CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

INTRODUCTION

This "Environmental Consequences" chapter analyzes both beneficial and adverse impacts that could result from implementing any of the alternatives related to off-road vehicle (ORV) management at Glen Canyon National Recreation Area (Glen Canyon). This section includes a summary of laws and policies relevant to each impact topic, methods used to analyze impacts, and the analysis methods used for determining cumulative impacts. As required by the Council on Environmental Quality's (CEQ) regulations implementing the National Environmental Policy Act of 1969 (NEPA), a summary of the environmental consequences for each alternative is provided in table 5 (in chapter 2). The resource topics presented in this section, and the organization of the topics, correspond to the impact topics identified in the "Purpose of and Need for Action" chapter, and the resource discussions contained in the "Affected Environment" chapter.

IMPACT ASSESSMENT METHODOLOGY AND ASSUMPTIONS

The general approach for measuring the effects of the alternatives on each impact topic includes the following elements:

- General analysis methods as described in guiding regulations
- Basic assumptions used in this analysis
- Define the level of impact resulting from each alternative
- Methods used to evaluate the cumulative impacts of each alternative in combination with unrelated factors or actions affecting Glen Canyon resources.

These elements are described in the following sections.

GENERAL ANALYSIS METHOD

The analysis of impacts follows CEQ guidelines and Director's Order 12 procedures (NPS 2011a).

A substantial body of scientific literature has described the effects of motor vehicle recreation on the environment. The Park Service interdisciplinary planning team reviewed literature and studies applicable to the region and setting and the resources being evaluated. This information was used to augment the on-site observations and documentation gathered by National Park Service (NPS) personnel at Glen Canyon and the advice of internal and external resource management experts to support the qualitative and quantitative statements presented in this impact analysis section. When resource-specific data, observations, studies, or other evidence is available these resources are noted in the methodology section for each impact topic. Geographic information system (GIS) analysis contributed significantly to the assessment of impacts for several topics.

ASSUMPTIONS

Several guiding assumptions, as defined below, were made to provide context for this analysis.

Analysis Period: This plan/DEIS establishes goals, objectives, and specific implementation actions needed to manage motor vehicle recreation for the next 10 to 15 years.

Analysis Area: The geographic study area for this plan/DEIS is Glen Canyon National Recreation Area and the surrounding planning landscape. Specifically, this includes all ORV areas in Glen Canyon, including Lone Rock Beach and Lone Rock Beach Play Area, the 13 accessible shoreline areas, and Paiute Farms and Nokai Canyon. The analysis also incorporates paved and unpaved General Management Plan (GMP) roads and designated ORV routes in Ferry Swale and adjacent areas. The analysis area may be adjusted to reflect each impact topic as deemed necessary. These adjustments are explained in the "Context" section associated with each impact topic.

Duration and Type of Impacts. For the purpose of the analysis provided in this plan/DEIS, the following assumptions are used for all impact topics:

- ***Duration*** describes the length of time an effect will occur, either short term or long term:
  - *Short-term* impacts are those that occur in the immediate future.
  - *Long-term* impacts are those occurring from motor vehicle management actions over several seasons through the next 10 to 15 years and beyond.
- ***Type*** describes the classification of the impact as beneficial or adverse, direct or indirect:
  - *Beneficial*: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
  - *Adverse*: A change that moves the resource away from a desired condition or detracts from its appearance or condition.
  - *Direct*: An effect that is caused by an action and occurs in the same time and place.
  - *Indirect*: An effect that is caused by an action but is later in time or farther removed in distance, but is still reasonably foreseeable.
- ***Context*** describes the area or location in which the impact will occur. The effects may be site-specific, local, regional, or even broader in scale. Director's Order 12 directs that impacts should be analyzed in several contexts when the impact varies geographically, over time, or in some other way (NPS 2011a, Section 4.5).

Other assumptions for impacts analysis of GMP roads and designated ORV routes included direct impacts within 33 feet (10 meters) from centerline (a 66-foot corridor) and indirect impacts for 33 feet (10 meters) up to approximately 200 feet (60 meters) for GMP roads. A smaller corridor was assumed for designated ORV routes, with possible direct impacts within 12 feet from centerline of the route and indirect impacts from 13 feet up to 200 feet meters (60 meters).

Significance of the Impacts

According to the NEPA Regulations adopted by the President's CEQ (40 CFR 1500-1508), the term significantly is based on the twin criteria of context and intensity (40 CFR 1508.27).

> ***Context***: This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

Intensity: This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

1. Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect will be beneficial.

2. The degree to which the proposed action affects public health or safety.

3. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.

4. The degree to which the effects on the quality of the human environment are likely to be highly controversial.

5. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.

6. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.

7. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

8. The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places (National Register) or may cause loss or destruction of significant scientific, cultural, or historical resources.

9. The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.

10. Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

CUMULATIVE IMPACTS ANALYSIS METHOD

The CEQ regulations, which implement NEPA (42 USC 4321 et seq.), require the assessment of cumulative impacts in the decision-making process for federal projects. A cumulative impact is defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or nonfederal) or person undertakes such other actions" (40 CFR 1508.7). Cumulative impacts are considered for all alternatives, including the no-action alternative.

Cumulative impacts were determined by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions. Therefore, it was necessary to identify other ongoing or reasonably foreseeable future projects and plans at Glen Canyon and, if applicable, the surrounding region. Table 27 summarizes the actions that could affect the various resources at Glen Canyon. These actions are described in more detail in the "Related Laws, Policies, Regulations, and Plans" section of this document (see "Chapter 1: Purpose of and Need for Action").

TABLE 27: ACTIONS THAT CONTRIBUTE TO CUMULATIVE IMPACTS

The study area for all impact topics in this table is the Glen Canyon National Recreation Area Boundary, plus adjacent land.

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
Geology and Soils	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach Environmental Assessment / Development Concept Plan (EA/DCP) **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina Development Concept Plan / Environmental Assessment (DCP/EA) Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 Record of Decision (ROD) Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc.	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Play Area** Implementation Interim Management Plan for Lone Rock Beach ORV Area (Play Area) Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of environmental assessment (EA) for group use permits on Hole-in-the-Rock Road Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP Operations of Amangiri Resort	**Glen Canyon-wide** Planning for a new GMP **Lone Rock Beach** Fee Station improvements Installation of portable decontamination facility for zebra mussels **Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office BLM Programmatic EIS for Oil Sands and Tar Sands in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Lake Powel Pipeline project Continued operation of the Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Road and ORV routes improvements for utility access by the Coconino County, Arizona Department of Transportation (DOT) Development of Bureau of Land Management (BLM) Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Adjacent Lands** Unauthorized off-road uses on adjacent lands	
Vegetation	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP Release of Tamarisk Beetles to control the tamarisk **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP Current effects of Tamarisk Beetles to control the tamarisk Escalante Watershed Partnership, invasive species removal (Russian olive) **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP **Play Area** Implementation of Interim Management Plan for Lone Rock Beach ORV Area(Play Area) **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Planning for new GMP **Lone Rock Beach** Fee Station improvements Installation of portable decontamination facility for zebra mussels **Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office BLM Programmatic EIS for Oil Shale and Tar Sands Development in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Unpaved GMP Roads Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. **Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of Programmatic EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP Operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Lake Powel Pipeline project Continued operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Wildlife and Wildlife Habitat	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP Recreational hunting as allowed by the Glen Canyon enabling legislation Military overflights **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area)	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP Implementation of recreational hunting as allowed by the Glen Canyon enabling legislation Military overflights **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP	**Glen Canyon-wide** Planning for new GMP Continued implementation of recreational hunting as allowed by the Glen Canyon enabling legislation Military overflights **Lone Rock Beach** Fee Station improvements Installation of portable decontamination facility for zebra mussels

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Accessible Shorelines Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. **Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Play Area** Implementation of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP Operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office BLM Programmatic EIS for Oil Shales and Tar Sands Development in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Lake Powel Pipeline project Continued operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
Special-status Species	**Glen Canyon-wide** Illegal off-road use Special-status species inventories for bald eagles, Christmas bird counts; Brady's pincushion Utah Pronghorn Statewide Management Plan affecting Lone Rock Beach, Ferry Swale, and unpaved GMP roads **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Illegal off-road use Special-status species inventory for Desert Bighorn Sheep Reintroduction of the California condor to the Colorado Plateau Designated Critical Habitat for the Mexican spotted owl critical habitat at Orange Cliffs Unit Reintroduction/release of Desert Bighorn Sheep **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Closure or seasonal closure for lambing areas for Desert Bighorn Sheep Reintroduction/release of Desert Bighorn Sheep **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Soundscapes	**Glen Canyon-wide** Illegal off-road use Initial grant for air tours as covered in the Interim Operating authority Federal Register notice by FAA in 2005); the initial grant has now been reduced Military overflights from nearby bases **Lone Rock Beach** Noise from ORV and boat use Personal Watercraft EIS **Accessible Shorelines** Personal Watercraft EIS Development of 2008 Uplake DCP/EA Antelope Point DCP Lees Ferry DCP Warm Creek DCP **Unpaved GMP Roads** Use of motor vehicles on roads	**Glen Canyon-wide** Illegal off-road use Reduced air tours Military Overflights from nearby bases **Lone Rock Beach** Noise from ORV and boat use Personal Watercraft EIS **Accessible Shorelines** Personal Watercraft EIS Implementation of 2008 Uplake DCP/EA Antelope Point DCP Lees Ferry DCP Warm Creek DCP **Unpaved GMP Roads** Use of motor vehicles on roads **Ferry Swale** Operation of Amangiri Resort and its associated air tours	**Glen Canyon-wide** Continue air tours operations Continued military overflights from nearby bases **Lone Rock Beach** Noise from ORV and boat use Personal Watercraft EIS to include 10-year phase out of 2-stroke engines; newer 4-stroke engines are quieter **Accessible Shorelines** Personal Watercraft EIS Continued implementation of 2008 Uplake DCP/EA Antelope Point DCP Lees Ferry DCP Warm Creek DCP **Unpaved GMP Roads** Continued use of motor vehicles on roads **Ferry Swale** Continued operation of Amangiri Resort and its associated air tours

