional employment, occupation, income changes, or tax base as a result of this project. The project area of effect is not populated and, per Executive Order 12898 on Environmental Justice, there are no potential effects on minorities, Native Americans, women, or the civil liberties (associated with age, race, creed, color, national origin, or sex) of any American citizen. No disproportionate high or adverse effects to minority populations or low-income populations are expected to occur as a result of implementing any alternative.

2.0 Alternatives

This chapter describes the alternatives considered, including the No Action Alternative. The alternatives described include mitigation measures and monitoring activities proposed to minimize or avoid environmental impacts. This section also includes a description of alternatives considered early in the process but later eliminated from further study; reasons for their dismissal are provided. The section concludes with a comparison of the alternatives considered.

2.1 Exotic Plant Management Concepts and/or Activities Common to Both Alternatives

There are elements of exotic plant management common to both alternatives, although the scope and scale of such actions as well as the integration of these activities varies as discussed separately for each alternative. The purpose of this section is to briefly describe these common exotic plant management activities as well as some fundamental exotic plant management concepts to avoid redundancies in subsequent sections. The weed management tools listed below have all been determined to be the minimum tool for past project work occurring in wilderness and thus represent potential tools for future projects designed to control exotic species in wilderness areas.

2.1.1. Integrated Pest Management

National Park Service policy (NPS 2006) requires the use of an integrated pest management (IPM) approach to pests, including invasive exotic plants. This concept is defined in policy as follows: "4.4.5.2. Integrated pest management is 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."

An IPM program generally consists of the following strategies:

- Identification of the pest
- Monitoring pest populations and damage levels
- Establishing injury and threshold/action levels
    - Injury level is the population size at which the pest causes unacceptable damage
    - Threshold or Action level is the population size at which some management action must be taken to prevent the population from reaching the injury level
- Implementing treatments
    - Indirect Suppression such as habitat modification, modifying human activities
    - Direct Suppression such as physical or mechanical removal, biological control, or chemical treatment
- Evaluation of treatment results
- Education of staff and others

IPM often employs a combination of treatment strategies specific to the species and location that are: least disruptive of natural controls; least hazardous to human health; least toxic to non-target organisms; least damaging to the general environment; most likely to produce permanent reduction in the pest; easiest to carry out effectively; and most cost effective in both the short- and long-term. For example, it is common to implement cultural practices to prevent the spread of weed seeds along with manual and chemical treatment of incipient and established populations.

2.1.2. Prioritization

Exotic plant management priorities can generally be classified as either site-led or weed-led. The term *weed-led* is used because the program is defined by what is needed to manage the spread of a specified weed species (Owen 1998) where each weed species known to occur or likely to occur is evaluated and ranked according to some standard and documented method. Such rankings then focus exotic plant management actions on specific species that pose the most threat to ecological values. A site-led program aims to protect the quality or integrity of the natural values within a particular place (Owen 1998). Its focus is a management unit with high natural ecological value, such are desert springs or rare plant habitat. Distinguishing between weed-led and site-led programs keeps attention focused on why time and effort are spent to manage invasive exotic plants. A weed-led program is a proactive strategy to minimize future risks – it focuses not on the needs of a specific place, but rather on what is required to eradicate or contain a specific weed species in the region. In contrast, site-led programs always focus on a specific place and what is required to protect the values of that place (Owen 1998).

Within the scope of weed-led management priorities, there are several methods by which individual plant species may be evaluated and ranked or prioritized for management purposes. Such efforts may be based entirely on expert opinion or may use systematic evaluation schemes that consider such characteristics as species biology, tendency to naturalize or invade undisturbed sites, feasibility of control, and impacts to other species and/or ecosystem processes.

2.1.3. Cultural Treatments

Cultural treatments are practices that promote the growth of desirable plants and reduce the opportunities for exotic plants to grow. Cultural treatment methods involve manipulating treatment areas to present exotic plants with effective native competitors.

Prevention of exotic plant introduction and/or spread is a high priority cultural treatment due to its long-term cost-effectiveness and effectiveness in protecting native plant communities.

Another common cultural treatment is the maintenance and restoration of native plant communities that are resistant to invasion and resilient after invasion and treatment. For many sites with established weed populations, the propagules of native plant species may be insufficient to provide for natural reestablishment of native plant communities, thus leaving the site vulnerable to re-invasion by the same exotic species or new invasions by other exotic species. In these cases, it may be necessary to actively modify the growing environment (e.g soil modifications) and/or revegetate the site to increase the establishment of native species and decrease the likelihood of exotic plant invasion. The decision to revegetate must consider direct

costs (seedbed preparation, seed or plant materials, follow-up management), indirect costs (risk of failure), and benefits (wildlife habitat, soil conservation). Revegetation efforts should focus on sites and methods with the greatest potential for increasing net benefits in the shortest amount of time (Jacobs et al. 1999). The Park has an active Restoration Program that deals primarily with human-caused disturbances (e.g. damage to soils and plants due to off-road vehicle trespass) and a Native Plant Nursery that propagates native plants for a variety of purposes.

2.1.4. Manual and Mechanical Treatments

Manual and mechanical treatments involve physical damage to or removal of part or all of the plant. Manual treatments involve physically damaging or removing exotic plants through non-mechanical means. Examples of manual treatment include hand-pulling or the use of draft animals to remove large individual plants. Mechanical treatments involve the use of tools to remove or physically damage exotic plants. Examples of mechanical treatments used at Lake Mead NRA include using cutting tools (shovels and clippers), pulling tools (such as weed wrenches™), and power tools (such as weed eaters and chainsaws). Any manual and mechanical methods would be highly selective for individual plants. Both manual and mechanical treatments can be used to treat individual plants or specific treatment areas. Manual or mechanical treatments may need to be performed several times during a season and are often used in concert with other treatment methods. For example, mechanical treatments of exotic trees, such as saltcedar, may be followed by application of pesticides.

Manual treatment can be used in any area. Manual treatment is most effective for pulling shallow-rooted, non-rhizomatous species. Hand-pulling is conducted by removing as much of the root as possible while minimizing soil disturbance. Manual treatment is generally not appropriate for rhizomatous species because the root fragments left behind will regenerate into many new plants where there was formerly only one, thus increasing the weed population.

Types of mechanical treatment include using hand cutting tools, pulling tools, power tools, or heavy equipment.

Hand cutting tools are a treatment option for removing the above ground portions of annual or biennial plants. Use of hand tools, such as trowels, shovels, and pulaskis are simple forms of mechanical treatments. These tools can be used to remove a larger portion of the root system or to sever the plant's taproot below the point where nutrients are stored. In some cases, mechanical treatment may be used to simply remove the seed heads of the plants prior to dispersal to prevent seed set that growing season. This is particularly appropriate for some biennial species with a large tap root (e.g. common mullein) for treatment of second year plants that are naturally going to die after seeds set where it would take a substantial amount of effort to remove the entire plant and no additional weed reduction would be realized from the effort.

Pulling tools are a treatment option for removing individual plants that are deep-rooted. Pulling tools can be used to control small infestations, such as when an exotic plant is first identified in an area. These tools grip the weed stem and remove the root by providing leverage. Pulling tools are most effective on firm ground rather than soft, sandy, or muddy substrate (Tu et al. 2001).

Power tools can be used to treat small to large infestations. Power cutting tools act as hand cutting tools to remove aboveground biomass, reduce seed production, and reduce plant growth, but can effectively be used on larger plants and woody species that exceed the capacity of hand tools. Power tools are useful for controlling annual plants before they set seed. Power tools can also be used along with other treatments, such as chemicals or prescribed fire, to treat perennial exotic plants. By removing aboveground biomass, nutrient reserves that are stored in root or rhizome systems are depleted. Once nutrient reserves are depleted, some exotic plants become more susceptible to subsequent chemical or fire treatments. Chainsaws are a power tool that may be used to remove aboveground biomass of shrubs and trees. Following biomass removal, chemicals are often applied directly to the stumps to prevent suckering. This is a common practice for the treatment of saltcedar at Lake Mead NRA.

2.1.5. Biological Control

Biological treatments are commonly referred to as biological control, or biocontrol. Biological treatments involve the use of "natural enemies" (including insects and microorganisms) to reduce the abundance of an exotic plant. Natural enemies are insects, mites, or pathogens that are imported from areas where the target exotic plant occurs as a native plant and are deliberately released into areas where the plant is exotic. These natural enemies limit the growth or reproduction of exotic plants or in some cases may damage the plant in ways that make it susceptible to other pathogens. Biological control may be a long-term solution for controlling some exotic species that are too widespread for control by other means. Biological control is best suited for infestations of a single, dominant exotic plant species that is not closely related to other native plant species.

In the United States, biological control agents are identified, tested, and regulated by the U.S. Department of Agriculture Animal and Plant Health Inspection Service (APHIS).

Biological control relies on the use of other biological organisms to maintain pest populations below the action thresholds. In some cases, such as when native insects and herbivores are not maintaining exotic plants at acceptable levels, releases of biological control agents may be necessary.

2.1.6. Chemical Treatments

Chemical treatments involve applying pesticides as prescribed by their labels, using a variety of application methods. Pesticides are most effective for treating monotypic stands of a single exotic plant species in areas where desirable plants are scarce or absent and where pulling or cutting is not feasible. The specific category of pesticide used to treat exotic plants is known as herbicide. As the scope of this document is limited to plants, the terms herbicide and pesticide are used interchangeably.

Active ingredients and their mode of action for herbicides that are used or expected to be used at Lake Mead NRA are summarized in Table 1. It is anticipated that new formulations of pesticides will become available in the future and new weed species are targeted for treatment using pesticides not currently in use at the park, thus this table is not meant to be a list of the only active ingredients allowed for use. Pesticides containing active ingredients that are not listed on

Table 1 may also be used at Lake Mead NRA; however, the use of any pesticide must meet all conditions outlined in this document and must also be approved annually by the NPS Regional or National IPM Coordinator through a Pesticide Use Proposal.

Table 1. Summary of herbicides for use at Lake Mead NRA.

Active Ingredient	Approved Uses	Mode of Action	Method of Application	Reference
2, 4-D amine	Herbaceous and aquatic broadleaf plants	It is absorbed by plant leaves, stems, and roots, and moves throughout the plant. It accumulates in growing tips. It mimics auxin, a plant growth hormone, which causes uncontrolled and disorganized plant growth and eventually death.	Aerial spraying, spraying from ground based equipment, cut stump treatments, foliar spray, basal bark spray, tree injection.	Tu et al. 2004
Aminopyralid	Broadleaf weeds in grasses, especially members of the sunflower, legume, and nightshade families	Absorbed by the leaves and roots of the plant and moves rapidly through the plant. It acts as a natural growth regulator causing disruption of plant growth processes.	Aerial spraying, spraying from ground based equipment, cut stump treatments, foliar spray, basal bark spray, tree injection.	Hartzler 2006
Chlorosulfuron	Pre-emergent and early post-emergent control of annual, biennial, and perennial broadleaf weeds	Absorbed by foliage and roots. It inhibits a key enzyme needed to synthesize proteins which causes disruption of plant growth processes.	Aerial spraying, spraying from ground based equipment, foliar spray.	DuPont 2007a
Clopyralid	Annual and perennial broadleaf plants, especially members of the sunflower, legume, and knotweed families	Absorbed by the leaves and roots of the plant and moves rapidly through the plant. It acts as a natural growth regulator causing disruption of plant growth processes.	Spraying from ground based equipment.	Dow AgroSciences, no date
Dicamba	Used in the control of annual and perennial broadleaf weeds, brush, and vines in rangeland and non-cropland areas.	Dicamba uptake is through roots, leaves and stems. The chemical moves to all plant tissues but builds up in growing tissues. Dicamba acts like a naturally occurring plant hormone and causes uncontrolled cell division and growth in plants.	Ground or aerial broadcast, soil (band) treatment, basal bark treatment, stump (cut surface) treatment, frill treatment, tree injection, and spot treatment.	National Pesticide Information Center 2002
Glyphosate	Grasses, herbaceous plants including deep-rooted perennial plants, brush, some broadleaf trees and	Absorbed by leaves and rapidly moves through the plant and accumulates in actively growing parts of the plant. It prevents the plant from producing an	Aerial spraying, spraying from ground based equipment, wipe application, frill treatment, cut stump treatment.	National Pesticide Information Center 2000

	shrubs, and some conifers. Does not control all broadleaf woody plants	important enzyme which then disrupts plant synthesis of compounds necessary for growth.		
Imazapic	Annual and perennial herbaceous plants and grasses.	Inhibits the production of an enzyme, which interferes with protein synthesis and growth.	Aerial spraying, spraying from ground based equipment.	Tu et al. 2004
Imazapyr	Annual and perennial grass, herbaceous weeds, brush, vines, and deciduous trees.	Absorbed by leaves and roots, then moves rapidly through the plant where it inhibits a specific enzyme required for protein synthesis and cell growth.	Aerial spraying, spraying from ground based equipment, basal bark and stem treatment, cut stump treatment, tree injection.	Tu et al. 2004
Metsulfuron methyl	Woody plants, annual and perennial herbaceous plants.	Absorbed through the roots and foliage and moves rapidly through the plant where it inhibits cell division in the roots and shoots, which stops growth.	Aerial spraying, spraying from ground based equipment.	DuPont 2007b
Picloram[1]	Herbaceous plants, vines, and woody plants.	Absorbed through plant roots, leaves, and bark. It moves both up and down within the plant and accumulates in new growth. It acts by deregulating plant growth metabolic pathways which interferes with vital plant growth processes.	Aerial spray as broadcast or low volume dormant spray, broadcast or spot foliar or soil treatment, basal spot treatment, tree injection, frill treatment, stump treatment, basal bark treatment, or low-volume dormant stem spray.	Dow AgroSciences 2002
Triclopyr	Control of woody plants and broadleaf weeds on right-of-way, non-crop areas, non-irrigation ditch banks, forests, wildlife openings, rangeland, and permanent grass pastures.	Triclopyr is absorbed by green bark, leaves, roots, and cut stem surfaces and moves throughout the plant where it accumulates in the meristem (growth region) of the plant. It mimics a plant growth hormone which interferes with normal plant growth processes.	Aerial spraying, spraying from ground based equipment, basal bark and stem treatment, cut surface treatment, tree injection.	National Pesticide Information Center 2002

[1] Products containing picloram are classified as "restricted use." As a result of this designation, the sale and use of these products are limited to licensed pesticide applicators only for the uses covered by their applicator's certification. The restricted use classification is due to picloram's mobility in water and the sensitivity of many important crop plants to damage.

An adjuvant is a substance added to a pesticide to aid its action, but has no pesticide action by itself. Some pesticides require the addition of an adjuvant to work effectively. Surfactants are adjuvants used in conjunction with pesticides to increase absorption of the chemical by the plant. Another adjuvant commonly used with herbicide is a dye product that turns the chemical mixture a specific color, usually blue, so that treated plants (or portions of plants) are easily recognized to

aid the pesticide applicator in assuring a thorough application of the chemical to the targeted plant.

Pesticides can be applied using one of several application methods. The most appropriate application method is determined by the weed being treated, the herbicide being applied, the skills of the applicator, and the application site (Tu et al.2004). Methods of application can be broadly classified as follows:

- Foliar application where herbicide is applied to intact, green leaves
    - Spot application using a precise tool such as a backpack applicator or spray bottle
    - Wick application where the herbicide is physically wiped onto the leaf surface
    - Broadcast application using boom or boomless sprayers to distribute herbicide over a relatively large area depending on the swath width
- Basal bark application where herbicide is applied to intact bark around the circumference of the trunk
- Frill or "hack and squirt" methods where the trunk or stem is first wounded then herbicide is applied to the wound
- Injection where herbicide is injected through the bark into the inner plant tissues
- Cut stump treatment where the tree or stem is first cut straight across then the herbicide is applied to the freshly cut stump for transport to the root system
- Pelletized treatment where herbicide is made into a pellet that is implanted at the plant's base
- Pre-emergent where the herbicide is applied to the soil before the target species seeds germinate and emerge

Pesticides selected for use at Lake Mead NRA must be labeled for that application, known to be effective on the target exotic plant, and known to have a minimal effect on the environment. To minimize potential environmental effects, pesticides are selected based on the presence of non-target plants (including sensitive and traditional use plants), soil texture, depth and distance to water, and environmental conditions. Only those pesticides that have been registered by the U.S. Environmental Protection Agency are allowed for use at Lake Mead NRA and all use must conform to the product label regarding application rates, methods, environmental protection measures, etc.

2.1.7. Prescribed Fire Treatments

Prescribed fire is any fire ignited by management actions to meet specific objectives. It follows a written, approved prescribed fire plan that includes specific objectives for undertaking the burn, as well as prescriptions for fire behavior and operational details. Effects of the prescribed fire treatment on specific plant species and vegetation communities are monitored. Monitoring is usually conducted at regular intervals, such as immediately after the fire, 1 year post-fire, 2 years post-fire, and 5 years post-fire.

One objective for a prescribed fire may be to decrease exotic plant species and/or increase native plant species. Prescribed fire can be a very effective weed management tool where exotic plants that are not fire tolerant grow interspersed with native plant species that are fire tolerant. It may also be used to remove exotic plant species that grow earlier than native plant species when both

are not fire tolerant, thus establishing a narrow window of opportunity to use fire to damage the early growing exotic plants while the native plants are not susceptible to damage. In some cases, prescribed fire can be used as part of a multi-treatment approach to exotic plant management. For example, dense saltcedar stands can be difficult to access for treatment and foliar application of herbicide on a dense stand of mature trees requires a great deal of chemical and application effort due to the volume of leaf area. In these cases prescribed fire may be used to burn the dense stand. Saltcedar will readily sucker post-fire and those suckers can either be treated with a foliar application of herbicide or with a cut-stem treatment of herbicide. Then after the viability of the existing saltcedar is sufficiently lowered, native tree and shrub species can be inter-planted to provide competition to newly germinated saltcedar seedlings and those seedlings can be manually treated. In this way, prescribed fire is part of a sequential exotic plant management scenario that involved fire, chemical treatment, cultural treatment, and manual treatment to achieve the objective of removing exotic plants and restoring a native plant community.

The use of prescribed fire at Lake Mead NRA is addressed in the Lake Mead NRA Fire Management Plan (2004) and Environmental Assessment, which states that:

> Prescribed fire may also be used to control invasive exotic plant species such as …. saltcedar trees (*Tamarix ramossisima*). Saltcedar pile burning may also be necessary following control projects.

2.1.8. Monitoring and Research

Monitoring is the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective (Elzinga et al. 1998). Detection of a change or trend may trigger a management action, or it may generate a new line of inquiry. Monitoring is often done by sampling the same sites over time, and these sites may be a subset of the sites sampled for the initial inventory.

Research is the methodical investigation into a subject in order to discover facts, to establish or revise a theory, or to develop a plan of action based on the facts discovered. Exotic plant related research can be applied research, such as plots used to compare the effectiveness of different application rates of an herbicide, or empirical research, such as explorations of the autecology of specific invasive species.

2.1.9. Adaptive Management

Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form- "active" adaptive management-employs management programs that are designed to experimentally compare selected policies or practices, by implementing management actions explicitly designed to generate information useful for evaluating alternative hypotheses about the system being managed.

Adaptive management is especially important in light of global climate change. Changes in the earth's temperature are now detectable on land, in the atmosphere, and in our seas. Alterations in the abiotic components of ecosystems have dramatic effects on habitats as well as plant and

animal distributions. A landscape of shifting climates and habitats may offer new opportunities for exotic plants to invade, although a series of complex and interacting factors make it impossible to predict with certainty how species will move and whether they are likely to be successful in the future. Adaptive management allows for flexibility in the way exotic plants are controlled, which will be necessary as scientists and managers expand their understanding of climate change patterns and their effects on plant communities.

2.2 No Action Alternative: Continue project-based Exotic Plant Management Actions

The No Action Alternative is required by the National Environmental Policy Act as well as NPS Directors Order/Reference Manual #12: Conservation Planning, Environmental Impact Analysis, and Decision-Making. The role of the No Action Alternative is to serve as a baseline of existing impact continued into the future against which to compare impacts of action alternatives. In this context it is not a "do nothing alternative" but rather a continuation of existing management action.

Under this alternative, exotic plant management activities would continue on a project-by-project basis. Such projects may be undertaken by the NPS, by interagency organizations, or by various cooperators. Such projects would continue to be "ad hoc" - - that is, done in response to a specific situation or problem without considering wider or longer-term issues. As such, most projects focus on site-led priorities, such as removal of exotic plants in springs or rare plant habitats, early detection and eradication of exotic plants along vector corridors, and weed prevention measures incorporated into a construction contract.

Such project-based exotic plant management efforts are limited in geographic scope and duration and have thus far been categorically excluded from the requirements of the National Environmental Policy Act. In the NPS, such categorical exclusions are applicable to actions that, under normal circumstances, are not considered major federal actions and that have no measurable impacts on the human environment. There is a specific list of categorical exclusions that apply to actions of the NPS. The project-based exotic plant management efforts (e.g. weed surveys, treatments, and post-treatment site restoration) at Lake Mead NRA have either been addressed in other NEPA documents (e.g. a site development plan that included removal of non-native landscape plants) or, more commonly, have met the requirements of one or more of the following categorical exclusions (NPS 2001):

> E (2): Restoration of non-controversial native species into suitable habitats within their historic range.
>
> E (3): Removal of individual members of a non-threatened/endangered species or populations of pests and exotic plants that pose an imminent danger to visitors or an immediate threat to park resources.

E (6): Non-destructive data collection, inventory (including field, aerial, and satellite surveying and mapping), study, research, and monitoring activities.

2.2.1. No Action Alternative: Integrated Pest Management

The NPS policy mandating the use of integrated pest management remains in effect for weed management activities undertaken on a project-by-project basis. For individual projects, the pest is identified, populations are monitored, treatments are implemented, and the effectiveness of those individual treatments is evaluated. In some cases, treatments are used in combination within the same project to realize effective control while minimizing hazards to human health and the environment. However, there is no effort to apply the integrated pest management concept across projects.

2.2.2. No Action Alternative: Prioritization

There is currently no explicit or systematic prioritization scheme in use at Lake Mead NRA. Projects are generally conceived to address some recognized need or threat, most often focused on park values being threatened by exotic plants such as rare plant habitats, desert springs, and high use recreation sites (e.g. public nuisance situations such as thorny puncturevine on sandy beach areas). In this way, the exotic plant management projects are generally conceived and funded as site-led efforts, although there is often some consideration of weed species biology and its ability to spread in a desert environment. There is currently no systematic evaluation and relative ranking of exotic plant species by which management actions are prioritized.

2.2.3. No Action Alternative: Cultural Treatments

Educational opportunities focusing on exotic plants and their management implications are periodically offered to the general public whenever the interest or need arises. Such programs may or may not include prevention of exotic plant introductions and/or spread as a primary topic. However, there is no overall strategy for public and/or employee education regarding actions needed to prevent the introduction and/or spread of exotic plants.

Currently some exotic plant control projects include active restoration and some do not. There is no systematic evaluation or consistency in the determination of whether or not to actively restore; however, practical considerations such as funding, timing, vulnerability of the site to reinvasion, and availability of suitable plant materials are all likely factors in the decision. Typically, spring sites are more likely to be actively restored than are dry upland sites, for the practical consideration that survivorship of outplanted seedlings in dry sites is low without supplemental water and piping or hauling water is logistically challenging in the desert, whereas moist soil environments (e.g. seeps and springs) offer more optimal conditions for plant establishment. Also, the relatively high soil moisture found at spring sites makes these locations vulnerable to re-invasion by the same exotic plant species and/or new invasions by other exotic plant species so active restoration serves to occupy the space with a native species to prevent the establishment of exotic species.

2.2.4. No Action Alternative: Manual and Mechanical Treatments

Hand-pulling Sahara mustard in high value sites (e.g. rare plant habitats) has been on-going for the last several years. For the most part, these efforts are funded by and undertaken in support of

a rare plant management project or public education opportunity. However, since the population exploded in 2005 such efforts have not kept pace with the mustard population expansion, even in relatively small high value sites.

Other manual and mechanical treatments have included:

- Frequently hand-pulling saltcedar seedlings in springs and washes
- Frequently hand-pulling small patches of Sahara mustard in rare plant habitat and other priority areas
- Occasionally hand-pulling London rocket, oriental mustard, and short-pod mustard in disturbed areas
- Infrequently hand-pulling seedlings of tree tobacco, palm species, and Russian thistle

2.2.5. No Action Alternative: Biological Control

There are no current biological control treatments at Lake Mead NRA. Biological control agents have not been systematically sought and evaluated for known weed species in the park. There are no standard Best Management Practices identified for biocontrol at Lake Mead NRA. The upstream release of Chinese leaf beetle (*Diorhabda elongate)* on state lands in both the Virgin River and Colorado River drainages makes it highly likely that this biocontrol agent will become established at Lake Mead NRA in the near future.

2.2.6. No Action Alternative: Chemical Treatments

Chemical treatments are currently used at Lake Mead NRA. Cut-stump treatment with Triclopyr herbicide is commonly used to treat about one acre annually of saltcedar in springs and washes. Scattered infestations of woody invasive species of oleander, fan palm, and Mexican palo verde are treated with a foliar application of glyphosate herbicide, for a total of less than one acre annually. Foliar application of imazapyr herbicide is commonly used to treat less than one acre annually of tall whitetop and camelthorn. Foliar application of triclopyr is used to treat less than one acre annually of tree tobacco. Foliar application of glyphosate is used to treat about four acres annually of fountain grass along the shoreline of Lake Mohave.

Pesticide use proposals are prepared annually and pesticide use logs are submitted at the end of each calendar year by the NPS as per agency requirements. All herbicides used on NPS lands, regardless of who's actually doing the treatment, are included in both submittals.

There are no standard best management practices or safety procedures for herbicide application at Lake Mead NRA, but the different work crews have their own standards which generally comply with state law and reflect industry standards. Plus the environmental protection and personal safety requirements identified on the product labels and material safety data sheets apply to all applicators.

2.2.7. No Action Alternative: Prescribed Fire Treatments

The use of prescribed fire to treat saltcedar is a current management strategy as described in the park's Fire Management Plan. Typically, fire is followed by a foliar herbicide application of the re-sprouts. Since the approval of the Fire Management Plan in 2004, approximately 52 acres of

saltcedar have been treated with this method and another 15 acres have been planned for treatment in the next five years.

2.2.8. No Action Alternative: Research and Monitoring

There are a number of weed related research efforts underway at Lake Mead NRA, most of which have been initiated by outside cooperators from universities. All research must have a research permit issued by Lake Mead NRA, so there is some level of NPS approval of all research projects in the park. However, the individual research projects may or may not address research needs of park managers and there is currently no list of research needs by which to solicit relevant research proposals.

There are several individual monitoring efforts associated with projects, some of which focus on the effectiveness of the management effort while others focus on status and trends of individual sites or weed populations. One universal flaw with these project-by-project monitoring efforts is that they are confined by the relatively short duration (a few years at best) and limited geographic scale of most projects, thus they fail individually to address the landscape level conditions and trends. There is no overall monitoring effort at this time that addresses exotic plants or integrates the monitoring efforts of these individual projects at Lake Mead NRA. The NPS's Mojave Network Inventory and Monitoring Program (I&M) has identified invasive species as a vital sign and is scheduled to develop a monitoring protocol in 2009-2010, but it is likely that this I&M led monitoring effort will be coarse-scale at best as it covers almost 8 million acres in 7 national parks in the Great Basin and Mojave Desert.

2.2.9. No Action Alternative: Adaptive Management

There is currently no implicit or explicit adoption of the adaptive management concept in the park's exotic plant management projects. Adaptive management generally requires a systematic approach that is difficult to implement on a project-by-project basis.

2.3 Proposed Action: Implement a Comprehensive Exotic Plant Management Plan

The Proposed Action is to implement a comprehensive exotic plant management plan that would serve to direct exotic plant management activities undertaken by the NPS and cooperators over the next twenty years. The environmental assessment for the plan, this document, addresses the impacts of routine and on-going exotic plant management programmatic activities; additional compliance would be needed to introduce biological control agents and/or conduct aerial herbicide applications. The plan would prescribe specific integrated pest management strategies and actions to address prevention of new exotic plant invasions, early detection and eradication of incipient exotic plant populations, and containment and control of established populations. The plan would also include standardized data management protocols, a monitoring strategy, and research priorities. All of these strategies and actions would also conform to the concept of adaptive management, whereby the Park is continually learning from experience and improving the effectiveness and efficiency of its exotic plant management effort.

Exotic plant species would be systematically evaluated and prioritized to determine those species that potentially pose the most risk to park values. Sites would be prioritized based on relative vulnerability to exotic plant invasion and/or impact to park values (e.g rare plant communities, recreation sites, springs, etc). These weed-led and site-led priorities would serve to focus exotic plant management efforts on managing those species that pose the most harm and protecting those high value sites that are most vulnerable to invasion.

A documented, proactive prevention program would be developed and implemented that would aim to keep exotic plant seeds and propagules from being brought into the park and/or from becoming established after entry. The prevention strategy would include two major components: 1) education of employees, cooperators, and visitors; and 2) proactively incorporating exotic plant prevention into agency operations and agency-controlled activities through a series of Standard Operating Procedures.

A documented early detection and eradication program would be developed to include:

- systematic monitoring of high risk areas for detection of new weed infestations, including the drawdown zone on Lake Mead,
- develop an early detection strategy focused on vascular exotic aquatic plants,
- aggressive treatment of new infestations to prevent population establishment and growth,
- and, monitor treatment effectiveness to assure that either eradication is successful or the management efforts transition to a strategy of containment and control of an established population.

A documented program would be established to contain, control, and, if possible, eradicate established exotic plant populations. This effort would focus on priority species and sites to be treated using various integrated pest management methods and tools. Containment strategies would be used to restrict the spread of an exotic species and to contain the population in a defined geographic location using chemical, mechanical, biological, or cultural treatment methods focused on the edges of the population to thwart its expansion. Species most likely to be successfully contained are those that spread slowly over short distances and those populations surrounded by unsuitable habitat whereby they are spatially confined. Control strategies would be used for the long-term reduction in density and abundance of an exotic species in a given population below an acceptable threshold. Treatment prescriptions would be researched, written, and periodically updated to address all high priority species in the park. The need for post-treatment restoration would be considered and implemented as appropriate to site-specific conditions. The effectiveness of treatments and post-treatment restoration would be monitored and that information would be incorporated into subsequent treatment and restoration efforts.

A data management strategy would be developed that would standardize the information recorded about weed surveys, treatments, and restoration efforts. These standards would be updated periodically as technology (e.g. software and hardware) requires and all cooperators would be required to provide data consistent with these standards so that it would be feasible to "roll-up" weed management statistics for all activities undertaken at Lake Mead NRA regardless of who accomplished that activity. In addition, a comprehensive monitoring strategy would be developed that would address treatment effectiveness monitoring as well as other aspects of

exotic plant trends and impacts relevant to park management and native plant conservation. Research priorities would be identified to solicit research proposals that are of most benefit to addressing the park's exotic plant management information needs.

Adaptive management would be incorporated into many aspects of the park's exotic plant management strategies and actions so that these efforts could be improved by experience to increase the effectiveness and efficiency of the park's exotic plant management program.

2.3.1. Proposed Action: Integrated Pest Management

Consistent with NPS policy, an integrated pest management approach would be applied programmatically to exotic plant management efforts. A park-wide prevention program would be combined with early detection and eradication of insipient populations as well as containment and control of established populations. Cultural, manual, mechanical, chemical, and perhaps biological controls, singly or in combination, would be used to manage exotic plants on a weed-led and site-led basis.

2.3.2. Proposed Action: Prioritization

In order to provide flexibility to address the expected and as yet unforeseen conditions of the future, both site-led and weed-led priorities would be established.

The site-led priorities would be based upon geographic locations that have a direct relationship with the park's purpose and/or legal mandates, including rare plant habitat, desert springs, cultural landscapes, high use recreational areas, and exotic plant vectors. Wilderness areas, while too large to be considered "sites" in their own right, may be given priority over non-wilderness areas facing the same threat. Where sites are identified as priorities, any exotic plant species may be controlled using whatever treatment methods best serve to remove the threat posed by the exotic plant while protecting the values of the site. For example, Sahara mustard (*Brassica tournefortii*) could be manually removed from habitat for the legally protected threecorner milkvetch (*Astragalus geyeri* var. *triquetrus*) because this exotic mustard is known to shade out and displace the smaller statured milkvetch, whereas elsewhere in the park the widespread distribution of Sahara mustard may precludes eradication. Desert fan palm (*Washingtonia filifera*) could be eradicated at desert springs where it alters the habitat quality through direct competition with native wetland species. This is the situation at Rogers and Blue Point Springs where palm seedlings and naturalized palm trees carpet large areas of moist soil adjacent to the spring pools and spring reach far beyond the original landscape plantings. Another example of site-led priority is the manual removal or herbicide spot treatment of puncturevine (*Tribulus terrestris*) from beach areas because the spiny fruits create a public nuisance that interferes with visitor enjoyment, which is a purpose of the park. Puncturevine is a common and widespread exotic plant that invades disturbed areas across much of the United States but rarely presents a threat to ecological values, and is otherwise a relatively low priority for treatment in the park outside of the beach areas.

The most urgent weed-led priority species are those insipient invasives that are just arriving in the park. In many cases, these are escaped ornamental species from landscaping in nearby urban areas or park developed areas. And, in some cases, the observation of "naturalized" individuals

may be the first indication that the species is potentially a concern to land managers. Re-occurring opportunities for seed and propagule transport into the park is provided by the close proximity of the Park to urban areas, and especially the fact that most urban storm drains in the surrounding communities eventually empty into either Lake Mead or Lake Mohave. In many cases, only one or a few individuals of a given species will be established when the species is first detected in the park. This small sample size makes it difficult to assess its ability to invade wildlands but makes it relatively easy to control. This reality, combined with the fact that there is usually very little ecological information available about such species beyond the horticultural production of the plant, makes it very difficult to evaluate these species using a standard protocol. For these reasons, insipient invasives and escaped ornamentals will be treated as the park's urgent priority without requiring systematic evaluation. In such situations, the observation that the plant has established itself outside of its planted location is prima facie of the threat it poses to the Park.

Otherwise, the weed-led priorities would be based on an established and credible evaluation program, such as the "Criteria for Categorizing Invasive Non-Native Plants that Threaten Wildlands" (Warner et al. 2003) developed by the California Exotic Pest Plant Council and the Southwest Vegetation Management Association, or "An Invasive Species Assessment Protocol" (Morse et al. 2004) developed by the National Park Service, The Nature Conservancy, and NatureServe. These programs provide a means to systematically evaluate exotic plant species based on their ecological impact and invasiveness. Under this alternative, either evaluation system or another similar evaluation system could be used to derive a relative priority for the management of exotic plant species. These weed-led priorities would serve to guide exotic plant management efforts wherever site-led priorities were not applicable (e.g. outside of rare plant habitat, desert springs, high use recreational areas, etc.), and management prescriptions would be prepared for those species that are ranked as high. These prioritized species lists would be reviewed and updated periodically as new information becomes available or new trends become apparent. Also, new exotic plant species would be evaluated and prioritized according to the same scheme thus accommodating new priorities over time while still focusing efforts on those species that pose the most risk to the park's environment. The prioritized list also accommodates the realities of variable funding and staffing levels, allowing managers to focus their management efforts on a larger section of the list in years where funds and staffing are available and on a shorter list of the highest priorities in lean funding years.

2.3.3. Proposed Action: Cultural Treatments

Two types of cultural treatments are proposed under this alternative: 1) prevention and 2) post-treatment restoration.

A comprehensive prevention program would be put into effect that would incorporate both visitor and employee education as well as provide internal direction and control in the form of Standard Operating Procedures to address a wide-range of park operations and agency controlled activities.

The education program would include special employee training and public awareness activities in support of the annual National Invasive Weed Awareness Week as well as on-going

interpretation and curriculum based education programs. In addition, the Exotic Plant Management Program would continue its use of community volunteers for special event exotic plant survey and treatment efforts through the Get Outdoors Nevada program, an interagency volunteer program in Southern Nevada that focuses on public lands.

Internal direction and control focuses on consistently and comprehensively incorporating exotic plant prevention measures into operations of the National Park Service and on exotic plant prevention in NPS-controlled activities such as concessions, contracts, research permits, special use permits, and other activities undertaken by non-NPS entities but under the authority of the park. To provide the most effective implementation of these prevention measures, a series of Standard Operating Procedures (SOPs) would be drafted to address the following topics: landscape plants, fire operations, soil and fill materials, native plant nursery operations, livestock operations, and general permit and contract conditions for agency controlled activities. These drafts SOPs would be reviewed by the senior management team, revised as necessary, and ultimately adopted as final SOPs for park operations. Some of these SOPs are already in practice, but this would be the park's first attempt to create a documented, comprehensive exotic plant prevention program. In the spirit of adaptive management, it is anticipated that these SOPs would be updated periodically and additional SOPs may be adopted to deal with emerging exotic plant management concerns.