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Development of Amangiri Resort and its associated air tours **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Adjacent Lands** Unauthorized off-road uses on adjacent lands
Visitor Use and Experience	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan	**Glen Canyon-wide** Illegal off-road use Upgrading exhibits in the Carl Hayden Visitor Center Upgrading Defiance House in Bullfrog area Implementation of 1979 Glen Canyon National Recreation Area GMP **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Play Area** Development of Interim Management Plan for Lone Rock Beach ORV Area (Play Area) Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office	**Glen Canyon-wide** Planning for new GMP Upgrading interpretation on the Glen Canyon reach of the Colorado River **Lone Rock Beach** Fee Station improvements **Accessible Shorelines** Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road Implementation of Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office **Ferry Swale** Continued operation of the Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Operations of Amangiri Resort **Adjacent Lands** Unauthorized off-road uses on adjacent lands	
Archeological Resources	**Glen Canyon-wide** Illegal off-road use Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Lone Rock Beach Play Area** Development of Play Area EA **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Illegal off-road use Implementation of 1979 Glen Canyon GMP **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Lone Rock Beach Play Area** Implementation of interim ORV plan Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Planning for new GMP **Lone Rock Beach** Continued implementation of 1981 Lone Rock Beach EA/DCP Fee Station improvements Installation of portable decontamination facility for zebra mussels **Accessible Shorelines** Continued implementation of 1988 Accessible Shorelines EA/DCP Continued implementation of 1986 Paiute Farms/San Juan Marina DCP/EA Continued implementation t of 2008 Uplake DCP/EA Update to 1996 Long Term Experimental and Management Plan for Glen Canyon Dam **Unpaved GMP Roads** Implementation of EA for group use permits on Hole-in-the-Rock Road BLM PEIS for Oil Shale and Tar Sands Development in Utah Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses

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	Unpaved GMP Roads Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. **Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Ferry Swale** Lake Powel Pipeline project **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Ethnographic Resources	**Glen Canyon-wide** Illegal off-road use **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Glen Canyon-wide** Illegal off-road use **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)	**Accessible Shorelines** Continued implementation of 1988 Accessible Shorelines EA/DCP Continued implementation t of 1986 Paiute Farms/San Juan Marina DCP/EA Continued implementation t of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines)

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Unpaved GMP Roads Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc. No ethnographic resources in Ferry Swale, Lone Rock Beach and Lone Rock Beach Play Area **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office American Indian archeological sites that are ethnographic resources in Ferry Swale, accessible shorelines, Lone Rock Beach and Lone Rock Beach Play Area Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Unpaved GMP Roads** Development of 1979 Glen Canyon National Recreation Area GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses Special use permits for filming, photography, etc. No ethnographic resources in Ferry Swale, Lone Rock Beach and Lone Rock Beach Play Area **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Socioeconomics	Buildout of Antelope Point Marina Phase I Construction of Town of Escalante Hole-in-the-Rock Cultural Facility **Ferry Swale** Development of Amangiri Resort adjacent to Ferry Swale	Construction of Town of Escalante Hole-in-the-Rock Cultural Facility	Future phases of build out of Antelope Point Marina Operations of Escalante heritage Center Lake Powell Pipeline
Health and Safety	Illegal off-road use Ferry Swale area annexed by the City of Page; now providing emergency response to the area Vehicle acquisitions to better respond to incidents to remote an rugged areas Increase in Air Ambulance service for back country rescues Acquisition of a fire boat for responses at accessible shorelines **Adjacent Lands** Unauthorized off-road uses on adjacent lands	Illegal off-road use Memorandums of Agreement with emergency service providers through Glen Canyon, BLM, mutual aid agreements Continued air ambulance service for back country rescues **Adjacent Lands** Unauthorized off-road uses on adjacent lands	Repeater Tower Improvements at Navajo Mountain - impact radio communication capabilities **Adjacent Lands** Unauthorized off-road uses on adjacent lands

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
Paleontological Resources	**Glen Canyon-wide** Development of 1979 Glen Canyon GMP Illegal off-road use **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Play Area EA **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Development of 1999 Grazing Management Plan Grazing and associated vehicle uses Special use permits for filming, photography, etc.	**Glen Canyon-wide** Implementation of 1979 Glen Canyon GMP Illegal off-road use **Lone Rock Beach** Implementation of 1981 Lone Rock Beach EA/DCP Off-road use at Lone Rock Beach **Play Area** Implementation of interim ORV plan Off-road use at Lone Rock Beach **Accessible Shorelines** Implementation of interim ORV plan Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of EA for group use permits on Hole-in-the-Rock Road Updated Resources Management Plans and Travel Management Plans for BLM Monticello Field Office and Hanksville Field Office Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses **Ferry Swale** Illegal off-road use; administrative use as outlined in the Glen Canyon GMP **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Development of 1979 Glen Canyon GMP **Lone Rock Beach** Development of 1981 Lone Rock Beach EA/DCP **Play Area** Development of Play Area EA **Accessible Shorelines** Development of 1988 Accessible Shorelines EA/DCP Development of 1986 Paiute Farms/San Juan Marina DCP/EA Development of 2008 Uplake DCP/EA Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (1995 EIS, 1996 ROD Glen Canyon Dam Operations; 2007 Shortage Guidelines) **Unpaved GMP Roads** Development of 1979 Glen Canyon GMP Development of 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan Implementation of the 1999 Grazing Management Plan, grazing and associated vehicle uses Special use permits for filming, photography, etc.

Impact Topic	Past Actions	Present Actions	Future Actions (life of this plan/DEIS)
	Ferry Swale Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands		**Ferry Swale** Road and ORV routes improvements for utility access by the Coconino County, Arizona DOT Development of BLM Arizona Strip Office Travel Management Plan Development of Amangiri Resort Special use permits for filming, photography, etc. Illegal off-road use **Adjacent Lands** Unauthorized off-road uses on adjacent lands
Wilderness	**Glen Canyon-wide** Initial grant for air tours as covered in the Interim Operating authority (FR notice by FAA in 2005); the initial grant has now been reduced Military overflights from nearby bases **I**llegal off-road use **Accessible Shorelines** Personal Watercraft EIS Development of 2008 Uplake DCP/EA Antelope Point DCP Warm Creek DCP Lees Ferry DCP **Unpaved GMP Roads** Use of motor vehicles on roads cherry-stemmed though areas managed as wilderness **Ferry Swale** Development of Amangiri Resort and its associated air tours **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Reduced air tours Military Overflights from nearby bases **I**llegal off-road use **Accessible Shorelines** Personal Watercraft EIS Development of 2008 Uplake DCP/EA Antelope Point DCP Warm Creek DCP Lees Ferry DCP **Ferry Swale** Operation of Amangiri Resort and its associated air tours **Unpaved GMP Roads** Use of motor vehicles on roads cherry-stemmed though areas managed as wilderness **Adjacent Lands** Unauthorized off-road uses on adjacent lands	**Glen Canyon-wide** Continue air tours operations Continued military overflights from nearby bases **Accessible Shorelines** Personal Watercraft EIS Continued implementation of 2008 Uplake DCP/EA Antelope Point DCP Warm Creek DCP Lees Ferry DCP **Unpaved GMP Roads** Continued use of motor vehicles on roads cherry-stemmed though areas managed as wilderness **Adjacent Lands** Unauthorized off-road uses on adjacent lands

The geographic scope for this analysis includes elements mostly within the boundaries of Glen Canyon, whereas the temporal scope includes projects within a range of approximately 15 to 20 years. The following points attempt to clarify potential cumulative impact issues in the vicinity of Glen Canyon:

- No projects are proposed or in planning stages that would change road access to any area in Glen Canyon.
- No new visitor use or developed areas are being considered in Glen Canyon.
- No new resorts or major upgrades of existing facilities are being planned.
- General visitation is expected to follow trends similar to those that have been experienced for the past several years.
- NPS is evaluating the need for a new GMP for Glen Canyon.

The analysis of cumulative impacts was accomplished using four steps:

- *Step 1*—Identify resources affected.

  Fully identify resources affected by any of the alternatives.

- *Step 2*—Set boundaries.

  Identify an appropriate spatial and temporal boundary for each resource.

- *Step 3*—Identify cumulative action scenario.

  Determine which actions to include with each resource.

- *Step 4*—Cumulative impact analysis.

  Summarize the impacts of these other actions (*x*) plus impacts of the proposed action (*y*), to arrive at the total cumulative impact (*z*). This analysis is included for each impact topic in this chapter. The following past, present, and foreseeable future actions at Glen Canyon or in the surrounding area have been identified as having the potential to impact the resources evaluated in this plan/DEIS.

GLEN CANYON PLANS, POLICIES, AND ACTIONS

Glen Canyon National Recreation Area General Management Plan (NPS 1979), Superintendent's Compendium (NPS 2010), EA/DCP for Lake Powell's Accessible Shorelines (NPS 1998), Uplake DCP/EA (NPS 2006b), EA/DCP for Lone Rock Beach (NPS 1981), DCP/EA for Paiute Farms/San Juan Marina, Uplake DCP/EA (NPS 2008e), Antelope Point Marina and Resort DCP/EA (NPS and Navajo Nation 2002), Lees Ferry Area Improvements Final EA (NPS 2006d), OHV Interim Management Plans at Lone Rock Beach and Accessible Shorelines (NPS 2007h), the Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan (NPS 1995), various cultural resources management plans (CRMPs), the grazing component of the GMP (NPS 1999a), Programmatic EA for Special Recreation Permits for Organized Use along Hole-in-the-Rock Road (NPS 2011c), and the personal watercraft EIS are all park planning documents that include policies, goals, or desired conditions, that, when implemented, could contribute to the cumulative effects on the resources addressed by this plan/DEIS. These plans are described in the chapter 1 under "Related Plans and Policies for Glen Canyon National Recreation Area."

PROJECTS THROUGHOUT GLEN CANYON

Numerous past, ongoing, and planned projects are occurring throughout Glen Canyon. These projects have added to or changed the infrastructure operating in Glen Canyon during the winter season, impacting how Glen Canyon operates and how the visitor experiences Glen Canyon during this time. Projects have included the following:

- Release of Tamarisk Beetles to control the tamarisk (*Tamarix* spp.)
- Upgrading exhibits in the Carl Hayden Visitor Center
- Upgrading Defiance House in Bullfrog area
- Upgrading interpretation on the Glen Canyon reach of the Colorado River
- Build out of Antelope Point Marina Phase I
- Vehicle acquisitions to better respond to incidents to remote an rugged areas
- Continued and increased air ambulance service for back country rescues
- Acquisition of a fire boat for responses at accessible shorelines
- Repeater tower improvements at Navajo Mountain to upgrade radio communication capabilities
- Memorandums of agreement with emergency service providers through Glen Canyon, to include the BLM
- Special-status species inventories for bald eagles, Brady's pincushion, and the desert bighorn sheep
- Christmas bird counts
- Implementation of several memorandums of agreement with other agencies or park units to manage pieces of Glen Canyon to include Canyonlands National Park for Orange Cliffs Special Management Unit (Orange Cliffs Unit); Grand Canyon National Park for Lees Ferry; and the BLM for the San Juan River and Escalante
- Planned fee station improvements at Lone Rock Beach
- Planned installation of portable decontamination facility for zebra mussels
- Implementation of the 1999 Grazing Management Plan (for grazing and associated vehicle uses).

OTHER ACTIVITIES WITHIN GLEN CANYON

A wide range of activities exist in Glen Canyon that includes the following:

- Off-road use at Lone Rock Beach and Lone Rock Beach Play Area and at accessible shorelines (legal and illegal)
- Recreational hunting and livestock grazing as allowed by the Glen Canyon's enabling legislation
- Rising and falling water levels, as a result of natural fluctuations and dam operations exposing more or less of the shorelines (Bureau of Reclamation 1996; Bureau of Reclamation 2007)
- Special use permits for filming, photography
- Air tours as covered under the Notice of Interim Operating Authority Granted to Commercial Air Tour Operators Over National Parks and Tribal Lands Within or Abutting National Parks (Federal Register Volume 70, Number 120, Thursday, June 23, 2005)

- Recreational motorized and non-motorized boating on Lake Powell, the Escalante River, and the Colorado River
- Day and overnight hiking and backpacking at multiple locations throughout Glen Canyon, including the Escalante River canyons
- A wide variety of special events
- Interpretive programs and activities
- Unauthorized off-road uses on adjacent lands.

OTHER FEDERAL AGENCY PLANS, POLICIES, AND ACTIONS

In addition to the laws and policies above, other federal planning documents exist that directly or indirectly relate to off-road use at Glen Canyon, were taken into consideration during the development of this plan/DEIS.

Record of Decision for Operation of Glen Canyon Dam Final Environmental Impact Statement (1996)

This ROD of the Department of the Interior, Bureau of Reclamation, documented the selection of operating criteria for Glen Canyon Dam, as analyzed in the final EIS, dated March 21, 1995 (Bureau of Reclamation 1996). The EIS on the operation of Glen Canyon Dam was prepared with an unprecedented amount of scientific research, public involvement, and stakeholder cooperation.

The Secretary of the Interior's decision is to implement the Modified Low Fluctuating Flow Alternative (the preferred alternative) as described in the final EIS on the operation of Glen Canyon Dam with a minor change in the timing of beach/habitat building flows. This alternative was selected because it will reduce daily flow fluctuations well below the no-action alternative levels (historic pattern of releases) and will provide high steady releases of short duration which will protect or enhance downstream resources while allowing limited flexibility for power operations.

Colorado River Interim Guidelines for Lower Basin Shortages and the Coordinated Operations for Lake Powell and Lake Mead Final Environmental Impact Statement/Record of Decision (2007)

Reservoir elevations have declined over the past decade (1997–2007) and the duration of this ongoing, historic drought is unknown. This is the first long-term drought in the modern history of the Colorado River, although climate experts and scientists suggest droughts of this severity have occurred in the past and are likely to occur in the future. The Colorado River provides water to two nations and to users within seven western states.

Declining reservoir levels in the basin led to interstate and interbasin tensions. As the agency charged with management of the Colorado River, the Department of the Interior had not yet developed rules for the full range of operations at Lake Powell and Lake Mead because these types of low-reservoir conditions had not yet occurred. At the direction of the Secretary of the Interior, the Department of the Interior initiated a public process in May 2005 to develop additional operational guidelines and tools to meet the challenges of the drought in the basin. While water storage in the massive reservoirs afforded great protection against the drought, the Department of the Interior set a goal to have detailed, objective operational tools in place by the end of 2007 in order to be ready to make informed operational decisions if the reservoirs continued to decline.

In 2007, the ROD constituted the Department of the Interior's final decision after facilitating, analyzing, and considering public input received over two and one-half years, during which the ongoing drought continued to focus nationwide attention on the basin. A broad range of alternatives were analyzed, involving water supply, environmental protection, hydropower production, and recreation.

Update to 1996 Long-term Experimental and Management Plan for Glen Canyon Dam, Bureau of Reclamation

The Bureau of Reclamation proposed to develop and adopt a long-term experimental plan that will implement a structured, long-term program of experimentation (including dam operations, modifications to Glen Canyon Dam intake structures, and other non-flow management actions, such as removal of nonnative fish species) in the Colorado River below Glen Canyon Dam (Bureau of Reclamation 2008).

Development or Update of Travel Management Plan, Bureau of Land Management

The Arizona Strip Field Office, Monticello Field Office, and Richfield Field Office are in the process of developing or updating their travel management plans. These comprehensive travel management plans will address all resource use aspects, including recreational, traditional, casual, agricultural, commercial, and educational uses; and the accompanying modes and conditions of travel on public lands that abut Glen Canyon.

Updated Resources Management Plans, Bureau of Land Management

The Monticello Field Office and Richfield Field Office are in the process of updating their resources management plan. The resources management plan for the Monticello Field Office will provide direction for future management of public lands administered by the BLM Monticello Field Office in San Juan and Grand Counties. The resources management plan for Richfield Field Office will provide for future management for Sanpete, Sevier, Paiute, Wayne, and Garfield Counties in central Utah.

Draft Programmatic EIS and Possible Land Use Amendments for Allocation of Oil Shale and Tar Sands Resources, Bureau of Land Management

The BLM recently published the Notice of Availability of the Draft Programmatic Environmental Impact Statement and Possible Land Use Amendments for Allocation of Oil Shale and Tar Sands Resources on Lands Administered by the BLM in Colorado, Utah, and Wyoming. The draft programmatic EIS analyzes several alternatives for land allocation and resource management. Under the BLM's preferred alternative identified in the draft programmatic EIS, the BLM would continue to support the research and development of hydrocarbon deposits in an environmentally responsible way that protects scarce water supplies in the arid West. If the BLM decides to adopt the preferred alternative, 461,965 acres would be available for research and development of oil shale, a kerogen-rich rock (35,308 acres in Colorado; 252,181 acres in Utah; and 174,476 acres in Wyoming). In addition, 91,045 acres in eastern Utah would be available for activities related to tar sands, a type of hydrocarbon-wet sedimentary deposit.

Memorandum of Understanding between Bureau of Land Management and National Park Service (1984) and Interagency Agreement between Bureau of Land Management and National Park Service for Grazing Management on Glen Canyon National Recreation Area (1993)

These agreements prescribe the manner in which the BLM administers grazing permits within Glen Canyon and the values and purposes determination[12] requirement for the Superintendent of Glen Canyon. The determination requirement is to ensure that grazing activities do not conflict with the protection of resources as called for in the 1916 NPS Organic Act of the Glen Canyon Grazing Management Plan (NPS 1999a).

Military Overflights from Nearby Bases

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

Reintroduction of the California Condor to the Colorado Plateau, U.S. Fish and Wildlife Service

California condors (*Gymnogyps californianus*) are the largest flying land bird in North America. Condors are opportunistic scavengers that feed primarily on large dead mammals such as deer, elk, bighorn sheep, range cattle, and horses.

As Euro-Americans began to extensively settle the West they often shot, poisoned, captured, and disturbed the native condors. Settlers also intensively hunted antelope, elk, and other large wild animals, significantly reducing the bird's food supply. Eventually condors could no longer survive in much of their former range, and by the 1970s just a few remaining wild individuals were left, confined to the mountainous areas of southern California.

The California condor has been protected as an endangered species by federal law since 1967. Captive-bred condors were first released to the wild in southern California in 1992, and since that time reintroduction efforts have been expanded. On the Colorado Plateau, condors are currently being reintroduced just north of the Grand Canyon in the Vermilion Cliffs region of southern Utah and northern Arizona (CP-LUHNA n.d.).

Endangered and Threatened Wildlife and Plants; Final Designation of Critical Habitat for the Mexican Spotted Owl; Final Rule, U.S. Fish and Wildlife Service (50 CFR Part 17)

In 2004, the U.S. Fish and Wildlife Service (USFWS) designated critical habitat under the Endangered Species Act of 1973, as amended, for the Mexican spotted owl (*Strix occidentalis lucida*). The owl inhabits canyon and forest habitats across a range that extends from southern Utah and Colorado, through Arizona, New Mexico, and west Texas, to the mountains of central Mexico. the USFWS designated approximately 3.5 million hectares (8.6 million acres) of critical habitat in Arizona, Colorado, New Mexico, and Utah, on federal lands. Critical habitat for the Mexican spotted owl has been designated in areas of the Orange Cliffs Unit of Glen Canyon.

[12] Before authorizing an activity (such as grazing) it must be determined if recreation area values and purposes are affected. This decision process is called a "Values and Purposes Determination" (NPS 1999).

Utah Pronghorn Statewide Management Plan, Utah Department of Natural Resources (2009)

This management plan is the statewide management plan for pronghorn in Utah. The plan provides overall direction and guidance to Utah's pronghorn management activities. Included in the plan are an assessment of current life history and management information; identification of issues and concerns relating to pronghorn management in the state; and the establishment of goals, objectives; and strategies for future management programs. The statewide plan provides direction for establishment of individual pronghorn unit management plans throughout the state.