A systematic evaluation process would be developed to consider whether or not to actively restore a site after exotic plant treatment. Restoration may be passive or active. The evaluation process will include likelihood of success, availability of appropriate plant materials, and site or soil preparation needs.

When determining the likelihood of success of active restoration, consideration would be given to the ability to either work with these species-specific and site-specific limitations or find ways to overcome these limitations in order for the effort to be successful. Some considerations might include:

- species selection appropriate to soil type, elevation and aspect
- expected germination rates under field conditions for the desired species
- seed dormancy mechanisms of desired species and ability to control the conditions necessary to induce germination
- seeding rates (lb/acre) or seedling spacing necessary to establish a dense enough population to resist invasion by exotic species
- timing of seed application or seedling outplanting in relation to available soil moisture and potential for seed/seedling loss due to erosion

2.3.4. Proposed Action: Manual and Mechanical Treatments

Manual and mechanical treatments for all high priority species would be investigated and written prescriptions would be prepared for those species that can be effectively treated with these techniques. It is anticipated that manual and mechanical treatments would focus on non-rhizomatous species occurring in low frequency. These methods would also be the first choice for site-led priorities where other treatment methods might pose an unacceptable risk to other values of the site (e.g. to avoid use of herbicide near springs or susceptible rare plants). Where

effective, these non-chemical methods would be used as a first choice for treatment of both site-led and weed-led priorities (see Figures 5-8 regarding decision process for manual and/or mechanical treatments).

In some cases, these methods might be used in combination with other treatment methods following an integrated pest management strategy. For woody perennial species that are known to re-sprout (e.g. saltcedar, athel, oleander, and tree tobacco), cut-stump treatments would continue to be used where mechanical methods are used to cut the tree down followed by an herbicide application to the freshly cut stump for uptake to the roots to prevent re-sprouting.

2.3.5. Proposed Action: Biological Control

Like the No Action Alternative there are no current biological control treatments at Lake Mead NRA. However, the upstream release of Chinese leaf beetle (*Diorhabda elongate)* on state lands in both the Virgin River and Colorado River drainages makes it highly likely that this biocontrol agent will become established at Lake Mead NRA in the near future. The Park will continue to be involved in the range-wide monitoring of this biocontrol agent. This beetle is expected to defoliate trees and thus weaken them, but does not necessarily kill the trees. So in addition to monitoring, under this alternative the park will follow beetle defoliated stands with herbicide treatments to kill the weakened trees while minimizing herbicide use. In some cases, this will be followed with either passive or active site restoration, where native plant species and processes will be allowed to naturally resume their place (passive restoration) or native plants may be re-planted from local stocks propagated by the Park's Native Plant Nursery (active restoration).

In addition, the Park's Exotic Plant Manager would periodically evaluate new biocontrol agents to evaluate their possible application to established populations of the park's highest priority weed species. Release of biological control agents at Lake Mead NRA would adhere to the following Best Management Practices:

- Only those biological control agents approved by APHIS are allowed for use at Lake Mead NRA.
- Prior to release, an implementation plan must be written to include: a summary of species biology and effectiveness of control, establishment of population and/or control thresholds, acquisition of biocontrol agents, strategy for actual release of organisms, and a strategy for monitoring the success of the release. The implementation plan should be peer reviewed by at least three people, one of which should be experienced in the use of that specific biocontrol agent and pest plant.
- Before a biological control agent is released, the Lake Mead Exotic Plant Manager must submit the implementation plan and receive approval from the National IPM Coordinator to release the agent.
- If biological control agents are to be obtained from another state, a permit which has been reviewed by the State Entomologist must also be obtained from APHIS. The transport, handling, and release of biological control agents must be in accordance with all permit conditions.
- Biological control agents should be released in each climatic zone that is occupied by the host so that the natural enemy has a chance to develop in all areas where the host occurs.

- The number of biological control agents released should account for the size and density of the treatment area and the number of agents required to maintain a viable biological control agent population.
- More than one release in an area may be necessary for successful establishment.
- Releases should be synchronized with the time period when the host plant is present.
- Biological control agents should be released at times of the day when they will not disperse from the treatment area.
- Biological control populations should be monitored according to the strategy identified in the implementation plan. Monitoring should occur annually at a minimum.

Table 2. Some biological control options for some priority weed species at Lake Mead NRA and those that might become an issue in the near future.

Biocontrol Agent	Target Plant	Target Habitat	Mode of Action	Impact on Target and Notes
Weevil, *(Cyrtobagous salviniae)*	giant salvinia *(Salvinia molesta)*	Aquatic	Larvae burrows through plant tissues	Kills plants with enough damage. Established in many southern and southwestern states, including the Colorado River
Chinese leaf beetle, *(Diorhabda elongate)*	Saltcedar *(Tamarix ramosissima)*	Riparian	Adults and larvae feed on foliage	Defoliates plants and can eventually cause death to individual trees. Established in several Great Basin states in the Colorado River drainage.
Seed-feeding weevil *(Microlarinus lareynii)*; Stem- and crown-mining weevil *(M. lypriformis)*	Puncturevine *(Tribulus terrestris)*	Upland	Seed destruction; stem, and crown damage	Reduces recruitment; kills plants with enough damage. Established in several southwestern states
Head smut fungus *(Ustilago bullata)*	Cheatgrass *(Bromus tectorum)*	Upland	Infects plant flowers and prevents seed production	Reduces recruitment. Needs to be combined with native plant re-establishment for optimal effect.
'Black fingers of death' soil fungus *(Pyrenophora semeniperda)*	Cheatgrass *(Bromus tectorum)*	Upland	Kills cheatgrass seed in the soil	Reduces recruitment.

Consideration for use of biological controls would follow the decision process outlined in Figure 10.

2.3.6. Proposed Action: Chemical Treatments

Pesticides would be used as part of an integrated pest management program targeting exotic plant species based on either site-led or weed-led priorities. Generally, herbicides would be used when non-chemical methods are not likely to be effective due to the plants physiology (e.g. rhizomatous plants) or where the population is too large to be effectively treated before seed production (see Figure 9 regarding decision process for chemical use). The most specific herbicide effective for the species and the application method would be used and in some cases herbicide may be used in combination with other treatment methods (e.g. cut stump treatment, or post-fire herbicide application).

Best Management Practices (BMPs) would be followed to ensure that the overall effectiveness of pesticides is maximized and the potential for impacts is minimized. These general BMPs include the following:

- All product labels would be read and followed by pesticide applicators. It is a violation of federal law to use a pesticide in a manner that is inconsistent with its label.
- Pesticide applicators would obtain and maintain any certifications or licenses required by the state and/or county.
- Pesticides would be applied as near to the target plant as possible.
- Pesticide application would account for meteorological factors such as wind speed, wind direction, inversions, humidity, and precipitation in relation to the presence of sensitive resources near the treatment area and direction provided on labels. Pesticides would only be applied when meteorological conditions at the treatment site allow for complete and even coverage and would prevent drifting of spray onto non-target sensitive resources or areas used by humans.
- Pesticides would be applied only during periods of suitable meteorological conditions as indicated on the pesticide label. The extreme high temperatures common at Lake Mead NRA may limit the use of pesticides during the summer months.
- Pesticides would be applied using large droplet size (coarse sprays) to minimize the potential for drift. Avoid combinations of pressure and nozzle type that would result in fine particles (mist). Add thickeners if the product label and application equipment permits.
- Pesticides would be applied at the appropriate time based on the pesticide's mode of action. Poor timing of application can reduce the effectiveness of pesticides and can increase the impact on non-target plants.
- Pesticides would be applied according to application rates specified on the product label.
- In areas where there is the potential to affect surface water or ground water resources, pesticide pH and soil pH would be considered to select the pesticide with the lowest leaching potential.
- Highly water-soluble pesticides would not be used in areas where there is potential to affect surface water or ground water resources.
- Pesticides with high volatility would not be used to treat areas located adjacent to sensitive areas because of the potential for unwanted movement of pesticides to these areas.
- Pesticides with high soil retention would be used in areas where there is potential to affect surface water or ground water resources.
- Pesticides with longer persistence would be applied at lower concentrations and with less frequency to limit the potential for accumulation of pesticides in soils.
- As needed to protect the efficacy of the pesticide, water used in chemical dilution would be buffered, depending on hardness, pH, and other factors.
- Safety protocols would be prepared for storing, mixing, transporting, handling spills, and disposing of unused pesticides and containers. Plans for emergency spills would also be prepared and updated as needed.

- All federal, state, and local regulations regarding pesticide use would be followed at all times.
- To maintain pesticide efficacy, only pesticide amounts that are expected to be used in a one year period will be purchased, as per NPS policy (NPS 2006).
- Equipment would be maintained and calibrated prior to each application of pesticides. During all applications, droplet size would be controlled to decrease the risk of pesticide drift to non-target species outside the immediate treatment area. Droplet size is controlled by nozzle settings.
- Only pesticides that are registered for use in aquatic habitats would be used in or near surface water (including reservoirs, rivers, springs, and seeps, but not including dry washes where no hydrophytic vegetation is present).
- Only those pesticides that have a low potential toxicity, would be used in ground water protection zones or in areas with a high leaching potential. Does Lake Mead have ground water protection zones?
- Applications of pesticides would be avoided during periods and in areas where seasonal precipitation is likely to wash residual pesticides into waterways.
- Applications of pesticides within 50 feet of surface water bodies (including streams, rivers, lakes, and waterways) would be done by hand or with vehicle mounted ground equipment to minimize the potential impacts to surface waters.

Once the Lake Mead Exotic Plant Manager determines that a pesticide is the appropriate weed management tool for the species and location, and a pesticide and application method has been selected, the Exotic Plant Manager would seek NPS approval. At the time of this writing, the approval process is to submit a pesticide use proposal using the Intranet-based IPM System. The proposal is generally reviewed and approved by the Regional IPM Coordinator. However, review and approval from the National IPM Coordinator would be required for pesticide use proposals that involve: aquatic applications or situations in which the applied pesticide could reasonably be expected to get into waters or wetlands; pesticide uses that may affect rare, threatened, or endangered species or associated critical habitat; pesticide use involving aerial application; pesticide use on 400 or more contiguous acres; or use of a restricted-use pesticide as defined by the USEPA (e.g. picloram). Once approved, the pesticide can be purchased and applied as prescribed. All pesticide use is reported annually on a pesticide use log submitted to the Regional IPM Coordinator.

2.3.7. Proposed Action: Prescribed Fire Treatments

The use of prescribed fire for exotic plant control is described in the Park's Fire Management Plan and would continue to be used in the same way under the Proposed Action.

2.2.8. Proposed Action: Research and Monitoring

A list of priority exotic plant related research topics would be prepared and made available to potential researchers. This list would be updated periodically, at least every five years to reflect the most pressing applied science needs of the park's resource managers. NPS funds may or may not be made available to support the research.

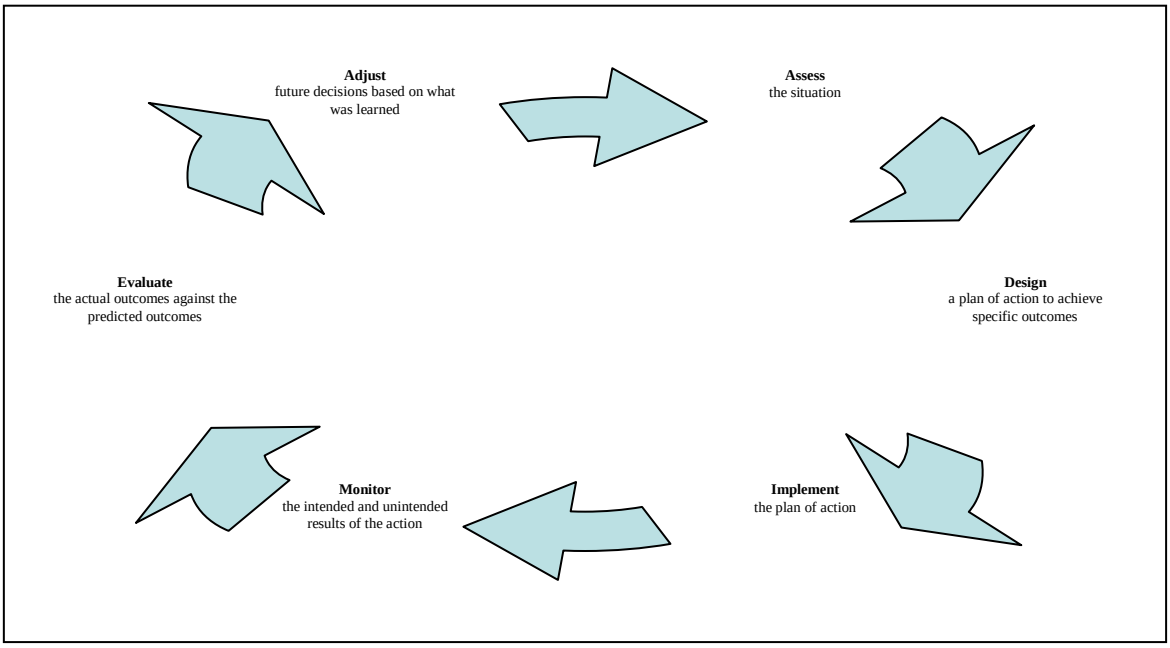
An exotic plant monitoring strategy would be developed to assess the effectiveness of exotic plant treatments, detect non-target and secondary impacts caused by treatments, and assess the overall status and trends of priority exotic plant species park-wide. In some cases, treatment effectiveness monitoring may include research components where different treatment methods are compared side-by-side in order to inform the day to day decisions made by the park's Exotic Plant Manager. The monitoring strategy would be compatible with the large scale monitoring efforts being developed throughout the Mojave Desert parks by the NPS's Mojave Network Inventory and Monitoring Program, but the park-led monitoring program would be geared toward collecting information on a spatial and temporal scale appropriate to inform day-to-day exotic plant management decisions at Lake Mead NRA.

2.2.9. Proposed Action: Adaptive Management

Adaptive management (Figure 3) is a major component of the Proposed Action based on the definition of the concept presented in the Department of the Interior Technical Guide to Adaptive Management (Williams et al. 2007):

> *Adaptive management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error process,' but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decision and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders.*

Figure 3: Generic adaptive management process.



Under the Proposed Action, adaptive management would be explicitly incorporated into many aspects of the exotic plant management program at Lake Mead NRA. Figure 4 shows flowchart symbology while the remaining flowcharts illustrate decision making processes used for:

- Situation Evaluation Process (Figure 5)
- Site-led Treatment Process (Figure 6)
- Incipient Population Treatment Process (Figure 7)
- Established Population Treatment Process (Figure 8)
- Detail Chemical Treatment Flowchart to confirm compliance (Figure 9)
- Detail Biocontrol Treatment Flowchart to confirm compliance (Figure 10)

Figure 4. Key to symbology used in flowcharts.

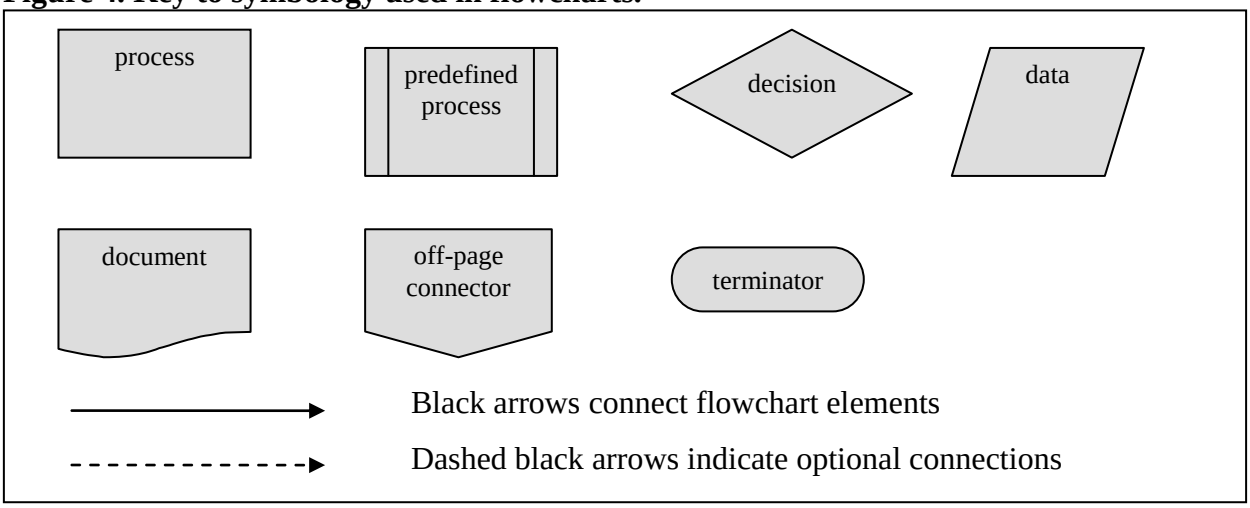


Figure 5. Flowchart of Situation Evaluation Process.

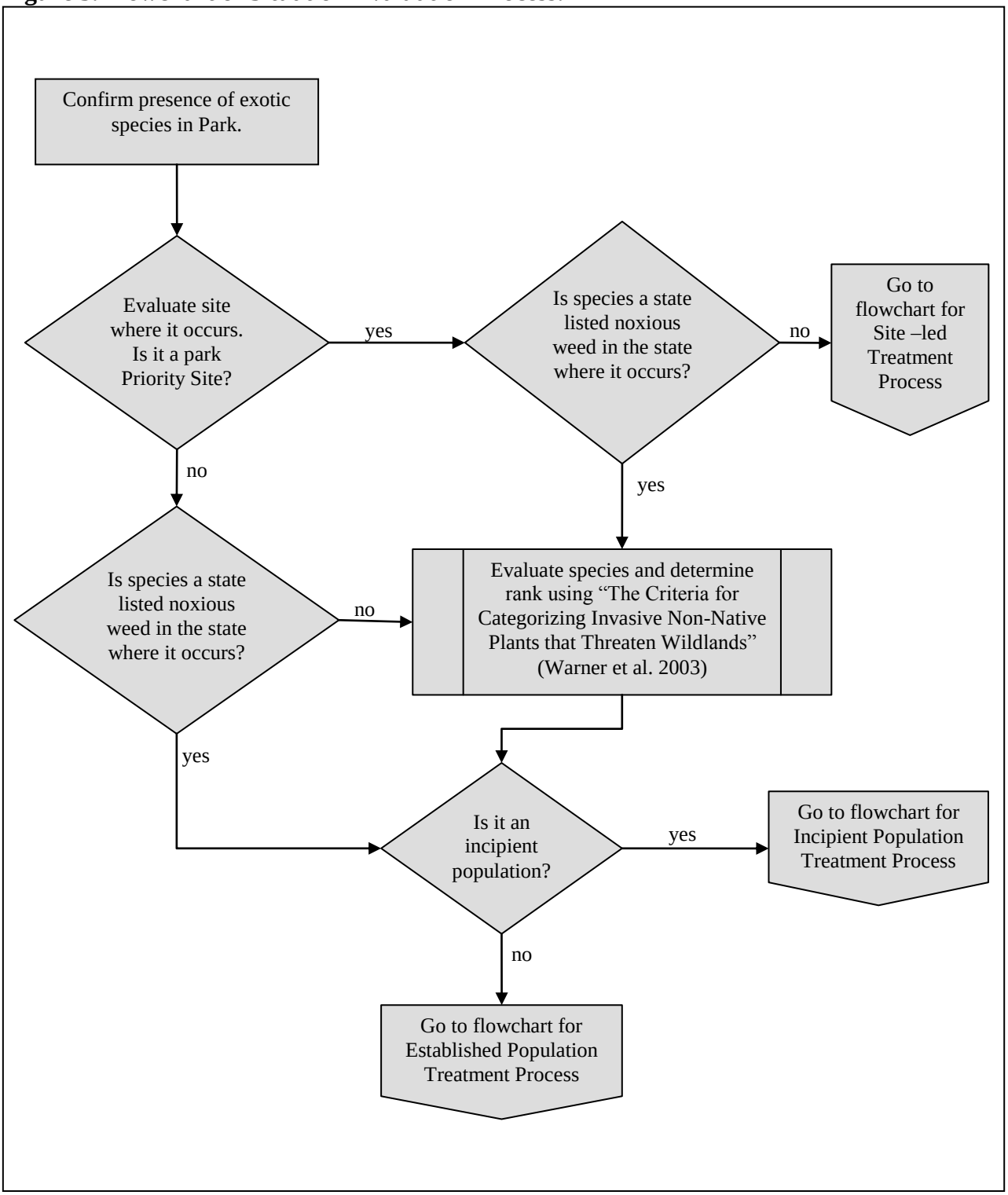


Figure 6. Flowchart for Site-led Treatment Process.

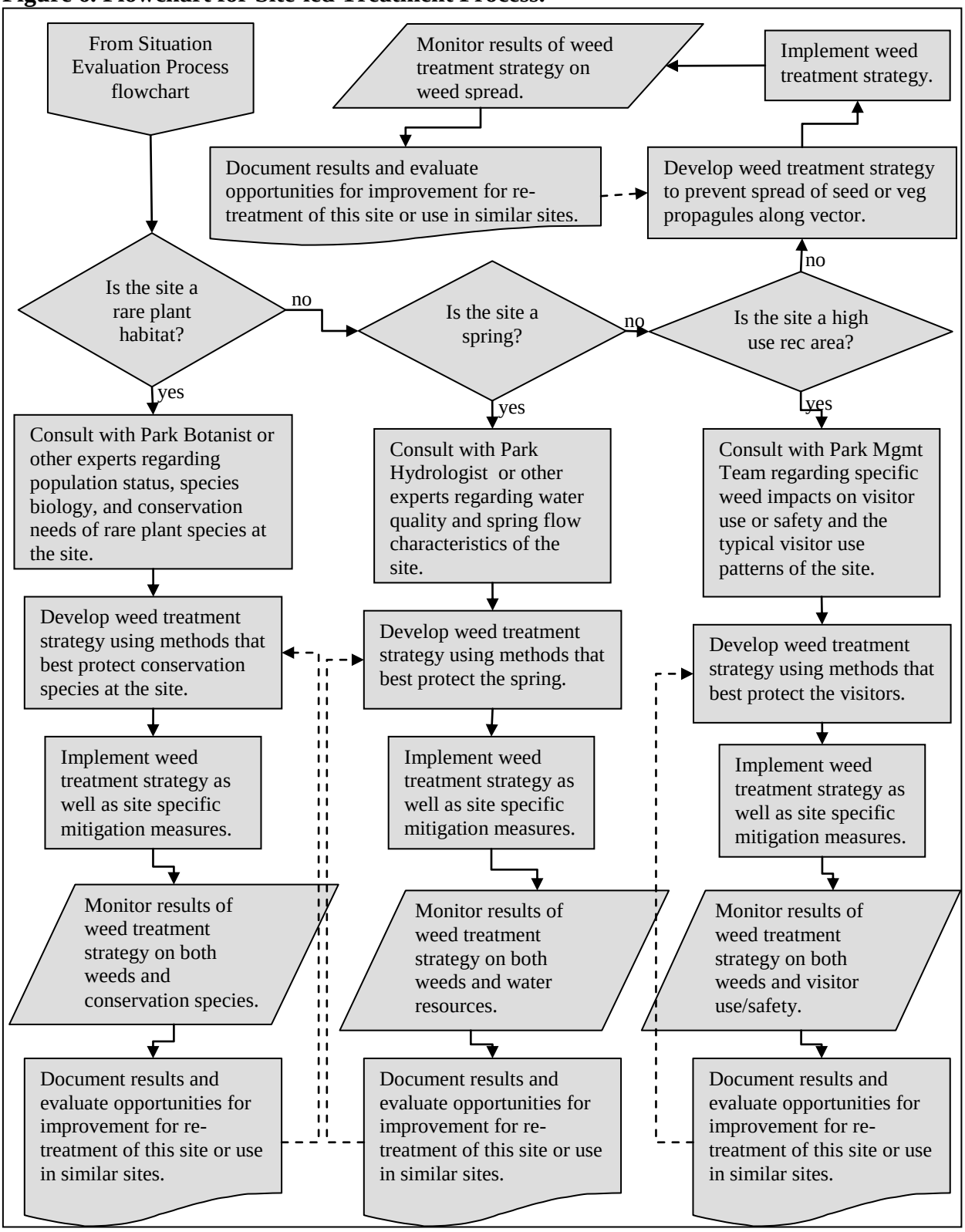


Figure 7. Flowchart for Incipient Population Treatment Process.

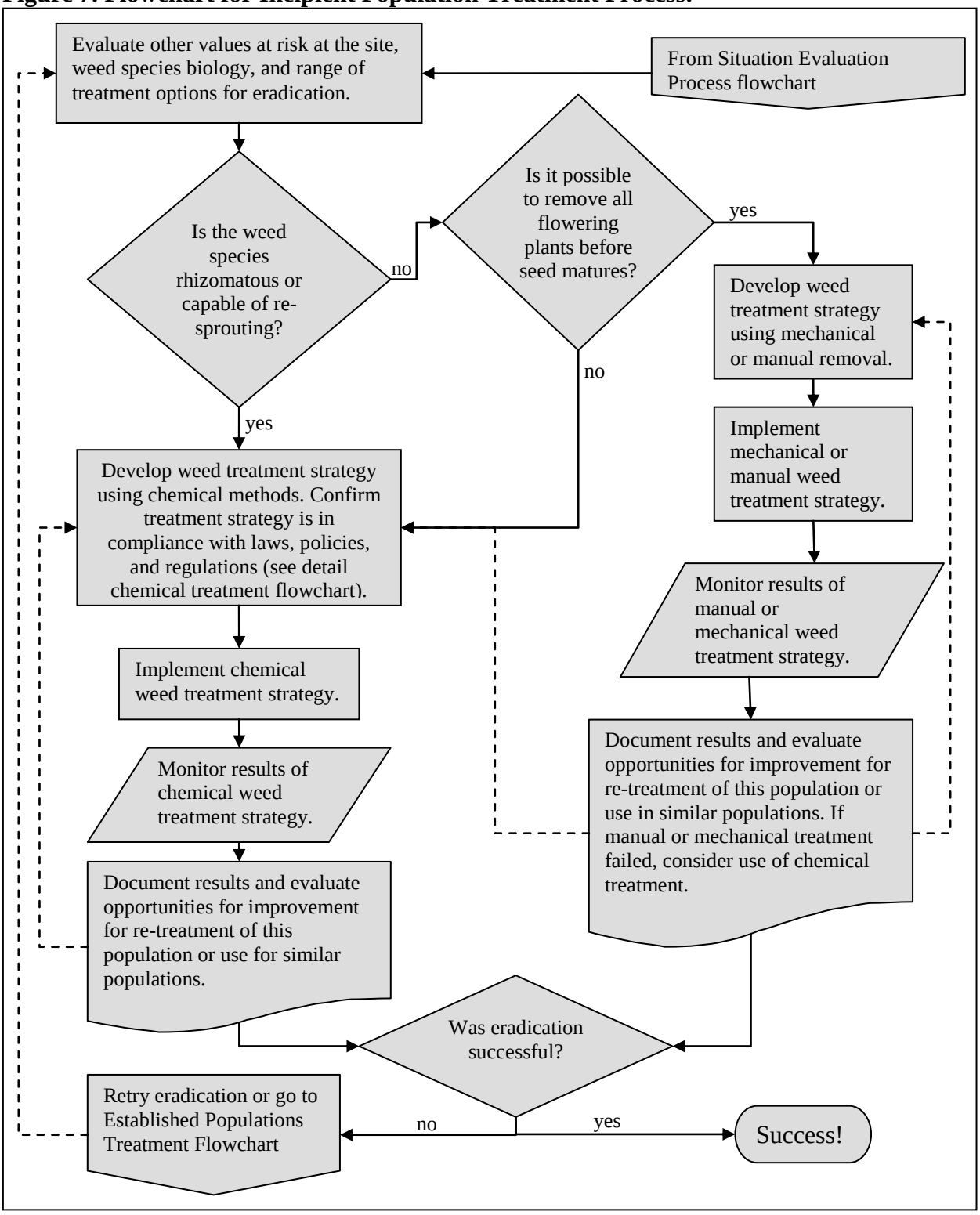


Figure 8. Flowchart for Established Population Treatment Process.

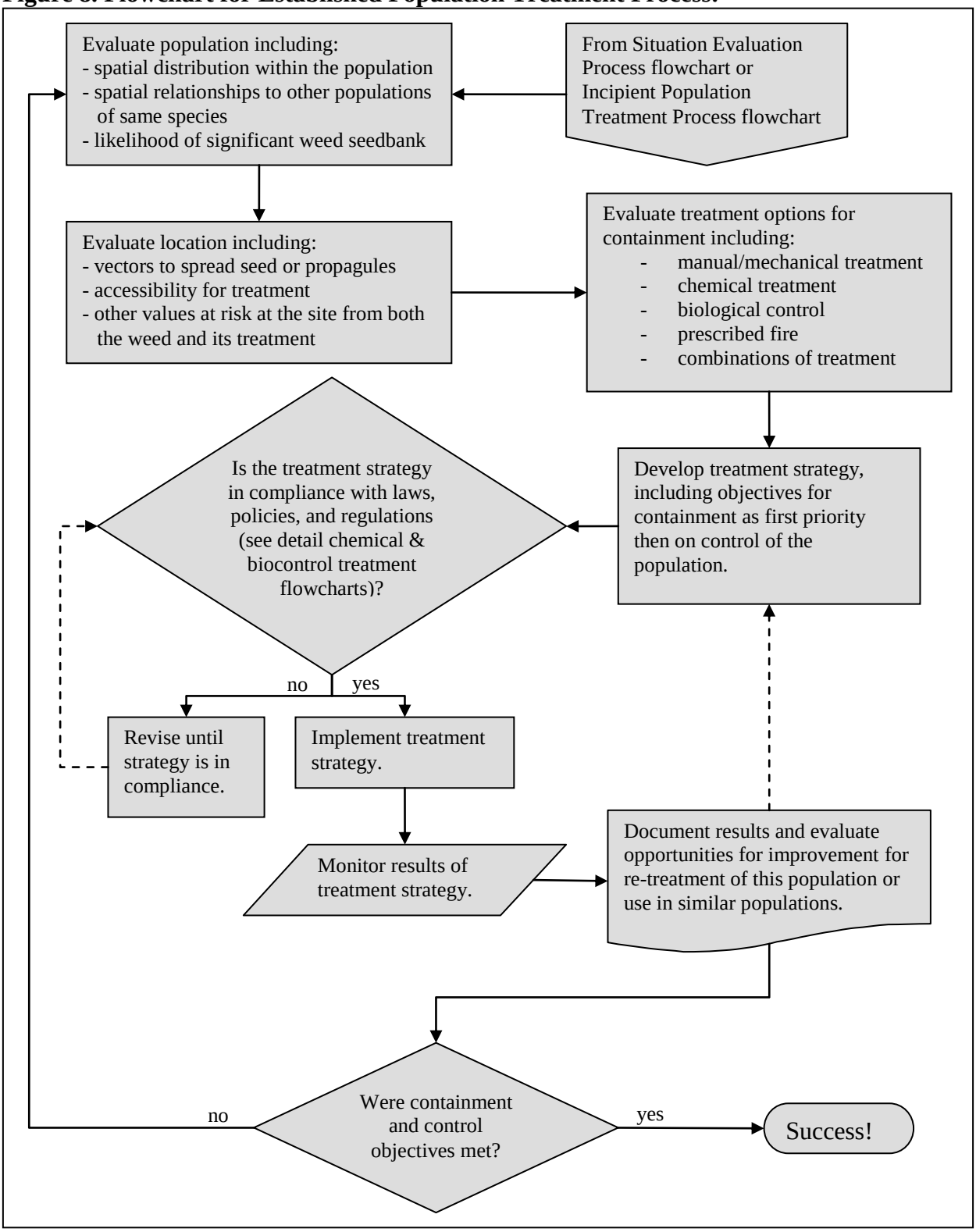


Figure 9. Detail Chemical Treatment Flowchart to confirm compliance.

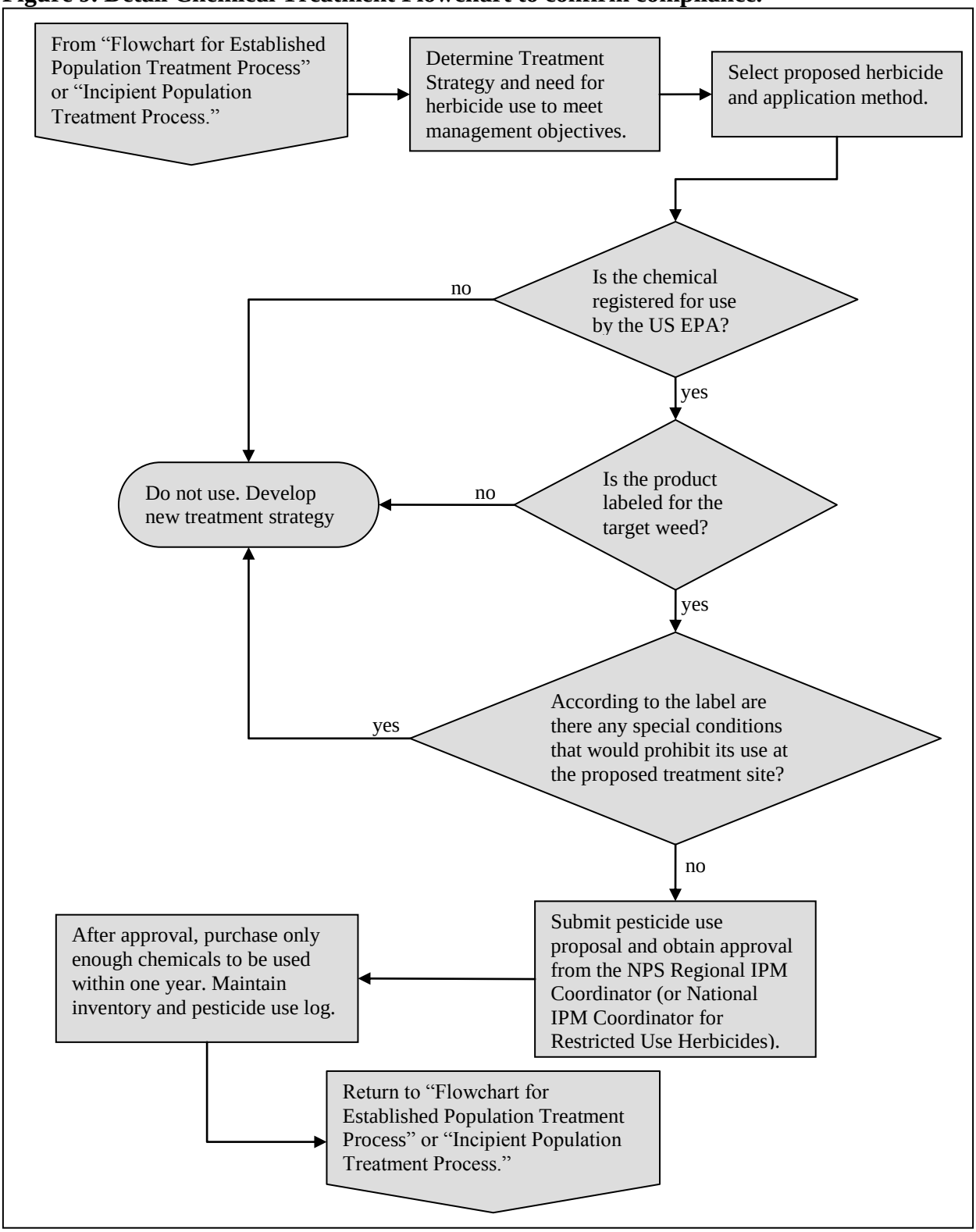


Figure 10. Flowchart for Site-led Treatment Process (page 1 of 2).