OTHER STATE AND LOCAL PLANNING DOCUMENTS, POLICIES, ACTIONS

Lake Powel Pipeline Project, Utah

The Utah State Board of Water Resources, Department of Natural Resources, is proposing to build 120 miles of 66-inch diameter pipeline from the Lake Powell Glen Canyon dam site in Arizona to Sand Hollow Reservoir near St. George, Utah, and 38 miles of 30-inch diameter pipeline from Sand Hollow to Cedar City. It is anticipated that much of the pipeline would be within the legislated utility corridor in Kane County that parallels highway US 89, and then would parallel Interstate-15 to Iron County. One alternative proposes that the pipeline would dip south back into Arizona and transverse the Kaibab Band of the Paiute Tribe Reservation, as well as sensitive BLM lands within the Arizona Strip Field Office.

Road and ORV Routes Improvements for Utility Access by the Coconino County, Arizona Department of Transportation

Improvements by the county include grading of access utility routes in Ferry Swale.

Development and Operation of the Amangiri Resort

The Amangiri Resort is located on 600 acres in Canyon Point, Utah, a 25-minute drive from the nearest town of Page, Arizona, and a 15-minute drive to the shores of Lake Powell. The resort offers a wide variety of activities, including hiking trails, boating trips, scenic flights, and spa treatments. In addition, the resort is located in proximity to Glen Canyon, and visitors to the resort can partake in all the opportunities Glen Canyon offers.

Operations of Escalante Heritage Center and Construction of Escalante/Hole-in-the-Rock Heritage Center, Town of Escalante, UT

The Escalante Heritage Center is dedicated to preserving the history and heritage of the Hole-in-the-Rock and San Juan pioneers who passed through the Escalante Valley in the winter of 1879 and 1880. The Escalante Heritage Center provides a special place to present and preserve the rich and amazing heritage and culture of the Escalante Valley.

Ferry Swale Area Annexed by the City of Page

The Ferry Swale area was annexed by the City of Page, Arizona, in 2010. The city now provides emergency response to the area.

Escalante Watershed Partnership, Invasive Species Removal of Russian Olive

Created in 2009, the Escalante River Watershed Partnership brings together a diverse group of private and federal agencies to achieve restoration goals for the Escalante River. The Escalante River Watershed Partnership now

includes federal and state agencies, local government representatives, nonprofit organizations, businesses, local landowners, and citizens. Since 2009, Glen Canyon has been teaming with the Escalante River Watershed Partnership to remove the Russian olive and restore the Escalante River watershed.

Release of Desert Bighorn Sheep at Last Chance Creek (Utah Division of Wildlife Resources)

The Utah Division of Wildlife Resources proposes to release 25 desert bighorn sheep from Nevada into Glen Canyon near the Last Chance Creek/Lake Powell confluence. Previous introductions by the state have occurred within Glen Canyon with NPS approval. Last Chance Creek is located in the northwest side of Glen Canyon. The UDWR Bighorn Sheep Statewide Management Plan (2008) identifies Last Chance Creek as a location where the state would like to augment existing populations to meet population management objectives.

Utah Division of Wildlife Resources is planning to capture 50 desert bighorn sheep in Nevada. Utah Division of Wildlife Resources would like to release 25 of the 50 sheep into Last Chance Creek. Utah Division of Wildlife Resources is interested in releasing the sheep near water, and is considering transporting the sheep to the release site by boat on Lake Powell. If this is not feasible, the sheep would be transported to a release site along County Road 230.

GEOLOGY AND SOILS

GUIDING REGULATIONS AND POLICIES

Soils and geologic features are fundamental natural resource components whose integrity is addressed in numerous laws and policies governing the management of national park system units. NPS *Management Policies 2006* (NPS 2006a) specifically directs that natural resources, including physical resources such as soils, be managed to preserve fundamental physical and biological processes. *Management Policies 2006* also states that "the Service will protect geologic features from unacceptable impacts of human activity while allowing natural processes to continue" (NPS 2006a, Section 4.8.2). Section 4.8.2.4 requires NPS to preserve soil resources and to prevent the unnatural erosion or removal of soils and to minimize adverse impacts on soil resources.

METHODOLOGY AND ASSUMPTIONS

The methodology for assessing impacts on geology and soils included a review of published literature, soils information from the Natural Resources Conservation Service, and the resource-specific knowledge of planning team members. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic study area for soils and geology is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

ALTERNATIVE A: NO ACTION

The impacts of off-road use have been thoroughly documented for areas with desert soils similar to Glen Canyon (Webb and Wilshire 1983). Major damage from off-road use to soils in arid areas includes destruction of soil stabilizers (Webb and Wilshire 1983), soil compaction and reduced rates of water infiltration (Webb 1982), accelerated rates of surface water runoff and erosion (Iverson 1980; Tuttle and Griggs 1987), accelerated rates of wind erosion (Gillette and Adams 1983), and declines in soil productivity (Adams et al. 1982; Tuttle and Griggs

1987; Belnap 2002). Damage to desert soils, like those found at Glen Canyon, can occur with a single pass of a vehicle (Webb and Wilshire 1983). The Colorado Plateau, which contains the greatest concentration of national parks in the United States (including Glen Canyon), is largely made up of deserts with scattered areas of forests. In the deserts of the Colorado Plateau, cyanobacterial soil crusts can account for 70% of the living soil cover (Belnap 1990). The function of these living soil crusts include stabilizing soils, improving soil structure to increase water infiltration, and concentrating essential nutrients for vascular plant growth (Belnap 2004). Cryptobiotic (or biological) crusts such as those found at Glen Canyon are particularly fragile, especially during the drier seasons. Small amounts of pressure will break through the crust and expose the loose sand or soil beneath to the forces of erosion. Such soils are very susceptible to damage by vehicles and may require 250 years or more for full recovery (Belnap 1993). Biological crusts are highly sensitive to disturbance. Tire treads can impact wide swathes of crusts, breaking down the delicate top layer through shearing and compaction and exposing the rocks and sand below to wind erosion (Belnap 1996). Crusts are most susceptible during the dry season, when footsteps or tire treads easily break through the brittle crust surface (Belnap and Lange 2001). Disturbance directly and indirectly affects many aspects of the structure and function of biological crust communities, including cover, species composition, and nitrogen fixation (Belnap 1993, 1996). Desert soils and associated biological crusts are slow to recover from disturbance due to lack of moisture, limited growth periods, and shallow, easily eroded soils. Crustal organisms are only active when wet; therefore, in desert ecosystems complete recovery may take centuries. Disturbance recovery rates for biological crusts in southern Utah are estimated at 45 years for lichen and 250 or more years for the entire crustal community (Belnap and Lange 2001). Impacts and associated recovery times increase with the number of passes, the total area of impact, and the timing and frequency of disturbance (Belnap and Lange 2001).

One important factor to consider in an analysis of soils is the extent to which already-denuded shorelines occur as a result of inundation as lake levels have fluctuated. Impacts on soils below the 3,700-foot elevation contour would occur on already-denuded areas that have been recolonized by native and exotic vegetation only over the last 10-12 years. There are unlikely to be any significant biological crusts occurring below this full pool elevation because there has not been sufficient time to allow for the redevelopment of these types of soils.

Glen Canyon contains very few areas of well-developed soils. Approximately one-third of the area is bare rock, another one-third is bare rock with pockets or thin cover (less than 20 inches) of windblown sand, and most of the remainder is unstable, wind- or water-deposited material subject to continual disturbance. Deeper, more mature soils do exist, however, in alluvial situations where active erosion is not now occurring (an estimated 1,850 acres). Except for these alluvial soils, all Glen Canyon soils are susceptible to erosion and are readily transported by wind and water. The only impediment to their movement is the sparse mantle of vegetation that helps bind the soil particles. Any disturbance of this vegetation cover by vehicles, trampling, or grazing can readily increase the volume of material transported.

Soil types can be described with regard to their susceptibility for erosion, which can be used to determine the degree of impact that would occur on specific soils given prolonged exposure to off-road use. Table 28 provides detail on the specific soil associations found at locations of interest for this analysis and their respective erodibility factor, or “K factor.” The K factor is a measure of the susceptibility of soil to erosion. Soils high in clay have low K values, from approximately 0.05 to 0.15, because they are resistant to detachment. Coarse-textured soils, such as sandy soils, have low K values, from approximately 0.05 to 0.2, because of low runoff even though these soils are easily detached. Medium-textured soils, such as the silt loam soils, have moderate K values, from approximately 0.25 to 0.4, because they are moderately susceptible to detachment and they produce moderate runoff. Soils having a high silt content are the most erodible of all soils. They are easily detached, and tend to crust and produce high rates of runoff. Values of K for these soils tend to be greater than 0.4 (IWR 2012). Soils in the study area are of low to moderate erodibility, as presented in table 28, with K factors ranging from 0.05 to 0.37.

TABLE 28: SOILS AT LOCATIONS OF INTEREST IN GLEN CANYON NATIONAL RECREATION AREA

Shoreline	Soil Series	K Factor
Crosby Canyon, Farley Canyon, Warm Creek	Rock outcrop–Torriorthents complex, 20% to 65% slopes, extremely bouldery	NR
Nokai Canyon	Rock outcrop–Moenkopi association, steep	NR
Bullfrog North, Bullfrog South, Lone Rock Beach, Lone Rock Beach Play Area, Ferry Swale, Warm Creek	Farb–Pagina–rock outcrop complex, 4% to 20% slopes, bouldery	0.37
Neskahi, Paiute Canyon, Paiute Farms	Lithic Torriorthents–Typictorriorthents–rock outcrop association, steep	0.24
Ferry Swale	Pagina–Denazar complex, 2% to 14% slopes	0.24
Copper Canyon	Hoskinnini–rock outcrop complex, 2% to 8% slopes	0.2
Blue Notch, Red Canyon, White Canyon	Somorent family–rock outcrop complex, 5% to 12% slopes	0.15
Dirty Devil	Tsaya–rock outcrop complex, 2% to 18% slopes	0.1
Stanton Creek	Myton very gravelly sandy loam, 5% to 18% slopes, very bouldery	0.05

Source: NRCS 2011.

NR = not rated.