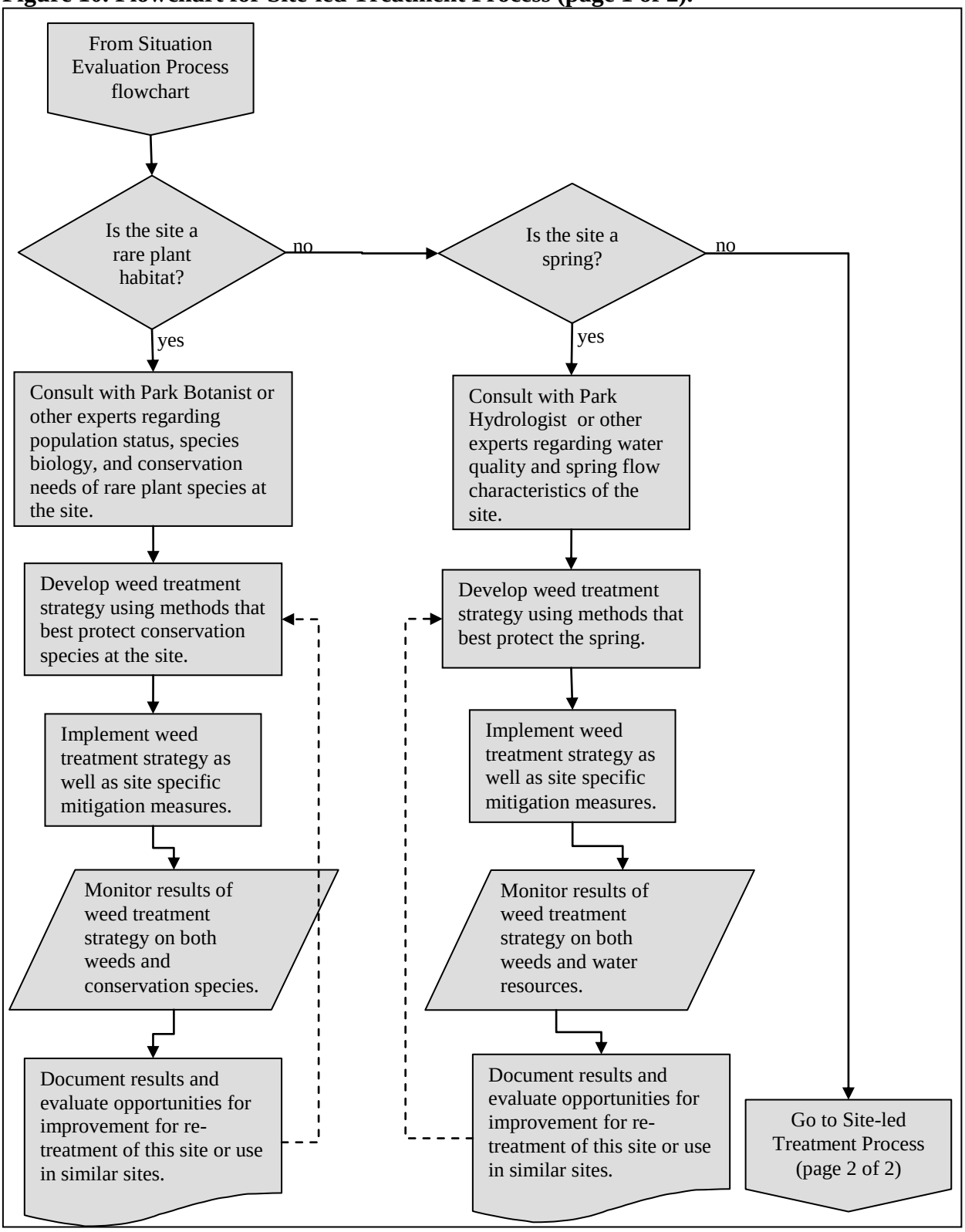
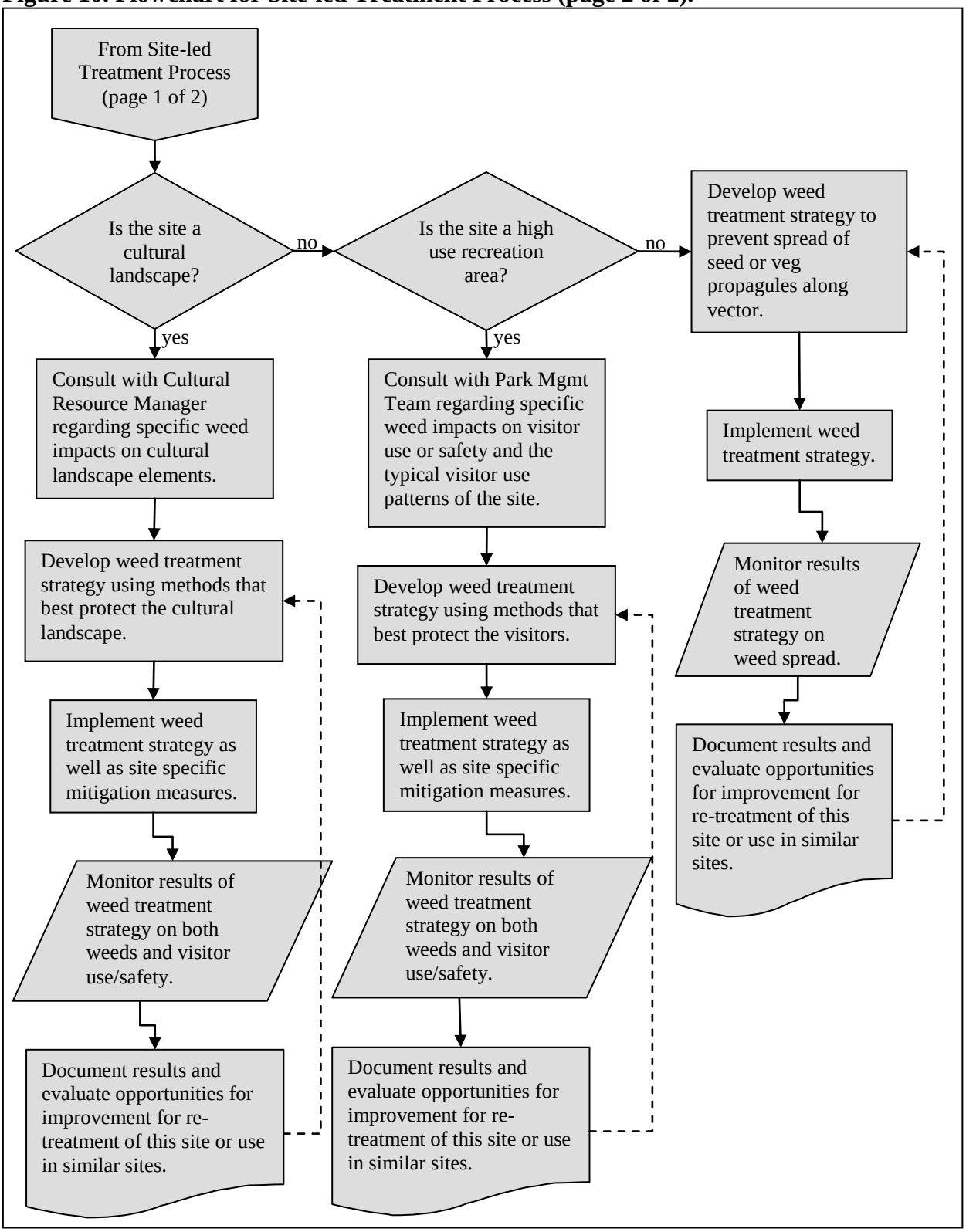


Figure 10. Flowchart for Site-led Treatment Process (page 2 of 2).



2.4 Alternatives Considered but Rejected from Further Consideration

The following alternatives were identified, considered, and ultimately rejected from further consideration for the reasons described.

2.4.1. No Herbicide Use

There are many species of exotic plants, particularly those perennial species with extensive root systems that are inherently resistant to control by manual, mechanical, biological, or cultural treatments. Once established, effective control of these species must employ the use of herbicides and in some cases manual or mechanical removal without chemical treatment may result in a dramatic increase in population size and thus exacerbate the problem. Examples of such species that occur in Lake Mead NRA include perennial pepperweed (*Lepidium latifolium*), camelthorn (*Alhagi pseudoalhagi*), and Russian knapweed (*Acroptilon repens*), among others. If these species are not treated with herbicide, their populations would likely continue to expand and invade other lands inside and beyond the park boundary. Therefore, this alternative would not meet the purpose and need identified for this plan in Chapter 1.

2.4.2. No Treatment of Exotic Plants

A few members of the public suggested that discontinuing the current management of exotic plants should be considered as an alternative in this planning effort, specifically citing that some of the exotic species targeted for control or eradication have other benefits to humans such as providing shade, beauty, or potentially as biofuels (e.g. saltcedar was specifically mentioned). This alternative was not considered for further evaluation because it would not meet the purpose and need for the plan or the objectives identified in Chapter 1. Furthermore, it is inconsistent with NPS policy as well as both Nevada and Arizona state laws and federal executive orders that mandate that exotic plants (or at least some species of exotic plants under state laws) and their effects on other resources be controlled.

2.5 Mitigation and Monitoring

Mitigation measures are specific actions designed to reduce, minimize, or eliminate impacts of alternatives and to protect Lake Mead NRA resources and visitors. Monitoring activities are actions to be implemented during or following project implementation to assess levels of impact. The following measures would be implemented under all applicable alternatives and are assumed in the analysis of effects for each alternative.

Best Management Practices for herbicide use (Section 2.3.6 of this EA), including selection of the proper chemical and application method, will minimize any unintended or deleterious effects of herbicides in the environment.

When seeding or replanting is necessary, native-species- preferably from local genetic stocks- will be used exclusively. A mix of species will be selected that closely represents the plant composition for the site being reseeded or revegetated.

Field personnel will attend a desert tortoise orientation class every three years.

Desert tortoise surveys will occur before prescribed burns during their active season (March-October).

Southwestern willow flycatcher surveys will occur before prescribed burns in potential habitat.

No treatments will occur in Southwestern willow flycatcher habitat during the nesting season (May-August).

Treated areas in potential Southwestern willow flycatcher habitat would be restored with native vegetation.

For any project or proposal not adequately considered in this EA, further compliance and a separate Minimum Requirement Analysis (MRA) will be completed. Similarly, proposed research proposals occurring in wilderness will consider the benefits of what can be learned, against the impacts on the wilderness resource and values, and a separate MRA will be completed to determine the appropriateness of conducting the research in wilderness and to identify the minimum tool. All MRAs will be reviewed by the Wilderness Coordinator, Environmental Compliance Specialist, and Superintendent.

Leave No Trace principles will be followed when working in wilderness areas.

Projects proposing the use of prescribed fire in wilderness areas will follow procedures outlined in the Fire Management Plan or to implementation plans subsequently developed (e.g. burn plan, fuel treatment plan, etc.). As explained in the Fire Management Plan (FMP), each prescribed burn requires a separate MRA to determine whether the use of fire is the minimum necessary to accomplish resource objectives. Implementation of Minimum Impact Suppression Tactics (MIST) would help prevent unnecessary damage to the wilderness resource from fire suppression activities.

All necessary steps will be taken to avoid cultural resources located in project areas. If the resources cannot be avoided, the NPS will consult with the Arizona or Nevada State Historic Preservation Office (SHPO) to determine the significance of the resources and the potential effect of the project on the resources. If the effect is adverse, the NPS will continue consultation with the SHPO to develop a plan to mitigate the adverse effect.

No weed treatment activities would occur in areas of high public use during peak visiting seasons (Memorial Day to Labor Day).

Herbicide applicators would follow all environmental protection and personal safety requirements identified on product labels and material safety data sheets.

2.5.2 Coordination, Consultation, and Permitting

Both the No Action Alternative and the Proposed Action include activities that may require consultation with, or permits from, other agencies. When specific actions are proposed, the following may first be necessary:

- Consultation with the U.S. Fish and Wildlife Service
- Permits from the Army Corps of Engineers
- State Water Quality permits
- Consultation with the State Historic Preservation Offices
- Consultation with Native American Tribes

2.6 Environmentally Preferred Alternative

The environmentally preferred alternative is the alternative that will promote NEPA, as expressed in Section 101 of NEPA. This alternative will satisfy the following requirements:

- Fulfill the responsibilities of each generation as trustee of the environment for succeeding generations;

- Assure for all generations safe, healthful, productive, and esthetically and culturally pleasing surroundings;

- Attain the widest range of beneficial uses of the environment without degradation, risk of health or safety, or other undesirable or unintended consequences;

- Preserve important historic, cultural, and natural aspects of our national heritage and maintain, wherever possible, an environment that supports diversity and variety of individual choice;

- Achieve a balance between population and resource use that will permit high standards of living and a wide sharing of life's amenities; and,

- Enhance the quality of renewable resources and approach the maximum attainable recycling of depletable resources.

The Proposed Action is the environmentally preferable alternative because overall it would best meet the requirements in Section 101 of NEPA. Compared to the No Action Alternative, it more effectively fulfills the responsibilities of each generation as trustee of the environment for succeeding generations by allowing for better, more efficient control of non-native plants and the impacts they create on the environment. Through the use of prioritization schemes, coordinated research and monitoring, and adaptive management, all of which are lacking from the No Action Alternative, it allows for non-native plant control while minimizing degradation, health and safety risks, and other undesirable or unintended consequences. More effective management of non-native plants is necessary to preserve important natural and cultural aspects of our national

heritage; without such management, non-native species will continue to adversely affect native vegetation and the wildlife that depends on it.

2.7 Comparison of Alternatives to be Analyzed in Further Detail

Both the No Action Alternative and Proposed Action include many of the same program areas: prevention, early detection and eradication, control and containment of existing populations, and research. The difference lies in how comprehensive those individual programs are, how well the program areas are integrated in the context of the park's vegetation management goals, and how well future needs are anticipated and proactively addressed.

Table 3. Descriptive comparison of alternatives.

Descriptor	No Action	Proposed Action
Uses a programmatic approach to integrate prevention, early detection and eradication of incipient populations, and containment/control of established populations.	No	Yes
Proactively anticipates future needs via systematic and periodic evaluation of weed species and treatment priorities.	No	Yes
Involves various partners and cooperators.	Yes	Yes
Includes a data management strategy that assures compatibility of multiple data sets, longevity of the data, and data integrity while still meeting the reporting needs of individual projects.	No	Yes
Provides for adaptive management via systematic evaluation of management actions and improvement in the design of future management actions based on that evaluation.	No	Yes
Treatment priorities based on either site-led, weed-led, or both.	Site-led	Both site-led and weed-led
Incorporates specific best management practices to minimize the potential for harm and maximize the efficacy of chemical treatments	No	Yes
Incorporates specific best management practices to minimize the potential for harm and maximize the efficacy of biological controls	No	Yes

Table 4 summarizes the potential long-term impacts of the No Action Alternative and the Proposed Action. Short-term impacts are not included in this table, but are analyzed in the Environmental Consequences section. Impact intensity, context, and duration are also defined in the Environmental Consequences section.

Table 4. Comparison of long-term impacts

Impact topic	No Action Alternative	Proposed Action
Geology and Soils	Potential moderate impacts	Moderate beneficial effects
Vegetation	Potential moderate impacts	Major beneficial effects
Wildlife	Moderate beneficial effects	Moderate beneficial effects
Threatened/Endangered Species	Potential for adverse effects	Not likely to adversely affect
Water Resources	Potential moderate impacts	Moderate beneficial effects
Wilderness	Major beneficial effects	Major beneficial effects
Cultural Resources	Moderate impacts	Minor impacts
Visual Resources	Moderate beneficial effects	Moderate beneficial effects
Park Operations	Moderate impacts	Moderate beneficial effects
Visitor Use and Experience	Minor impacts	Minor beneficial effects
Adjacent Lands	Minor beneficial effects	Moderate beneficial effects

3.0 Affected Environment and Environmental Impacts

This section provides a description of the existing environment in the project area and the resources that may be affected by the proposals and alternatives under consideration. Complete and detailed descriptions of the environment and existing use at Lake Mead NRA are found in the *Lake Mead NRA Lake Management Plan and Final Environmental Impact Statement* (2002), *Lake Mead NRA Resource Management Plan* (NPS 1999) and the *Lake Mead NRA General Management Plan* (NPS 1986).

This section also presents the likely beneficial and adverse effects to the natural and human environment that would result from implementing the alternatives under consideration. This section describes short-term and long-term effects, direct and indirect effects, cumulative effects, and the potential for each alternative to result in unacceptable impacts or impairment of park resources. Interpretation of impacts in terms of their duration, intensity (or magnitude), and context (local, regional, or national effects) are provided where possible.

3.1 Terminology and Methodology of Impact Assessment

3.1.1. Impact Characterization

In describing potential environmental impacts, it is assumed that the mitigation identified in the *Mitigation and Monitoring* section of this EA would be implemented under any of the applicable alternatives. Impact analyses and conclusions are based on NPS staff knowledge of resources and the project area, review of existing literature, and information provided by experts in the NPS or other agencies. Any impacts described in this section are based on preliminary design of the alternatives under consideration. Effects are quantified where possible; in the absence of quantitative data, best professional judgment prevailed.

Impacts are characterized as negligible, minor, moderate, or major, according to definitions provided for each impact topic below. In addition, the following terms may also be used in characterizing impact type:

- *Localized Impact*: The impact occurs in a specific site or area. When comparing changes to existing conditions, the impacts are detectable only in the localized area.

- *Direct Effect*: The effect is caused by the action and occurs at the same time and place.

- *Indirect Effect*: The effect is caused by the action and may occur later in time or be farther removed in distance, but is still reasonably foreseeable.

- *Short-Term Effect*: The effect occurs only during or immediately after implementation of the alternative.

- *Long-Term Effect*: The effect could occur for an extended period after implementation of the alternative. The effect could last several years or more and could be beneficial or adverse.

In the absence of quantitative data concerning the full extent of actions under a proposed alternative, best professional judgment prevailed.

3.1.2. Impairment Analysis

In addition to determining the environmental consequences of the alternatives, NPS *Management Policies* (2006) requires the analysis of potential effects to determine if actions would impair park resources. Under the NPS Organic Act of 1916 and the NPS General Authorities Act of 1970, as amended, the NPS may not allow the impairment of park resources and values except as authorized specifically by Congress. The NPS must always seek ways to avoid or minimize, to the greatest degree practicable, adverse impacts on park resources and values. However, the laws do give the NPS management discretion to allow impacts to park resources and values when necessary and appropriate to fulfill the purposes of a park, as long as the impact does not constitute impairment to the affected resources and values.

Impairment to park resources and values has been analyzed within this document. Impairment is an impact that, in the professional judgment of the responsible NPS 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 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 enabling legislation or proclamation of the park; is key to the cultural or natural integrity of the park or to opportunities for enjoyment of the park; or is identified as a goal in the park's general management plan or other relevant NPS planning document. An impact would be less likely to constitute an impairment to the extent that it is an unavoidable result, which cannot be reasonably further mitigated, of an action necessary to preserve or restore the integrity of park resources or values.

Impairment may result from NPS activities in managing the Park, visitor activities, or from activities undertaken by concessioners, contractors, and others operating in the Park. In this "Environmental Consequences" section, a determination on impairment is made in the conclusion statement of each natural and cultural resource topic for each alternative. The NPS does not analyze recreational values, visitor use and experience (unless impacts are resource based), socioeconomic values, health and safety, or park operations in terms of impairment.

3.1.3. Unacceptable Impacts

The impact threshold at which impairment occurs is not always readily apparent. Therefore, the NPS will apply a standard that offers greater assurance that impairment will not occur. NPS *Management Policies* (2006) requires that park managers evaluate existing or proposed uses and determine whether the associated impacts on park resources and values are acceptable. Unacceptable impacts are impacts that fall short of impairment, but are still not acceptable within a particular park's environment.

Virtually every form of human activity that takes place within a park has some degree of effect on park resources or values, but that does not mean the impact is unacceptable or that a particular use must be disallowed. For the purposes of this analysis, an unacceptable impact is an impact that individually or cumulatively would

- be inconsistent with a park's purposes or values
- impede the attainment of a park's desired future conditions for natural and cultural resources as identified through the park's planning process
- create an unsafe or unhealthful environment for visitors or employees
- diminish opportunities for current or future generations to enjoy, learn about, or be inspired by park resources or values
- unreasonably interfere with
    - park programs or activities
    - an appropriate use
    - the atmosphere of peace and tranquility, or the natural soundscape maintained in wilderness and natural, historic, or commemorative locations within the park
    - NPS concessioner or contractor operations or services

In this *Environmental Consequences* section, a determination on unacceptable impacts is made in the conclusion statement of the applicable impact topics for each alternative.

3.1.4. Cumulative Impacts

Cumulative effects are the direct and indirect effects of an alternative's incremental impacts when they are added to other past, present, and reasonably foreseeable actions, regardless of who carries out the action. Federal agencies are required to identify the temporal and geographic boundaries within which they will evaluate potential cumulative effects of an action and the specific past, present, and reasonably foreseeable projects that will be analyzed. This includes potential actions within and outside the Park boundary. The geographical boundaries of analysis vary depending on the impact topic and potential effects. While this information may be inexact at this time, major sources of impacts have been assessed as accurately and completely as possible, using all available data.

Specific projects or ongoing activities with the potential to cumulatively affect the resources (impact topics) evaluated for the project are identified in this document. Some are identified in the narrative immediately following, while others are specific to a certain resource or set of resources and thus are described in the effects section of the applicable topics. How each alternative would incrementally contribute to potential impacts for a resource is included in the cumulative effects discussion for each impact topic.

The Exotic Plant Management Plan sets policies and identifies strategies for dealing with exotic plants park-wide. As such, adoption of the plan has the potential to have landscape-level effects. These effects may be cumulative with other plans or activities that affect the park at the ecosystem level. The park's General Management Plan (NPS 1986), as well as the subsequent Lake Management Plan (NPS 2002) and Low Water General Management Plan Amendment (NPS 2005), establish guidance on how the park is managed, including what types of activities

are permissible or appropriate in different areas. The Fire Management Plan (NPS 2004) authorizes the use of wildland fire and prescribed fire to restore ecosystems to desired resource conditions. The recently completed Muddy Mountains Wilderness plan and the Lake Mead Wilderness Management Plan, currently in development, will establish resource goals and visitor use guidelines for designated wilderness areas within the park. Weed management practices on adjacent and nearby lands under the jurisdiction of other agencies can affect weed dynamics at Lake Mead. At the regional level, the park is a participant in both the Clark County Multi-Species Habitat Conservation Plan and the Lower Colorado River Multiple Species Conservation Plan. All of these plans guide resource management actions within Lake Mead NRA and directly affect ecosystem conditions therein.

The park has initiated several new exotic plant management projects in recent years in response to the increased priority placed on exotic plant management in the NPSThe Lake Mead Exotic Plant Management Team focuses on treatment of high priority exotic plant populations in several desert parks. There are also on-going park operations that contribute to exotic plant management in various ways, including the native plant nursery which provides native plants to restore sites that have been degraded by exotic plants, and the interpretation program which seeks to educate park visitors and the surrounding communities about the parks native resources.

In addition, native plant communities (and park resources in general) are impacted by a variety of actions taking place both within and outside the Park. Within the park, roads, rights-of-way, and construction projects create disturbance that increases susceptibility to exotic plant invasions. Past grazing practices, feral burros (which have been significantly reduced over the past decade), and trespass livestock have negative effects on the vegetation community. Las Vegas and other adjacent urban communities have vast amounts of artificial landscaping that can serve as source populations of exotic plants. Exotic plant control activities that occur at Lake Mead NRA have the ability to offset some of these deleterious effects.

3.2 Impact Analysis and Discussion

3.2.1. Geology and Soils

Affected Environment

Lake Mead NRA lies within the southern extent of the basin and range physiographic province, characterized by generally north-south trending mountain ranges separated by broad, shallow valleys. The mountains are dissected by deep ravines that open into broad alluvial fans. Commonly, adjoining fans coalesce and form a continuous alluvial apron, known as a bajada, along the base of the mountains. The valley floors are usually nearly level and often contain one or more playas or dry lakes where silt, clay, evaporates, and weakly cemented gravels have been deposited. In the tilted fault-block mountains, the age of strata ranges from Precambrian to Tertiary, while the sediments in the intervening structural basins are all younger than the Mesozoic and consist chiefly of late Tertiary and Quarternary deposits.

From these parent materials and geomorphic processes, soils are formed. While the soil classifications within the Park show many different soil series, the soils can be qualitatively described in three major categories (as interpreted from USDA 2004 and USDA 2006):

- The Sunrock Series and its related soils are found in upland positions on hills, mountains, and mesas. These are very shallow, loamy soils with a large gravel component. The parent material is colluvium derived from volcanic rock. These soils are somewhat excessively drained with moderately rapid permeability and are moderately alkaline. These soils typically support sparse desert shrublands dominated by creosotebush and white brittlebush, and bursage.
- The Huevi Series and its related soils are found on fan terraces. These are very deep, loamy soils with a large gravel or cobble component. The parent material is alluvium derived from mixed rock sources. These soils are well drained with moderately rapid permeability and are moderately alkaline with high calcium carbonate content. These soils typically support sparse desert shrublands dominated by creosotebush and bursage.
- The Seanna Series and Goldroad Series are found on the backslopes of mountains. These are moderately shallow, loamy soils with a large gravel and cobble component. The parent material is residuum weathered from granite. These soils have high rock fragment content on the surface and are moderately alkaline. They produce very high runoff and moderately rapid permeability. These soils typically support sparse desert shrublands dominated by creosotebush, white brittlebush, and bursage.

Soil itself is an ecosystem, supporting a host of bacteria, protozoa, nematodes, and fungi. One of the signature features of the desert is the presence of biological soil crusts – a complex mosaic of cyanobacteria, green algae, lichens, mosses, microfungi and other bacteria. Biological soil crusts serve many important functions in arid environments including carbon fixation, nitrogen fixation, albedo, sites for seed germination and establishment, water retention, and soil stabilization. Invasive plants can impact these soil ecosystems, and through those changes impact the vascular plant communities they support. Of particular concern are: invasive annual grasses that occupy interspaces in desert shrublands and are implicated in increasing fire frequency to the detriment of both biological soil crusts as well as native desert shrub species (Belnap et al. 2001); alterations in soil nitrogen levels that can alter species composition (Evans et al. 2001, Monaco et al. 2003); and increase invasive plant dominance (Brooks 2003); and alterations in soil moisture due to timing of water uptake by invasive plant species (Kulmatiski et al 2006); and/or removal of biological soil crusts (Belnap et al. 2001).

Laws, Regulations, and Policies

NPS *Management Policies* (2006) stipulates that the NPS will preserve and protect geologic resources as integral components of park natural systems. Geologic resources include geologic features and geologic processes. The fundamental policy, as stated in the NPS *Natural Resource Management* (*NPS-77,* 1991) is the preservation of the geologic resources of parks in their natural condition whenever possible.

Soil resources would be protected by preventing or minimizing adverse potentially irreversible impacts on soils, in accordance with NPS *Management Policies* (2006). *NPS-77* specifies objectives for each management zone for soil resources management. These management

objectives are defined as: (1) natural zone- preserve natural soils and the processes of soil genesis in a condition undisturbed by humans; (2) cultural zone-conserve soil resources to the extent possible consistent with maintenance of the historic and cultural scene and prevent soil erosion wherever possible; (3) park development zone- ensure that developments and their management are consistent with soil limitations and soil conservation practices; and, (4) special use zone- minimize soil loss and disturbance caused by special use activities, and ensure that soils retain their productivity and potential for reclamation.

Zones within the Park have been designated in the Lake Mead NRA *General Management Plan*, which provides the overall guidance and management direction for Lake Mead NRA.

Criteria and Thresholds for Impact Analysis

The following impact thresholds were established for analyzing impacts to geology and soils in the project area.

- *Negligible impacts*: Impacts have no measurable or perceptible changes in soil structure and occur in a relatively small area.

- *Minor impacts*: Impacts are measurable or perceptible, but localized in a relatively small area. The overall soil structure is not affected.

- *Moderate impacts*: Impacts are localized and small in size, but cause a permanent change in the soil structure in that particular area.

- *Major impacts*: Impact on the soil structure is substantial, highly noticeable, and permanent.

Impacts Common to Both Alternatives

Under both alternatives, administrative actions such as prioritization, monitoring and research, and adaptive management will have little direct relationship to soil or geologic resources, although these actions may influence the use of treatments that affect soil or geologic resources. In such cases, the impacts are considered in context of the treatment.

The potential of treatments to impact geologic resources is limited to effects on rates of erosion, whereby removal of exotic plants via whatever means may increase erosion rates for a short time. This is because the removal of plants, whether they are native or non-native species, can leave the soil surface vulnerable to both wind and water erosion. This effect is further exacerbated by techniques that physically remove the root system as well which otherwise would serve to hold soil even if the above ground portion of the plant was removed, thus hand-pulling of herbaceous plants and root-plowing or extraction of woody plants are treatments that have increased potential for erosion. The scale of erosion impacts tends to be proportional to the scale of the treatment area as well as its topographical position, where removal of plant cover on slopes tends to result in greater rates of erosion via water due to its increased capacity to remove sediment as a result of flow velocity downslope and that less force is needed to mobilize sediment on a slope. Thus treatments that remove large areas of plants on slopes, such as

broadcast herbicide applications or prescribed fire treatments, have increased potential for erosion. Regardless, the magnitude of any increase in erosion caused by exotic plant treatments would be negligible given the naturally high rates of wind and water erosion in desert landscapes.

Under both alternatives, integrated pest management ideology and procedures would be used including the requirements that all herbicides proposed for use must be registered by the Environmental Protection Agency, used in accordance with their label, actual use must be recorded in a pesticide use log, and all herbicides used in NPS lands are subject to annual approval via the pesticide use proposal system. These requirements serve to minimize the use of herbicides and focus such efforts on situations where they are most effective, thus reducing the potential for herbicide persistence in soil. The one exception is where a pre-emergent herbicide is prescribed, in which case the effectiveness of the herbicide depends upon its ability to persist in the soil through the germination season for the target exotic species as is sometimes prescribed for landscape scale suppression of annual invasive brome grasses (*Bromus* spp.) in desert shrubland communities. Generally, desert soils are relatively coarse in texture with low organic content, both of which serve to naturally minimize herbicide persistence in the soil. Unplanned release of herbicide in the environment via a spill of concentrated chemical or a diluted solution also poses a risk to soils and due to the localized concentrations possible under this scenario the chemicals may be more persistent than when applied via label instructions. Herbicide use may have effects on biological soil crusts. One study looked at glyphosate on moss-dominated biological soil crusts and found no short-term negative impact on bryophyte cover (Youtie et al. 1989). However, there is little information on the effects of repeated herbicide application or the long-term effects of glyphosate or other herbicides (Belnap et al. 2001).

Manual and mechanical treatments can have highly variable impacts to soils, largely dependent upon the scale of the treatment, travel methods used to access the treatment site, and tools or equipment used. The most common scenario at Lake Mead NRA is the use of chainsaws for saltcedar treatment. In most cases, the weed management personnel access the site on foot which results in either no impact if the travel route is over rocky surfaces or negligible impacts if the travel route is over soil. Where the treatment area is large, an ATV/UTV may be used to transport equipment such as chainsaws, saw fuel, bar oil, and herbicide for the cut stump treatment to follow. In such cases, the ATV/UTV generally makes a minimal number of passes and would result in a minor impact to soil, particularly where the path of travel requires driving over biological soil crusts. For some herbaceous species, hand-pulling is used to remove both the above ground portion of the plant as well as much of the below ground portion. In this case, there is highly localized, minor soil disturbance where the plants are removed.

Biological control has a limited relationship with soil, primarily limited to the after affects of a successful biological control treatment that leaves the target plants dead and increases soil litter and/or increases potential for post-treatment erosion. Some biological control agents involve an insect life-stage or microorganism (e.g. fungi, bacterium, or other pathogen) that lives in the soil for all or part of its life. In these cases, it is reasonable to anticipate the introduction of the biological control agent may impact the soil ecosystem, but there is so little known about soil

microorganisms and ecosystems it is difficult to describe impacts with any measure of confidence.

Cultural treatments that focus on restoration of a site, either as a follow-up action to another treatment described above or as a stand-alone treatment, has the potential for impacts to soils. The most common type of impact involves disturbance of soil structure in order to re-contour the soil surface, install native plants, rake in seed, root-plow to remove stumps prior to planting, or similar techniques. These soil structure impacts can be very surficial disturbing only the upper most portion of the soil profile or can be much deeper, disturbing all or most of the soil profile. Another impact may be to the soil chemistry or soil water conditions if either is altered via amendments or irrigation to provide better growing conditions for native plants. Given the labor-intensive and expensive characteristics of restoration, most often these impacts are very localized but are long-term alterations of the soil.

Prescribed fire has the potential for localized impact soils. The heat generated by the fire can consume some of the litter and other organic matter in the surface of the soil or along root chambers that are capable of carrying fire to depth. Recent research in the Mojave Desert (Brooks 2002) has shown that fire temperatures in desert shrublands generate spatially variable heat where peak fire temperatures occur under the canopy of shrubs with significantly less heat generated in the drip line of the shrubs and very little heat in the interspace between shrubs. The same research also found that heat generated by fire did not penetrate the soil surface very deep, with the most intense heat measured 5 cm above ground level with less heat on the soil surface and the heat penetrating 2 cm below soil surface was only about 50% of the peak temperature. The combustion of the fuel and soil organic matter deposits ash on the soil surface and tends to increase soil pH making it more alkali and altering the soil chemistry (Neary et al. 2005). Finally, soils exposed to fire that removes the vegetation are subsequently subject to erosion either by wind or water at least until plants re-colonize and stabilize the area or desert pavement forms.

Non-treatment of exotic plants can also have impacts to soils through alteration of soil chemistry and soil water. A good example is saltcedar, an exotic tree that invades riparian areas where its high evapotranspiration rate decreases the availability of water and increases the salinity of the soil, sometimes making it very difficult for native species to re-establish on the site. The increase in salinity is often a long-lasting impact on soils that have been invaded by saltcedar, persisting even long after the removal of the saltcedar. Another example is exotic annual grasses (*Bromus spp*, *Schismus spp.*) that germinate in winter and thus utilize the available soil water and nutrients before the native plants are able to establish (Brooks 2000). This sort of impact tends to short-lived, lasting only for that growing season. However, there is great potential for invasive annual grasses to have long-term negative impacts on biological soil crusts through increased fire frequency (Belnap et al. 2001), eventually resulting in the loss of the soil crusts and all of their ecological functions including soil stabilization.

<u>Alternative A- No Action, Continue With Current Vegetation Management</u>
Under the No Action Alternative, the Park would continue its existing ad hoc, project-based exotic plant management efforts. Overall, this would result in fewer acres treated than in

Alternative B, so would minimize the negative impacts of various treatment techniques on soil and geologic resources. However, there would continue to be minimal integration of exotic plant management efforts and thus the potential for the proximity of unrelated treatments to magnify their impacts, such as multiple treatments being undertaken in the different areas of the same wash and thus increasing the amount of herbicide applied and potentially its persistence in the soil.

Likewise, the continuation of existing ad hoc, project-based exotic plant management efforts reduces the overall effectiveness of exotic plant management in the park which would allow the negative impacts of exotic plants to continue. For example, if few saltcedar stands are treated, then there are more areas that are experiencing increased soil salinity. Soils affected by exotic plants would also not be consistently evaluated for restoration potential, so those soil impacts may go un-remediated even if the exotic plants are removed. Biological soil crusts would decline and eventually disappear where invasive annual grasses establish and increase fire frequency.

There would potentially be more manual and/or mechanical treatments under this alternative because the provision of the categorical exclusion for exotic plant control under the National Environmental Policy Act would limit the amount of acres subject to herbicide treatment. In some cases, this could increase the intensity of soil disturbance because such treatment methods are more likely to remove root material than herbicide treatments. The limited scope and scale of manual and mechanical methods would mean that control efforts would be unable to keep pace with expanding populations or new invasions, particularly in remote areas.

There would also be no coordinated prioritization, thus some exotic plant species or sites that have the most potential to affect soil resources may not be identified as management priorities and so may go untreated.

There would be no comprehensive prevention program that addresses both administrative actions as well as visitor and employee education. So there would be lost opportunities to prevent and/or intercept new introductions of exotic plants to the Park or to new areas of the Park. Some of the exotic plants may have as yet unknown impacts on soils, particularly where those species are allelopathic.

There would be no coordinated research and monitoring effort focused on learning from exotic plant management efforts and incorporating new knowledge into future management decisions in an adaptive management framework. This could result in lost opportunities for improvement in treatment effectiveness or identification of improved treatment techniques that minimize negative impacts.

Cumulative Effects: The removal of exotic plants and subsequent exposure of soil to erosion would be a negligible contribution to the regional loss of soil through a variety of planned and unplanned actions. Such activities include illegal and legal off-road vehicle use, earthmoving and re-contouring for urban development, and grazing by feral animals (e.g. burros and trespass cattle) as well as domestic livestock operations. In addition the drawdown of Lake Mead has

resulted in thousands of acres of exposed soil along the shoreline subject to wind and water erosion.

Chemical changes to the soil as a result of herbicide use or the persistence of saltcedar would be similar in scope within the park as well as outside of the park on adjacent federal lands where land managers utilize similar tools for exotic plant control.

Conclusion: Implementation of this alternative is expected to have minor, short-term impacts to soil and geologic resources due to the limited extent of treatment efforts and the reliance on manual and mechanical methods. There is also the potential for long-term, moderate impacts due to persistence and expansion of exotic plant species and their impacts on soil resources. There are no unacceptable impacts and no impairment of geology and soils under this alternative.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan

Under the Proposed Action, the Park would implement a comprehensive exotic plant management plan that would guide the actions of the NPS and its many partners working in Lake Mead NRA. Overall, this coordinated effort would provide opportunities for more aggressive treatment, particularly for early detection and eradication of newly invading species, and thus would likely increase the total acres treated. This overall trend of increased treatment efforts would likewise increase the negative impacts associated with the various treatment methods while simultaneously reducing the negative impacts associated with leaving invasive plants unchecked.

The prioritization effort itself would not result in impacts to soil and geologic resources, but the focused site-led or weed-led treatment efforts that results from the prioritization would likely result in increased local impacts at the point of treatment. Furthermore, the potential for invasive species to alter ecosystems (e.g. soil resources) is a consideration in establishing priorities so the prioritization effort may serve to focus more management attention on those species that are most likely to impact soil resources and thus reduce their negative impacts.

This alternative also includes a comprehensive prevention program that addresses both agency-controlled activities as well as visitor activities. By intercepting the pathways by which new invasive plants may enter the park or be moved around the park from infested to uninfested areas, the geographic extent and intensity of exotic plant control efforts would be expected to decline over time. Thus the negative impacts to soils and geologic resources associated with those control efforts would also decline over time.

The implementation of a targeted restoration program would result in highly localized soil disturbance while exotic plants are removed and native plants are being established, but such impacts are expected to be short-lived and of very limited spatial extent.

The impacts associated manual, mechanical, biological, and chemical control efforts are expected to be highest under this alternative as compared to the No Action Alternative. However, many of those impacts would be avoided, minimized, and/or mitigated through the adoption of best management practices. These guidelines would serve to target the treatment methods

appropriately to the exotic plant species and the site conditions, including soil characteristics, to ensure the maximum effectiveness of the treatment while minimizing impacts to the other values of the site. Any treatment strategy involving the use of herbicides would specifically include both chemical selection and application method with consideration for soil retention and soil persistence properties of the chemical given the soil characteristics and climatic conditions of the site.

The use of prescribed fire for exotic plant control is addressed in the Park's approved Fire Management Plan and thus is largely unaffected by either the Exotic Plant Management No Action Alternative or the Proposed Action. The one minor difference is the provisions of the Proposed Action to systematically learn from treatment efforts, including prescribed fire, and to integrate that knowledge into future decisions in an adaptive management framework.

Under the Proposed Action, a targeted research and monitoring program would be initiated. By monitoring treatment effectiveness and non-target impacts of treatments, there would be opportunities to both improve treatments in the future and to identify and reduce impacts to soil resources where possible. Similarly, autecological research focused on high priority invasive species may be useful to identifying soils that are particularly vulnerable to invasion and thus aid in efforts to curtail that invasion and thus maintain the natural soil properties and its resident microbial communities and biological soil crusts. Research and monitoring results would be conducted within the framework of adaptive management and lessons learned would be incorporated into future decisions, thus improving exotic plant control efforts over time while minimizing unintentional impacts on all resources, including soil and geologic resources.

Cumulative Effects: The cumulative effects of this alternative would be similar to those described for Alternative A, with the potential for relatively less mechanical soil disturbance and more chemical changes introduced through an increase in herbicide use.

Conclusion: Implementation of this alternative is expected to have minor, short-term impacts to soil and geologic resources due to the relative increase in overall acres treated while employing best management practices to minimize negative impacts. Long-term, this alternative is expected to have moderate beneficial impacts to soil resources due to the curtailment of the spread of invasive species and their negative persistent impacts on soil chemistry and biological soil crusts. There would be no unacceptable impacts and no impairment of geology and soils under this alternative.

3.2.2. Vegetation

Affected Environment

Lake Mead NRA lies within the Mojave Desert ecoregion, with Sonoran Desert influences increasing in the southern end of the park. The signature plant species of the Mojave Desert is the Joshua tree (*Yucca brevifolia*), which does occur in Lake Mead NRA. In the eastern Mojave Desert, where Lake Mead NRA lies, rainfall averages about 4.5 inches annually, characterized by gentle, predictable winter rains resulting from frontal passages and less predictable, intense

summer thunderstorms resulting from the southwestern monsoon. This bimodal precipitation pattern is a major influence on the native flora of the eastern Mojave Desert.

Lake Mead NRA is known to support 738 species of vascular plants, including 93 species considered exotic (e.g. non-native). Ephemeral species are annuals that respond to seasonal rain, typically germinating in late winter and appearing in spring or early summer or occasionally in the fall in response to summer monsoonal moisture. Ephemeral species make up almost half of the park's known flora which results in high inter-annual variability in both species distributions and abundance. Where plants occur depends on elevation, amount of precipitation, soil type, temperature, slope, aspect, and past land use. Notably, most of the non-native plant species occur in areas disturbed by either natural or human-causes, and while most of these species are restricted to disturbed lands some are capable of naturalizing into surrounding undisturbed lands.

The most abundant ecological system in the Park occupies about 85% of the terrestrial environment and is classified as Sonora-Mojave Creostebush-White Bursage Desert Scrub (Table 5). This geospatial classification for the southwestern United States is provided by NatureServe (2004) based on multi-season satellite imagery from 1999-2001 with a minimum mapping unit of 1 acre. While 25 other ecological systems are also found in the park, none occupy more than 10% of the terrestrial lands. Notably, the Invasive Southwest Riparian Woodland and Shrubland, dominated by saltcedar, occupies about 1% of terrestrial lands and is concentrated around the shores of the reservoirs and in washes. The following is the concept summary for the dominant ecological system in Lake Mead NRA (NatureServe 2004):

> Sonora-Mojave Creosotebush-White Bursage Desert Scrub: This ecological system forms the vegetation matrix in broad valleys, lower bajadas, plains and low hills in the Mojave and lower Sonoran deserts. This desert scrub is characterized by a sparse to moderately dense layer (2-50% cover) of xeromorphic microphyllous and broad-leaved shrubs. *Larrea tridentata* and *Ambrosia dumosa* are typically dominants, but many different shrubs, dwarf-shrubs, and cacti may codominate or form typically sparse understories. Associated species may include *Atriplex canescens*, *Atriplex hymenelytra*, *Encelia farinosa*, *Ephedra nevadensis*, *Fouquieria splendens*, *Lycium andersonii*, and *Opuntia basilaris*. The herbaceous layer is typically sparse, but may be seasonally abundant with ephemerals. Herbaceous species such as *Chamaesyce* spp., *Eriogonum inflatum*, *Dasyochloa pulchella*, *Aristida* spp., *Cryptantha* spp., *Nama* spp., and *Phacelia* spp. are common.

There are no federally-listed threatened or endangered plant species that occur at Lake Mead NRA; however, Las Vegas buckwheat (*Eriogonum corymbosum*, perennial shrub) occurs in the Park and is currently being considered for federal listing under the Endangered Species Act. State-listed rare plants in the Park include Las Vegas buckwheat, threecorner milkvetch (*Astragalus geyeri var. triquetrus*, herbaceous annual/ephemeral), sticky buckwheat (*Eriogonum viscidulum*, herbaceous annual), and Las Vegas bearpoppy (*Arctomecon californica*, herbaceous perennial). Conservation direction and legal protection is also afforded to species under the Clark

County Multiple Species and Habitat Conservation Plan, which includes the Las Vegas bearpoppy, threecorner milkvetch, and sticky buckwheat discussed above as well as ringstem (*Anulocaulis leiosolenus var. leiosolenus*, herbaceous perennial). Within the Park, all of these protected plant species are potentially threatened by invasive exotic plant species, either through direct competition for resources or habitat alteration (e.g. altered fire regime) (D. Bangle, botanist, personal communication).

Table 5. Ecological systems, excluding open water, found in Lake Mead NRA (based on geospatial analysis of data presented in NatureServe 2004).

Ecological System	Acres in Park	% of Park's terrestrial lands
Sonora-Mojave Creosotebush-White Bursage Desert Scrub	797,888	85
North American Warm Desert Bedrock Cliff and Outcrop	58,224	6
North American Warm Desert Volcanic Rockland	23,982	3
North American Warm Desert Badland	18,467	2
North American Warm Desert Pavement	14,844	2
Mojave Mid-Elevation Mixed Desert Scrub	10,440	1
Invasive Southwest Riparian Woodland and Shrubland	6,070	1
North American Warm Desert Wash	1,945	< 1
North American Arid West Emergent Marsh	1,481	< 1
Colorado Plateau Mixed Bedrock Canyon and Tableland	1,225	< 1
North American Warm Desert Riparian Mesquite Bosque	1,015	< 1
Inter-Mountain Basins Semi-Desert Shrub Steppe	885	< 1
Great Basin Pinyon-Juniper Woodland	707	< 1
Sonora-Mojave Mixed Salt Desert Scrub	664	< 1
North American Warm Desert Riparian Woodland and Shrubland	342	< 1
Colorado Plateau Blackbrush-Mormon Tea Shrubland	181	< 1
Sonoran Mid-Elevation Desert Scrub	153	< 1
Inter-Mountain Basins Montane Sagebrush Steppe	62	< 1
Inter-Mountain Basins Big Sagebrush Shrubland	55	< 1
North American Warm Desert Playa	11	< 1
Developed, Open Space - Low Intensity	10	< 1
Inter-Mountain Basins Semi-Desert Grassland	6	< 1
Inter-Mountain Basins Mixed Salt Desert Scrub	5	< 1
Barren Lands, Non-specific	1	< 1
Mogollon Chaparral	1	< 1

Exotic invasive plant species have been a subject of management concern at Lake Mead NRA for decades. Of the 93 exotic plant species known to occur in the Park, only about 15% of the species have been subject to management effort. For the past 20 years, most effort has focused

on control of saltcedar (*Tamarix ramosissima*), a hardy tree species that readily invades shorelines, washes, and springs where is displaces native riparian plant and animal species and alters the habitat by increasing soil salinity, drawing down groundwater with a high evapo-transpiration rate, and increasing fire frequency and intensity. In recent years, efforts have also focused on a related tree species called athel (*Tamarix aphylla*) which was commonly thought to be non-invasive until it was found to exhibit many of the same invasive characteristics as saltcedar at Lake Mead NRA. Also of concern is the ability of saltcedar and athel to hybridize with each other. In recent years, management efforts have also been directed at basic research and treatment of Sahara mustard (*Brassica tournefortii*), a robust annual species that has dramatically increased since 2005 in many areas of the Mojave Desert, including the Park.

Of increasing concern to desert land managers is the increase in invasive annual grasses in many areas of the Mojave and Great Basin Deserts, including cheatgrass (*Bromus tectorum*) at higher elevations like pinyon-juniper woodland and sagebrush shrublands, red brome (*Bromus rubens*) at moderate elevations like blackbrush shrublands and Joshua tree woodlands, and Mediterranean grass (*Schismus spp.*) at the lowest elevations like creosotebush shrublands. In addition to the ability of these winter-germinating species to outcompete native species for soil nutrients and water, the invasion of these grasses causes great concern to managers due to their ability to establish in otherwise barren inter-shrub spaces. This "filling in the gaps" is a major alteration of the natural vegetation pattern of the lower elevation Mojave Desert and serves to greatly increase both fuel loads and fuel continuity, thus making the landscape much more flammable. Eventually, the increased fire frequency and fire size can fundamentally alter the native floral composition and structure through establishment of a grass/fire cycle (D'Antonio and Vitousek 1992; Brooks et al. 2004) whereby the more an area burns the more it can burn until the native desert shrubland, which is relatively fire intolerant, is converted to a fire-tolerant non-native grassland. The consequence is a fundamental alteration of the desert whereby almost all of the native plant and animal species are lost and opportunities for successful restoration is very low due to persistent fire, altered nutrient cycles, changes in erosional and depositional environments, etc.

Laws, Regulations, and Policies

The NPS Organic Act directs the park to conserve the scenery and the natural objects unimpaired for future generations. NPS *Management Policies* (2006) defines the general principles for managing biological resources as maintaining all native plants and animals as part of the natural ecosystem. When NPS management actions cause native vegetation to be removed, then the NPS will seek to ensure that such removals will not cause unacceptable impacts to native resources, natural processes, or other park resources. Exotic species, also referred to as non-native or alien, are not a natural component of the ecosystem. They are managed, up to and including eradication, under the criteria specified in NPS *Management Policies* (2006) and *NPS-77.*

Criteria and Thresholds for Impact Analysis

The following impact thresholds were established for analyzing impacts to vegetation in the project area:

- *Negligible impacts*: Impacts have no measurable or perceptible changes in plant community size, integrity, or continuity.

- *Minor impacts*: Impacts are measurable or perceptible and localized within a relatively small area. The overall viability of the plant community is not affected and the area, if left alone, recovers.

- *Moderate impacts*: Impacts cause a change in the plant community (e.g. abundance, distribution, quantity, or quality); however, the impact remains localized.

- *Major impacts*: Impacts to the plant community are substantial, highly noticeable, and permanent.

Impacts Common to Both Alternatives

By definition all aspects of exotic plant management either directly or indirectly impact vegetation because, after all, the purpose of exotic plant management is to change the vegetation.

The integrated pest management approach serves to maximize the impacts on the exotic plants and minimize the impacts to the native plants. The use of multiple treatments, either in combination or sequentially, tends to have the most impact on exotic plants and if successful will have beneficial impacts on community composition and vegetation structure.

Cultural treatments that are successful in preventing the introduction of new exotic plant species are almost wholly beneficial to native plants and pose minimal impacts to native plants. Restoration treatments are generally beneficial to native plants, restoring individual plants to a site after the removal of non-native plants. However, there can be some damage to nearby native plants, especially herbaceous plants that are easily trampled, due to soil surface disturbance associated with the restoration effort. Similarly, the soil disturbance inherent in some restoration techniques can disturb seedbanks of native species.

Manual treatments tend to be very selective and thus almost wholly beneficial to native plants, although the means used to access the treatment site (e.g. ATV) may inadvertently impact some individual native plants. Some mechanical treatments are very selective while others are not, primarily influenced by the mechanical tool used for the job where precise tools (e.g. chainsaw) poses no risk to the native plants while less precise tools (e.g. mowing) tends to have more impacts on non-target plants.

Biological control impacts non-native plants and, if successful, provides beneficial impacts to native plants. The rigorous testing and permitting process used to screen biological control species virtually eliminates the risk that these agents may pose a risk to native plants.

Chemical treatments can be selective or non-selective depending on the herbicide properties and application method. Generally, the use of a selective herbicide coupled with a precise application method (e.g. hand spraying) will result in very minimal impacts to native plants while controlling exotic plants. The functional pathway of the herbicide and the environmental conditions present

during application can also influence the effectiveness of the treatment on exotic plants and the potential for non-target impacts to native plants. Broadcast application methods, pre-emergent herbicides, and broad-spectrum formulations will all have increased impacts to native plants but may still be valuable tools in some situations if needed to curtail the invasion of other lands.

Prioritization, research and monitoring, and adaptive management are all administrative actions that have no direct impacts on vegetation but can have substantial indirect impacts by influencing the effectiveness of on the ground treatment efforts. They may also reduce the potential for negative impacts to native plant communities that may arise from poorly thought-out treatment efforts.

Non-treatment of exotic plants can have substantial irreversible impacts to native plants by allowing exotic plants to increase unchecked. Directly, the exotic plants will compete with native plants for available resources needed for growth and survival. In particular soil water in the desert is a limiting factor for plant growth so plants that drawdown the water table (e.g. saltcedar) or deplete available water prior to native species germination (e.g. red brome) pose major threats to native plants. Plants can also directly compete for growing space, sunlight, soil nutrients, and other vital resources. Indirectly, exotic plants can alter basic ecosystem characteristics and/or processes that lead to the demise of entire plant communities, such as the establishment of a grass/fire cycle and the conversion of native shrubland to non-native grassland. These direct and indirect impacts combine over time and space to fragment native plant communities which leads to declines in pollinator populations and their services, restricted gene flow, and increased vulnerability to other stressors, generally promoting the downward decline or abrupt demise of native flora and the habitat it provides.

Alternative A- No Action, Continue With Current Vegetation Management

Under the No Action Alternative, the Park would continue its existing ad hoc, project-based exotic plant management efforts. Overall, this would result in fewer acres treated than in Alternative B, with more reliance on manual and mechanical treatment methods. However, there would continue to be minimal integration of exotic plant management efforts and thus the potential for the proximity of unrelated treatments to magnify their impacts, such as multiple treatments being undertaken in the different areas of the same wash and thus increasing the amount of trampling to which native plants are subjected.

Likewise, the continuation of existing ad hoc, project-based exotic plant management efforts reduces the overall effectiveness of exotic plant management in the park which would allow the negative impacts of exotic plants to continue. For example, if few saltcedar stands are treated, then there are more areas that are experiencing increased soil salinity which would impair the ability of many native plants to re-colonize the site. Sites affected by exotic plants would also not be consistently evaluated for restoration potential, so those impacts to native plants may go un-remediated even if the exotic plants are removed.

There would potentially be more manual and/or mechanical treatments under this alternative because the provision of the categorical exclusion for exotic plant control under the National Environmental Policy Act would limit the amount of acres subject to herbicide treatment. The

limited scope and scale of manual and mechanical methods would mean that control efforts would be unable to keep pace with expanding populations or new invasions, particularly in remote areas. This would result in increased impacts to native plant communities, particularly those plant communities that occur in moist soil environments where exotic plants tend to more easily become established. Such environments would include springs, seeps, reservoir shorelines, and riparian corridors.

There would also be no coordinated prioritization, thus some exotic plant species or sites that have the most potential to affect native plants may not be identified as management priorities and so may go untreated. This is of particular concern in situations where exotic plants invade rare plant habitats and, under this alternative, such sites would not be consistently considered as a high priority for early detection and/or treatment park-wide.

There would be no comprehensive prevention program that addresses both administrative actions as well as visitor and employee education. So there would be lost opportunities to prevent and/or intercept new introductions of exotic plants to the Park or to new areas of the Park. Some of the exotic plants may have as yet unknown impacts to native plants, particularly where those species are capable of altering ecosystem processes needed to sustain native plant communities (e.g. pollination, surface hydrology, fire regimes, etc).

There would be no coordinated research and monitoring effort focused on learning from exotic plant management efforts and incorporating new knowledge into future management decisions in an adaptive management framework. This could result in lost opportunities for improvement in treatment effectiveness or identification of improved treatment techniques that minimize negative impacts.

Cumulative Effects: The region surrounding Lake Mead NRA is largely under federal administration by the Department of Defense, U.S. Forest Service, Bureau of Land Management, U.S. Fish and Wildlife Service, and even other National Park Service lands. As such, all of these land managers undertake similar exotic plant control efforts as required by various laws and executive orders. The tools used are similar, although there is some variation from agency to agency and funding cycle to funding cycle regarding how aggressive efforts are and what species or areas are targeted. Generally, the impacts of the park's efforts are additive to the efforts of surrounding lands, thus the same sort of impacts tend to occur regionally.

Wildland fire management activities, both within the Park as described in the 2004 Fire Management Plan as well as outside the park on other federal lands, generally have significant impacts on vegetation resources, both beneficial and adverse. The Park's exotic plant management efforts are additive to these impacts.

Exotic plant management efforts serve to advance preservation of the Park's natural and cultural resources while providing for visitor enjoyment. These are the same general goals of all of the Park's management plans, including the General Management Plan, Lake Management Plan, and Low Water General Management Plan Amendment. As such, concurrent implementation of

these plans as well as exotic plant management should enhance the beneficial effects of these efforts.

Conclusion: Implementation of this alternative is expected to have minor, short-term impacts to vegetation resources due to the limited extent of treatment efforts and the reliance on manual and mechanical methods. There is also the potential for moderate, long-term impacts due to persistence and expansion of exotic plant species and their impacts on native plant communities. There would be no unacceptable impacts and no impairment of vegetation under this alternative.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan

Under the Proposed Action, the Park would implement a comprehensive exotic plant management plan that would guide the actions of the NPS and its many partners working in Lake Mead NRA. Overall, this coordinated effort would provide opportunities for more aggressive treatment, particularly for early detection and eradication of newly invading species, and thus would likely increase the total acres treated. This overall trend of increased treatment efforts would likewise increase the negative impacts associated with the various treatment methods while simultaneously reducing the negative impacts associated with leaving invasive plants unchecked.

The prioritization effort itself would not result in impacts to vegetation resources, but the focused site-led or weed-led treatment efforts that results from the prioritization would likely result in increased local impacts at the point of treatment. Furthermore, the potential for invasive species to affect native plant communities is a consideration in establishing priorities so the prioritization effort may serve to focus more management attention on those species that are most likely to impact vegetation resources and thus reduce their negative impacts.

This alternative also includes a comprehensive prevention program that addresses both agency-controlled activities as well as visitor activities. By intercepting the pathways by which new invasive plants may enter the park or be moved around the park from infested to uninfested areas, the geographic extent and intensity of exotic plant control efforts would be expected to decline over time. Thus the negative impacts to vegetation resources associated with those control efforts would also decline over time.

The implementation of a targeted restoration program would result in highly localized disturbance to surrounding native plants while exotic plants are removed and native plants are being established, but such impacts are expected to be short-lived and of very limited spatial extent.

The impacts associated manual, mechanical, biological, and chemical control efforts are expected to be highest under this alternative as compared to the No Action Alternative. However, many of those impacts would be avoided, minimized, and/or mitigated through the adoption of best management practices. These guidelines would serve to target the treatment methods appropriately to the exotic plant species and the site conditions, including soil characteristics, to ensure the maximum effectiveness of the treatment while minimizing impacts to the other values of the site. Any treatment strategy involving the use of herbicides would specifically include

both chemical selection and application method with consideration for non-target impacts of the chemical given the native plant composition of the site.

The use of prescribed fire for exotic plant control is addressed in the Park's approved Fire Management Plan and thus is largely unaffected by either the Exotic Plant Management No Action Alternative or the Proposed Action. The one minor difference is the provisions of the Proposed Action to systematically learn from treatment efforts, including prescribed fire, and to integrate that knowledge into future decisions in an adaptive management framework.

Under the Proposed Action, a targeted research and monitoring program would be initiated. By monitoring treatment effectiveness and non-target impacts of treatments, there would be opportunities to both improve treatments in the future and to identify and reduce impacts to non-target plants where possible. Similarly, autecological research focused on high priority invasive species may be useful to identifying native plant communities that are particularly vulnerable to invasion and thus aid in efforts to curtail that invasion. Research and monitoring results would be conducted within the framework of adaptive management and lessons learned would be incorporated into future decisions, thus improving exotic plant control efforts over time while minimizing unintentional impacts on all resources, including vegetation resources.

Cumulative Effects: The cumulative effects are similar to those described for Alternative A. However, under this alternative the prioritization process, research, monitoring, and adaptive management framework all provide opportunities to better coordinate exotic plant management efforts with surrounding land managers. As such, the impacts, both positive and negative, of regional exotic plant management efforts are likely to be increased when compared with Alternative A. In addition, this alternative provides consideration of site-led priorities and identifies recreational use areas as possible sites for consideration. In this way, the implementation of this alternative would enhance visitor enjoyment cumulatively with those actions described in the Park's General Management Plan, Low Water General Management Plan Amendment, and Lake Management Plan. Similarly, the explicit accommodation of site-led priorities provides for increased opportunity to address exotic plant impacts on rare plant habitats, an interagency goal of the Clark County Multiple Species Habitat Conservation Plan.

Conclusion: Implementation of this alternative is expected to have minor, short-term impacts to vegetation resources due to the relative increase in overall acres treated while employing best management practices to minimize negative impacts. Long-term, this alternative is expected to have major beneficial impacts to vegetation resources due to the curtailment of the spread of invasive species and their negative persistent impacts on native plant communities, rare plant populations, and the ecological processes that sustain them. There would be no unacceptable impacts and no impairment of vegetation under this alternative.

3.2.3. Wildlife

Affected Environment

Lake Mead NRA contains over 500 species of vertebrates, including, fish, amphibians, reptiles, birds, and mammals. For wildlife populations to be viable, resources and environmental conditions must be sufficient for animals to forage, hide, nest or den, and disperse. The

distribution, type, and amounts of territory, shelter, water, and food must be sufficient for the basic needs of self-sustaining wildlife populations on a daily, seasonal, annual, and multi-year basis. Habitat must be well distributed over a broad geographic area to allow breeding individuals to interact spatially and temporally within and among populations. The ecology of native habitats, and, therefore, the assortment of wildlife species they support, can be altered if non-native plants become established and displace native plants. Non-native plants can change the habitat qualities needed to support the park's wildlife species. Such changes are most prevalent in riparian areas, along washes, around areas of physical disturbance, and along the shoreline where the majority of invasive plant species are found. These effects include alterations in vegetation type and structure, reductions in natural forage and cover plant species, and introduction of a fire regime to an environment historically nearly devoid of burning.

Mammals

The most recent inventory and review of literature for Lake Mead NRA has documented 57 mammal species as occurring within the park boundaries (Drost and Hart 2008). White-footed mice, Pocket mice, Kangaroo rats, and Woodrats comprise the vast majority of individual mammals occurring at Lake Mead NRA. The species representing these taxa are broadly distributed throughout the Park wherever suitable habitat exists. Less abundant small mammal species have patchy distributions or are isolated to areas within the Park that meet their more selective ecological requirements. Eleven bat species are recorded within Lake Mead NRA. Compared to most other native mammals, there is a comparatively limited knowledge base for bats. In particular, less is known of habitat preferences and the overall distribution of bat species within the Park (Drost and Hart 2008). Generally, bats utilize caves, rock overhangs, and abandoned mines for roosting and may make nightly migrations to riparian and aquatic habitats to feed and drink. The large mammals inhabiting the Park include desert bighorn sheep, coyote, kit fox, mountain lion and tend to be widely distributed with large home ranges within this distribution.

Birds

Because of the extensive aquatic, wetland, and riparian habitat created by Lake Mead and Lake Mohave, 356 species of birds have been recorded at Lake Mead NRA. Aquatic and shorebird species such as Great Blue Heron, American Coot, Ruddy Duck, Cinnamon Teal, Semipalmated Plover, and Willet generally restrict their activities to the lakes, the shoreline areas surrounding the lakes, and associated wetland habitats. Riparian zones along the lake, side canyons, washes, and around spring sources are the most heavily utilized corridors for breeding and foraging by non-aquatic bird species such as Gambel's Quail, Red-tailed Hawk, Greater Roadrunner, Cactus Wren, Phainopepla, and House Sparrow. Tamarisk is the most prolific and visible exotic plant along these areas and a major focus of weed control efforts within the Park. Some birds are known to use tamarisk for nesting and to forage for invertebrates, particularly when higher value, native habitat is absent. However, tamarisk dominated habitats along the Lower Colorado River support lower diversity and lower density of bird species than native vegetation configurations (Hunter et al. 1988).

Herpetiles

The last survey of Lake Mead NRA lists 54 species of reptiles and amphibians occurring within the Park (Schwartz et al. 1978). The Park is home to 20 species of snakes. Coachwhip, gopher snake, common king snake, sidewinder, glossy snake, and speckled rattlesnake are commonly encountered snakes at the Park. None of the snake species listed in the Park's inventory have a population status considered to be of concern (but this may be a reflection of the paucity of data for snake species rather than the actual condition of the populations). Many lizards may be found throughout the Park including side-blotched lizard, desert iguana, Great Basin collared lizard, western whiptail, western banded gecko, chuckwalla, and desert spiny lizard. The Gila monster has been found in Lake Mead NRA and is state listed in Nevada as "Imperiled due to rarity or other demonstrable factors". Southern Nevada represents the northern limit of the geographic distribution of the species and the state's western boundary is close to the delineation of the western extent of the gila monster's range. Additionally, gila monsters spend 95% of their time below ground which significantly reduces detectability of the species. These factors, no doubt, contribute to the rarity—both real and perceived--of gila monsters within Nevada. However, Lake Mead NRA has suitable habitat in sufficient abundance that the populations within Lake Mead NRA are, most likely, secure. The relict leopard frog is a Nevada state listed species, considered for federal listing as endangered, and is of special concern to the Park. For this reason, the relict leopard frog is given a full treatment below.

Relict leopard frog

The relict leopard frog is a medium-sized brownish gray frog in the family Ranidae. Historical records of this species exist for more than 12 sites along the Virgin and Colorado rivers in Utah, Nevada, and Arizona. Considered extinct since the 1950s, the species was rediscovered in the 1990s, during which time populations were known from only seven sites in three relatively small areas (Jaeger et al. 2001). By 2001, populations had disappeared from two of these sites, leaving only two areas inhabited by a total of five small populations of relict leopard frogs—all in Lake Mead NRA (Bradford et al. 2004). Primary threats to the relict leopard frog include decreased water availability due to dam construction for power management, conversion of wetlands habitat to agriculture and urbanization, and habitat degradation through recreational use. Bradford et al. (2004) conducted relict leopard frog population studies at Blue Point Spring between 1991 and 2001, and made intermittent observations at Rogers Spring during the same time period. Numbers of relict leopard frogs observed at the Blue Point Spring study area varied from 4 to 32 individuals along the upper stream segment that was observed consistently between 1991 and 2001. Numbers of relict leopard frogs observed appeared to increase in 1996, after an embankment around a culvert approximately 394 feet downstream from the stream source eroded, potentially providing easier access to the upper section for frogs from below. Most individuals captured were adults, regardless of season. At the other segments of Blue Point and Rogers springs, relict leopard frogs were observed throughout the period 1993 through 2001 (Bradford et al. 2004). In 2005, an inter-disciplinary team (Relict Leopard Frog Conservation Team) completed Conservation Agreement and Rangewide Conservation Assessment and Strategy for the Relict Leopard Frog (*Rana onca*). This document serves as the conservation plan for the relict leopard frog. Currently, Lake Mead NRA in cooperation with the Public Lands Institute of the University of Nevada Las Vegas maintains an active captive rearing program. The program collects egg masses during breeding season, hatches the eggs, and raises the

tadpoles in a facility within the Park. Juveniles are then released at their original collection location to maintain the genetic integrity of each isolated population and to bolster recruitment within populations. Declines in relict leopard frog populations at two sites with in Lake Mead NRA have been so severe, it is likely the species survived extirpation from these areas only through the intervention of the captive rearing program. Exotic plants at frog breeding sites have degraded the relict leopard frog habitat by altering stream hydrology and reducing flow through the higher evapotranspiration rates of the exotic plants. This results in fewer and smaller breeding pools which reduces relict leopard frog breeding success and may increase the effectiveness of predation on eggs and tadpoles by non-native fish.

Fish

Twenty-two species of fish occur in Lake Mead, Lake Mohave, their tributaries, and spring areas within the Park. Only two species (Razorback Sucker and Bonytail chub) are native to the Colorado River system and both are critically endangered. Game fish, such as largemouth bass, striped bass, bluegill, crappie, and rainbow trout have been introduced or are stocked to provide recreational opportunities for sport fisherman. At several spring sites, fish from the commercial pet trade have been released and continue to pose a threat to native wildlife including the relict leopard frog.

Laws, Regulations, and Policies

The NPS Organic Act, which directs parks to conserve wildlife unimpaired for future generations, is interpreted by the NPS to mean native animal life should be protected and perpetuated as part of the Park's natural ecosystem. Natural processes are relied on to maintain populations of native species to the greatest extent possible. The restoration of native species is a high priority. Management goals for wildlife include maintaining components and processes of naturally evolving park ecosystems, including natural abundance, diversity, and ecological integrity of plants and animals.

Lake Mead NRA also manages and monitors wildlife cooperatively with the Arizona Game and Fish Department and the Nevada Division of Wildlife.

Criteria and Thresholds for Impact Analysis

The following impact thresholds were established for analyzing impacts to wildlife and wildlife habitat in the project area:

- *Negligible impacts*: No species of concern are present; no impacts or impacts with only temporary effects are expected.

- *Minor impacts*: Non-breeding animals of concern are present, but only in low numbers. Habitat is not critical for survival; other habitat is available nearby. Occasional flight responses by wildlife are expected, but without interference with feeding, reproduction, or other activities necessary for survival. Mortality of species of concern is not expected.

- *Moderate impacts*: Breeding animals of concern are present; animals are present during particularly vulnerable life-stages, such as migration or winter; mortality or interference

with activities necessary for survival expected on an occasional basis, but not expected to threaten the continued existence of the species in the park.

- *Major impacts*: Breeding animals are present in relatively high numbers, and/or wildlife is present during particularly vulnerable life stages. Habitat targeted by actions has a history of use by wildlife during critical periods, but there is suitable habitat for use nearby. Few incidents of mortality could occur, but the continued survival of the species is not at risk.

Impacts Common to Both Alternatives

The Park is currently engaged in weed management activities covered under Programmatic Categorical Exclusions. For this reason, the No Action Alternative and the Proposed Action share some common exotic plant management activities which, in turn, create similar environmental consequences. Both Alternative A and Alternative B would result in the removal of invasive non-native plants. Localized, long-term, moderate impacts to wildlife would occur as a result of these activities. Short to intermediate term disruptions in distribution patterns of wildlife could occur during the lag between the time when exotic species are removed and when native plants become established. Under both alternatives, wildlife would experience long-term benefit from the removal of invasive plant species and the re-establishment of native ecosystems.

All methods of mechanical or chemical removal of exotic plant species and subsequent native re-vegetation efforts require staff to enter areas targeted for treatment. The presence of staff may cause flight response by any wildlife utilizing the treatment area. This response is expected to be highly localized and of short duration. Infrequent mortalities of individual animals may occur as a result of crew and vehicles accessing sites. These incidental mortalities would not affect species at the population level.

The list of active ingredients and adjuvents used in herbicides to control non-native plants within the Park will be the same for both alternatives and must be approved by NPS Regional or National IPM Coordinator. The process of certifying an herbicide for use within NPS at the regional and national level results in a more restrictive list of approved herbicides than allowed by the Environmental Protection Agency (EPA). This assures more recent research is being used to evaluate the environmental safety and efficacy of Park approved herbicides. Pesticide use must conform to product label regarding application rates, methods, and environmental mitigation measures.

The use of prescribed fire as a weed management tool would be the same under both alternatives. Currently, fire is used nearly exclusively to control large stands of tamarisk. Prescribed fires are conducted outside of avian, reptile, and most mammalian breeding seasons. Fires will cause a flight response by wildlife and pose a negligible risk to species which have retreated to burrows (some reptiles and some mammals). This may cause localized, individual mortalities but would pose no long-term risk to populations. Reduction in habitat utilization and population densities across taxonomic groups within treated areas could be expected until native plant communities become established.

Neither alternative would result in increased risk to fish. On Lake Mead, the Park would only treat weeds below the high water area where exotic plant populations pose a threat to one of the site led priorities (e.g. rare plant habitat, vectors, recreational use). The Lake Mohave drawdown zone will be targeted for weed-led treatment where high priority species will be treated annually along the entire shoreline. Only aquatic approved herbicides are used near water sources and water bodies, and these herbicides are safe when used according to labeling instructions. An additional layer of protection for fish species is provided by the large dilution factor of the lake compared to the small amount of potential herbicide contact with the water body.

Alternative A- No Action, Continue With Current Vegetation Management

All herbicides used within the Park are approved by NPS Regional or National IPM Coordinator. However, there exists no systematic way to determine the best pesticide to use based on each site's individual hydrology and soil chemistry. There also exists no standardized method of herbicide application and use. Inconsistent application methods could pose a potential risk to wildlife by allowing too much individual judgment by crews and crew members. This could lead to over or under application of herbicide under certain conditions and use of the wrong herbicide for a given application. For example, amphibians are of particular concern when in close proximity to pesticide application. The life history and physiology of amphibians make them uniquely vulnerable to chemical perturbations in aquatic environments. The key factors influencing herbicide induced amphibian mortality are the type of herbicide formulation used (terrestrial or aquatic), application rate (above or below labeling restrictions), and application method (aerial, ground, broadcast, or spot spray). Lack of uniformity in application rate or method by individuals or crews could result in disparate amphibian mortality within and between sites. This would make it difficult or impossible to uncover a correlation between herbicide use and amphibian mortality if one exists. While only herbicides labeled for use in aquatic environments are used near water sources or water bodies, there is no standard procedure for their use which considers proximity to water source, threat potential, and ability of herbicide to travel through soil and contaminate the water source.

While weed prevention measures exist to some extent within most operational areas controlled by the Park, there is no uniform, cohesive exotic plant prevention plan. The lack of internal direction results in exotic plant prevention actions that are undertaken at the discretion of individual employees and cooperators and, as such, these prevention actions are inconsistently applied and highly variable.

Currently, eradication of exotic plants occurs on a site led, project-by-project basis. Most effort focuses on rare plant habitats, desert springs, and high use recreation sites. While this does offer a moderate level of protection for niche-dependant species, these actions do not address larger, range-wide threats to wildlife habitat.

Cumulative Effects: Tamarisk eradication efforts on federal and state lands outside of the Park are occurring concurrently with Park sponsored tamarisk eradication programs. In some areas, because of its displacement of native vegetation, tamarisk serves as the only riparian habitat being utilized by wildlife. Since the tamarisk infestation is so massive in scale, eradication efforts merely reduce the amount of tamarisk in treated locations. Overtime, these areas are re-

colonized by native plants which, in turn, provide preferred habitat for wildlife as additional tamarisk sites are treated. These actions result in localized, long-term, moderate, adverse impacts to wildlife within and near treated areas. However, cumulative tamarisk removal activities also have a major, long-term, beneficial impact to wildlife by improving the quantity and quality of native riparian habitats.