The Farb–Pagina–rock outcrop complex (see figure 12) has the largest K factor (0.37), and is moderately likely to become eroded with continued off-road use. By contrast, Myton soils have a K factor of 0.05, representing a low susceptibility for erosion. It should be noted, however, that these K factors are intended as measurements of soils in their natural condition. They do not indicate how past management or misuse of a soil increases a soil's erodibility. In those areas where the subsoil is exposed, the organic matter has been depleted and/or the soil's structure destroyed, or soil compaction has reduced permeability, the K factor would be increased regardless of soil type (IWR 2012).

Lone Rock Beach

Lone Rock Beach and the neighboring play area are the only locations in Glen Canyon where all types of motor vehicle use (conventional and nonconventional) are currently allowed. Soils at Lone Rock Beach include those classified as Farb–Pagina–rock outcrop complex, with a soil K factor of 0.37, indicating a moderate susceptibility to erosion. Under the no-action alternative, direct impacts on soils and geology, including the erosion of these more sensitive soils, would continue to occur on approximately 250 acres with ongoing off-road use (by conventional motor vehicles, OHVs, and street-legal all-terrain vehicles (ATVs)) at Lone Rock Beach. Soils in these areas have historically been impacted through years of motor vehicle use, and damage to the soil substrate through shearing, compaction, and erosion resulting from motor vehicle use would continue and potentially increase in severity of impact under the no-action alternative.

Lone Rock Beach Play Area

The Lone Rock Beach Play Area at Lone Rock Beach is a fence-enclosed, 180-acre area that is open to high-intensity motor vehicle use. The play area is the only location in Glen Canyon where all types of ORVs (including conventional motor vehicles, OHVs, and street-legal ATVs) are allowed to be operated in an unrestricted manner.

Soils at Lone Rock Beach Play Area include those classified as Farb–Pagina–rock outcrop complex, with a soil K factor of 0.37, indicating a moderate susceptibility to erosion. Under the no-action alternative, impacts on soils and geology at the play area, including the erosion of these more sensitive soils, would continue to occur with ongoing unrestricted use. Soils in this area have historically been impacted through years of unrestricted motor-vehicle use, and damage to the soil substrate through shearing, compaction, and erosion resulting from motor vehicle use would continue and potentially increase in severity of impact under the no-action alternative.

Accessible Shorelines

Off-road use under alternative A would impact a relatively limited portion of the Lake Powell shoreline in comparison to the entire approximately 2,000 miles of shoreline available at Glen Canyon. The no-action alternative would result in adverse impacts on the soils and geology at accessible shoreline areas in Glen Canyon. Under alternative A, 13 accessible shorelines with ORV areas would remain open for use by conventional motor vehicles (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, White Canyon, and Hite Boat Ramp) for a total of approximately 5,900 acres. These ORV areas are not intended as play areas (climbing hills in vehicles, driving at high speeds, and similar behavior is prohibited), and the operation of any OHVs or street-legal ATVs would not be allowed. Permitted off-road use in these areas would remain strictly to serve the purpose of providing immediate access to the shorelines. Because the no-action alternative would maintain current management practices related to these accessible shorelines, the control of off-road use by conventional motor vehicles at these shorelines would not be completely protective of Glen Canyon resources, including soil and geological features. As a result, these areas could continue to be vulnerable to off-road use in unauthorized areas or by unauthorized vehicles.

Under the no-action alternative, conventional motor vehicles would be permitted to depart roads and drive directly to the shoreline to park in designated areas, resulting in the continued disturbance of soils in this area. Approximately 258 acres of Farb-Pagina type soils would be directly disturbed at shoreline areas under this alternative (see table 29). Soil erodibility at accessible shorelines ranges from low to moderate, with soil K factors indicating a higher susceptibility to erosion at Warm Creek and Bullfrog North and South compared to the other accessible shorelines. Moderately erodible Farb-Pagina rock outcrop complex soils are present at the Warm Creek, Bullfrog North, and Bullfrog South shoreline areas. Soils at other shoreline areas are less susceptible to erosion and would incur less severe impacts from off-road use. These soils are described further in chapter 3 of this plan/DEIS, which describes in greater detail their presence at various shorelines.

Biological soil crusts occur in areas of Glen Canyon, which are free from historic or current non-natural disturbance, with shallow soil and limited water and wind erosion. As described in Belnap and Lange (2001), biological soil crust cover generally increases in areas with low vascular plant cover, at lower elevation, and with more loosely embedded rocks, shallower soils, and fine soil texture. These cryptobiotic crusts, which exist above the full pool 3,700-foot elevation in these areas, would be damaged by pressure from motor vehicles, which would expose the loose sand or soil beneath to the forces of erosion. Continued off-road use by conventional motor vehicles at the accessible shorelines would lead to changes in soil structure due to the crushing and shearing of the soil substrate, resulting in soil compaction and accelerated erosion. These direct impacts would continue to occur at and near the accessible shoreline sites. Continued soil erosion in these areas would result in a degraded surface, a diminished ability for vegetation to become established, and the eventual loss in the amount of shoreline suitable for recreational use. These direct impacts would be long term and localized, occurring at specific locations rather than being widespread over the entire Glen Canyon area.

The designated accessible shorelines were established at a time when Lake Powell was at or near full pool. When the water level of Lake Powell is at these higher elevations, each designated ORV area is bounded by natural topographical features, resulting in a confined space for off-road use. The Lake Powell water level has dropped in recent years, leading to more topography being exposed at these shoreline areas. In some instances the designated ORV area is no longer bounded by natural features, resulting in land beyond the designated ORV area being

available to off-road use as recreational visitors seek access to the lake. Sensitive paleontological resources occur in these and other areas of Glen Canyon (see the "Paleontological Resources" section later in this chapter). Under the no-action alternative, Glen Canyon would place controls on this activity, such as signage informing visitors that travel is restricted to authorized areas. Although this measure may be only marginally effective, such restrictions would potentially curtail impacts on additional acres resulting from occasional off-road driving in unauthorized areas.

In aerial views, motor vehicle use in non-authorized areas is evident throughout Glen Canyon, and may greatly impact any biological soil crusts (as discussed above), leading to increased erosion, increased formation of physical crusts, and reduced overall soil stabilization. Additionally, because of slow recovery times, tracks made by motor vehicles driving off-road on the soil may be evident for many years, particularly if they occur in areas of otherwise well-established biological crusts. These tracks from unauthorized off-road use may attract additional ORV traffic to an area and increase soil disturbance and subsequent erosion.

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue the off-road use of these shoreline areas. Currently Warm Creek, Crosby Canyon, and Bullfrog North and South are temporarily closed due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. The Paiute Farms and Nokai Canyon accessible shorelines (approximately 1,400 acres) are not officially authorized for off-road use, although they are currently being accessed. Under alternative A, off-road use at Paiute Farms and Nokai Canyon would be discontinued and management action taken to prevent access. Soils in these ORVs areas would benefit from the recovery time provided by the cessation of off-road use.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on all GMP roads in Glen Canyon (there are approximately 315 miles of unpaved GMP roads, and approximately 75 miles of paved GMP roads at Glen Canyon), with the exception of the Orange Cliffs Unit where street-legal ATVs are prohibited. OHVs and ATVs that do not meet the street-legal requirements under Utah and Arizona code are prohibited from operating on any road in Glen Canyon. Under the no-action alternative, these current management practices would continue.

No impacts on soils would result from motor vehicle use on paved GMP roads because paved roads contain an asphalt top and no soils that would be disturbed, and it is assumed that vehicles would be travelling on the roadway, including paved shoulders, and not contributing to erosion at roadway edges. Soils along unpaved GMP roads, by contrast, may be subject to increased wind erosion and compaction due to vehicle pass-bys and shoulder pull-offs. However, the impact is expected to be low as long as these vehicles remain on the roadways. Direct impacts (those within 33 feet (10 meters) on either side of the road centerline) would occur on approximately 714 acres of the most commonly occurring soils at Glen Canyon, including approximately 240 acres of moderately-erodible soils of the Farb-Pagina soil complex. Indirect impacts (those between 33 feet (10 meters) and approximately 200 feet (60 meters) on either side of the road centerline) would occur on approximately 3,428 acres of the most common soils at Glen Canyon, including approximately 1,167 acres of moderately- erodible soils of the Farb-Pagina soil complex.

Because the majority of Glen Canyon's unpaved GMP roads have compacted dirt surfaces, impacts on soils on designated unpaved GMP roads would likely be contained to the edges of already disturbed areas. Soils along these roads are previously disturbed through blading, compaction, other earthmoving activities required for road construction and routine maintenance, and use. As a result, the continued use of conventional motor vehicles and street-legal ATVs would not result in notable harm to soils on these surfaces.

Ferry Swale

In Ferry Swale there are areas with unauthorized user-created routes over which ORVs travel before crossing onto federal lands administered by the BLM. The Vermilion Cliffs is an area of sensitive geologic formations administered by the BLM. The formation itself is composed of a 3,000-foot sandstone escarpment. These unauthorized user-created routes are currently being accessed. Under the no-action alternative, approximately 53 miles of unauthorized user-created routes would be authorized and designated for use by conventional motor vehicles, OHVs, and street-legal ATVs.

Under alternative A, soils in Ferry Swale would experience direct adverse impacts from continued rutting, erosion, and compaction along the approximately 53 miles of designated ORV routes. However, because the majority of these designated ORV routes have compacted dirt surfaces, impacts on soils would likely be contained to the edges of already disturbed areas. Soils along these ORV routes are previously disturbed. As a result, the continued use of conventional motor vehicles, OHVs, and street-legal ATVs along these routes would not result in notable harm to soils on these surfaces.

Soil K factors in the Ferry Swale area indicate a relatively low to moderate susceptibility to erosion. These soils include Farb-Pagina; Juanalo; Needle-Sheppard; and Pagina-Denazari. Under the no-action alternative, off-road use would be allowed only on designated ORV routes. Direct disturbances within 12 feet of either side of the centerline of the ORV routes in Ferry Swale would occur over approximately 40 acres of moderately erodible Farb-Pagina type soils, while indirect disturbances to these soils (i.e., disturbances over an area from 13 feet to approximately 200 feet (60 meters)) from the centerline of the designated ORV route would equate to approximately 527 acres under this alternative (see table 29).

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect soils and geology. These cumulatively considerable actions are presented on table 27 in this chapter and described in greater detail in chapter 1. Both adverse and beneficial impacts have occurred as a result of these cumulative actions. Adverse impacts have accrued to soils and geological resources from illegal off-road use within the recreation areas and on adjacent lands, reintroduction of desert bighorn sheep, grazing, and associated vehicle use, all of which have contributed to soil compaction and erosion. The formation of nonbiotic or physical soil crusts, in particular, which are formed in soils with low organic matter and low silt and clay content, is reduced by livestock grazing management, soil surface protection, and increased soil organic matter (Neff et al. 2005). Beneficial impacts on soils and geology have also occurred, and would continue to occur into the future from the implementation of the following plans or actions:

- 1979 Glen Canyon National Recreation Area General Management Plan, which considers soils and geology in managing Glen Canyon resources
- 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan which determines how the backcountry areas of Glen Canyon should be managed.
- Road and ORV route improvements at Ferry Swale

Additional actions include the development of BLM Arizona Strip Office Travel Management Plan, which also results in beneficial impacts on soils and geology. Beneficial cumulative impacts may also result from the above-mentioned management plans where restrictions to where ORVs can be operated are established. These actions contribute to cumulatively considerable long-term adverse and beneficial impacts on soils and geologic resources. The continuation of local and adverse impacts on soils and geological resources under alternative A, in

combination with the beneficial impacts from the other, primarily NPS-related actions, would result in a slight contribution of adverse impacts on overall long-term beneficial impacts.

ALTERNATIVE B: NO OFF-ROAD USE

Lone Rock Beach

Under alternative B, off-road use at Lone Rock Beach would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs, and the area restored to natural conditions. Soils at Lone Rock Beach, which include those classified as Farb-Pagina rock outcrop complex, with a soil K factor of 0.37 indicating a moderate susceptibility to erosion, would benefit from the recovery time provided by the cessation of off-road activity in Glen Canyon under alternative B. These benefits would extend to approximately 250 acres of soil at Lone Rock Beach. By prohibiting all off-road use in this area, alternative B would allow for soils in impacted areas of Lone Rock Beach to recover. As vegetation is allowed to reestablish in areas of former impact, soil erosion would diminish. Over the long term, these beneficial effects would become readily apparent in areas of previous disturbance.

Lone Rock Beach Play Area

Under alternative B, off-road use at the 180-acre Lone Rock Beach Play Area would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs, and the area restored to natural conditions. In the same way as described above for Lone Rock Beach, soils at Lone Rock Beach Play Area would benefit from the recovery time provided by the cessation of all off-road activities in Glen Canyon under alternative B. By prohibiting off-road use, alternative B would allow soils in impacted areas of Lone Rock Beach Play Area to recover. As vegetation is allowed to reestablish in areas of former impact, soil erosion would diminish. Over the long term, these beneficial effects would become readily apparent in areas of previous disturbance in the play area, where moderately erodible soils of the Farb–Pagina–rock outcrop complex have been impacted.

Accessible Shorelines

Under alternative B, off-road use at 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be discontinued permanently and restored to natural conditions. Farb-Pagina rock outcrop complex soils are present at the Warm Creek, Bullfrog North, and Bullfrog South shoreline areas. These soils are moderately susceptible to erosion. Soils at other shoreline areas are less susceptible to erosion and would incur less severe impacts from off-road use. By prohibiting off-road use at accessible shorelines areas, alternative B would remove the existing source of soil disturbance and allow soils in impacted areas of accessible shorelines (approximately 7,300 acres) to recover. In the same way as described above for Lone Rock Beach, soils at the accessible shoreline areas would benefit from the recovery time provided by the cessation of all off-road activities. As vegetation becomes reestablished in areas of former impact, soil erosion would be lessened. These beneficial effects would be more apparent in areas of previous disturbance and in areas of moderately erodible soils (based on K factors of 0.25 and above), such as the Bullfrog North and South shoreline area. These impacts would be long term and localized, occurring at specific locations rather than being widespread over the entire Glen Canyon area.

Travel on GMP Roads in Glen Canyon

Direct and indirect impacts on soils along paved and unpaved GMP roads under alternative B would be the same as those under alternative A. Conventional motor vehicles and street-legal ATVs would continue to operate on GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be authorized.

Ferry Swale

No off-road use would be allowed in Ferry Swale and existing user-created routes would be closed and the area restored to natural conditions. In the same way as described above for Lone Rock Beach, Lone Rock Beach Play Area, and the accessible shoreline areas, soils in Ferry Swale would benefit from the recovery time provided by the cessation of off-road activities in Glen Canyon under alternative B.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the beneficial impacts on soils and geology under alternative B, would result in long-term beneficial cumulative impacts on soils and geology.

Alternative C: Increased Motorized Access

Lone Rock Beach

Impacts on soils and geology at Lone Rock Beach under alternative C would be similar as impacts described for these areas under the no-action alternative. However, under this alternative, areas authorized for off-road use at Lone Rock Beach would be marked and defined with improved signage and/or barriers in a manner consistent with the control of off-road use for the protection of Glen Canyon resources, including soil and geological features. All ORV users would require a permit to operate at Lone Rock Beach and be permitted to drive off-road only from the end of the road directly to the shoreline areas; soils along this path between the roads and shorelines would continue to be impacted. Requiring all operators desiring to travel off-road to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations and resource protection which could result in better protection of the recreation area's resources.

Lone Rock Beach Play Area

Impacts on soils and geology at Lone Rock Beach Play Area under alternative C would be the same as impacts described for these areas under the no-action alternative. Similar to Lone Rock Beach, areas authorized for off-road use at the play area would be marked and defined with improved signage and/or barriers in a manner consistent with the control of off-road use for the protection of Glen Canyon resources. The addition of a permit system would be a means to better manage off-road use in the area and provide a means to monitor use as well as educate operators about rules and regulations and resource protection.

Accessible Shorelines

Under alternative C, a total of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles, OHVs, and street-legal ATVs by permit, subject to water-level closures. This alternative would result in the increased potential for localized impacts on soils to approximately 7,300 acres of ORV areas that would be open to off-road use by conventional motor vehicles, OHVs, and street-legal ATVs at the accessible shorelines. The degree of impacts could be severe in specific areas with soil K factors indicating a higher susceptibility to erosion, such as at Bullfrog North and South.

Continued off-road use by conventional motor vehicles combined with the additional off-road use by OHVs and street-legal ATVs would lead to changes in soil structure due to the crushing and shearing of the soil substrate, resulting in soil compaction and accelerated erosion. These impacts would occur at and near the accessible shoreline areas. Approximately 258 acres of Farb-Pagina type soils would be directly disturbed at shoreline areas

under this alternative (see table 29). With increased off-road use, soils in already disturbed areas would be prevented from recovering through the reestablishment of erosion-mitigating vegetation.

Under this alternative, areas authorized for use at the shorelines would be marked and defined in a manner and defined with improved signage consistent with the control of off-road use for the protection of Glen Canyon resources, including soil and geological features. All ORV users would require a permit to operate at accessible shorelines and would be permitted to drive off-road only from the end of the road directly to the shoreline areas; soils along this path between the roads and shorelines would continue to be impacted. Requiring all operators desiring to travel off-road to obtain a permit will provide a means to monitor use as well as educate operators about rules and regulations and resource protection which could result in better protection of the recreation area's resources. Although increased motor vehicle use at accessible shorelines would result in the potential for more widespread and higher-intensity adverse impacts on soils and geology.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on all GMP roads in Glen Canyon, including roads within the Orange Cliffs Unit. Impacts on soils and geology from increased use on unpaved GMP roads under alternative C would be similar to the impacts described for the no-action alternative. Direct impacts would occur up to 33 feet (10 meters) from the road centerline. As under the no–action alternative, approximately 714 acres of the most common soils at Glen Canyon, including approximately 240 acres of moderately-erodible soils of the Farb-Pagina soil complex, would be directly impacted on GMP roads under alternative C. Indirect impacts (those from 33 feet (10 meters) to approximately 200 feet (60 meters)) would take place on approximately 3,428 acres of the most common soils at Glen Canyon, including approximately 1,167 acres of moderately-erodible soils of the Farb-Pagina soil complex. Although the geographic extent of impacts would be identical, assuming an accompanying increase in motor vehicles operating on GMP roads, impacts under alternative C would be potentially greater than the no-action alternative because of the addition of OHVs on unpaved GMP roads as well as OHVs and street-legal ATVs on unpaved GMP roads in the Orange Cliffs Unit. No impacts on soils would result from vehicle use on paved GMP roads because these roads have an asphalt top and no soils that would be disturbed, and it is assumed that vehicles will travel on the roadways and not contribute to erosion at roadway edges.

Ferry Swale

The designation of ORV routes (approximately 15 miles) in Ferry Swale could increase damage to soils and geologic resources along those routes because motor vehicle use would be concentrated to the 15 miles, but would be beneficial to segments of unauthorized user-created routes where its use would cease. Where unauthorized user-created routes become designated ORV routes, soils would be even more susceptible to damage from compaction, resulting in accelerated runoff potential that would lead to higher rates of erosion. Direct disturbances within 12 feet of either side of the route centerline in Ferry Swale would occur over approximately 0.2 acres of moderately erodible Farb-Pagina type soils, while indirect disturbances to these soils (i.e., those disturbances occurring over an area from 12 feet to approximately 200 feet [60 meters] of the route centerline) would equate to approximately 5 acres under this alternative (see table 29). Whereas previously, unauthorized off-road use would create dispersed, short-term effects on soils, alternative C would concentrate off-road impacts in specific areas along designated routes. Over the long- term, this would cause continued damage that could constitute a substantial level of impact on soils in the area due to their relative susceptibility to erosion.

Mitigation measures under this alternative would be similar to those in other ORV areas such as Lone Rock Beach, Lone Rock Beach Play Area, and accessible shorelines, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on soils and geology to some degree by limiting driving outside of designated ORV routes s, thereby limiting erosion and compaction outside of authorized areas.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the adverse impacts on soils and geology under alternative C, would result in long-term adverse cumulative impacts on soils and geology. However, the beneficial impacts on soils and geology accruing from greater protection of these resources provided under alternative C would provide long-term beneficial cumulative impacts.