Lake Mead serves as the discharge basin for urban runoff and wastewater from Las Vegas as well as smaller upstream communities on the Virgin River. These activities serve as a source of chemical pollutants within Lake Mead. Some chemicals discharged into the Lake are known to cause disruptions in certain metabolic processes of animals (especially those related to the endocrine system). Within Lake Mead, evidence of endocrine disruption in fish has been documented in Las Vegas Wash and Las Vegas Bay near the point source for pollutants. Even within the context of these pollutants , the lake provides a large dilution factor which mitigates the effects of the pollutants. Chemical treatment of invasive plants poses a small risk of introducing herbicides into the Lake. When considering the much larger pollutant source and the large dilution factor of the Lake, the potential of chemical introduction into the lake system through the treatment of invasive plants is insignificant. The cumulative impact of pollutants in Lake Mead on wildlife is long-term, minor, and adverse.

Lake Mead NRA receives between eight and ten million visitors per year. The majority of these visitors remain in developed areas and on paved roads. However, the numerous Wilderness and scenic areas within the park draw visitors into areas where they are likely to encounter wildlife. These activities, along with ongoing park operations (e.g. maintenance, research, rights-of-way) and invasive plant management, have the potential of causing short-term flight response and occasional mortalities of wildlife. These actions have cumulative effect on wildlife that is long-term, moderate, and adverse.

Conclusion: Alternative A would continue with the ongoing exotic plant management within Lake Mead NRA. Weed treatments would continue on a project-by-project basis with no cohesive plan or prioritization scheme. Chemical treatment practices would remain the same with no uniform application method between crews and left open to individual subjective use within labeling requirements. In the context of localized, landscape level, and range-wide degradation of wildlife habitat caused by invasive plants, the adverse effects of Alternative A are negligible. Local present actions would contribute to reversing the major adverse impacts of past actions on wildlife and wildlife habitat, and would produce long-term moderate beneficial effects. There would be no unacceptable impacts and no impairment of wildlife under this alternative.

<u>Alternative B- Implement a Comprehensive Exotic Plant Management Plan</u>
Under the Proposed Action, treatment of invasive plants would be considered under both site-led and weed-led priorities. Weed treatments within the Park would still occur on a site-by site basis and treatment efforts would be based upon geographic locations that have a direct relationship with the park's purpose and/or legal mandates, including rare plant habitat, desert springs, and high use recreational areas. Additionally, Alternative B would utilize an established protocol for evaluating exotic plant species based on their ecological impact and invasiveness. This would

allow the Park to be flexible in prioritizing treatment efforts and committing resources to specific exotic species which have the potential to create large-scale, range-wide modifications to wildlife habitat.

Development of Best Management Practices for pesticide use within Lake Mead NRA would be an important improvement over current pesticide application methods. Standardization of application methods would ensure proper use of chemicals by all cooperators and minimum environmental impact. Pesticides selected for use would consider site dependent factors to minimize leaching, accumulation of chemicals within the soil, and chemical reactivity between herbicide and soil. This process would result in selection of an herbicide with the highest efficacy for a particular site. Over time, this reduces the amount of chemical applied and may reduce both the frequency and duration of treatment within a particular area. This, in turn, produces long-term, beneficial impacts to wildlife.

A comprehensive weed prevention program would be initiated and incorporated into NPS-controlled activities such as concessions, contracts, research permits, special use permits, and other activities undertaken by non-NPS entities but under the authority of the park. Systematic, park-wide prevention efforts would reduce the necessary eradication response and, thus, the disturbance to wildlife and wildlife habitat. Also, the Park would develop an evaluation process for determining whether or not to actively restore a site, the type of restoration required, and the extent of the restoration action. This would benefit wildlife by both restoring habitat and minimizing the disturbance to wildlife by reducing the need for re-treatment of a site.

Adaptive management is an integral component of the Proposed Action. Emergent threats to wildlife habitats from specific exotic plants and their required treatment regimes are unpredictable. Because of the current method for identifying treatment areas, there is substantial lag time between the realization of a new threat and directing resources to contain and treat the threat. This often results in the threat being elevated to a crisis before treatment ever begins. Adaptive management is a decision making process that promotes flexible decision making that adjusts management decisions to better reflect current monitoring data and scientific advances. This allows the exotic plant management program to be much more responsive and capable of committing resources both to new threats as they emerge and to the changing conditions of established threats. The process will assure a deeper level of protection for wildlife habitat, particularly for landscape level threats, than is provided in Alternative A by addressing emergent and changing threats before they reach a crisis state.

Cumulative Effects: The past, present, and reasonably foreseeable projects affecting wildlife would be the same as those under Alternative A. Past impacts on wildlife have been adverse and long-term. Local present actions would contribute to reversing the major adverse impacts of past actions on wildlife, and would produce long-term moderate beneficial effects. In the context of the multiple and spatially massive, past and present effects, the impacts of Alternative B are negligible. The past, present, and future effects, along with the localized long-term moderate beneficial impacts of Alternative B, would result in long-term adverse moderate impacts on wildlife. The cumulative adverse effects to wildlife under Alternative B are less than those under Alternative A.

Conclusion: Alternative B would implement a comprehensive exotic plant management plan within Lake Mead NRA. Weed treatments areas would be prioritized based on their threat to park resources, level of invasiveness, and response to treatment. The Park would develop a coordinated program to prevent weed introduction and to restore treated areas. Chemical treatment practices would be standardized using Best Management Practices. In the context of localized, landscape level, and range-wide degradation of wildlife habitat caused by invasive plants, the adverse effects of Alternative B are negligible. Local present actions would contribute to reversing the major adverse impacts of past actions on wildlife and wildlife habitat, and would produce long-term moderate beneficial effects. Because long-term impacts on wildlife associated with Alternative B would be moderate and beneficial, there are no unacceptable impacts and no impairment of wildlife under Alternative B.

3.2.4. Special Status Species

Affected Environment

The razorback sucker (*Xyrauchen texanus*) was once common and widespread throughout the Colorado River basin. Dam construction on the Colorado River altered and segmented potential habitat which, coupled with the introduction of non-native sport fishes, has caused populations to plummet. Small, isolated populations of razorback suckers occur along the Colorado, with the population in Lake Mohave being the most substantial. Spawning takes place from January through May and occurs in shallow, rocky areas. Young fish may stay in these shallow areas during the first few weeks of their lives, while adult fish utilize all areas of the lake.

The U.S. Fish & Wildlife Service listed the razorback sucker as endangered in 1991, and designated critical habitat in 1994. Both Lakes Mead and Mohave are designated critical habitat for this species. The presence of larvae indicates that the fish are reproducing in both lakes within the park, although recruitment into the adult population is extremely low due to predation by game fishes. As part of a headstarting program, razorback larvae are collected and raised in controlled environments, and re-released into Lake Mohave in hopes that larger fish will be able to avoid predation and enter the breeding population.

The bonytail chub (*Gila elegans*) is also listed as endangered, and is the rarest fish in the Colorado River Basin. Lake Mohave has been designated as critical habitat for this species. Populations of bonytail chub consist of large, old adults with recruitment being virtually nonexistent. These fish were once known to reproduce in lower Lake Mohave, although it is unclear if this is still the case. Bonytails are known to utilize both deep water channels and shallow shoreline habitats.

Lake Mead NRA provides important habitat for the desert tortoise (*Gopherus agassizii*), a federally-listed threatened species. This species occurs throughout the park in Mojave desert scrub habitats. Desert tortoises are generally active in the spring and fall, retreating into self-constructed burrows the remainder of the year to avoid extreme weather conditions. Tortoise populations in the park are generally low density, with scattered high density areas. Changes in vegetation structure have occurred throughout the Mojave region due to an increase in exotic ephemerals and an increase in fire frequency and intensity. Changes in fire regimes have led to

the conversion of desert shrublands into ephemeral grasslands, reducing the availability of native forbs and perennial grasses which comprise the majority of the tortoise diet (Fish and Wildlife Service 1994).

Desert tortoise populations have been declining throughout their range due to urban development, disease, off-road vehicle disturbance, construction activities, mining, and grazing. Habitat fragmentation due to urbanization is a continuing problem, and the park provides large areas of protected, continuous habitat.

The Southwestern willow flycatcher (*Epidonax trailii extimus*) was federally listed as endangered in 1995, and is a neotropical migrant known to visit both Lakes Mead and Mohave. Willow flycatchers generally nest in dense riparian habitats with standing water or saturated soils. Although typically associated with native riparian tree species, willow flycatchers have been observed nesting in tamarisk and other non-native riparian vegetation (Fish and Wildlife Service 2002). Nesting occurs in the Overton Wildlife Management Area, along the Virgin and Muddy River inflows into Lake Mead, and at the Lake Mead delta near the Grand Canyon. Additional suitable habitat exists along the shoreline of Lake Mohave. Declines in Southwestern willow flycatcher populations are primarily due to habitat alteration for water impoundment and diversion, agriculture, and development.

The bald eagle (*Haliaeetus leucocephalus*) was removed from the Federal List of Threatened and Endangered Wildlife in 2007. Bald eagles are common winter residents throughout the park, especially in the Overton Arm of the Lake Mead. Avoiding areas of heavy human use, they roost in both trees and on cliffs at lakes Mead and Mohave.

Potential habitat for the endangered Yuma clapper rail (*Rallus longirostris yumanensis*) exists within the park, particularly where the Muddy and Virgin Rivers enter Lake Mead, the Las Vegas Wash, and near Davis Dam on Lake Mohave. To date, no sightings have occurred within the Park. Clapper rails are wading birds that occupy freshwater marshes often dominated by cattails and bulrush. Preferred habitat is generally open marsh with dispersed stands of vegetation. Threats to the clapper rail include loss of habitat from dredge/fill activities and accumulation of biotic materials.

Laws, Regulations, and Policies

Section 7 of the Endangered Species Act mandates all federal agencies to determine how to use their existing authorities to further the purposes of the Act to aid in recovering listed species, and to address existing and potential conservation issues. Section 7(a)(2) states that each federal agency shall, in consultation with the Secretary of the Interior, ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat.

NPS *Management Policies* (2006) directs the parks to survey for, protect, and strive to recover all species native to National Park System units that are listed under the Endangered Species Act. It sets the direction to meet the obligations of the Act. NPS *Management Policies* (2006) also directs the NPS to inventory, monitor, and manage state and locally listed species, and other

native species that are of special management concern to the parks, to maintain their natural distribution and abundance.

The *General Management Plan* designated 1,050,030 acres, or 70 percent of the Park, as natural zones, and areas with known habitat or potential habitat for rare, threatened, or endangered species were further protected by placement in the environmental protection or outstanding natural feature subzone of the natural zone. Management of these zones focuses on the maintenance of isolation and natural process and restoration of natural resources.

Criteria and Thresholds for Impact Analysis: The Endangered Species Act defines the terminology used to assess impacts to listed species as follows:

- *No effect*: The appropriate conclusion when the action agency determines that its proposed action would not affect a listed species or designated critical habitat.

- *Is not likely to adversely affect*: The appropriate conclusion when effects on listed species are expected to be discountable, insignificant, or completely beneficial. Beneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on the best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur.

- *Is likely to adversely affect:* The appropriate finding if any adverse effect to listed species may occur as a direct or indirect result of the proposed action or its interrelated or interdependent actions, and the effect is not: discountable, insignificant, or beneficial. If the overall effect of the proposed action is beneficial to the listed species, but is also likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species. If incidental take is anticipated to occur as a result of the proposed action, an "is likely to adversely affect" determination should be made.

- *Is likely to jeopardize listed species/adversely modify critical habitat:* The appropriate conclusion when the action agency or the U.S. Fish and Wildlife Service identifies situations in which the proposed action is likely to jeopardize the continued existence of a listed species or adversely modify critical habitat.

Impacts Common to Both Alternatives:
Although both Lakes Mead and Mohave are designated critical habitat for the razorback sucker and Lake Mohave is designated as critical habitat for the bonytail chub, adverse impacts to these species would be negligible. Both of these species utilize a variety of habitat types throughout their life stages, and removal of invasive riparian vegetation could alter shoreline habitat. Re-establishment of native vegetation would likely negate any adverse impacts associated with these treatments. Due to their size, impacts on both lakes resulting from chemical treatments would be negligible.

Under both alternatives, the desert tortoise would benefit from the removal of invasive weeds and the re-establishment of native plant communities. Invasive weed species can alter fire regimes which can threaten tortoises and their habitat. Invasive weeds can also crowd out plant species that comprise large portions of tortoise diets. Both chemical and mechanical control methods may occur in site-led treatment areas (washes, rare plant habitat) which could be areas utilized by tortoises. Both alternatives would require attendance of desert tortoise informational classes every three years by field personnel involved with weed management. This requirement would ensure that all field personnel are aware of tortoise issues and helps prevent adverse affects.

Prescribed fire treatments are generally small scale, and when occurring in areas inhabited by desert tortoises, field surveys would be done to identify and avoid tortoises and their burrows. Alteration of willow flycatcher habitat due to fire treatment is possible, although invasive riparian species, namely tamarisk, are low quality habitats. Burns would take place outside of the nesting season and would be relatively small, leading to negligible impacts on Southwestern willow flycatchers. Human activity during mechanical and chemical treatments has the potential to temporarily disturb this species. Surveys for Southwestern willow flycatchers would be completed before treating areas in suitable habitat, and these activities would not occur during the nesting season. Mitigation measures from the biological opinion for the Park's Fire Management Plan remain in effect.

Impacts to overwintering bald eagles would be minimal under both alternatives. Bald eagles are known to roost in large trees and cliffs, and weed management activities would have little impact in these areas. Bald eagles feed primarily on fish, so a change in vegetation type would have negligible impacts on foraging behaviors.

While Yuma clapper rail habitat exists within the park, impacts to this species under both alternatives would be negligible. Weed control activities may temporarily disturb birds within or near a project area, although these birds inhabit shoreline marsh habitats which are uncommon and would rarely receive treatment. If the presence of Yuma clapper rails was confirmed, actions would be taken to avoid disturbance in these areas.

Alternative A- No Action, Continue With Current Vegetation Management

Under the No Action Alternative, project-based weed management actions would continue to occur. These actions would focus on specific areas where an issue has been identified, and without necessarily considering long term goals. Most projects would target invasive plants in springs and rare plant habitat, and weed prevention measures would be incorporated in construction contracts. These activities would have beneficial impacts on the habitat of the desert tortoise.

The use of chemical treatments to control and eradicate weeds would have the potential to contaminate water bodies, although all environmental protection and personal safety requirements identified on product labels and material safety data sheets would apply to all applicators. No Best Management Practices would be used to guide herbicide selection or improve herbicide applications to protect park resources. Herbicides entering surface water

bodies would only impact fish or larvae in the immediate shoreline area, and would have negligible impacts on the habitat of the razorback sucker and bonytail chub.

The No Action Alternative would not include a comprehensive weed prevention program, and public education on the importance of stopping the spread of invasive plants would not occur. Instead, public education would occur only when the interest or need arose. The spread of aquatic and terrestrial invasive plants could have adverse impacts on threatened and endangered species and their critical habitats.

Without a systematic evaluation process to determine which treatment sites to restore, potential Southwestern willow flycatcher habitat could be lost. While invasive weeds, namely tamarisk, are considered low quality habitats, treatment of areas dominated by invasives would provide no habitat at all. The No Action Alternative would have an adverse impact on the Southwestern willow flycatcher.

There are currently no biological controls used within the park, and no Best Management Practices would be developed under the No Action Alternative. Separate compliance would be necessary to introduce a new a biological control agent.

Under the No Action Alternative, individual short term research and monitoring projects would continue, although they would be small in geographic scope and would fail to capture trends at the landscape level. There would be no overall park-wide monitoring of invasive weeds or integration of monitoring efforts of individual projects. Without a park-wide monitoring plan, park managers could lack data beneficial to protecting threatened and endangered species habitat. No explicit adaptive management plan would be implemented. Site led and weed led projects would occur on an individual basis with no strategy to actively alter treatment methods based on results. The activities that occur would have beneficial impacts on the desert tortoise.

Cumulative Effects: There are many sources of pollution that impact razorback sucker and bonytail chub habitat in both Lakes Mead and Mohave. Treated effluent enters Lake Mead through Las Vegas Wash and the Virgin River. Contamination due to recreation occurs in the form of oil and gas spills from boats, as well as exhaust gases from personal watercraft being expelled into both lakes.

Chemical and mechanical treatments are common throughout the region to control tamarisk, and more recently a beetle has been introduced as a biological control on nearby public lands. Tamarisk removal or alteration in riparian areas without follow up restoration could result in the loss of Southwestern willow flycatcher habitat.

Desert tortoise habitat has been destroyed or altered throughout the Southwest due to development, grazing, and off-road vehicle disturbance. Invasive plants have changed landscapes and increased fire frequency in the Mojave Desert, which has had a negative impact on tortoises and their habitat.

Conclusion: Due to limited use of herbicides near Lakes Mead and Mohave and the size of these water bodies, as well as the potential for establishment of native vegetation in treatment areas, this alternative is not likely to adversely affect the razorback sucker or the bonytail chub. Pre-fire surveys for desert tortoise will help protect this species if fire treatments are used during their active seasons. Treatment of invasive weeds will have a beneficial impact on the desert tortoise. This alternative is not likely to adversely affect the desert tortoise. Due to the removal of invasive riparian plants, Southwestern willow flycatchers may lose potential habitat. This alternative is likely to adversely affect the Southwestern willow flycatcher. Due to the nature of treatment methods and locations, there will be no effect on the bald eagle or the Yuma clapper rail. There would be no unacceptable impacts and no impairment of threatened or endangered species under this alternative.

Alternative B: Implement a Comprehensive Exotic Plant Management Plan

Under Alternative B, a systematic weed ranking system would be adopted. Weeds would be ranked according to their ecological impact and potential invasiveness. This ranking system identifies high priority species and provides park-wide guidance on species led control efforts. High priority species can be treated before they have an opportunity to invade sensitive areas, and before their impact is significant enough to warrant a site led treatment. A systematic weed ranking system would provide guidance to ensure all weed control projects in the park are working towards the same goals, and would have beneficial impacts on threatened and endangered species.

The use of herbicides to control and eradicate weeds would have the potential to contaminate water bodies, although only pesticides that are registered for use in aquatic habitats would be used. In addition, all applications within 50 feet of a surface water body would be applied by hand. These mitigation measures would serve to further reduce possible impacts to fish and larvae in the immediate project area, and there would be negligible impacts to the water body as a whole. Additionally, Best Management Practices would be adopted to ensure impacts on threatened and endangered species would be minimal.

Education programs associated with the action alternative would be aimed at the visiting public, and could serve as an important tool in the ongoing effort to keep invasive aquatic plants from being introduced into Lake Mead NRA waterways. These education efforts are expected to have beneficial impacts to the razorback sucker and the bonytail chub.

Under Alternative B, Best Management Practices would be developed for the implementation of biological controls. Biological control agents would be analyzed on a case by case basis, and additional compliance would be required for their use.

A list of priority exotic plant research topics would be created to help direct research within the park. A monitoring plan would be developed to assess treatment effectiveness as well as overall status and trends of high priority exotic plant species. Information on invasive plants at the landscape scale would help direct day-to-day management decisions and identify treatments necessary to protect the habitat of threatened and endangered species.

Alternative B includes a systematic evaluation process to determine which treatment sites to restore. Although removal of invasive weeds has the potential to reduce Southwestern willow flycatcher habitat, these habitats are of low quality. While removal of exotic vegetation could temporarily reduce flycatcher habitat, this alternative would have a beneficial impact on the Southwestern willow flycatcher by restoring treated areas in potential habitat with native riparian vegetation.

An adaptive management plan would be implemented to make educated changes in treatment prescriptions based on outcomes identified during research and monitoring. These changes would have beneficial impacts on the protection and restoration of endangered species habitat.

Cumulative Effects: There are many sources of pollution that impact razorback sucker and bonytail chub habitat in both Lakes Mead and Mohave. Treated effluent enters Lake Mead through Las Vegas Wash and the Virgin River. Contamination due to recreation occurs in the form of oil and gas spills, as well as exhaust gases from personal watercraft being expelled into both lakes.

Chemical and mechanical treatments are common throughout the region to control tamarisk, and more recently a beetle has been introduced as a biological control on nearby public lands. Tamarisk removal or alteration in riparian areas without follow up restoration could result in the loss of Southwestern willow flycatcher habitat.

Desert tortoise habitat has been destroyed or altered throughout the Southwest due to development, grazing, and off-road vehicle disturbance. Invasive plants have changed landscapes and increased fire frequency in the Mojave Desert, which has had a negative impact on tortoises and their habitat. Treatment of invasive weeds in the park under Alternative B would result in beneficial impacts to tortoise habitat.

Conclusion: Due to limited use of herbicides near Lakes Mead and Mohave and the size of these water bodies, as well as the potential for establishment of native vegetation in treatment areas, this alternative is not likely to adversely affect the razorback sucker or the bonytail chub. Pre-fire surveys for desert tortoise will help protect this species if fire treatments are used during their active seasons. Treatment of invasive weeds will have a beneficial impact on the desert tortoise. This alternative is not likely to adversely affect the desert tortoise. Although removal of invasive riparian vegetation may reduce Southwestern willow flycatcher habitat, restoration of these areas will improve Southwestern willow flycatcher habitat overall. This alternative is not likely to adversely affect the Southwestern willow flycatcher. Due to the nature of treatment methods and locations, there will be no effect on the bald eagle or the Yuma clapper rail. There would be no unacceptable impacts and no impairment of threatened or endangered species under this alternative.

3.2.5. Water Resources

Affected Environment

Lake Mead NRA includes almost 182,000 surface acres of water, namely Lakes Mead and Mohave. Both are reservoirs created by dams that impound the Colorado River and serve as the

primary water resources in the region. The major rivers supplying water to the reservoirs are the Colorado River flowing from the east and the Virgin and Muddy Rivers flowing from the north into the Overton Arm. Las Vegas Wash, which flows year-round into Lake Mead, is the outflow for the treated municipal and industrial wastewater as well as stormwater from the urban lands of the Las Vegas valley. The upper reaches of both reservoirs still exhibit some riverine characteristics, such as directional flow, while the downstream ends of both reservoirs are deepwater environments whose outflows are regulated by Hoover Dam (Lake Mead) and Davis Dam (Lake Mohave).

The water levels of both lakes are controlled by the U.S. Bureau of Reclamation for the purposes of irrigation, drinking water, and power generation for communities in Arizona, Nevada, and Southern California. Lake Mead is a major flood control reservoir whose water levels fluctuate dramatically while downstream Lake Mohave is primarily a pass-through reservoir whose water levels are fairly stable. Lake Mead reservoir is currently about 120 feet below "full pool" as a result of persistent regional drought and water demands that continue to exceed supply, a condition that is likely to be exacerbated in the coming decades. Lake Mohave experiences seasonal fluctuations of about 10 feet, typically experiencing high water in the early summer months and low water in the fall months.

The shoreline vegetation of the reservoirs is variable. The dramatic drop in lake level at Lake Mead has resulted in a "bathtub ring" staining of calcium carbonate along vertical surfaces (e.g. cliffs) of the shoreline, while more sloping shores tend to be mudflats which support both native and non-native colonizing plant species. Where desert washes empty into either reservoir, there is often a cove dominated by invasive saltcedar and sometimes athel.

In addition to the reservoirs, Lake Mead NRA also includes other water resources. Short reaches of riverine environments exist within the Park along about one mile of the Muddy River and two miles of the Virgin River before these rivers enter the Overton Arm of Lake Mead. The year-round flow of municipal effluent through the Las Vegas Wash creates a perennial stream for about a mile prior to its entry into Lake Mead in the Boulder Basin. There are 87 springs known to occur in the Park, some of which flow year round while others are seasonal in nature. The flowing springs generally empty into a desert wash with a short spring brook near the outflow before the water is absorbed into the sand of the wash. There are also many desert washes that are dry most of the time and only run following rain events. As landscape features, these washes generally have deep dry sandy substrates with flood strewn boulders and are usually incised or may be deeply incised forming narrow canyons. The washes often support a non-native saltcedar or athel and sometimes native species such as desert willow, honey mesquite, screwbean mesquite, and catclaw acacia.

The reservoirs are the primary attraction that draws almost 8 million visitors annually to Lake Mead NRA. People come to enjoy boating, swimming, water skiing, windsurfing, and fishing. Lake Mead has outstanding body contact waters almost unrivaled in the United States. The water quality of Lakes Mead and Mohave consistently meet established standards for full body contact (e.g. swimming) and state drinking water quality standards, although there is occasional degradation where perennial streams enter Lake Mead. In cooperation with the Lake Mead Water

Quality Forum, the NPS is engaged with both water users and wastewater dischargers in the surrounding communities to identify issues related to water quality and seek solutions to the threats to water quality at Lake Mead. In recent years, sanitation facilities for recreational lake users have been improved with the construction of additional shoreline restroom facilities as well as floating toilets in high use areas. Lake Mead NRA has entered into water quality monitoring partnerships with local, state, and federal agencies. Water quality in Boulder Basin in intensively monitored to ensure that community discharges occur in a manner that maintains the high water quality of Lake Mead.

Laws, Regulations, and Policies

The Clean Water Act of 1987, and supporting criteria and standards promulgated by the EPA, the Nevada Department of Environmental Protection (NDEP), and the Arizona Department of Environmental Quality (ADEQ), are used at Lake Mead NRA to protect the beneficial uses of water quality, including human health, health of the aquatic ecosystem, and recreational use.

A primary means for protecting water quality under the Clean Water Act is the establishment, implementation, and enforcement of water quality standards. Generally, the federal government has delegated the development of standards to the individual states subject to EPA approval. Water quality standards consists of three components: (1) the designated beneficial uses of a water body, such as aquatic life, cold water fishery, or body contact recreation (i.e. swimming or wading); (2) the numerical or narrative criteria that define the limits of physical, chemical, and biological characteristics of water that are sufficient to protect the beneficial uses; and (3) an anti-degradation provision to protect the existing uses and quality of water.

A state's anti-degradation policy is a three-tiered approach for maintaining and protecting various levels of water quality. In Tier 1 waters, the existing uses of a water body and the quality necessary to protect the uses must be maintained. This is considered to be the base level of protection that must be applied to the water body. If the water quality in a water body already exceeds the minimum requirements for the protection of the designated uses (Tier 2), then the existing water quality must be maintained. The third level provides protection for the state's highest quality waters or where ordinary use classification my not suffice; these water bodies are Tier 3 waters and are classified as Outstanding National Resource Waters. The existing water quality must be maintained and protected at this level. Lakes Mead and Mohave are Tier 1 water bodies.

Water quality in Lake Mead NRA in Nevada is regulated by NDEP under water quality standards and regulations that are promulgated in the Nevada Administrative Code (Chapter 445A.118-445A.225). Consistent with federal regulations, Nevada has established numerical and narrative standards that protect existing and designated uses of the State’s waters, and implements the anti-degradation requirements by establishing “requirements to maintain existing higher quality.” Compliance with the numerical standards for water quality is determined at control points that are specified in the regulations.

Title 18, chapter 11 of the Arizona Administrative Code lists ADEQ’s water quality standards. The standards establish water quality criteria for the waters of Arizona and designated uses for surface waters, including Lakes Mead and Mohave.

Criteria and Thresholds for Impact Analysis

The following impact thresholds were established for analyzing impacts to water resources in the project area:

- *Negligible impacts*: Effects are not detectable or are well within water quality standards and/or historical ambient or desired water quality conditions.

- *Minor impacts*: Effects are detectable but within water quality standards and/or historical ambient or desired water quality conditions.

- *Moderate impacts*: Effects are detectable and within water quality standards, but historical baseline or desired water quality conditions are being altered on a short-term basis.

- *Major impacts*: Effects are detectable and significantly and persistently alter historical baseline or desired water quality conditions. Limits of water quality standards are locally approached, equaled, or slightly singularly exceeded on a short-term and temporary basis.

Impacts Common to Both Alternatives

Under both alternatives, integrated pest management ideology and procedures would be used including the requirements that all herbicides proposed for use must be registered by the Environmental Protection Agency, used in accordance with their label, actual use must be recorded in a pesticide use log, and all herbicides used in NPS lands are subject to annual approval via the pesticide use proposal system. These requirements serve to minimize the use of herbicides and focus such efforts on situations where they are most effective, thus reducing the potential for herbicides to result in chemical contamination of water resources.

Cultural treatments focused on the prevention of introduction and/or spread of exotic plants pose no direct impact to water resources. Cultural treatments that focus on restoration of a site after exotic plant removal can result in some very localized impacts to water resources if re-contouring the soil surface disrupts surface flows or if soils are exposed to erosion by water, resulting in the potential for temporary increases in turbidity of nearby water bodies. In fact, temporary and localized increases in turbidity may result from any weed management activity (e.g. chemical, mechanical, and prescribed fire treatments) that results in removal of plant biomass and the exposure of soil to erosion. However, desert landscapes are very dynamic and naturally experience high rates of erosion and sediment transport, as evidenced by the sediment-laden floodwaters that course through desert washes following thunderstorms. Generally, localized and short-lived increases in turbidity do not pose a significant impact to the water resources in this environment.

The primary concern related to chemical treatments and water resources is the potential for chemical contamination of surface or groundwater by herbicides and any adjuvants (dyes, adhering agents, etc) used in herbicide application. The application method selected has a great

deal of influence on the opportunity for herbicide to enter water bodies, with broadcast foliar application posing the most risk and frilling or injection posing the least risk. The size of the water body has a great deal of influence on the impact realized by herbicide contamination where the smaller the water volume the more at risk it is to contamination because it takes a much smaller amount of chemical to affect the water chemistry of a small water body. The extremely large water volumes found in Lakes Mead and Mohave essentially means that there is no functional risk posed to these water bodies by the scale of herbicide treatments that might be undertaken by the Park. Chemical contamination of low volume water resources, such as springs and seeps, is a greater concern that can still be mitigated by carefully selecting the herbicide and the application method, then carefully applying the herbicide according to the label instructions.

Mechanical treatments that employ power tools (e.g chainsaws) pose a remote and very localized risk for chemical contamination as a result of accidental release of fuel (e.g. diesel) or other substances (e.g. bar oil) in or near water bodies. Such risks can be significantly reduced through the implementation of best management practices.

Manual treatments and biological controls pose no direct impacts to water resources.

Prescribed fire can impact water resources through short-lived and localized alteration of water chemistry due to ash and sediment washing from the burned area into the water. However, the small scale of prescribed fire utilized at Lake Mead NRA as described in the Park's 2004 Fire Management Plan means that such impacts are likely to be negligible.

Prioritization, research and monitoring, and adaptive management are all administrative actions that have no direct impacts on water resources but can have indirect impacts by influencing the effectiveness of on the ground treatment efforts. They may also reduce the potential for negative impacts to native plant communities that may arise from poorly thought-out treatment efforts.

Non-treatment of exotic plants can have impacts to water resources by allowing exotic plants to continue to grow and drawdown groundwater. Some exotic plants, such as saltcedar, are phreatophytes whose roots contact the water table and can drawdown or deplete groundwater resources through their very high evapotranspiration rates. This can affect the groundwater flow to nearby seeps and springs, possibly diminishing their flow. Non-treatment of aquatic exotic plants can significantly disrupt water resources and aquatic habitats through depletion of dissolved oxygen, increases in organic matter and other biochemical changes.

Alternative A- No Action, Continue With Current Vegetation Management

Under the No Action Alternative, the Park would continue its existing ad hoc, project-based exotic plant management efforts. Overall, this would result in fewer acres treated than in Alternative B, so would minimize the negative impacts of various treatment techniques on water resources. However, there would continue to be minimal integration of exotic plant management efforts and thus the potential for the proximity of unrelated treatments to magnify their impacts, such as multiple treatments being undertaken in the different areas of the same wash and thus increasing the amount of herbicide applied in the watershed.

Likewise, the continuation of existing ad hoc, project-based exotic plant management efforts reduces the overall effectiveness of exotic plant management in the park which would allow the negative impacts of exotic plants to continue. For example, if few saltcedar stands are treated, then there are more areas that are experiencing drawdown of the groundwater and possible disruption of spring flow.

There would potentially be more manual and/or mechanical treatments under this alternative because the provision of the categorical exclusion for exotic plant control under the National Environmental Policy Act would limit the amount of acres subject to herbicide treatment. In some cases, this could increase the intensity of soil disturbance because such treatment methods are more likely to remove root material than herbicide treatments. The soil disturbance could lead to increased turbidity of nearby surface waters as a result of erosion. The limited scope and scale of manual and mechanical methods would mean that control efforts would be unable to keep pace with expanding populations or new invasions, particularly in remote areas.

There would also be no coordinated prioritization, thus some exotic plant species or sites that have the most potential to affect water resources may not be identified as management priorities and so may go untreated. Of particular concern, there would be no systematic effort for early detection and eradication of aquatic exotic plants, which can significantly impact to the biochemistry of surface waters and severely disrupt aquatic habitats.

There would be no comprehensive prevention program that addresses both administrative actions as well as visitor and employee education, so there would be lost opportunities to prevent and/or intercept new introductions of exotic plants to the Park or to new areas of the Park. Some of the exotic plants may have as yet unknown impacts on water resources, particularly where those species are phreatophytes with high evapotranspiration rates.

There would be no coordinated research and monitoring effort focused on learning from exotic plant management efforts and incorporating new knowledge into future management decisions in an adaptive management framework. This could result in lost opportunities for improvement in treatment effectiveness or identification of improved treatment techniques that minimize negative impacts.

Cumulative Effects: Urban run-off currently enters the Park via Las Vegas Wash and presents many water quality challenges. Cumulatively, the potential for chemical contamination of surface waters due to exotic plant management activities in the Park are additive to these

regional and much larger water quality impacts. However, the impacts to water chemistry from the Park's exotic plant management activities are dispersed over the landscape and very localized in their effect while the urban run-off impacts are concentrated in the area of Las Vegas Wash.

Conclusion: Implementation of this alternative is expected to have negligible, short-term impacts to water resources due to the limited extent of treatment efforts and the reliance on manual and mechanical methods. There is also the potential for long-term, moderate impacts due to persistence and expansion of exotic plant species and the impact of exotic phreatophytes on groundwater resources and spring flows. There would be no unacceptable impacts and no impairment of water resources under this alternative.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan

Under the Proposed Action, the Park would implement a comprehensive exotic plant management plan that would guide the actions of the NPS and its many partners working in Lake Mead NRA. Overall, this coordinated effort would provide opportunities for more aggressive treatment, particularly for early detection and eradication of newly invading species, and thus would likely increase the total acres treated. This overall trend of increased treatment efforts would likewise increase the negative impacts associated with the various treatment methods while simultaneously reducing the negative impacts associated with leaving invasive plants unchecked.

The prioritization effort itself would not result in impacts to water resources, but the focused site-led or weed-led treatment efforts that results from the prioritization would likely result in increased local impacts at the point of treatment. Furthermore, the potential for invasive species to alter ecosystems (e.g. water resources) is a consideration in establishing priorities so the prioritization effort may serve to focus more management attention on those species that are most likely to impact water resources and thus reduce their negative impacts.

This alternative also includes a comprehensive prevention program that addresses both agency-controlled activities as well as visitor activities. By intercepting the pathways by which new invasive plants may enter the park or be moved around the park from infested to uninfested areas, the geographic extent and intensity of exotic plant control efforts would be expected to decline over time. Thus the negative impacts to water resources associated with those control efforts would also decline over time.

The implementation of a targeted restoration program would result in highly localized soil disturbance and the potential for increased turbidity in nearby surface waters while exotic plants are removed and native plants are being established, but such impacts are expected to be short-lived and of very limited spatial extent.

The impacts associated with manual, mechanical, biological, and chemical control efforts are expected to be highest under this alternative as compared to the No Action Alternative. However, many of those impacts would be avoided, minimized, and/or mitigated through the adoption of best management practices. These guidelines would serve to target the treatment methods appropriately to the exotic plant species and the site conditions, including proximity to water

resources, to ensure the maximum effectiveness of the treatment while minimizing impacts to the other values of the site. Any treatment strategy involving the use of herbicides would specifically include both chemical selection, including herbicides labeled for use in aquatic environments, and application method to minimize opportunities for transport to water resources.

The use of prescribed fire for exotic plant control is addressed in the Park's approved Fire Management Plan and thus is largely unaffected by either the Exotic Plant Management No Action Alternative or the Proposed Action. The one minor difference is the provisions of the Proposed Action to systematically learn from treatment efforts, including prescribed fire, and to integrate that knowledge into future decisions in an adaptive management framework.

Under the Proposed Action, a targeted research and monitoring program would be initiated. By monitoring treatment effectiveness and non-target impacts of treatments, there would be opportunities to both improve treatments in the future and to identify and reduce impacts to water resources where possible. Research and monitoring results would be conducted within the framework of adaptive management and lessons learned would be incorporated into future decisions, thus improving exotic plant control efforts over time while minimizing unintentional impacts on all resources, including water resources.

Cumulative Effects: Cumulative effects are similar to those discussed under Alternative A, but such impacts to water quality from the Park's exotic plant management activities would be further reduced through the implementation of best management practices.