ALTERNATIVE D: DECREASED MOTORIZED ACCESS

Lone Rock Beach

Under alternative D, Lone Rock Beach would remain open to conventional motor vehicles, however, OHVs or street-legal ATVs would not be allowed. In areas of the beach where access with conventional motor vehicles is allowed, soils on approximately 250 acres would continue to experience impacts from shearing and compaction, leading to a greater potential for erosion. Soils at Lone Rock Beach include those classified as Farb-Pagina rock outcrop complex, with a soil K factor of 0.37, indicating a moderate susceptibility to erosion. Impacts in these areas would be adverse and considerable. Soils at Lone Rock Beach could benefit some from the recovery time provided by the reduction of activity because of no OHVs or street-legal ATVs would be allowed on the beach under alternative D. Soils in impacted areas of Lone Rock Beach would not have a greater chance of full recovery because vegetation in areas would continue to be impacted by conventional motor vehicle use. The potential for further soil erosion could be diminished. Over the long term, these beneficial effects could become readily apparent in areas of previous disturbance.

Lone Rock Beach Play Area

Under alternative D, off-road use at Lone Rock Beach Play Area would be discontinued and the area restored to natural conditions. Impacts on soils and geology at Lone Rock Beach Play Area under alternative D would be the same as impacts described for these areas under alternative B.

Accessible Shorelines

Under alternative D, off-road use at a total of 11 accessible shoreline areas would be discontinued permanently, whereas four (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp, approximately 1,100 acres) would be open only to conventional motor vehicles by permit, subject to water-level closures. No acres of Farb-Pagina type soils would be directly disturbed at the shoreline areas authorized for use under this alternative (see table 29).The cessation of off-road use in these 11 areas would allow soils in impacted areas to recover through a reprieve from routine compaction and by the reestablishment of erosion-mitigating native vegetation. Improvements to soils would be most notable in areas of currently heavy off-road use. It can be anticipated, however, that the loss of 11 accessible shoreline areas could result in those visitors relocating to other shoreline areas where off-road use is permitted; therefore, impacts on resources could increase at the four open accessible shorelines as demand for access and visitation to those sites increase. As a consequence, damage to soils and geologic features at Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp could be intensified beyond current levels. In these areas, soils would be damaged by compaction, resulting in accelerated runoff potential that would lead to higher rates of erosion, resulting in substantial to severe levels, but contained within the accessible shoreline area, of impacts because of the increased intensity of use in these areas. These impacts would be adverse, both short and long term and localized, occurring at the four specific accessible shoreline locations rather than being more widespread over the entire Glen Canyon area. Mitigation measures under this alternative would be the same as under alternative C, and would include improved signs and communication/education with partners and

users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on soils and geology to some degree by limiting driving outside of designated ORV areas, thereby limiting erosion and compaction outside of authorized areas.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on soils on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on soils from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

Under alternative D, no ORV routes would be designated. Direct and indirect impacts on soils and geology in Ferry Swale would be similar to alternative B. Soils in Ferry Swale would benefit from the recovery time provided by the cessation of off-road activities. Mitigation measures would result in closure and barricading of unauthorized routes. As a result, levels of erosion and soil compaction would be reduced and eventual restoration would occur in areas of prior disturbance, resulting in beneficial impacts on soils at the recreation area.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur. As a result of discontinuation and non-designation of ORV routes, however, adverse impacts on soils and geology under alternative D would be greatly reduced compared to those described for alternative A. The impacts of cumulative actions, in combination with the beneficial impacts on soils and geology accruing from greater protection of these resources provided under alternative D, would result in long-term beneficial cumulative impacts.

Alternative E: Mixed Use

Lone Rock Beach

Impacts on soils and geology at Lone Rock Beach under alternative E would be similar to the impacts described for this area under alternative C. Under this alternative, impacts on soils and geology through shearing, compaction and erosion resulting from vehicle use would continue to occur with ongoing off-road use by conventional motor vehicles, OHVs, and street-legal ATVs. The prohibition of motor vehicles on a portion of the beach (approximately 20-acre vehicle-free zone) could slightly lessen impacts on soils. Although no substantial beneficial effects would accrue over time from this restriction, the cessation of motor vehicle use within the designated 20 acre vehicle-free area would produce benefits from decreased potential for soil shearing, compaction, and erosion.

Lone Rock Beach Play Area

Impacts on soils and geology at Lone Rock Beach Play Area under alternative E would be similar to the impacts described for this area under alternative C.

Accessible Shorelines

Under alternative E, off-road use at one accessible shoreline area would be discontinued permanently (Warm Creek). Fourteen areas (12 existing areas plus Paiute Farms and Nokai Canyon) would remain open to conventional motor vehicles and street-legal ATVs (approximately 6,000 acres), only by permit, subject to water-level closures. Under this alternative, the cessation of off-road use at Warm Creek would allow the soils in impacted areas to

recover through a reprieve from routine compaction and by the reestablishment of erosion-mitigating vegetation. Improvements to soils would be most notable in areas of currently heavy off-road use.

The loss of one shoreline access area is not anticipated to result in substantial impacts on resources at the other 14 accessible shorelines as a result of increased demand for access and visitation to those sites because the remaining areas could absorb the increased demand without additional disturbance of resources. Moreover, damage to soils and geologic features at 12 of the authorized accessible areas and Paiute Farms and Nokai Canyon is not likely to intensify to severe levels because only street-legal ATVs would be introduced. However, with the continued use of shoreline access sites, soils would remain impacted and damaged through compaction, and the resulting accelerated runoff potential would continue to occur, leading to higher rates of erosion and resulting in substantial levels of impacts. Approximately 270 acres of Farb-Pagina type soils would be directly disturbed at shoreline areas under this alternative (see table 29). These impacts would be adverse, both short and long term and localized, occurring at the authorized accessible shorelines rather than being widespread over the entire Glen Canyon area. Mitigation measures under this alternative would be the same as under alternatives C and D, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on soils and geology to some degree by limiting driving outside of designated ORV areas, thereby limiting erosion and compaction outside of authorized areas.

Travel on GMP Roads in Glen Canyon

Under alternative E conventional motor vehicles and street-legal ATVs, would be authorized to operate on paved GMP roads in Glen Canyon. OHVs and street-legal ATVs would also be authorized on unpaved GMP roads. No OHVs or street-legal ATVs would be allowed on any road segments of the Orange Cliffs Unit. Direct and indirect impacts on soils would be similar to alternative C. Soils near unpaved GMP roads in these areas would remain compacted from ongoing use, with a higher proportion of impacts directly within 12 feet of the road centerlines. The effects of erosion as a result of runoff from compacted areas, as discussed for other alternatives, would continue to impact areas immediately adjacent to roads, particularly near culverts and in areas of steeper terrain. No direct impacts on soils would result from vehicle use occurring on paved GMP roads because these roads contain no soils that would be disturbed and it is assumed that vehicles will travel on the roadways and not contribute to erosion at roadway edges.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 12 miles of designated ORV routes in the Ferry Swale area. Impacts on soils in this area would be the same as to those expected under alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect soils and geology under the no-action alternative would occur, and cumulatively considerable actions under alternative E would be the same as those described for alternative A. The impacts of these actions, in combination with the adverse impacts on soils and geology under alternative E, would result in long-term adverse cumulative impacts on soils and geology. However, the beneficial impacts on soils and geology accruing from greater protection of these resources provided under alternative E would provide long-term beneficial cumulative impacts. As a result, overall there would be negligible cumulative effects regardless of whether they are adverse or beneficial in character.

CONCLUSION

Table 29 below provides additional detail regarding the amounts of disturbance to various soils types under each alternative.

TABLE 29: COMPARISON OF IMPACTS ON SOILS ACROSS ALTERNATIVES*

Select Soil Types	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Accessible Shorelines (acres impacted)					
Farb-Pagina-Rock outcrop complex	258.3	0	Same as alternative A	0	270.2
Moenkopie-Rock outcrop complex	26.0		Same as alternative A	6.8	Same as alternative A
Myton very gravelly sandy loam	120.4		Same as alternative A	8.8	Same as alternative A
Pagina-Denazar complex	49.5		Same as alternative A	0	75.2
Rock outcrop-Needle complex	31.7		40.7	Same as alternative C.	Same as alternative C
Rock outcrop-Torriorthents complex	151.0		Same as alternative A	42.8	134.1
Sheppard sand	42.1		Same as alternative A	0	Same as alternative A
Somorent family-Rock outcrop complex	84.4		Same as alternative A	38.0	84.8
Torriorthents-Rock outcrop-Badland complex	59.6		Same as alternative A	0	Same as alternative A
Tsaya-Rock outcrop complex	35.0		Same as alternative A	1.0	Same as alternative A
TOTAL	858	0	867	138	888
Ferry Swale (acres impacted)					
Farb-Pagina-Rock outcrop complex	Direct: 40.6 Indirect: 527.0	Direct: 0 Indirect: 0	Direct: 0.2 Indirect: 4.6	Direct: 0 Indirect: 0	Same as alternative C
Juanalo family-Rock outcrop complex	Direct: 0 Indirect: 4.0		Direct: 0.2 Indirect: 4.0		Same as alternative A
Needle-Sheppard complex	Direct: 4.7 Indirect: 71.7		Direct: 12.6 Indirect: 174.9		Same as alternative C
Pagina-Denazar complex	Direct: 131.8 Indirect: 1,445.6		Direct: 4.8 Indirect: 80.3		Same as alternative C
Rock outcrop-Needle complex	Direct: 7.5 Indirect: 89.0		Direct: 12.8 Indirect: 184.0		Same as alternative C
Rock outcrop-Torriorthents complex	Direct acres impacted: 0.1 Indirect acres impacted: 2.9		Direct: 0.4 Indirect: 9.1		Same as alternative C