Conclusion: Implementation of this alternative is expected to have minor, short-term impacts to surface waters due to the relative increase in overall acres treated. The use of best management practices would serve to minimize those negative impacts, particularly related to herbicide selection and application methods. Long-term, this alternative is expected to have moderate beneficial impacts to water resources due to the curtailment of the spread of invasive species and their negative persistent impacts on groundwater resources and spring flows. There would be no unacceptable impacts and no impairment of water resources under this alternative.

3.2.6. Wilderness

Affected Environment

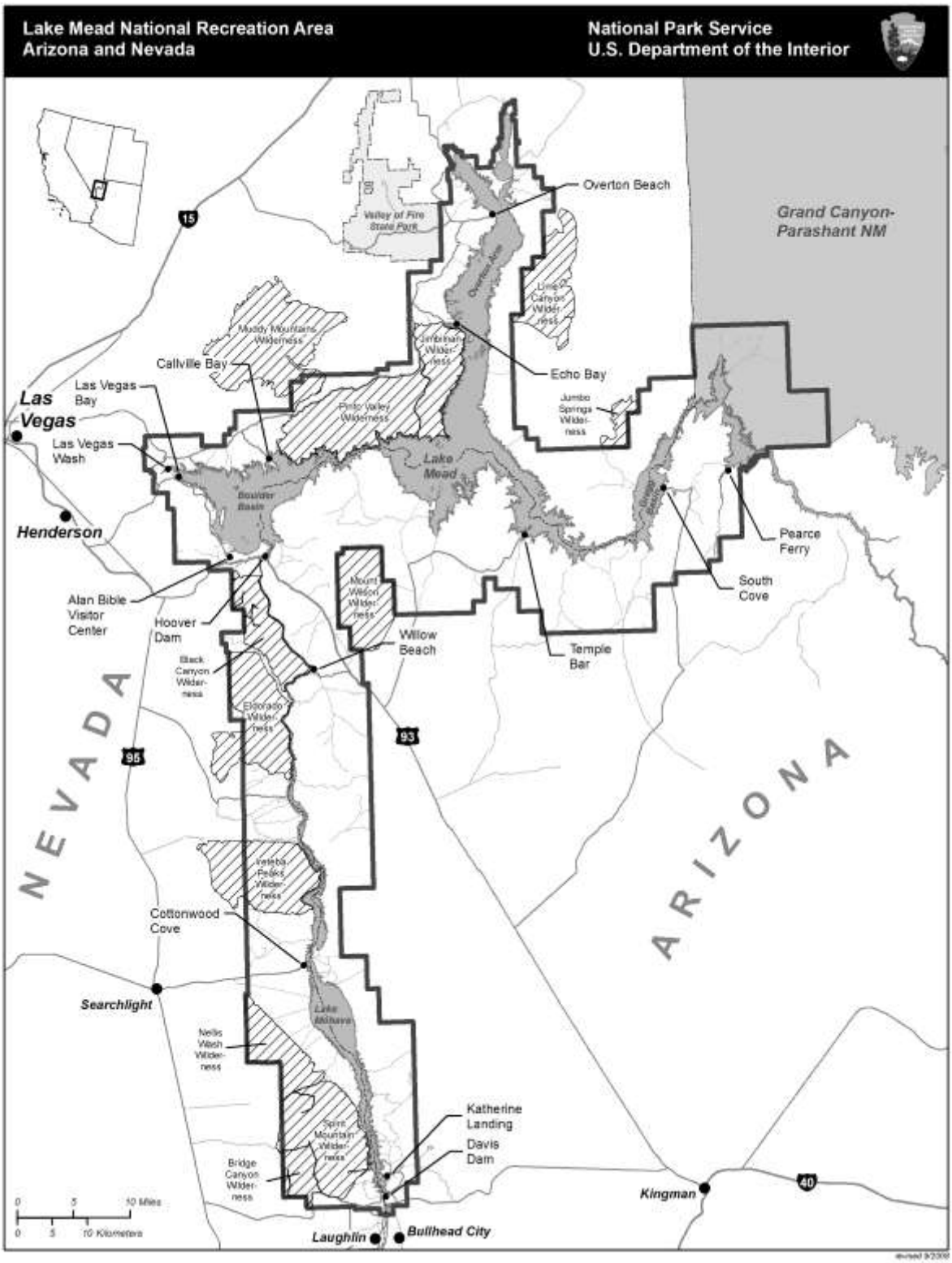
The Exotic Plant Management Plan addresses management of 185,051 acres of designated wilderness, and approximately 212,900 acres of proposed, potential, and suitable wilderness within Lake Mead NRA. There are nine designated wilderness units in Lake Mead NRA: Jimbilnan, Pinto Valley, Muddy Mountains, Black Canyon, Eldorado, Ireteba, Nellis Wash, Spirit Mountain, and Bridge Canyon (Figure 11). Four of the nine designated wilderness areas are co-managed with the BLM: Muddy Mountains, Eldorado, Ireteba, and Spirit Mountain. At Lake Mead NRA, the wilderness boundary begins 300 ft. beyond the high water mark, and has a 100 ft. setback from the edge of approved roads. Over 25% of Lake Mead NRA is either designated wilderness or has been identified as suitable for wilderness designation.

Wilderness Character
A wilderness, in contrast to those areas where humans dominate the landscape, is defined by the qualities comprising its wilderness character. Wilderness character is considered to have four general components: untrammeled, undeveloped, natural and primeval character, and having outstanding opportunities for solitude and a primitive and unconfined type of recreational experience.

Each particular wilderness area varies in the degree to which each quality of wilderness character is realized. The wilderness resource at Lake Mead NRA is mostly pristine and very little evidence of human influence is recognizable. Some trammeling activities have occurred in the past from weed control and fire control. The wilderness is substantially undeveloped, but some occurrences of earthen or concrete dams, wildlife enhancements (guzzlers), closed two-track vehicle routes, trails, fencing, and evidence of visitor recreational pursuits (sandbags at hot springs, ladders, bolts, fire rings, etc.) may be present. The natural and primeval character of the wilderness resource is mostly preserved; however, some changes have occurred to vegetation from the presence of non-native plant species. Another change from the natural and primeval character is the presence of feral horses and burros. Although their presence is limited, damage to spring areas, native vegetation, and soils has occurred in some areas. Most of the wilderness areas offer outstanding opportunities for solitude except near roads, the lake, high use areas, and within the pathways of helicopter and airplane overflights. Outstanding opportunities for unconfined recreational opportunities exist for hiking, camping, hunting, equestrian use, and exploration and scenery. Additional wilderness features include archeological resources (rock art, evidence of prehistoric and historic habitation), scenic, educational, and ecological values of geological and hydrological formations (tinajas, hot springs, cold springs), wildlife, and rare plants.

Presence of Known Weed Infestations in Wilderness Areas
The primary sources of exotic plant introductions and spread are the inflow areas of the lakes, washes that drain into the park, people, construction, ground disturbance, off-road vehicle disturbances, vehicles and road corridors, boaters, animals, and from adjacent lands. The main vectors for potential weed introduction into wilderness include weather events, fire suppression efforts, off-road vehicle disturbances, people, and animals. Several invasive, non-native species are known to be present in the wilderness areas, including red brome (*Bromus rubens*), saltcedar (*Tamarix spp.*), sahara mustard (*Brassica tournefortii*), and cheatgrass (*Bromus tectorum*). Saltcedar infestations are found within washes and near springs in some of the wilderness areas. Sahara mustard and invasive annual grasses are widespread in the Mojave Desert, including Lake Mead NRA wilderness areas. Stock operations in wilderness areas can also introduce non-native plants into the park through animal feed and waste. Visitors to wilderness areas can carry non-native seeds on their clothing, shoes, and/or recreational equipment.

Figure 11. Wilderness Map



Laws, Regulations, and Policies

The *Wilderness Act of 1964* (P.L. 88-577) established a National Wilderness Preservation System to ensure that federally owned areas designated by Congress as wilderness shall be "administered for the use and enjoyment of the American people in such manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character, and for the gathering and dissemination of information regarding their use and enjoyment as wilderness". Section 2(c) of the *Wilderness Act* defines wilderness as an area untrammeled by man; an area of undeveloped land that retains its primeval character and influence; an area protected and managed to preserve its natural conditions; and, which has outstanding opportunities for solitude or a primitive and unconfined type of recreation. The *Wilderness Act* also prohibits certain activities such as the use of motorized equipment, mechanical transport, structures or installations, permanent roads, temporary roads, commercial enterprises, use of motorboats, and landing of aircraft, unless considered the minimum requirement necessary for administration of the area as wilderness.

NPS wilderness management policies are based on provisions of the 1916 *NPS Organic Act*, the 1964 *Wilderness Act*, NPS policies and Director's Orders, and legislation establishing individual units of the national park system. According to the 2006 *NPS Management Policies*, "the purpose of wilderness in the national parks includes the preservation of wilderness character and wilderness resources in an unimpaired condition and, in accordance with the Wilderness Act, wilderness areas shall be devoted to the public purposes of recreational, scenic, scientific, educational, conservation, and historical use". The policies in the 2006 *NPS Management Policies* are supplemented by Director's Order 41 - *Wilderness Preservation and Management*, and Reference Manual 41. It is specifically stated that the term "wilderness" includes the categories of eligible, study, proposed, recommended, and designated wilderness, and that wilderness policies apply in these areas regardless of the category. All management decisions affecting wilderness will further apply the concept of "minimum requirement" for the administration of the area regardless of wilderness category. The minimum requirement concept is "a documented process used to determine if administrative actions, projects, or programs undertaken by the NPS or its agents and affecting wilderness character, resources, or the visitor experience are necessary, and if so how to minimize impacts" (NPS Management Policies 2006).

The *Clark County Conservation of Public Land and Natural Resources Act of 2002* designated eighteen wilderness areas in Southern Nevada. Nine of these wilderness areas are within Lake Mead NRA. In addition, Lake Mead NRA is comprised of proposed, proposed potential, recommended, and suitable wilderness and these areas are managed to preserve wilderness character.

The Muddy Mountains Wilderness Management Plan/EA was approved in April 2007. This plan provides direction and guidance for long-term management of the BLM and NPS co-managed Muddy Mountains wilderness area. In addition, the NPS has released for public and agency review a Wilderness Management Plan that will provide guidance for management of the remaining eight designated wilderness areas within Lake Mead NRA.

Criteria and Thresholds for Impact Analysis

In evaluating environmental impacts, the NPS would take into account wilderness characteristics and values. Wilderness character encompasses a combination of biophysical, experiential, and symbolic elements as described by four principal qualities defined in the Wilderness Act. The combination of these qualities distinguish wilderness from all other lands. These four qualities are of equal importance and are defined as:

- Untrammeled- wilderness is unhindered and free from modern human control and manipulation.
- Undeveloped- wilderness is substantially without permanent developments or modern human occupation.
- Natural and Primeval Character- wilderness ecological systems, being affected primarily by the forces of nature, retain their primeval character and influence substantially free from the effects of modern human civilization.
- Outstanding Opportunities for Solitude or a Primitive and Unconfined Type of Recreation- wilderness provides opportunities for people to experience solitude or primitive and unconfined recreation, including the values of inspiration and physical and mental challenge.

The following impact thresholds were established for impacts on the wilderness resource:

- *Negligible*: Impacts to wilderness character or the wilderness visitors' experiences would not be detectable or barely detectable.

- *Minor*: One or more qualities of wilderness character or the visitors' experiences change slightly in one or more wilderness areas; however, the change is detectable only for a short duration and to only a few visitors. There is a slight change in one or more qualities of wilderness character and in the quality of a few visitors' experiences.

- *Moderate*: One or more qualities of wilderness character or the visitors' experiences change considerably in one or more wilderness areas; however, the change is not permanent and does not affect an entire visitor season. There is a noticeable change in one or more qualities of wilderness character and the quality of some visitors' experiences.

- *Major*: One or more qualities of wilderness character or the visitors' experiences change substantially in one or more wilderness areas, on a permanent basis, and over an entire visitor season. There is a substantial change in one or more qualities of wilderness character and in the quality of most wilderness visitors' experiences.

Impacts Common to Both Alternatives

Both alternatives are comprised, to some degree, of the following concepts: integrated pest management, cultural treatments, manual and mechanical treatments, chemical treatments, prescribed fire treatments, and research and monitoring. Although non-native plants are present in Wilderness areas, they do not currently affect vast expanses of Lake Mead NRA's Wilderness areas. As a result, prevention and early detection practices play a primary role in controlling the

spread of non-natives. In the prevention and control of non-native species, the management ideal is to sustain only native species in the wilderness areas. To achieve this, active weed management would occur to prevent, control, or eradicate weeds from the native plant communities. Activities that facilitate the introduction or spread of non-native species would be scrutinized to determine if an activity should be disallowed, or if special stipulations would be satisfactory to mitigate impacts related to the activity.

Treatment and Control Methods

Manual, mechanical, motorized, cultural, and chemical control methods would result in a temporary change in the wilderness character and associated values during invasive plant management activities. Some aspects of control may intrude on the quality of the wilderness experience. For example, mechanized and motorized equipment such as chainsaws and weed eaters would cause a certain level of noise which would impact visitors' wilderness experience, and thereby compromise the natural soundscape of the area and opportunity for solitude. In addition, the presence of crews may distract from some wilderness visitors' experience. Cut marks caused by chainsaws and handsaws may detract from the untrammeled and natural quality of wilderness. Activities to conceal cut marks, such as rubbing ash or dirt on cuts, could make cuts less apparent. There would be short-term, localized, minor, adverse impacts on the natural, untrammeled, and experiential qualities of wilderness from employing non-native plant treatment methods. Major, long-term beneficial effects from removing non-native plants and restoring native habitat would enhance the natural and experiential qualities of wilderness.

Prescribed Fire Treatments

The Park's FMP contains stipulations for consideration of the use of prescribed fire to attain resource benefits. Prescribed fire may be used as part of a multi-treatment approach in removing exotic plant species, and may be followed up with herbicide application and/or restoration of native plants. Projects proposing the use of prescribed fire in wilderness areas will follow procedures outlined in the FMP or to implementation plans subsequently developed (e.g. burn plan, fuel treatment plan, etc.). As explained in the FMP, each prescribed burn requires a separate MRA to determine whether the use of fire is the minimum necessary to accomplish resource objectives. Implementation of Minimum Impact Suppression Tactics would help prevent unnecessary damage to the wilderness resource from fire suppression activities. The use of MIST would help preserve the wilderness characteristics and naturalness of the wilderness areas. Prescribed fire treatments could create temporary, adverse, impacts on individuals seeking a wilderness experience during treatment methods and on the untrammeled quality of wilderness. In the long-term, as treatment areas are restored to their native conditions, the wilderness character would improve, having long-term, beneficial effects.

Research and Monitoring

Scientific activities (including inventory, monitoring, and research) that involve a potential impact to wilderness resource or values may be allowed when the benefits outweigh the impacts on the wilderness resource or values, and as long as the project would not significantly interfere with other wilderness purposes (recreational, scenic, educational, conservation, or historical) over a broad area, or for a long period of time. Monitoring and research would continue to evaluate changes in conditions and document progress toward meeting invasive plant

management goals and to keep abreast of application methods and effectiveness. Short-term, localized, negligible to minor, adverse impacts on the natural, untrammeled, and experiential qualities of wilderness character could occur from research and monitoring activities. However, appropriate research and monitoring activities would have long-term, beneficial effects on wilderness character and the overall wilderness resource.

Alternative A- No Action, Continue With Current Vegetation Management

Under Alternative A, no action would be taken to develop comprehensive park guidelines or a plan to apply the integrated pest management concept across projects. Weed treatments would continue on a case-by-case basis and would occur in response to a specific situation or problem. Project work would focus on a recognizable need or threat, such as removal of exotic plants from springs or rare plant habitats, along vector corridors, and would include prevention measures in construction contracts. For the most part, project work in wilderness would be limited to spring areas, rare plant habitats, and special status species habitat. Treating non-native plant species to restore native habitat has long-term beneficial effects on the natural component of wilderness and ecosystem health, however, the lack of a comprehensive approach to managing non-natives in wilderness may exacerbate some issues or cause redundancy which in turn may result in minor to moderate, long-term, adverse impacts on the overall wilderness resource.

There is currently no overall strategy for public and/or employee education regarding exotic plant introduction and spread. For designated wilderness areas (Muddy Mountains, Jimbilnan, Pinto Valley, Black Canyon, Eldorado, Ireteba, Nellis, Spirit Mountain, and Bridge Canyon), vegetation management would adopt the direction and guidelines in approved wilderness management plans, i.e. the Muddy Mountains Wilderness Management Plan and the Lake Mead NRA Wilderness Management Plan. No specific plan or comprehensive guidance would be established for vegetation management of the remaining areas that are suitable for wilderness designation. The lack of a comprehensive plan providing vegetation management guidance for all areas exhibiting wilderness characteristics could result in mismanagement of the wilderness resource and have long-term, minor to moderate, adverse impacts on the overall wilderness character and visitors' experiences.

Treatment and Control Methods

Under the No Action Alternative, the impacts from treatment methods would generally be the same as listed above under Impacts Common to Both Alternatives. Currently, vegetation management activities are evaluated under separate categorical exclusions (CE). The MRAs for existing vegetation-related programmatic CEs include a number of treatment methods (cultural, manual, mechanical, chemical, and motorized), which are then subject to the discretion of the project leader to make an informed decision on which treatment method to implement based on the needs of the project and constraints identified in the compliance document. Although project work ultimately results in removal of non-native species and restoration of native habitat which has long-term beneficial effects on the natural component of wilderness character, there is minimal site-specific analysis done to determine the temporal, spatial, and experiential impacts that may occur at the time of the treatment. This can result in short-term, minor to moderate, adverse impacts on the wilderness visitors' experience and create more trammeling than may be necessary to accomplish a task. In addition, the opportunity to capture data important in

monitoring the health of the overall wilderness resource may not be realized under current vegetation management practices.

Prescribed Fire Treatments
Impacts on the wilderness resource from prescribed fire treatments are described above in Impacts Common to Both Alternatives. Prescribed fire treatments could create temporary, adverse, impacts on individuals seeking a wilderness experience during treatment methods and on the untrammeled quality of wilderness. In the long-term, as treatment areas are restored to their native conditions, the wilderness character would improve, having long-term, beneficial effects.

Research and Monitoring
There is currently no standardized research and monitoring established for exotic plant management activities occurring in the park, including in wilderness areas. Most research and monitoring that is currently being undertaken is initiated by external project proponents. Consistent with the *Wilderness Act*, research and monitoring is fully realized in wilderness areas because of the relatively pristine environment supported by the wilderness resource. The Muddy Mountains Management Plan and EA provide direction for research and monitoring in that wilderness area only. The Lake Mead NRA Wilderness Management Plan provides guidance related to research and monitoring in the remaining eight designated wilderness areas. Under this alternative, there would be no standardized or coordinated vegetation research and monitoring activities within the remaining suitable wilderness areas with wilderness status.

Biological Control Treatments
Currently, there are no biological control treatments initiated by Lake Mead NRA. There are, however, biological control treatments being applied on adjacent lands by various land management agencies. These have the potential to enter into the park and impact Lake Mead NRA natural resources, including the wilderness resource. Under this alternative, no standard Best Management Practices are identified for responding to or implementing biocontrol treatments which could potentially have long-term, adverse impacts on the wilderness resource at Lake Mead NRA.

Adaptive Management Program
There is currently no formal adaptive management program established for vegetation management at Lake Mead NRA. The opportunity to learn from modifying plant management methods based on experience derived from past use to improve the effectiveness and efficiency of the park's exotic management is not fully realized under current vegetation management practices. This could potentially have long-term, adverse impacts on the wilderness resource if better vegetation management options are not realized and implemented as they are discovered.

Application of the Minimum Requirement Concept
The minimum requirement concept would continue to be used to determine whether a proposed action is necessary for the administration of the area as wilderness and to determine the minimum tool necessary for accomplishing project objectives. Currently, vegetation management activities are evaluated under separate CEs. Each vegetation-related programmatic

CE has an accompanying MRA for proposed actions occurring within wilderness. During the annual programmatic CE review, each programmatic CE is reviewed and updated to reflect changes in location, methods, etc., and evaluated to determine whether project components are still relevant.

Cumulative Effects: In 2007, the NPS and BLM completed a wilderness management plan that provides direction for vegetation management within the Muddy Mountains Wilderness Area. The Park is currently preparing a Wilderness Management Plan to address management of the remaining eight designated wilderness units within the park. In addition, other federal agencies in the region are working on wilderness management plans for wilderness areas that were recently designated. A bill has been introduced to Congress, and if approved, could designate approximately 91,000 acres as wilderness in the Gold Butte portion of Lake Mead NRA.

The main threats to wilderness character occur mostly from external influences. Illegal off-road vehicle disturbances remain one of the largest threats to the wilderness resource and have the potential to spread non-native plants into pristine areas and affect the natural, untrammeled, and experiential qualities of wilderness. The park has an active Arid Restoration Program that monitors the backcountry of the park and restores off-road disturbances as soon as they are discovered. Opportunities for solitude would remain degraded from the number of helicopter overflights.

Numerous resource management activities occur within wilderness areas at Lake Mead NRA and can affect wilderness character and the overall wilderness resource. Under Alternative A, there is less coordination of projects occurring within wilderness. While temporary, adverse, cumulative impacts on the untrammeled condition of wilderness could arise if a number of trammeling projects occurred during a season, long-term beneficial cumulative effects would result from removal of non-native vegetation and restoration of the native ecosystem.

This alternative would not have any cumulative effect on the undeveloped condition of the wilderness resource. Alternative A would have a beneficial cumulative effect on the naturalness and primitive character of wilderness from removing non-native plants and restoring the native ecosystem. Opportunities for solitude would remain degraded from aircraft overflights. Alternative A would not appreciably add to the cumulative impact on the opportunity for solitude. No cumulative impacts on primitive and unconfined recreation would occur from implementation of Alternative A.

Summarily, implementation of the No Action Alternative would result in long-term, beneficial cumulative impacts on Lake Mead NRA's wilderness resource. Implementation of Alternative A would not appreciably add to the cumulative effects on wilderness areas in the Region or those identified in the National Wilderness Preservation System.

*Conclusion***:** Under Alternative A, there would be no established comprehensive and integrated exotic plant management plan to guide vegetation management at Lake Mead NRA. While implementation of the various treatment methods would result in varying degrees of impacts on the untrammeled component and experiential component of wilderness, the impacts occurring

during the actual treatment would be temporary, localized, minor, and adverse. Long-term, major, beneficial effects to the wilderness resource would occur from removing non-native plants and restoring the native ecosystem.

Unlike the Proposed Alternative, there would be no systematic, coordinated effort to restore treatment sites, resulting in temporary, adverse impacts on the natural condition until site restoration occurs. There would be no impact on the undeveloped condition of wilderness. The quality of outstanding opportunity for solitude would be affected during weed treatment activities, resulting in temporary, adverse, minor impacts. Unlike the Proposed Action, less scrutiny would occur during the MRA process, potentially leading to adverse impacts on the wilderness resource. Alternative A would not result in any unacceptable impacts and would not impair the wilderness resource.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan

The Proposed Action is to implement a comprehensive exotic plant management plan that would prescribe specific integrated pest management strategies and actions to address prevention of new exotic plant invasions, early detection and eradication of incipient exotic plant populations, and containment and control of established populations. Under Alternative B, the NPS would adopt comprehensive guidelines for weed prioritization and management that would include both site-led and weed-led priorities and would apply to all wilderness units regardless of their status as wilderness. For the most part, project work in wilderness would be limited to spring areas, rare plant habitats, and special status species habitat. Treating non-native plant species to restore native habitat has long-term beneficial effects on the natural component of wilderness and ecosystem health. A comprehensive, systematic approach for integrated pest management would ensure that the minimum necessary for administration of an area as wilderness would be implemented resulting in long-term, moderate beneficial effects on the overall wilderness resource.

Treatment and Control Methods

Two types of cultural treatments would occur under this alternative: prevention and post-treatment restoration. Exotic plant prevention measures would be incorporated into NPS-controlled activities, such as in research and collecting permits, and would provide additional measures that would help prevent non-native plant introduction or spread into wilderness areas. When seeding or replanting is necessary, native-species- preferably from local genetic stocks- would be used exclusively. A mix of species would be selected that closely represents the plant composition for the site being reseeded or revegetated. Short-term, adverse, minor impacts on the untrammeled and experiential qualities of wilderness would occur from the presence of crews in the area and replanting activities. Revegetating the area with native species would have long-term, beneficial, effects on the natural quality of wilderness. A comprehensive prevention program that incorporates both visitor and employee education, along with a systematic evaluation process to determine the need and probability of success from actively restoring a treatment site, would help assure that only projects with high-success rates would occur within wilderness, resulting in long-term, beneficial effects.

The impacts from treatment methods, including: manual, mechanical, chemical, and motorized would generally be the same as listed above under Impacts Common to Both Alternatives. Weed treatment would first focus on reducing infestation size and ultimately seek complete eradication of weed species. Treatment activities would utilize the current knowledge of effective treatment methods and treatment strategies appropriate for the target plant and compatible with the wilderness setting. The level of treatment intensity and the minimum tool necessary would be determined prior to site-specific weed treatment activities. The following methods, if determined to be the minimum tool, could be used for treatment and control:

- Hand grubbing with or without hand tools if plants would not re-sprout and where infestations are of a size manageable by small hand crews (this may occur concurrent with monitoring)
- In accordance with a site-specific pesticide use proposal, herbicides may be applied by backpack or horse pack spraying equipment (or other wilderness compatible methods), when grubbing is not effective. Treatment may include the use of hand tools to cut plants down prior to treatment.
- Herbicides applied with or in conjunction with mechanical or motorized equipment, used in accordance with a site-specific pesticide use proposal, where the infestation is of such size that treatment by hand tools and herbicides are impractical, and secondary impacts from the control activity are minor and easily rehabilitated. Treatment may include cutting plants down prior to treatment. No ground vehicles would be driven into wilderness. Reseeding control areas with native species would be incorporated where on-site seed sources are not adequate for natural recruitment.
- Biological control agents approved by the Animal and Plant Health Inspection Service where infestations are of such size that eradication is not feasible. Additional environmental compliance would be required before release of a biological control agent by the NPS could occur.

Reductions of invasive plant populations would enhance the wilderness visitor's experience and the natural quality of wilderness. Recreationists, near the treatment zone, may encounter treatment crews and witness evidence of chemical and physical treatments while the action is actually occurring or after the treatment has happened, from evidence such as weed piles and cut marks. This adverse impact would be temporary and localized, and would improve as the treatment site recovers. To help preserve the outstanding opportunities for solitude or a primitive and unconfined type of recreation, instances where noise-producing equipment and tools have been determined to be the minimum necessary, steps would be taken to notify the public of the soundscape disturbance, and project work would be planned to avoid high-use times. Protected or restored native plant communities resulting from more effective weed treatment would further enhance recreation sites and the recreational experience, having long-term, beneficial effects on the natural and experiential qualities of wilderness.

Prescribed Fire Treatments
Impacts on the wilderness resource from prescribed fire treatments are described above in Impacts Common to Both Alternatives. Prescribed fire treatments could create temporary, adverse, impacts on individuals seeking a wilderness experience during treatment methods and on the untrammeled quality of wilderness. In the long-term, as treatment areas are restored to their native conditions, the wilderness character would improve, having long-term, beneficial effects.

Research and Monitoring
Under the Proposed Alternative, a list of priority exotic plant related research topics would be prepared and made available to potential researchers. Although research is appropriate for wilderness and is essential for managing and protecting wilderness, some proposed research projects may be better suited to non-wilderness settings or designed with alternative low-impact field methods. In addition, analysis of exiting datasets may be a better option than collecting new field data. These types of considerations would be used in assessing research proposals for the wilderness areas weighing the benefits of what can be learned, against the impacts on wilderness resources and values.

Under Alternative B, an exotic plant monitoring strategy would be developed to assess the effectiveness of exotic plant treatments. Developing a standardized research and monitoring strategy would aid in the effort to monitor wilderness character. Monitoring for non-native plants would occur on a regular basis so that treatment could occur as soon as practicable. Review of documented fieldwork would help in monitoring the untrammeled condition of wilderness by reviewing all annual management and other activities that control or manipulate flora in the wilderness. In addition, documented work with descriptions of the location and non-native species treatment occurring in wilderness, would help assess improvements made to the naturalness and primeval character of wilderness. Appropriate research and monitoring activities within wilderness would have long-term, moderate, beneficial effects on the overall wilderness resource.

Biological Control
Like the No Action Alternative, there are currently no biological control treatments at Lake Mead NRA. However, the Chinese leaf beetle, released on adjacent lands to control saltcedar, is highly likely to enter into Lake Mead NRA. Lake Mead NRA would monitor the impacts and respond as necessary, including herbicide treatments and passive or active site restoration. It is unlikely that the Chinese leaf beetle would penetrate into wilderness areas as most tamarisk is along the shorelines and outside of wilderness areas.

Under Alternative B, the NPS would systematically seek new biocontrol agents to evaluate their possible application on the park's highest priority weed species. Release of biocontrols would adhere to strict BMP guidelines. Since there are many unknowns associated with the release of biological control agents, a separate NEPA document would be prepared to analyze the specific impacts on resources, including the wilderness resource, from the identified biological control agent proposed for release. Release of biocontrols could have potential long-term adverse and beneficial impacts on the wilderness resource.

Adaptive Management
Under the Proposed Action, all strategies and actions delineated in this plan would conform to the concept of adaptive management, whereby Lake Mead NRA is continually learning from experience and improving the effectiveness and efficiency of its exotic plant management efforts. Adaptive management allows the park to develop alternative strategies to address issues relating to treatment of new species that may become established, consider new herbicides which are not considered in this analysis, and to implement alternative strategies if an identified proposed treatment fails. This assures that the best possible treatment method or strategy is undertaken and has beneficial effects on the vegetation at Lake Mead NRA, including within wilderness areas.

Application of the Minimum Requirement Concept
A separate MRA would be completed as part of future environmental analyses for projects involving any of the prohibited uses as described in the *Wilderness Act* and would be reviewed by the wilderness coordinator, environmental compliance specialist, and Superintendent. This process assures that the proposed project activity is necessary for management of the area as wilderness and that the minimum tool has been selected. It also assures consistency with wilderness-related planning documents and provides a record of management activities involving prohibited uses important in wilderness monitoring purposes.

Unlike Alternative A which has a few MRAs covering a number of vegetation management activities and treatment methods, Alternative B would provide an MRA evaluation for each project proposing a prohibited use. This would result in a more site-specific evaluation of impacts of the proposed activity on the wilderness resource. It would provide for improved communication and utilization of resources to make the best decision in administering the area as wilderness, provides an avenue to notify affected or interested parties of the activity if applicable, and supports long-term wilderness monitoring efforts. In addition, this assures that the work can occur as efficiently and effectively as possible, resulting in long-term, beneficial effects on the wilderness resource.

Cumulative Effects: The cumulative effects of the Proposed Alternative are similar to the No Action Alternative, except that there would be more coordination and scrutiny of projects proposed in wilderness, thus reducing the potential for cumulative impacts on the untrammeled condition of wilderness. Summarily, implementation of the Proposed Alternative would result in long-term, beneficial cumulative impacts on Lake Mead NRA's wilderness resource. Implementation of Alternative B would not appreciably add to the cumulative effects on wilderness areas in the Region or those identified in the National Wilderness Preservation System.

Conclusion: Unlike Alternative A, the Proposed Alternative would provide comprehensive guidance for managing non-native plant species in all wilderness units regardless if its status is designated, suitable, proposed, or potential wilderness. Under this alternative, active restoration of sites would occur if anticipated to be successful. A standardized research and monitoring strategy would be developed and would aid in the effort to monitor wilderness character. These

components would result in long-term, major, beneficial impacts on wilderness character and the overall wilderness resource.

While implementation of the various treatment methods would result in varying degrees of impacts on the untrammeled component and experiential component of wilderness, the impacts occurring during the actual treatment would be temporary, localized, minor, and adverse. Long-term, major, beneficial effects to the wilderness resource would occur from removing non-native plants and restoring the native ecosystem. Improvements in prevention, early detection, public outreach, and implementing adaptive management strategies would have major, beneficial effects on wilderness character and values. Implementation of this alternative would have no impact on the undeveloped condition of wilderness. Under the Proposed Action, there would be more scrutiny of vegetation management projects proposed in wilderness, which should further minimize impacts on the untrammeled, natural, and experiential qualities of wilderness character. No unacceptable impacts or impairment on the wilderness resource would occur from implementation of the Proposed Alternative.

3.2.7. Cultural Resources

Affected Environment

Cultural resources are the physical evidence of past and current use of the land by humans. These are found throughout Lake Mead NRA and include archaeological sites, historic structures, cultural landscapes, ethnographic resources, and traditional cultural properties.

Archaeological sites include both historic and prehistoric sites where there is evidence of past human activity. These sites include but are not limited to artifact scatters, rock shelters, pueblo ruins, rock art, mines, and historic trash scatters. They contain important information about past human activity. Over 1,200 archaeological sites have been located within the park.

Historic structures are defined as a constructed work, usually immovable by nature or design, created to serve some human activity, such as buildings, bridges, earthworks, roads, and railroad grades. They are constructed from a variety of materials and are located in both developed areas and in remote backcountry. The park's List of Classified Structures has 57 entries which represents most but not all of the park's historic structures.

Cultural Landscapes are settings that humans have created in the natural world and reveal fundamental ties between people and the land. Natural features such as landforms, soils, and vegetation are not only part of the cultural landscape, they provide the framework within which it evolves. In the broadest sense, a cultural landscape is a reflection of human adaptation and use of natural resources and is often expressed in the way land is organized, patterns of settlement, land use, systems of circulation, and they types of structures that are built. The character of a cultural landscape is defined both by physical materials, such as roads, buildings, walls, and vegetation, and by use that reflects cultural values and traditions.

Ethnographic resources are subsistence and ceremonial locales and sites, structures, objects, and rural and urban landscapes assigned cultural significance by traditional users. Associated peoples perceive them as traditionally meaningful to their identity as a group and the survival of their

lifeways. The park continues to consult with affiliated tribes to identify these resources within its boundaries.

Traditional Cultural Properties are tangible and intangible ethnographic resources in which their significance is derived from their 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. The park has two traditional cultural properties listed on the National Register of Historic Places.

Laws, Regulations, and Policies

Numerous legislative acts, regulations, and NPS policies provide direction for the protection, preservation, and management of cultural resources on public lands. Further, these laws and policies establish what must be considered in general management planning and how cultural resources must be managed in future undertakings resulting from the approved plan regardless of the final alternative chosen. Applicable laws and regulations include the NPS Organic Act of 1916, the Antiquities Act of 1906, the National Historic Preservation Act of 1966 (1992, as amended), the National Environmental Policy Act of 1969, the Archeological Resources Protection Act of 1979, and the Native American Graves Protection and Repatriation Act of 1990. Applicable agency policies relevant to cultural resources include Chapter 5 of NPS *Management Policies* (2006) and *Director's Order 28: Cultural Resource Management* (1998).

Section 106 of the National Historic Preservation Act requires that federal agencies with direct or indirect jurisdiction over undertakings take into account the effect of those undertakings on properties that are listed on, or eligible for listing on, the National Register of Historic Places. Section 110 of the act further requires federal land managers to establish programs in consultation with the state historic preservation office to identify, evaluate, and nominate properties to the national register. This act applies to all federal undertakings or projects requiring federal funds or permits.

Criteria and Thresholds for Impact Analysis

The following impact thresholds were established for analyzing impacts to cultural resources in the project area:

- *Negligible impacts*: No potentially eligible or listed properties are present; there are no direct or indirect impacts. For purposes of Section 106, the determination would be *no effect*.

- *Minor impacts*: Potentially eligible or listed properties are present; there are no direct impacts that diminish the integrity of the property, or impacts with only temporary effects are expected. For purposes of Section 106, the determination would be *no adverse effect*.

- *Moderate impacts*: Potentially eligible or listed properties are present; indirect impacts may occur or, in the case of structures, activity is limited to rehabilitation

conducted in a manner that preserves the historical and architectural value of the property. For purposes of Section 106, the determination would be *no adverse effect*.

- *Major impacts*: Potentially eligible or listed properties are present; direct impacts include physical destruction, damage, or alteration of all or part of a property. A property is isolated from its setting, or there is alteration of the character of a property's setting when that character contributes to its eligibility. Visual, audible, or atmospheric elements are introduced that are out of character with the property or alter its setting. Neglect of a property results in its deterioration or destruction. For purposes of Section 106, the determination would be *adverse effect*.

Impacts Common to Both Alternatives

Under both alternatives, administrative actions such as prioritization, monitoring and research, and adaptive management will have no effect on cultural resources, although these actions may influence the use of treatments that could affect cultural resources. In such cases, the impacts are considered in context of the treatment.

Cultural Treatments, and Manual and Mechanical Treatments could involve ground disturbing activities that would have an adverse effect on archaeological resources. These ground-disturbing activities would move artifacts around, destroy features, and mix stratified deposits destroying the integrity of an archaeological site. In most cases these treatments would have no effect on historic structures; however, they could have an adverse effect on roads and trails. By removing vegetation along the edges and embankments of roads and trails erosion could occur that would adversely affect the integrity of the resource.

Prescribed Fire Treatments could have an adverse effect on cultural resources. The process for evaluating the effects of prescribed fire on cultural resources is described in the Park's Fire Management Plan and would continue to be used in the same way under the Proposed Action.

The effects of Chemical Treatments on cultural resources are poorly understood. Because of unknown effects, chemical treatments would not be directly applied to historic structures with limestone grout, hearth features, rock art, or cultural resources comprised of organic material, bone, pollen, seeds, and materials containing from plant fiber or organic residues. However, pesticides may be used in lands surrounding cultural or historic sites in accordance with BMPs.

Non-treatment of exotic plants can also have negative impacts on cultural resources. Exotic plants, for example tamarisk, grow in dense stands with extensive root systems that could damage archaeological sites by bioturbation and could damage the foundations of historic structures.

Alternative A- No Action, Continue With Current Vegetation Management

The continuation of existing ad-hoc, project based exotic plant management efforts would reduce the overall effectiveness of exotic plant management in the park, which would allow the negative impacts of exotic plants on cultural resources to continue. There would be potentially more manual or mechanical treatments under this alternative because the provision for categorical

exclusion of exotic plant control limits the use of other techniques. This increased ground disturbance could negatively affect artifacts and cultural resource sites. Under this alternative, there would also be no coordinated prioritization and less attention to early detection and prompt treatment; as a result impacts to areas identified as management priorities (including cultural resource sites) may be greater than under the Proposed Action.

Cumulative Effects: Cultural resources at Lake Mead NRA are impacted by natural processes (such as aging and weathering), illegal activities (such as vandalism and looting), and legitimate endeavors (such as construction and development projects). Impacts from exotic plant management would contribute negligibly to these effects.

Conclusion: Existing ad hoc exotic plant management efforts provide some protection to cultural resources but offer less opportunity to maximize efficiency and minimize negative effects. Under this alternative, impacts to cultural resources would be moderate. There would be no unacceptable impacts and no impairment to cultural resources under this alternative.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan
Under the Proposed Action, a coordinated exotic plant management effort would allow for more aggressive treatment, particularly for early detection and eradication of newly invading species, which would reduce impacts to cultural resources as compared to the No-Action Alternative. By allowing for a broader array of control techniques, there may be proportionally less ground disturbance resulting from manual and mechanical techniques, which would reduce impacts to artifacts and cultural resource sites. A prioritization effort would allow management attention to be focused on sites of greatest concern, including cultural resource sites.

Cumulative Effects: Cultural resources at Lake Mead NRA are impacted by natural processes (such as aging and weathering), illegal activities (such as vandalism and looting), and legitimate endeavors (such as construction and development projects). Impacts from exotic plant management would contribute negligibly to these effects.

Conclusion: Adoption of a formal Exotic Plant Management Plan would provide an efficient way to control exotic plants while minimizing impacts of the control efforts on cultural resources. Under this alternative, impacts to cultural resources would be minor. There would be no unacceptable impacts and no impairment of cultural resources.

3.2.9. Visual Resources

Affected Environment
The park's scenic vistas are an important visual resource, and striking backdrops for recreational activities include deep canyons, dry washes, sheer cliffs, distant mountain ranges, the lakes, colorful soils and rock formations, and mosaics of different vegetation. Listed below are outstanding view corridors within Lake Mead NRA that provide spectacular views of significant natural features:

1. Newberry Mountains - scenic geologic formations in the Christmas Tree Pass and Spirit Mountain areas

2. Cholla Forest - a fascinating dense stand of teddy bear cholla cactus straddling the boundary north of the Cottonwood Cove access road

3. Palo Verde (*Cercidium* sp.) Forest - northernmost natural occurrence of palo verde trees in the United States and only stand in the Park

4. Fire Mountain Area - scenic geologic formations of volcanic origin permeated by very colorful Andesitic flows

5. Black Canyon of the Colorado River - significant geologic and scenic values, with numerous hot and warm water springs and winter habitat for bald eagles

6. Fortification Hill/Paint Pots - colorful and scenic geologic examples of volcanic activity and erosion

7. River Mountains - desert bighorn lambing grounds and habitat (most productive herd in Nevada)

8. Redstone - impressive and scenic geologic formations of Aztec Sandstone

9. Boulder Canyon – spectacular geologic and significant scenic values

10. Pinto Valley - impressive and scenic geologic mix of smooth Aztec sandstone and jagged granite outcrops demonstrating the mountain building geologic process of tilting

11. Rogers and Blue Point Springs – interesting warm water springs

12. Stewarts Point Area - exposed or close to the surface salt deposits and habitat for rare Las Vegas bear poppy

13. Overton Wildlife Management Area - protected aquatic habitat area managed by the state of Nevada

14. Gypsum Beds - fascinating crystalline gypsum formations and wintering bald eagle habitat

15. Iceberg Canyon - scenic geologic formation demonstrating tilting and unique distribution of the locally limited ocotillo plant

<u>Laws, Regulations, and Policies</u>

The enabling legislation of Lake Mead NRA specifically addresses the preservation of the scenic features of the area. The NPS manages the natural resources of the park, including highly valued associated characteristics such as scenic views, to maintain them in an unimpaired condition for future generations.

The intent of this analysis is to identify how each alternative would affect the overall visual character of the area. The assessment of potential visual impacts involves a subjective judgment concerning the degree of landscape modification allowable before a threshold of impact is exceeded. Human preference for landscape types or characteristics is not uniform across cultures and populations, but there are common preferences among visitors to federal lands, and natural-looking landscapes are thought to be the most appealing.

In determining impacts on the visual resource, the NPS considered the visual sensitivity of the area and the level of visual obtrusion each alternative would have on the existing landscape. Visual sensitivity is dependent on the ability of the landscape to absorb the potential impact and the compatibility of the change with the overall visual character of the area. Absorption relates to how well the project will blend into the landscape, taking into account factors such as form, line, and color. Compatibility considers the character of the visual unit and how much contrast is created by the project.

Criteria and Thresholds for Impact Analysis

The following impact thresholds were established for analyzing impacts to visual resources in the project area:

- *Negligible impacts*: The impact is at the lower level of detection and causes no measurable change. The effects of the project do not dominate the landscape and are essentially imperceptible. The ability of the landscape to absorb the effects is very high, and the change is compatible with the existing visual character of the area.

- *Minor impacts*: The impact is slight but detectable and the change would be small. The project effects are subordinate to the surrounding landscape and relatively low in dominance. The ability of the landscape to absorb the effects is high, and the change is compatible with the existing visual character of the area. If mitigation is needed to offset adverse effects, it is simple and likely to be successful.

- *Moderate impacts*: The impact is readily apparent and the change attracts attention and alters the view, and the dominance of the effects on the landscape is high. The ability of the landscape to absorb the impact is low, and the change is moderately compatible with the existing visual character of the area. Mitigation measures are necessary to offset adverse effects and are likely to be partially successful.

- *Major impacts*: The impact is severe and the change would be highly noticeable. The effects of the project dominate the landscape. The ability of the landscape to absorb the impact is very low, and the impact has very little compatibility with the overall visual character of the area. Extensive mitigation measures are needed to offset adverse effects, and their success is not guaranteed.

Impacts Common to Both Alternatives

Under both alternatives, palm trees would potentially be removed from Roger's and Blue Point springs. These spring areas are an important visual resource to the park, and the palm trees have been growing at the springs for decades. Some visitors have grown accustomed to the presence of the palms. Despite the fondness some visitors may feel toward these plants, the palms are an invasive species that has naturalized from landscape plantings and competes with native riparian plant species. In this way, the palm trees degrade the natural character of springs and their continued presence is inconsistent with Park values. These trees also alter the character of landscape by reducing the amount of available water at the spring sites which, in turn, changes the stream hydrology.

Tamarisk is the most highly visible riparian plant within Lake Mead NRA. The plant is so ubiquitous along the shoreline, in washes, in side canyons, and at spring sites that is probably the most familiar plant to visitors. Because of its invasiveness and its ability to alter critical habitats, tamarisk removal is a high priority for most federal agency exotic plant management programs in the western United States. Tamarisk control efforts would occur under both alternatives. This action would alter the appearance of treated areas by removing the most obvious vegetation that occurs within the treatment sites. Tamarisk is an invasive, exotic plant which severely degrades the natural appearance of the visual resource by displacing native plant species, altering the hydrology, and changing the soil characteristics in areas it occurs.

The use of prescribed fire as a weed management tool would be the same under both alternatives. Currently, fire is used nearly exclusively to control large stands of tamarisk. Fire may char rock and soil surfaces leaving visible marks on the landscape. Burned stumps and branches may also remain where they have not completely burned.

Treatment of exotic plant sites requires staff to enter areas of high visual value and, for a short time, disrupt the visual character of a site. After an area has been treated, the staff may leave behind slash and other vegetative debris to decompose; these materials could contrast visually with the untreated areas in terms of texture and color. Combined, these actions would be short-term and, in the context of the spatially massive visual resource, minor.

Alternative A- No Action, Continue With Current Vegetation Management

Under Alternative A, management of invasive plants would continue to be site lead on a project-by-project basis as funding allows. Most effort focuses on rare plant habitats, desert springs, and high use recreation sites. Currently, there is no systematic method to prioritize weed management efforts on both a site led and weed led basis. This leaves no way to categorize individual exotic plant species based on their ecological impact and invasiveness and then direct treatments efforts accordingly. While the current actions will help to protect smaller, high quality visual sites, there is the potential that certain invasive exotics could cause broad, landscape-level changes that would severely degrade the natural visual quality of some areas before these impacted areas would reach the threshold for Park action.

While the Park does actively restore some treated sites, it does not have a systematic evaluation process which considers likelihood of restoration success, availability of appropriate plant

species, and site preparation needs for determining whether or not to actively restore a site. This could result in restoration of sites where success is unlikely and in lack of restoration at more suitable locations. As a consequence, the time required for a view shed to recover from the short-term, minor, adverse impacts of exotic plant eradication would be increased.

Cumulative Effects: Exotic plant management programs administered by other agencies are operating on federal and state lands adjoining the Park and are occurring concurrently with Park sponsored weed eradication efforts. Significant visual resources cannot be delineated solely by the park boundaries, and areas adjoining the Park boundary are visible by visitors from within the Park. In terms of total area treated within the view sheds and duration of activities, exotic plant management activities would have short-term, minor, adverse impacts to visual resources. As treatment efforts remove exotic plants from the landscape and native plants return the view shed to its natural state, the treatment activities would have long-term, moderate, beneficial impacts to visual resources.

Conclusion: Treatment actions described under Alternative A would result in a short-term, minor, adverse impact to visual resources and a long-term, moderate, beneficial impact to visual resources as areas of native vegetation recover. No adverse impacts to the visual resources are considered unacceptable. Overall, there would be a long-term minor beneficial impact to visual resources under Alternative A. Because long-term impacts under Alternative A would be moderate and beneficial, visual resources would not be impaired for future generations.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan

A system of prioritization for treatment of invasive plants would be considered under both site-led and weed-led priorities. Weed treatments within the Park would still occur on a site-by site basis and treatment efforts would be based upon geographic locations that have a direct relationship with the park's purpose and/or legal mandates, including rare plant habitat, desert springs, and high use recreational areas. Additionally, Alternative B would utilize an established protocol for evaluating exotic plant species based on their ecological impact and invasiveness. This would allow the Park to be flexible in prioritizing treatment efforts and committing resources to specific exotic species which have the potential to create large-scale, range-wide modifications to vegetation structure and, thus, the natural state of the visual resource.

Under Alternative B, the Park would develop an evaluation process for determining whether or not to actively restore a site, the type of restoration required, and the extent of the restoration action. The process would consider the likelihood of restoration success, availability of appropriate plant species, and site preparation needs. A directed approach would assure greater efficacy in restoration actions and, possibly, increase the total number of actively restored sites. This would reduce the time required for some view sheds to recover from the short-term, minor, adverse impacts of exotic plant eradication.

Cumulative Effects: The past, present, and reasonably foreseeable projects affecting scenic resources would be the same as those under Alternative A. Local and regional present and foreseeable future actions would produce short-term, minor, adverse effects. Overall, control of

invasive plants under Alternative B would result in long-term, moderate, beneficial impacts to visual resources within Lake Mead NRA.

Conclusion: Treatment actions described under Alternative B would result in a short-term, minor, adverse impact to visual resources and a long-term, moderate, beneficial impact to visual resources as areas of native vegetation recover. The addition of a prioritization scheme for invasive plant management and of an evaluative process for restoration under Alternative B would provide greater protection for landscape level threats to visual resources and greater mitigation of adverse impacts to visual resources than is provided by Alternative A. No adverse impacts to the visual resources are considered unacceptable. Because long-term impacts under Alternative B would be moderate and beneficial, visual resources would not be impaired under this alternative.

3.2.9. Park Operations

Affected Environment

Park managers at Lake Mead NRA have the responsibility of managing approximately 1.5 million acres, of which almost 87% is backcountry. Lake Mead NRA is organized operationally into seven divisions, each with a functional area of responsibility, including: Office of the Superintendent, Commercial Services Division, Center for Business Operations, Division of Visitor Services, Division of Ranger Activities, Maintenance and Engineering Office, and Resources Management Division. Most employees of Lake Mead NRA are stationed in Boulder City, Nevada at the Headquarters and Warehouse sites. Employees are also stationed at the major developed areas within the park including: Katherine's Landing, Cottonwood Cove, Willow Beach, Meadview, Temple Bar, Boulder Beach, Callville Bay, Echo Bay, and Overton Beach.

All park divisions play a role in invasive plant management. Primary management of the invasive plant program falls under the Resources Management Division. Within this Division, the Vegetation Management Office and the Exotic Plant Management Team Office perform the majority of the functions related to non-native plant control, including surveying for rare plant habitat and weed infestations; monitoring, treatment, and control of non-native plants; and, site restoration and rehabilitation. Vegetation management at Lake Mead NRA consists of four main programs: the Rare Plants Program (monitoring special status and rare plants and habitat), the Restoration Program (monitoring Lake Mead NRA for resource disturbance in the backcountry and identifying restoration needs), the Nursery Program (collecting and propagating seeds and native plants for rehabilitation and restoration efforts), and the Fencing and Grazing Program (identifying areas within Lake Mead NRA that are susceptible to illegal grazing and protecting native plant habitat).

Criteria and Thresholds for Impact Analysis

Park operations refer to the ability of the park to adequately protect and preserve vital park resources and to provide for an enjoyable visitor experience. Operational efficiency is influenced not only by park staff, but also by the adequacy of the existing infrastructure used in the day to day operation of the park. Analysis of impacts to park operations must consider (1) employee and visitor health and safety, (2) the park's mission to protect and preserve resources,

and (3) existing and needed facilities and infrastructure. The following impact thresholds were established for analyzing impacts to park operations in the project area:

- *Negligible impacts*: Park operations are not affected, or the effects are at low levels of detection and do not have an appreciable effect on park operations.

- *Minor impacts*: The effect is detectable and likely short-term, but is of a magnitude that does not have an appreciable effect on park operations. If mitigation is needed to offset adverse effects, it is simple and likely to be successful.

- *Moderate impacts*: The effects are readily apparent, likely long-term, and result in a substantial change in park operations in a manner noticeable to staff and to the public. Mitigation measures are necessary to offset adverse effects and are likely to be successful.

- *Major impacts*: The effects are readily apparent, long-term, and result in a substantial change in park operations in a manner noticeable to staff and the public. Changes are markedly different from existing operations. Extensive mitigation measures are needed to offset adverse effects, and their success is not guaranteed.

Impacts Common to Both Alternatives

Under both alternatives, all park divisions would continue their active or supporting roles in the prevention, control, or treatment of non-native species in the park. The Office of the Superintendent provides management direction and establishes park priorities, provides guidance on safety and environmental compliance, and keeps the public abreast of park- and visitor-related issues. The Commercial Services Division administers concession contracts, commercial use authorizations, and ensures that concessioners are aware of non-native plant issues. The Center for Business Operations provides budgeting, human resource, contracts, and agreements that help support non-native plant management activities. The Division of Visitor Services relates a variety of park issues to the public through direct contact and communication at entrance stations and visitor centers, and by providing visual media and informational handouts. The Division of Ranger Activities oversees law enforcement, resource protection, and fire management activities. Fire managers play a vital role in the control of invasive plants by performing prescribed burns for resource benefit, and mitigating fire impacts during suppression activities. All prescribed burn treatments would be coordinated with the Fire Management Office and would rely on their availability and leadership. The Maintenance and Engineering Office maintains the park infrastructure, which includes buildings, grounds, roads, trails, and utilities. Employees from this division are stationed throughout the park at developed areas, and can be an asset in the early detection of invasive plant populations. This division also provides equipment support for large scale projects, including removing tamarisk from shoreline areas and aiding in restoration efforts.

The prevention of exotic plant introduction and/or spread would remain a high priority for park staff because of its long-term cost-effectiveness and efficiency in protecting native plant communities. Implementing prevention efforts and identifying and treating incipient weed populations has long-term, beneficial effects on park operations because it is more cost-effective

and reduces staffing demands than controlling invasive species once they have become established. Labor intensive treatment and re-treatment efforts of established exotic plant populations would continue until they can be controlled or contained.

Crews and funding are currently available to implement the various aspects of exotic plant management within the park. As funding allows, staffing demands would remain in the Division of Resources Management, specifically in the Vegetation Management Office and Exotic Plant Management Team Office, to directly implement exotic plant management activities. Other offices within this division also help support exotic plant management at Lake Mead NRA by performing activities such as: wildlife surveys and cultural resource surveys of project sites, data management and map production, inspecting construction equipment for weeds, and preparing environmental documents that include non-native plant mitigation.

The Maintenance and Engineering Office and Environmental Compliance Office would continue efforts in preventing the introduction and spread of non-native plants into the park by ensuring mitigation measures are included in environmental analyses documents, right-of-way permits, research and collecting permits, and construction contracts. Mitigation measures, such as vehicle and construction equipment inspections and having resource project managers on-site during construction activities helps assure compliance with non-native plant control procedures.

Job Hazard Analyses, proper training, use of personal protective equipment, and other safety protocols would be followed to protect employee health and safety. The use of prescribed fire as a weed management tool would subscribe to safety protocols established in the Fire Management Plan.

Alternative A- No Action, Continue With Current Vegetation Management

Under Alternative A, no action would be taken to develop comprehensive park guidelines or a plan to apply the integrated pest management concept across projects and park divisions. Weed management activities would occur on a project-by-project basis. There would be no continuity or prioritization on which weed species or site locations to concentrate prevention, control, eradication, or restoration efforts on. Without prioritization of which species or which areas to target treatments, the various vegetation management programs, along with other park divisions, would have no clear communication or comprehensive guidance in carrying out vegetation management objectives. By not identifying and rehabilitating project sites anticipated for successful restoration, certain locations may be vulnerable to reinvasion by the same exotic plant species or other exotic plant species. Unlike the Proposed Action, there would be no attempt to implement an adaptive management program, which could result in the Park's failure to realize the opportunity for improvements in exotic plant management. No standard BMPs for biological control at Lake Mead NRA would be developed. This misses the opportunity to be proactive and prepared to deal with the high likelihood of biological control agents coming onto parkland from adjacent lands. The lack of a comprehensive, integrated exotic plant management plan leads to inefficiencies, redundancy, or overlapping efforts which could have long-term, minor to moderate adverse, impacts on park operations.

In regards to exotic plant management, the Park has one draft Standard Operating Procedure (SOP) that focuses on plant selection and plant replacement in landscaped areas within the park. No other SOP containing specific guidance and standard requirements for exotic plant prevention exists. The lack of internal guidance and direction results in inconsistent exotic plant prevention activities that are under the discretion of individual employees and cooperators, which may have long-term, adverse impacts on park operations.

Crews are currently available to implement the various aspects of non-native plant control at Lake Mead NRA. Despite the availability of additional funds, personnel, and priority for exotic plant management at Lake Mead NRA, under this alternative, the Park would be unable to expand its existing exotic plant management efforts beyond the scope allowed in the existing categorical exclusions without a programmatic environmental assessment. This could have long-term, minor, adverse impacts on park operations from the inability to implement large scale weed management activities at optimum times.

The work crews at Lake Mead NRA have developed standards which generally comply with state law and reflect industry standards related to herbicide application, however, there are no standard BMPs or safety procedures established at Lake Mead NRA. Although no major problems have occurred, the lack of standardized safety procedures could have adverse impacts on employee health and safety.

Cumulative Effects: Park operations are already challenged by the rapidly increasing prices in materials and services, forcing the park to try to do more with less. In addition, low water conditions and construction projects occurring within the park have increased work loads for park staff. Large scale projects initiated by outside entities, such as Southern Nevada Water Authority's Third Intake, the Clean Water Coalition's Systems Conveyance and Operations Program, the U.S. Highway 93 Hoover Dam Bypass project, Northshore Road Rehabilitation, and numerous other construction projects, require the time and commitment of park staff. The spread of non-native grasses through the Mojave Desert ecosystem has the potential to create more frequent fires which would directly impact both exotic plant management efforts and fire management operations at Lake Mead NRA.

The number of employees at Lake Mead NRA is constantly changing. Full-time, permanent staffing at the park has fluctuated approximately 18% over the past ten years. Term, seasonal, and contract employees have increased in response to the Southern Nevada Public Lands Management Act, which provides money generated from the sale of public land in Southern Nevada to fund capital improvement projects and conservation-related projects. As land and subsequent funding becomes unavailable, so would support for some of the positions that either directly or indirectly support vegetation management activities. By not having a standardized, comprehensive, and coordinated exotic plant management plan in place, efforts to prevent and treat exotic plants within the park would not be fully realized and could have negligible to minor, adverse, cumulative effects on the efficiency and effectiveness of park operations.

Conclusion: All park divisions would continue to play an active or supporting role in exotic plant management efforts at Lake Mead NRA. Crews and the necessary infrastructure are currently

available to continue implementing the various aspects of non-native plant control. The No Action Alternative would not optimally utilize available funding, resources, and personnel for the most effective and efficient exotic plant management program. Under this alternative, there would be no unacceptable impacts to park operations. However, no action would be taken to develop a comprehensive and integrated exotic plant management plan which could lead to inefficiencies, redundancy, or overlapping efforts, resulting in long-term, minor to moderate, adverse impacts on park operations.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan

The Proposed Action is to implement a comprehensive exotic plant management plan that would provide guidance and direction on specific integrated pest management strategies and actions to address prevention, early detection, control, and treatment of exotic plant populations. Under this alternative, a prioritized species list would be developed to focus efforts on those species that pose the most risk to the park's environment. The prioritized list would also accommodate the realities of variable funding and staffing levels, allowing managers to focus their management efforts on a larger section of the list in years where funds and staffing are available and on a shorter list of the highest priorities in lean funding years. Identifying and restoring sites anticipated to be successful should reduce the need for retreatment by park staff. The Proposed Action would incorporate an adaptive management program which would increase the effectiveness and efficiency of the Park's exotic plant management program. These elements of the Proposed Action would have long-term, moderate, beneficial effects on park operations.

The Proposed Alternative incorporates both visitor and employee education and would provide internal direction by establishing SOPs to address a wide-range of park operations and external projects. This concerted effort ensures that exotic plant management prevention is incorporated into all NPS-controlled activities and that cooperators and the public are informed and educated to help in preventing exotic plants from entering the park. Implementing a park-wide prevention program would reduce the potential for the introduction and spread of exotic plants into the park, reducing the time, money, and staff involved in treating exotic plants.

A data management strategy would be developed and would standardize information recorded about weed surveys, treatments, and restoration efforts, which would provide pertinent information to park managers influencing decisions on issues affecting park operations. Under this alternative, a park priority list of exotic plant related research and monitoring needs would be established and would benefit park operations by keeping decision makers informed.

Standardized BMPs for biological control at Lake Mead NRA would be developed so that the park is prepared to respond to the high probability of biological control agents coming onto parkland from adjacent lands. Under this alternative, the Park would treat defoliated stands with herbicide and in some cases actively restore native plants to beetle-kill sites. Being proactive and prepared in the event that a biological control agent enters the park would have beneficial effects on park operations. If the Park proposes the release of a biological control agent, additional environmental compliance would be required and would increase the work load of certain park employees, having temporary, short-term, adverse impacts on park operations.

Under the Proposed Action, BMPs would be followed to ensure the overall effectiveness of herbicides which includes safety protocols for storing, mixing, transporting, handling spills, disposing of unused herbicides and containers, and plans for emergency spills. Although safety protocols are currently established and followed by each program that uses herbicides, this alternative would provide standardized BMPs and SOPs that would have moderate, beneficial effects on the safety and health of employees working with herbicides.

Designation of park lands as wilderness influences access, tools, and methods that can be employed in these areas throughout the park, which in turn may increase the amount of effort, funds, and staff required to accomplish projects. Under this alternative, a separate MRA would be prepared for vegetation management activities in wilderness proposing a prohibited use and/or use of herbicide. This would require program managers to devote more time in preparing MRAs, which temporarily and negligibly increases work load, but results in better overall management of the wilderness resource.

Cumulative Effects: Cumulative effects for the Proposed Action are similar to those described in Alternative A, with the exception that the Proposed Action would have minor, beneficial cumulative effects on park operations because a comprehensive plan would be established and would provide long-term direction and guidance on the park's overall exotic plant management efforts.

Conclusion: The Proposed Action would provide comprehensive guidance and documentation for project managers and cooperators. Initial implementation of the plan and certain aspects of the plan may require additional demands on certain park employees, resulting in temporary, minor, adverse impacts on those employees work load, but would negligibly impact overall park operations.

The Proposed Action would provide a context for systematic evaluation and adaptive management, facilitate the transfer of information to the public and our partners, and improve fiscal accountability by focusing on species and/or places where efforts yield the most benefit. Implementation of the alternative would enhance the effectiveness of exotic plant management by providing the required environmental analysis of more aggressive control measures, improve efficiency by identifying and eliminating redundancies between program elements, and lay a course for the future by identifying additional program elements that are needed to achieve the park's exotic plant management goals. All of these components of the Proposed Action would result in moderate, beneficial, effects on the Vegetation Management Program and overall park operations. There would be no unacceptable impacts to park operations under this alternative.

3.2.10. Safety and Visitor Use and Experience

Affected Environment

Lake Mead and Lake Mohave offer a variety of recreational opportunities and are the primary attraction for most of the visitors to the park. Lake Mead NRA visitors include boaters, swimmers, fishermen, hikers, photographers, roadside sightseers, backpackers, and campers. Recreation visits in 2006 totaled just over 8 million and represent a substantial contribution to the area's economy. The majority of park visitation occurs during the summer months and

involves water-based recreation. However, visitation is increasing in the spring and fall as visitors discover the backcountry regions of the Park through hiking and travel on the approved road system.

There are several major developed areas in the park: Boulder Beach, Las Vegas Bay, Callville Bay, Echo Bay, Overton Beach, and Temple Bar on Lake Mead; and Willow Beach, Cottonwood Cove, and Katherine's Landing on Lake Mohave. Water, power, and phone systems are available at all areas. With the exceptions of Overton Beach and Las Vegas Bay, all areas provide launch ramps for boats, marinas, and food service. Some areas also offer campgrounds, formal lodging, and other visitor services. Each area also serves as a base for maintenance and park protection operations.

Boulder Beach Area
The Boulder Beach developed area is situated on Lake Mead and receives the highest visitation of all the developed areas, exceeding 2 million people in 2006. Some of the facilities and services offered in the Boulder Beach area include the Alan Bible Visitor Center; ranger station; boating education facility; two marinas with boat rentals, restaurants, and general stores; a ferry cruise operation; hotel; Nevada Department of Wildlife fish hatchery; Southern Nevada Water Authority Facility; SCUBA, sailboat, and special events beaches; shoreline fishing; campgrounds; NPS housing area and maintenance facility; long-term trailer village; and numerous overlooks, trails, and picnic areas.

Callville Bay
The Callville Bay developed area is situated on Lake Mead and receives heavy visitation during the summer months. In 2006, visitation exceeded 632,000. In February 2007, half of the marina slips that were at Overton Beach were relocated to this area. Some of the facilities and services offered in the Callville Bay area include a ranger station; marina and boat rentals; restaurant; general store; NPS and concessioner housing; campground; picnic area; and launch ramp.

Echo Bay
Echo Bay is situated on the Overton Arm of Lake Mead and attracted over 200,000 people in 2006. This area could see an increase in visitation in response to the termination of services previously offered at Overton Beach. Some of the facilities and services offered at Echo Bay include a ranger station; marina and boat rentals; restaurant; motel; NPS and concessioner housing; campground; picnic area; launch ramp; and trailer village.

Overton Beach
Overton Beach is the northernmost developed area of the park and is situated on the Overton Arm of Lake Mead. In February 2007, low water levels resulted in the relocation of marina slips to Callville Bay and Temple Bar and the eventual closure of all recreational facilities. However, should water levels rise these facilities could be re-opened in the future.

Temple Bar
Temple Bar is the eastern most developed area of the park and is situated on Lake Mead near the boundary with Grand Canyon National Park. Visitation to this area in 2006 was nearly 75,000. In

February 2007, half of the marina slips that were at Overton Beach were relocated to this area. An increase in visitation is expected as a response to the relocation and the rapid development occurring on adjacent lands. Some of the facilities and services currently offered include a ranger station; marina and boat rentals; general store; restaurant; motel; cabin rentals; NPS and concessioner housing; campground; trailer village; beach area; launch ramp; and picnic area.

Willow Beach
Willow Beach serves primarily as a day-use lake access point and provides boat access to northern Lake Mohave and the Black Canyon area south of Hoover Dam. Visitation to this area in 2006 was over 120,000 and is expected to increase in response to completion of the Hoover Dam Bypass in 2010 and planned development on adjacent lands. Some of the facilities and services currently offered in the Willow Beach area include a ranger station; a USFWS fish hatchery; marina and boat rentals; general store and snack bar; NPS, USFWS, and concessioner housing; shoreline fishing; launch ramp; and picnic area.

Cottonwood Cove
Cottonwood Cove is located on Lake Mohave and attracts many visitors from California, Arizona, and Nevada. Visitation in 2006 was nearly 265,000. Some of the facilities and services offered at Cottonwood Cove include a ranger station; marina with boat rentals; general store; restaurant; motel; NPS and concessioner housing; trailer village; campgrounds; swim beach; shoreline fishing; launch ramp; and picnic area.

Katherine's Landing
Katherine's Landing is located at the southern extent of Lake Mohave and is near Laughlin, Nevada and Bullhead City, Arizona. This area attracts many visitors from Arizona and California during the summer months and on holidays. Visitation in 2006 was over 950,000. Facilities and services offered in the Katherine's Landing area include a ranger station; visitor center; marina and boat rentals; general store; restaurant; NPS and concessioner housing; motel; SCUBA, sailboarding, and beach areas; shoreline fishing; campground; cabin sites; trailer village; picnic area; and launch ramps.

Laws, Regulations, and Policies
NPS *Management Policies* (2006) states that the enjoyment of the park's resources is part of the fundamental purpose of all parks and that the NPS is committed to providing appropriate, high-quality opportunities for visitor enjoyment.

Part of the purpose of Lake Mead NRA is to offer opportunities for recreation, education, inspiration, and enjoyment. Consequently, one of the park's management goals is to ensure that visitors safely enjoy and are satisfied with the availability, accessibility, diversity, and quality of the park's facilities, services, and appropriate recreational opportunities.

Criteria and Thresholds for Impact Analysis
Public scoping input and observation of visitation patterns, combined with an assessment of what is available to visitors under current management, were used to estimate the effects of the actions in the various alternatives of this document. The impact on the ability of the visitor to safely

experience a full range of Lake Mead NRA resources was analyzed by examining resources and objectives presented in the park's significance statement. The potential for change in visitor experience proposed by the alternatives was evaluated by identifying projected increases or decreases in use of the areas impacted by the proposal, and determining how these projected changes would affect the desired visitor experience. The following impact thresholds were established for analyzing impacts to safety and visitor use and experience:

- *Negligible impacts*: Safety would not be affected, or the effects are at low levels of detection and do not have an appreciable effect on visitor or employee health and safety. The visitor is not affected, or changes in visitor use and experience are below or at the level of detection. The visitor is not likely be aware of the effects associated with the alternative.

- *Minor impacts*: The effect is detectable, but does not have an appreciable effect on health and safety. Changes in visitor use and experience are detectable, although the changes would be slight. Some visitors are aware of the effects associated with the alternative, but the effects are slight and not noticeable by most visitors.

- *Moderate impacts*: The effects are readily apparent and result in substantial, noticeable effects to health and safety on a local scale. Changes in visitor use and experience are readily apparent to most visitors. Visitors are aware of the effects associated with the alternative and might express an opinion about the changes.

- *Major impacts*: The effects are readily apparent and result in substantial, noticeable effects to health and safety on a regional scale. Changes in visitor use and experience are readily apparent to all visitors. Visitors are aware of the effects associated with the alternative and are likely to express a strong opinion about the changes.

Impacts Common to Both Alternatives

Under both alternatives, beaches, springs, and other high use areas would be targeted for treatment. These treatments would remove exotic vegetation such as tamarisk and puncture vine which have negative impacts on visitor use. These treatments would have minor beneficial impacts on visitor safety, use, and experience.

Spring systems are relatively rare in desert environments, and these oases are popular visitor destinations. Springs provide water, shade, and a high diversity of bird species in an otherwise hostile environment. Because of the availability of water, springs are particularly vulnerable to invasion by exotic plants. Exotic plants can reduce water flow due to increased evapotranspiration, crowd out native vegetation, and reduce the diversity of birds and other wildlife. Removal of weeds at spring sites could reduce the availability of shade in some areas, although these impacts would be negligible. Treated areas improve natural habitats and enhance visitor opportunities to observe native birds and other wildlife. The removal of exotic vegetation at springs will have moderate beneficial impacts to visitor use and experience.

Alternative A- No Action, Continue With Current Vegetation Management
While the treatment of high use areas will have beneficial impacts to visitors and enhance both recreation opportunities and the potential to enjoy native plant and animal communities, treatment activities may interfere with public use. The presence of personnel associated with manual, mechanical, and chemical treatment methods would have minor negative impacts on visitor safety, use, and experience.

There is currently no systematic weed ranking method to use as a basis for weed led prioritization. Most treatment is confined to beaches, springs, and rare species habitat. This lack of a weed led approach does not allow pre-emptive treatments to keep dangerous or highly invasive species out of visitor use areas, having minor negative impacts on safety, visitor use, and experience.

Cumulative Effects: In recent years, declining water levels and the introduction of an invasive mussel species has had serious impacts on park visitors. In 2007, quagga mussels were discovered at Lake Mead. This highly invasive aquatic species has had a negative impact on visitor use. Quaggas attach to most submerged surfaces and can cause damage to boats and other recreational equipment. Shells from dead mussels wash ashore and can cause problems at beaches utilized by the public. The purpose of weed management in the park is to protect resources and manage invasive species to help minimize negative impacts to visitor use and recreation.

The water level in Lake Mead fluctuates regularly, and newly exposed shorelines are very susceptible to invasion by non-native weeds. Shoreline areas are sometimes treated to allow continued public access to Lakes Mead and Mohave by removing large, dense stands of exotic plants. Treatment of exotic plants helps minimize negative impacts to visitor use caused by fluctuating lake levels.

Conclusion: Negative impacts to visitors due to treatment activities would be short-term and minor. The lack of pre-emptive weed led treatments would have long-term, minor, negative impacts on visitor use and experience. There would be no unacceptable impacts to visitor use under this alternative.

Alternative B: Implement a Comprehensive Exotic Plant Management Plan
While the treatment of high use areas will have beneficial impacts to visitors and enhance both recreation opportunities and the potential to enjoy native plant and animal communities, treatment activities may interfere with public use. Treatment of high use areas would not occur during peak visiting seasons (Memorial Day to Labor Day), and efforts would be made to have as little impact on visitors as possible. The presence of personnel associated with manual, mechanical, and chemical treatment methods would have negligible negative impacts on visitor safety, use, and experience.

Weed led priorities would target those species that are particularly invasive or have major impacts to native plant communities or public use. These species would be targeted for treatment

whether or not they occur in high visitor use areas. This proactive approach would prevent impacts to visitors and have a minor beneficial impact on safety, visitor use, and experience.

Exotic plant education for park employees and visitors would serve to increase awareness of the types of impacts invasive weeds can have and help prevent their spread both into and within the park. Under Alternative B, restoration activities post treatment would help minimize impacts to visitors and provide a more natural and pristine recreational experience. These cultural treatments would have a minor beneficial impact on safety, visitor use, and experience.

Cumulative Effects: In recent years, declining water levels and the introduction of an invasive mussel species has had serious impacts on park visitors. In 2007, quagga mussels were discovered at Lake Mead. This highly invasive aquatic species has had a negative impact on visitor use. Quaggas attach to most submerged surfaces and can cause damage to boats and other recreational equipment. Shells from dead mussels wash ashore and can cause problems at beaches utilized by the public. The purpose of weed management in the park is to protect resources and manage invasive species to help minimize negative impacts to visitor use and recreation.

The water level in Lake Mead fluctuates regularly, and newly exposed shorelines are very susceptible to invasion by non-native weeds. Shoreline areas are sometimes treated to allow continued public access to Lakes Mead and Mohave by removing large, dense stands of exotic plants. Treatment of exotic plants helps minimize negative impacts to visitor use caused by fluctuating lake levels.

Conclusion: High use areas would not be treated during peak visitor seasons. Negative impacts to visitors due to treatment activities would be short-term and negligible. The adoption of a proactive weed led treatment strategy and public education would have long-term, minor, beneficial impacts to visitor use and experience. There would be no unacceptable impacts to visitor use under this alternative.

3.2.11. Adjacent Lands

Affected Environment

Lake Mead NRA lies within the watershed of the Colorado, Virgin, and Muddy Rivers. These hydrographic basins encompass millions of people representing numerous agencies and stakeholders. The 404 miles of the Park's perimeter adjoin many public and private lands with a multitude of use and missions. Land management immediately adjacent to the park ranges from urban interface to wilderness. Adjacent stakeholders can be broadly grouped as government agencies with some degree of land management as part of their mission or as cities and towns with potential private stakeholders.

The Park's adjacent and nearby stakeholders includes federal agencies such as the Bureau of Land Management, the U.S. Fish and Wildlife Service, the U.S. Forest Service, other units of the National Park Service, and Nellis Air Force Base. Non-federal governments include the States of Arizona and Nevada, Clark and Mohave Counties, and Native American reservations. Cities and towns in close proximity to the Park include Las Vegas, North Las Vegas, Henderson,

Boulder City, Laughlin, Nelson, Searchlight, Logandale, Glendale, Overton, Mesquite, Moapa, and Bunkerville (all in Nevada), and Bullhead City, Meadview, and Dolan Springs (in Arizona).

Laws, Regulations, and Policies

In addition to being regulated by federal laws, which are uniform across the affected area, adjacent lands are also bound by state laws (Arizona or Nevada as appropriate) and local ordinances. On federal lands, policies vary by agency. Land use plans are available for some areas. Lake Mead's Exotic Plant Management Plan will not violate any laws and will be consistent with all applicable land use plans and policies. The scoping process includes adjacent landowners and land managers, so all relevant policies and regulations can be determined.

Criteria and Thresholds for Impact Analysis

Impacts to adjacent lands were analyzed using the best available information and best professional judgment of park staff. Terms referring to impact intensity are used in the effects analysis and defined as follows:

- *Negligible impacts*: The impact is at the lower level of detection; there would be no measurable change.

- *Minor impacts*: The impact is slight but detectable; there would be a small change.

- *Moderate impacts*: The effect is readily apparent; there would be a measurable impact that could result in a small but permanent change.

- *Major impacts*: The impact is severe; there would be a highly noticeable, permanent measurable change.

Impacts Common to Both Alternatives

Under both alternatives, control of exotic plants at Lake Mead NRA has beneficial effects to both the park and adjacent lands. Non-native plants move across landscapes through a variety of dispersal mechanisms. In weed-infested areas, the non-native plants can serve as source populations, colonizing nearby lands. Conversely, lands without non-native plants are susceptible as sink areas and can be invaded by species present in the surrounding landscape. Active management and control of non-native plants at Lake Mead not only minimizes the effects of the Park being a sink area, but also reduces the likelihood of the Park acting as a source population that could impact adjacent lands.

Resource impacts associated with non-native plant control actions have been described in previous sections. These effects are usually minor and have localized geographic scope. Any adverse effects to the Park's geology, soils, vegetation, wildlife, water, wilderness, and cultural resources would rarely affect adjacent lands. Activities occurring very near the park boundary could have impacts to the adjacent land (erosion, residual herbicide, visual changes, and other effects described previously), but such impacts would be negligible to minor.

Alternative A- No Action, Continue With Current Vegetation Management

Under the No Action Alternative, the Park would continue its existing ad hoc, project-based exotic plant management efforts. These efforts have benefitted adjacent lands by reducing the Park's influence as a source population for non-native plants. However, the No Action Alternative results in fewer acres treated than under Alternative B and reduced efficiency in controlling the negative impacts of non-native species on the environment. In addition, there would be no prioritized coordination, and some non-native species or infested sites that have the most potential to affect native plants may not be identified as management priorities and so may go untreated. There would be no comprehensive prevention program that addresses both administrative actions as well as visitor and employee education, which could result in lost opportunities to intercept new introductions of non-native plants. Finally, there would be no coordinated research and monitoring effort focused on incorporating new knowledge and improved techniques into future management decisions. Although the Park's existing control efforts would continue to have minor beneficial effects to adjacent lands by reducing the likelihood of the Park serving as a source population for non-native plants, the effects are not as great as they would be under Alternative B.

Cumulative Effects: Other landowners and land managers in the area are undertaking non-native plant management activities of their own, and Lake Mead NRA's existing control program supplements these efforts by reducing populations of weeds that may disperse to areas outside the Park through any of a variety of mechanisms. Although the magnitude of the cumulative effect of Lake Mead NRA's program on adjacent lands cannot be readily quantified, it is a recognized beneficial effect due to the regional scale of the non-native plant problem. Because the adverse impacts of control activities are so limited in geographic scope, there are no negative cumulative effects to adjacent lands associated with the No Action Alternative.

Conclusion: The No Action Alternative would have minor beneficial effects to adjacent lands by reducing the likelihood of the Park serving as a source population of non-native plants. There would be no unacceptable impacts to adjacent lands from this alternative.

Alternative B- Implement a Comprehensive Exotic Plant Management Plan

Under the Proposed Action, the park would implement a comprehensive exotic plant management plan that would guide the actions of the NPS and its many partners working in Lake Mead NRA. This coordinated effort would provide opportunities for more aggressive treatment, particularly for early detection and eradication of newly invading species, and thus would likely increase the total acres treated. A prioritized coordination effort would ensure that species and sites of high management concern were identified and treated. A comprehensive prevention program addressing both administrative actions as well as visitor and employee education would create opportunities to intercept new introductions of non-native plants. Finally, a coordinated research and monitoring effort would allow the Park to incorporate new knowledge and improved techniques into future management decisions. These factors would improve the efficiency of Lake Mead's control efforts, making the Park less likely to serve as a source population for non-native plants and resulting in greater beneficial effects to adjacent lands.

Cumulative Effects: Other landowners and land managers in the area are undertaking non-native plant management activities of their own, and Lake Mead's implementation of an Exotic Plan Management Plan would supplement these efforts by reducing populations of weeds that may disperse to areas outside the Park through any of a variety of mechanisms, and would do so to a greater extent than the Park's current program. Although the magnitude of the cumulative effect of an Exotic Plant Management Plan on adjacent lands cannot be readily quantified, it is a recognized beneficial effect due to the regional scale of the non-native plant problem. Because the adverse impacts of control activities are so limited in geographic scope, there are no negative cumulative effects to adjacent lands associated with this alternative.

Conclusion: The Proposed Action would have moderate beneficial effects to adjacent lands by reducing the likelihood of the Park serving as a source population of non-native plants. There would be no unacceptable impacts to adjacent lands from this alternative.

4.0 Public and Agency Involvement

A 30-day public scoping period occurred from August 19-September 19, 2003. A scoping press release (Appendix A) was sent to television stations, newspapers, magazines, and radio stations in Las Vegas, Henderson, Boulder City, Pahrump, Overton, Logandale, Laughlin, Nevada; Meadview, Kingman, Phoenix, and Bullhead City, Arizona; and Needles and Los Angeles, CA. The press release was also posted on the Lake Mead NRA internet website and on the NPS Planning, Environment, and Public Comment (PEPC) internet website. Two written comments were received during the scoping period. One comment from the Nevada Department of Wildlife expressed its support of the invasive plant management planning effort, particularly at it relates to park lands in Nevada and the Department's Overton Wildlife Management Area. Another comment was received from a Las Vegas resident advocating that Park efforts be focused on finding beneficial uses of saltcedar rather than removing the trees.

A press release announcing the availability of this environmental assessment is sent to the above entities and is posted on the park and PEPC websites.

Lake Mead NRA's mailing list is comprised of 237 entities including federal, state, and local agencies; tribes; individuals; businesses; libraries; and organizations. The environmental assessment is distributed to those individuals, agencies, and organizations likely to have an interest in this project. Entities on the park mailing list that do not receive a copy of the environmental assessment receive a letter notifying them of its availability and methods of accessing the document.

The environmental assessment is published on the Lake Mead NRA internet website at (http://www.nps.gov/lame) and on the NPS PEPC internet website at http://parkplanning.nps.gov/. Copies of the environmental assessment are available at area libraries, including: Boulder City Library, Clark County Community College (North Las Vegas), Clark County Library, Las Vegas Public Library, Green Valley Library (Henderson), James I. Gibson Library (Henderson), Sahara West Library (Las Vegas), Mohave County Library (Kingman, AZ), Sunrise Public Library (Las Vegas), University of Arizona Library (Tucson, AZ), University of Nevada Las Vegas James R. Dickinson Library, Meadview Community Library, Moapa Valley Library (Overton, NV), Mesquite Library, Mohave County Library (Lake Havasu City, AZ), Laughlin Library, Searchlight Library, and Washington County Library (St. George, UT).

A copy of the environmental assessment can also be obtained by direct request to:

National Park Service, Lake Mead NRA
Attention: Compliance Office
601 Nevada Way
Boulder City, Nevada 89005
Telephone: (702) 293-8956

Comments on this environmental assessment must be submitted during the 30-day public review and comment period. Comments on the EA can be submitted in writing to the address above or on the PEPC website at http://parkplanning.nps.gov/.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment – including your personal identifying information – may be made publicly available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

5.0 Preparers

This document was prepared by an interdisciplinary team including the following people:

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6.0 References

6.1 Federal Regulation, Order, Law

All U.S. Public Laws, Codes, Federal Regulations, and Statutes can be found at the Office of the Federal Register, U.S. Government Printing Office, Washington, DC. Many can be found on the Internet at http://www.gpo.gov.

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6.5 Glossary

Adaptive Management: Adaptive management is a decision process that promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error process' process, but rather emphasizes learning while doing. Adaptive management does not represent a end in itself, but rather a means to more effective decision and enhanced benefits. Its true measure is in how well it heals meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders. (Williams et al. 2007)
Alien: Same as exotic and non-native. A species that is not native to the region in which it is growing.
Annual: Completes life cycle in one growing season, not woody (Bangle 2007).
Biennial: Completes life cycle in two growing seasons, not woody (Bangle 2007).
Common: Species is often found in proper habitat in Lake Mead NRA (Bangle 2007).
Control: Efforts aimed on the long-term reduction in density and abundance of an exotic species in a given population below an acceptable threshold
C_3 Plant: A plant that uses C_3 photosynthesis: a form of photosynthesis in which CO_2 is captured by RuBP carboxylase/oxygenase and the first stable product is a three-carbon compound (Gurevitch et al. 2002).
C_4 Plant: A plant that uses C_4 photosynthesis: a form of photosynthesis in which CO_2 is captured by PEP carboxylase and the first stable product is a four-carbon compound (Gurevitch et al. 2002).
Disturbed: Areas or regions that are not in their natural state. Areas that have been disrupted or changed in some form or manner either by people or by natural events.
Dormancy: A special condition of arrested growth in which the plant and such plant parts as buds and seeds do not begin to grow without special environmental cues. The requirement for such cues, which include cold exposure and a suitable photoperiod, prevents the breaking of dormancy during superficially favorable growing conditions. (Raven et al. 1981).
Edaphic: describes the effect of soil characteristics, especially chemical or physical properties, on plants and animals.
Emergent: Erect, rooted, herbaceous plants that may be temporarily or permanently flooded at the base but do not tolerate prolonged inundation of the entire plant (adapted from Cowardin 1979).
Eradication: to bring about the elimination, complete removal, or total destruction of a pest from a defined geographic area to such an extent that the pest no longer poses a threat to other park resources and where the potential of re-infestation is preventable.
Established Population: A reproducing population of a given invasive species that persists over time without human intervention.
Exotic: Same as alien and non-native. A species that is not native to the region in which it is growing.
Floating plant: A non-anchored plant that floats freely in the water or on the surface (adapted from Cowardin 1979).

Germination: The beginning or resumption of growth by a spore, seed, bud, or other structure (Raven et al. 1981).
Genotype: An individual's DNA sequence (Gurevitch et al. 2002).
Granivore: Seed-eating animal (Gurevitch et al. 2002), typically ants and rodents in the Mojave Desert
Gypsophile: A plant living in soil high in gypsum content.
Halophyte: A plant that lives in saline soil (Gurevitch et al. 2002)
Heterozygosity: The condition of having two different alleles at the same locus on homologous chromosomes (Raven et al. 1981).
Incipient invasive: A plant that could become invasive- or that is naturalizing and is likely to become invasive in the future.
Invasive: a species that is capable of naturalizing in undisturbed, natural areas and is capable of competing with native species for niche.
Native: Indigenous to the region. A species that has evolved in the region in which it is found growing.
Natural: Areas or regions that have not been disturbed by the agency of humans.
Naturalized, naturalizing: A species that is non-native to the region but is well established and reproducing independent of human care in either waste places, disturbed, or natural areas.
Niche: The total of all factors and interactions that define the place or position of a particular species in its ecosystem. Niche includes the species use of both the abiotic and biotic environment and its interactions with that environment and other organisms in it.
Non-native: Same as alien and exotic. A species that is not native to the region. It has evolved elsewhere in the world and has spread to the region either naturally or thru the agency of people. Frequently non-native is taken to mean that plants have been moved to new regions by or in association with humans and not by natural dispersal.
Noxious weed: A nuisance plant species that causes significant economic damage. Noxious is a legal term with a legal definition for each state or county. Noxious is used to describe plants that are nuisance species that are recognized as such by a state or country. Often a species may be highly invasive and widespread nuisance and not be declared a noxious weed of a particular state because it is not considered controllable. Noxious weeds are typically defined as species which can be controlled. Therefore, highly invasive species that are widespread may not be listed as noxious weeds in all states in which they are a nuisance.
Occasional: Species may be found in proper habitat in Lake Mead NRA (Bangle 2007).
Perennial: Living more than two growing seasons (Bangle 2007).
Pernicious: Refers to a plant species that is difficult to control once established. Spreads rapidly and/or has features that prevent rapid and easy control, such as deep rhizomes, ability to sucker, resprouting, thorns, herbicide resistance, etc.
Photoperiod: Duration and timing of day and night (Raven et al. 1981)
Propagule: A seed or other dispersal structure, such as a seed cluster (Gurevitch et al. 2002).
Rare: Only a few occurrences within Lake Mead NRA (Bangle 2007).
Recruitment: The influx of new individuals entering a population each year as a result of reproduction or immigration.
Remote Sensing: The practice of obtaining data on a target, using distantly placed detection devices. Such devices, often mounted in aircraft or satellites, may detect radiation at a number of wavelengths in order to infer characteristics of the emitting or reflecting object. The

characteristics that can be learned about an object include surface temperature, composition, structure, and size. (Rice 2004)
Research: The methodical investigation into a subject in order to discover facts, to establish or revise a theory, or to develop a plan of action based on the facts discovered.
Rhizomes/Rhizomatous: An underground stem/A plant bearing such structures. Rhizomes differ from roots by having meristematic tissue that allows species to reproduce from the rhizome or a portion thereof. Rhizomes are typically capable of producing both roots and aboveground stems from nodes, or centers of meristematic tissue. The rhizomes may also act as storage tissue for nutrients, allowing the above ground portions of the plant to be nourished during times of stress. Rhizomatous plants are often difficult to kill due to the action of the rhizome in protecting, replacing, and reproducing the above ground portion of the plant.
Seed: An embryonic sporophyte embedded in a female gametophyte and covered with one or more integuments derived from the maternal sporophyte (Gurevitch et al. 2002). A structure formed by the maturation of the ovule of seed plants following fertilization (Raven et al. 1981).
Seed bank: The seeds buried in the soil, can refer to either a single species or an entire community (Gurevitch et al. 2002).
Seedling: A young sporophyte developing from a germinating seed (Raven et al. 1981).
Soil retention: An index of the binding capacity of the pesticide molecule to soil organic matter and clay. In general, pesticides with high soil retention are strongly bound to soil and are not subject to leaching. Those not exhibiting high soil retention are not strongly bound and are subject to leaching (Miller and Westra 1998).
Soil persistence: Refers the longevity of a pesticide molecule, typically expressed in terms of a half-life, as determined under normal conditions in the region where the pesticide would be used (Miller and Westra 1998).
Submergent: A vascular or nonvascular plant, either rooted or nonrooted, which lies entirely beneath the water surface, except for flowering parts in some species (adapted from Cowardin 1979).
Treatment: to act upon a pest with the lowest risk, most effective approach feasible to reduce its impact or spread. Integrated pest management approaches to be considered include: no action; biological, cultural, physical, chemical or a combination of one or more of these approaches.
Uncommon: Species is not often found in proper habitat in Lake Mead NRA (Bangle 2007).
Volatility: Refers to the tendency of a pesticide molecule to become a vapor. Pesticides with high vapor pressures are likely to escape from the soil and volatilize in the atmosphere (Miller and Westra 1998).
Weed: A nuisance species of plant. A plant that is growing in an area in which it is not desired. The term is often used interchangeably for non-native, or invasive plant species. Term is also sometimes used for native species that are nuisance species in gardens or rangelands.
Wildlands: Areas or regions that have flora and fauna still in their natural state.

6.6 Acronyms

APCAM	Alien Plant Control and Monitoring
APHIS	Animal and Plant Health Inspection Service
BLM	Bureau of Land Management
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
DOI	Department of the Interior
EA	Environmental Assessment
EPMT	Exotic Plant Management Team
GIS	Geographic Information System
GPS	Global Positioning System
IPM	Integrated Pest Management
LAME	Lake Mead National Recreation Area
NEPA	National Environmental Policy Act
NPS	National Park Service
PL	Public Law
PLI	Public Land Institute
SNRT	Southern Nevada Restoration Team
UNLV	University of Nevada - Las Vegas
USC	United States Code
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service

7.0 Appendices

Appendix A: Pesticides in the Environment
Appendix B: August 19, 2003 Scoping Letter
Appendix C: Wilderness Minimum Requirements Analysis

Appendix A: Pesticides in the Environment

Each pesticide varies in terms of its chemical and biological behavior in the environment and thus is suitability for a given application. Factors that affect pesticide behavior in the environment include pesticide properties, soil characteristics, and climatic conditions. Factors that influence the behavior of pesticides in the environment are provided by Miller and Westra (1998) and are summarized in the bullets below. These factors influence the environmental fate and effects of a pesticide and must be considered for herbicides used at Lake Mead NRA.

- Acid or base strength - refers to whether a pesticide has basic, acidic, or non-ionizable properties. This factor determines the ability of a pesticide to exist in soil water or be retained onto soil solids. In general, pesticides whose pH is close to the pH of soil are strongly retained and are not subject to runoff, erosion, and/or leaching. In contrast, herbicides whose pH is not close to that of the soil are less strongly retained and are subject to runoff, erosion, and/or leaching. These pesticides are also more available for plant uptake than those pesticides that are strongly retained onto soil solids. Native soils at Lake Mead NRA tend to be alkali (high pH).
- Water solubility - refers to how readily a pesticide dissolves in water and determines the extent to which a pesticide is in the solution (water) phase or the solid phase. A pesticide that is water soluble generally is not retained by soil.
- Volatility - refers to the tendency of a pesticide molecule to become a vapor. Pesticides with high vapor pressures are likely to escape from the soil and volatilize in the atmosphere.
- Soil retention - is an index of the binding capacity of the pesticide molecule to soil organic matter and clay. In general, pesticides with high soil retention are strongly bound to soil and are not subject to leaching. Those not exhibiting high soil retention are not strongly bound and are subject to leaching.
- Soil persistence - refers the longevity of a pesticide molecule, typically expressed in terms of a half-life, as determined under normal conditions in the region where the pesticide would be used.

Appendix B: August 19, 2003 Scoping Letter

National Park Service
U.S. Department of the Interior

Lake Mead National Recreation Area

601 Nevada Way
Boulder City, NV 89005

702.293.8947 phone
702.293.8936 fax

Lake Mead National Recreation Area News Release
For Immediate Release: August 19, 2003 **Release #:68-03**
Roxanne Dey, 702.293.8947

Public Comments Requested for Invasive Plant Management Plan

Officials at Lake Mead National Recreation Area are soliciting public comments on a proposal to implement an invasive plant management plan at Lake Mead National Recreation Area.

The invasive plant management plan is being created to provide a framework for evaluating and controlling known invasive plants and weed invasions.

The invasion of National Park Service areas by alien species of plants (also called exotics, non-indigenous, non-native, or weeds) is a well-recognized ecological problem. Lake Mead National Recreation Area has, until recently, been spared of large-scale alien plant invasions. Unfortunately, Lake Mead NRA is now experiencing an increasing invasive plant problem. During this unusual period of 40-year low lake levels, the habitat for these invasive plants has increased dramatically.

Invasive plants can alter or destroy intact natural ecosystems, resulting in an irreversible loss of biodiversity. Heavily invaded systems can be permanently altered and may never fully recover. National Park Service laws and policies dictate that alien plants be identified and eradicated where feasible.

The National Park Service is in the process of preparing an environmental assessment to identify and evaluate feasible alternatives, including no action, for this proposal. As a result, officials at Lake Mead National Recreation Area are seeking public feedback on the issues and potential alternatives. Written comments should be sent by September 19, 2003 to: Superintendent, Lake Mead National Recreation Area, Attention: Compliance Office, 601 Nevada Way, Boulder City, Nevada 89005.

EXPERIENCE YOUR AMERICA™
The National Park Service cares for special places saved by the American people so that all may experience our heritage.

Appendix C: Wilderness Minimum Requirement Analysis

The Minimum Requirement Decision Process – Part I

Produce any required documentation on separate sheets.

Project Title

Step 1- Determine whether the proposed action or components of the program takes place in designated Wilderness, suitable or potential wilderness.

In general, Wilderness boundaries fall 100 feet from the center line of all paved and approved backcountry roads, and 300 feet from the high water elevation of Lakes Mead and Mohave.

If you are unsure if your proposed action would occur within wilderness boundaries, contact the Wilderness Coordinator.

Suitable and potential wilderness also exists within the Park. Lands designated as suitable or potential wilderness additions shall be managed by the Secretary insofar as practicable as wilderness until such time as said lands are designated as wilderness and will require the minimum requirement analysis.

If the proposed action will take place in designated, suitable, or potential wilderness, proceed to step 2.

If the proposed action or program will not take place in wilderness, suitable, or potential wilderness, proceed with the Compliance review process.

Step 2- Determine whether the proposed action or program is required for the administration of the Wilderness

DO-41 states: "In order to allow a prohibited activity, the activity must be necessary to manage the area as wilderness."

The action must also comply with all other applicable laws and policies

If the action is not required for the administration of the area, it is not allowed.

If the action is required for the administration of the area, document what wilderness management objective (see DO-41) is being met and why this action is essential to meet that objective. Proceed to step 3.

Step 3- Determine if the objectives of the proposed action can be met with actions outside of wilderness.

Consider:

- *Can the objective be met outside of wilderness?*
- *Will increased educational efforts help attain the objective?*
- *Will a reduction in visitor use (through disincentives, quota reductions, or closures) eliminate or reduce the need for the action? If so, will that reduction be an acceptable impact to the visitor experience?*

If the objectives of the proposed action can be met with actions outside of, proceed with compliance process and conduct action outside of wilderness.

If the objectives of the proposed action cannot be met outside of wilderness, document the reasons and proceed to step 4.

Step 4-Develop a list of alternatives to meet the objective of the proposed action. Include ways to reduce or mitigate the impacts of each alternative.

Alternatives should be detailed and specific and include a no-action alternative.

Proposed actions that use motorized equipment or mechanized transport should include, at least the following alternatives: 1) no-action, 2) action using only non-motorized equipment and non-mechanized transport, 3) action using motorized equipment and mechanized transport, and 4) some mixture of 1, 2, and 3. Or, provide justifications to rule out the alternatives.

Again, the preservation of wilderness resources and character will be given significantly more weight than economic efficiency and convenience.

If a compromise of wilderness character is unavoidable, only those actions that preserve wilderness character and/or have localized short-term adverse impacts will be accepted.

Proposed actions that do not use motorized equipment or mechanized transport should still include a range of alternatives that include varying degrees of administrative intrusion on wilderness character.

Consider ways to reduce or mitigate the impacts of each alternative:

- *Can the action be timed to minimize impacts to the visitor experience or ecological health?*
- *Do your alternatives include all available options, tools and techniques?*
- *Can increased education help mitigate the impacts of the action?*
- *Can reduced use mitigate the impacts of the action?*

List each alternative along with any applicable mitigation measures.

Step 5- Determine the effects of each alternative on wilderness health and character. Include cumulative effects.

Consider:

1. *Biophysical effects*

- *Describe any effects this action will have on the ecological health of the area, including air and water quality, vegetation, wildlife, introduction of exotic species, erosion, siltation, wetlands, and rare, threatened, endangered, or sensitive species. Include both biological and physical effects. Consult subject matter experts as needed.*

- *In potential wilderness additions, describe whether this action will make restoration to a wilderness condition more difficult when the area is designated as wilderness.*

2. *Experiential effects*

- *Describe any effects this action will have on the experience of wilderness visitors. Consider the effects on the opportunity for solitude, natural quiet, self-reliance, surprise, and discovery.*

- *Describe any effect this action will have on the natural appearance of the area.*

3. *Effects on wilderness character*

- *Describe any interference with natural processes, constraints on the freedom of wildlife or visitors, increase of management presence, or other reduction of wildness that this action may cause.*

Proceed to step 6 before documenting these effects.

Step 6- Determine the management concerns of each alternative.

Consider:

1. *Health and safety concerns*

- *Describe any health and safety concerns associated with this action. Include health and safety considerations of both employees and the public.*

2. *Societal/political/economic effects*

- *Describe any political considerations such as MOUs, agency agreements, etc. that may be affected by this action.*

- *Estimate the economic costs of this action.*

Describe the effects of each alternative as determined in steps 5 and 6. Quantify these effects when possible, and describe whether the effects are short- or long-term, adverse or beneficial, and localized or far-reaching.

Step 7- Choose a preferred alternative

NPS management policies states:

"Potential disruption of wilderness character and resources and applicable safety concerns will be considered before, and given significantly more weight than, economic efficiency. If some compromise of wilderness resources or character is unavoidable, only those actions that have localized, short-term adverse impacts will be acceptable."

Using the information developed in steps 5 and 6, and using the law and policy guidelines presented in this document, choose a preferred action and carefully justify in writing your reasons for choosing this alternative. Submit this document to the Wilderness Coordinator when completed.

Step 8- Proceed with appropriate NEPA compliance pathway.

To be completed by Environmental Compliance Specialist

Step 9- Notification and Superintendent Sign-Off

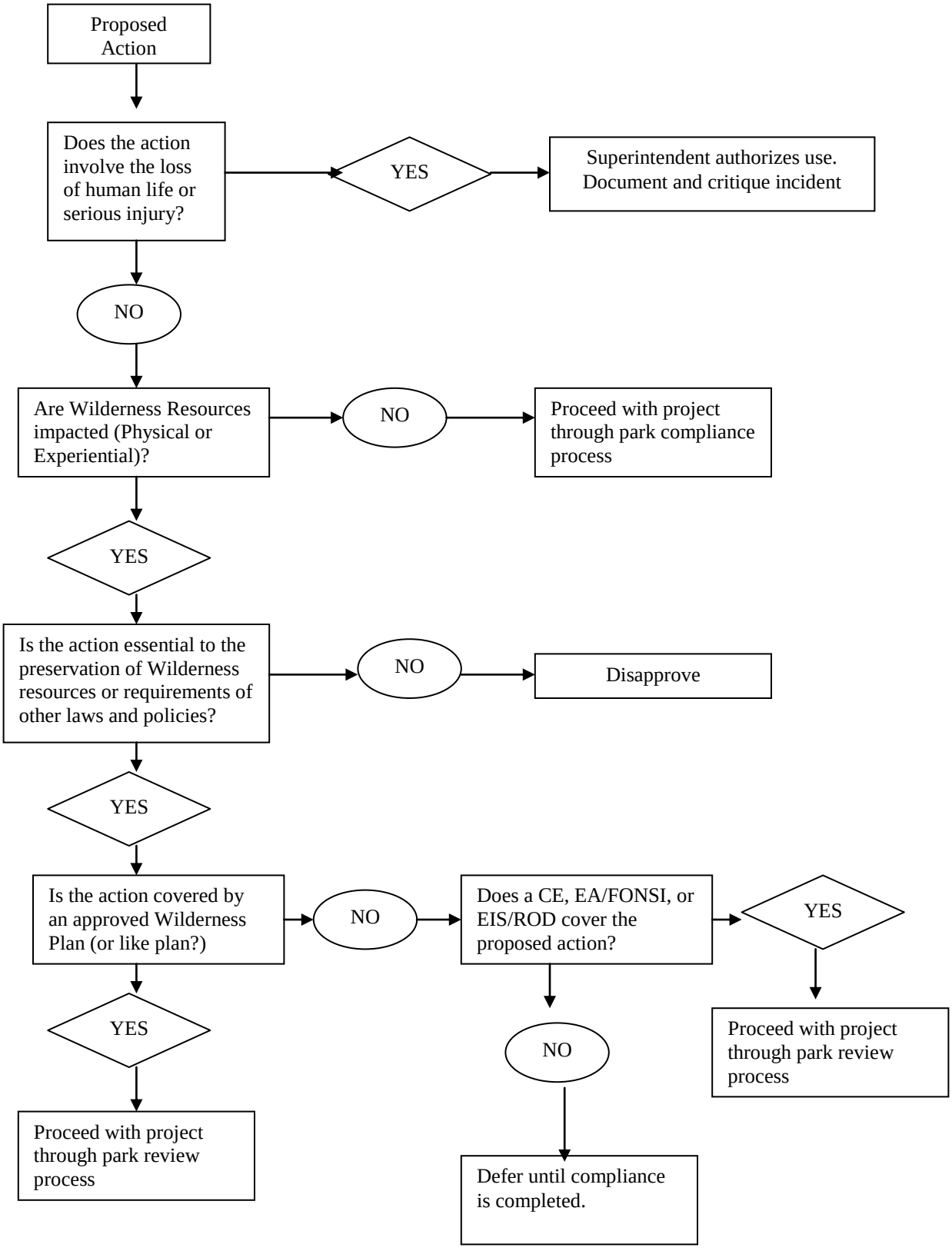
To be completed by Environmental Compliance Specialist

Following park staff reviews and appropriate environmental compliance, including public and agency notification:

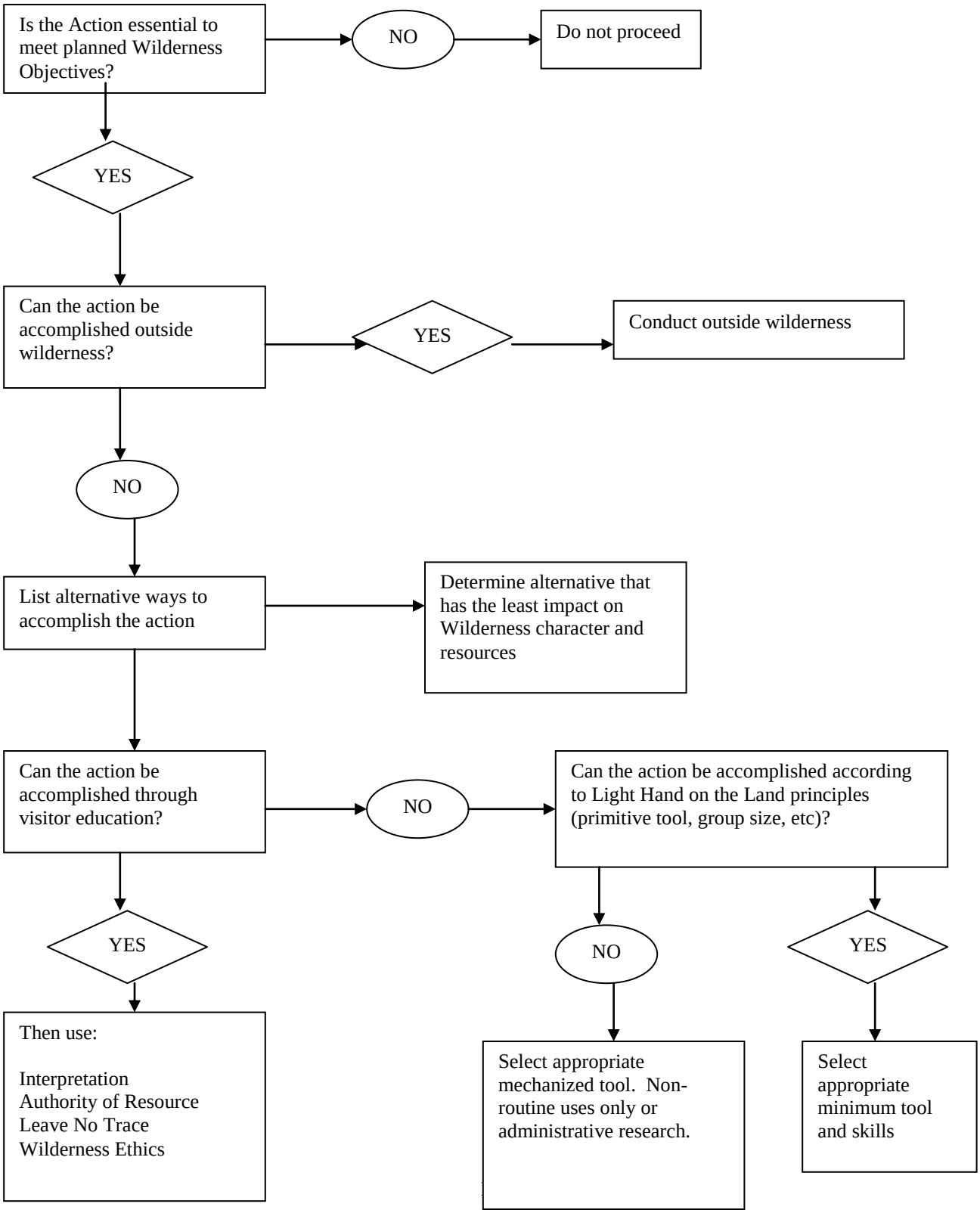
- *Complete the Wilderness Project Review and Approval Form.*
- *Complete the Proposed Action Summary Notice for an Action Within a Wilderness Area and provide to interested (commenting) parties and adjacent land management agencies (i.e. Jointly Managed Wilderness Units).*
- *Include these forms and the record of public notification in the compliance administrative record.*

APPENDIX A – FLOW CHARTS AND SCREENING QUESTIONS

MINIMUM TOOL REQUIREMENT ANALYSIS
PART 1



MINIMUM TOOL REQUIREMENT ANALYSIS
PART 2



Minimum Requirement Analysis
Decision Screening Questions

These questions can help you evaluate your proposed action and complete the minimum requirement analysis.

1. Does your action insure that wilderness is not occupied and modified?

2. Does your action maintain or move the Wilderness toward less human influence within legal constraints?

3. Does your rationale allow Wilderness to retain solitude and elements of surprise and discovery?

4. Did you evaluate the traps of making decisions based on economy, convenience, comfort, or commercial value?

5. Did you look beyond the short-term outputs to ensure that future generations will be able to use and enjoy the benefits of an enduring resource of Wilderness?

6. Does the alternative support the Wilderness resource in its entirety rather than maximizing an individual resource?

7. Do you recognize the unique characteristics for this particular Wilderness?

8. Does the action prevent the effects of human activities from dominating natural conditions and processes?

To be completed by Environmental Compliance Specialist

PROPOSED ACTION SUMMARY NOTICE
ACTION WITHIN A WILDERNESS AREA
LAKE MEAD NATIONAL RECREATION AREA

Notice Date: Proposed Action Date:

Wilderness Name:

State: Designated Suitable Potential (circle one)

Notification Period Begins: Notification Period Ends:

Location within Wilderness:

Summary of Proposed Action:

To be completed by Environmental Compliance Specialist

PROJECT REVIEW AND APPROVAL FORM
FOR ACTIVITIES IN WILDERNESS

Proposed Action _____

Location/Wilderness Unit _____

Project Proponent _____

Check one:

- ❑ The proposed action is a temporary, one-time activity.
- ❑ The proposed action will be an on-going, long-term activity.

Reviewed By:

_____

Environmental Compliance Specialist Date

_____

Wilderness Coordinator Date

Approved By:

_____

Superintendent Date

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