Select Soil Types	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Sheppard sand	Direct: 15.5 Indirect 205.9		Direct: 3.2 Indirect: 48.4		Same as alternative C
TOTAL (direct)	200	0	34	0	34
TOTAL (indirect)	2,346	0	505	0	505
Unpaved GMP Roads (acres impacted)					
Farb-Pagina-Rock outcrop complex	Direct: 239.9 Indirect: 1,167.2	Same as alternative A	Same as alternative A	0	Same as alternative A
Moenkopie-Rock outcrop complex	Direct: 32.4 Indirect: 151.7	Same as alternative A	Direct: 57.4 Indirect: 176.7	0	Same as alternative A
Myton very gravelly sandy loam	Direct: 45.7 Indirect: 213.2	Same as alternative A	Direct: 70.7 Indirect: 238.2	0	Same as alternative A
Juanalo family-Rock outcrop complex	Direct: 101.5 Indirect: 489.2	Same as alternative A	Same as alternative A	0	Same as alternative A
Needle-Sheppard complex	Direct: 24.9 Indirect: 123.7	Same as alternative A	Same as alternative A	0	Same as alternative A
Pagina-Denazar complex	Direct: 261.4 Indirect: 1,241.6	Same as alternative A	Same as alternative A	0	Same as alternative A
Sheppard sand	Direct: 7.7 Indirect: 41.8	Same as alternative A	Same as alternative A	0	Same as alternative A
TOTAL (DIR)	713.5	713.5	763.5	0	713.5
TOTAL (IND)	3,428.4	3,428.4	3,478.4	0	3,428.4

*Note: For the purpose of supporting the narrative discussion, only pertinent soil types are provided in the table. These are the most common and highly representative of soils generally found within the park unit. Direct impacts apply to soils contained within 12 feet (3.6576 meters) on either side of designated ORV route centerlines at Ferry Swale and within 33 feet (10.0584 meters) on either side of road centerlines on paved and unpaved GMP roads. Indirect impacts apply to soils contained within an area between 12 feet (3.6576 meters) and 196.85 feet (60 meters) on either side of route centerlines at Ferry Swale and between 33 feet (10.0584 meters) and 196.85 feet (60 meters) on either side of road centerlines on GMP roads.

As described above, impacts to soils from off-road use and on-road OHV use may include erosion, compaction, and sedimentation. The severity of impacts to soils varies by type of use and location. Understanding the significance of these impacts requires a closer look at the context in which these impacts occur.

Impacts to soils from on-road OHV use are not expected to be severe or significant, because roadways have been designed and engineered to be driven upon, and soils existing along these routes have been disturbed previously through blading, compaction, and other earthmoving activities required for road construction and routine maintenance. The most severe impacts to soils from on-road OHV use are likely to occur where moderately erodible Farb-Pagina soils exist. Unpaved GMP roads roughly occur on approximately 240 acres of that soil type.

Off road use at accessible shorelines would also cause erosion, rutting, sedimentation and other adverse impacts to soils. These impacts would be highly noticeable, apparent, and severe at the higher use accessible shorelines, such as Bullfrog North and South and Stanton Creek. Moderately erodible Farb-Pagina type soils at Bullfrog North and South would experience repeated use and may not readily recover from ongoing impacts. Past off-road use at these areas contribute to degraded soils, also make impacts at these locations more severe. However, these impacts are concentrated to certain portions within authorized accessible shorelines and generally do not extend beyond authorized areas.

Impacts to soils at Lone Rock Beach and Play area are extremely severe. Farb–Pagina type soils found in these areas do not readily recover from repeated disturbance and the soil structure has been significantly altered. For this reason, Glen Canyon has intentionally confined off-road use of this type to the play area in order to ensure that this level of impact does not occur in any other location in Glen Canyon. Off-road use at the play area severely impacts roughly 120 acres of the moderately erodible soils type at the play area.

Impacts on soils in Ferry Swale under alternative A, under which the most miles of ORV routes would be designated (approximately 53 miles, approximately 1 acre), are not likely to be severe because, although the direct effects of off-road use would continue, use would be confined to these existing routes. Soils outside of these routes would not be impacted. Additionally, under the action alternatives, Glen Canyon would mitigate impacts to soils by using signage, additional enforcement, and closures to ensure additional erosion does not occur outside designated routes.

In conclusion, in some areas, like the Ferry Swale area, soils are likely significantly degraded from past and present uses such as grazing and illegal off-road use. Future uses in this area, such as the Lake Powell Pipeline construction and ongoing maintenance of existing utilities have created and would likely continue to create severely degraded soils. Significant adverse impacts on soils are likely already occurring regardless of whether any off-road use is authorized. Alternatives A, C, D and E, which would authorize off-road use, would contribute to those significant impacts on soils. However, the authorization of off-road use and on-road OHV use within Glen Canyon by itself is not significant, because adverse impacts to soils from these uses would contribute only a small fraction of the overall adverse soil impacts. The total footprint of impacts on soils from off-road use estimated under alternative C, the alternative authorizing the most use, (from direct and indirect impacts along unpaved GMP and ORV routes in Ferry Swale and at accessible shorelines) is 19,970 acres. This represents less than 2% of the total 1,249,934 acres of soils within the park unit. Impacts to soils along accessible shorelines make up a tiny part of the 2,000 mile shoreline of Lake Powell. And finally, narrowing the context to soil type, the soil type most impacted by off-road use and on-road OHV use under any alternative is the moderately erodible Farb-Pagina. Even under the alternative authorizing the most use, less than 1% of the 66,766 acres of this soil type are impacted by use that would be authorized under this plan.

VEGETATION

GUIDING REGULATIONS AND POLICIES

The Park Service seeks to maintain all native plant populations in parks as part of the natural ecosystem, including the natural abundance, diversity, dynamics, distribution, and habitats of native plants (NPS 2006a). The Park Service is directed to minimize human impacts on native plants, populations, communities, and ecosystems, as well as the processes that sustain them (NPS 2006a, Section 4.4.1). This protection against impacts extends to individual plants as genetic parts of larger species communities and populations (NPS 2006a, Section 4.4.1.1).

Executive Order 13112, "Invasive Species," directs federal agencies to prevent the introduction of invasive species and not to take actions that the agency believes are likely to cause or promote the introduction or spread of invasive species. NPS *Management Policies 2006* states that exotic (nonnative) species will not be allowed to displace native species if possible (NPS 2006a). The Park Service works to prevent the introduction of nonnative species (NPS 2006a, Section 4.4.1.1) and to restore natural systems, specifically including the removal of nonnative species and the restoration of native plants (NPS 2006a, Section 4.1.5).

The Strategic Plan for Glen Canyon NRA and Rainbow Bridge NM FY2008 – FY2012 (NPS 2007e) identifies restoring lands to natural conditions and controlling lands infested with nonnative, invasive species as management goals for Glen Canyon.

METHODOLOGY AND ASSUMPTIONS

The primary sources of information for assessing impacts on vegetation included information from Glen Canyon's botanist, site visits, and material from published literature for similar environments, and information from scientists with the Park Service to determine the likely effects on species present in Glen Canyon. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Context

The geographic study area for vegetation is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

ALTERNATIVE A: NO ACTION

Off-road use affects desert vegetation in two ways: first, of the five primary resources required to support terrestrial vegetation, three—water, mineral nutrients, and a porous medium for physical support—are derived directly from the soil. As soils are damaged, they lose the ability to support desert vegetation. Second, off-road use causes direct damage that includes the crushing of foliage, root systems, and seedlings; the uprooting of small plants; and the disruption of large plant root systems by shearing and compaction of desert soils (Luckenbach and Bury 1983). The extent of these existing conditions at Glen Canyon is discussed in detail in chapter 3.

Deserts and arid regions generally are considered areas of low productivity. Vegetation is slow growing and sparse, a reflection of the environmental stresses present in arid and semiarid environments. Damage to desert vegetation can be immediate and long lasting.

Scientific studies have reported a highly negative response by perennial desert vegetation to most types and intensities of off-road use. Smaller plants can be destroyed at very low levels of off-road use and larger, more resilient plants will succumb to damage following repeated impacts. In arid climates, areas that sustain heavy off-road use have been observed to have little to no vegetation, suggesting that the severity of damage to vegetation is directly correlated with the intensity of off-road use (Bury 1980; Luckenbach and Bury 1983).

Direct damage also clearly affects vegetation species, primarily blackbrush. Most species are capable of recovering from direct contact with ORVs; however, blackbrush does not reestablish after the elimination of the species. Due to the loose sandy soils of these areas, ORV tracks tend to fade away within a few years, allowing soil nutrients and vegetation species the opportunity to recover or return (Spence n.d.).

The introduction and spread of nonnative, invasive species by ORVs is also a concern. Invasive species are a significant threat, displacing native plant species and threatening the biodiversity and overall productivity of the desert environment. Off-road use and vehicle use in general have been shown to contribute to the introduction and establishment of invasive and nonnative species in three ways: expansion or creation of routes and trails, disturbance to previously undisturbed soils, and direct transportation of seeds into new areas (Switalski and Jones 2008).

Although off-road use may not account for ecologically significant nonnative seed dispersal, off-road use has been shown to transport seeds (Rooney 2005). A study by Lacey et al. (1997) demonstrated that a single vehicle engaging in off-road use is capable of distributing 2,000 knapweed seeds in one 10-mile trip. In another study, the number of seeds collected from a single vehicle during four sampling times over one year ranged from 513 to 1,330 (Schmidt 1989).

Although Glen Canyon possesses a significant variety of vegetation, vegetation species that are of particular concern are those located below 5,000 feet above sea level, in the area of off-road use. Vegetation in these areas is dominated by blackbrush and shadscale, with smaller populations of sand sage and Cutler-Mormon-tea and grasslands. To assess the potential effects of off-road use on desert vegetation, the planning team developed a GIS map using vegetation community layers to show which vegetation communities exist in ORV routes and areas and have the most potential to be affected (see chapter 3, figure 11, "Vegetation of Glen Canyon National Recreation Area").

Lone Rock Beach

Adverse impacts on vegetation at Lone Rock Beach would continue based on continued off-road use by conventional motor vehicles, OHVs, and street-legal ATVs at the beach. Vegetation communities consisting primarily of grasses, weeds and bushes at the beach were previously covered when the lake was inundated, killing all native plants. When the lake water receded a new colonization of vegetation communities began, much by exotic species. These communities have historically been physically impacted through vegetation crushing, as well as being impacted from the loss of the ability of soils to provide habitat for remaining vegetation species as a result of off-road use. Due to these impacts, minimal vegetation communities remain and are primarily exotic. However, for those native communities that do exist, damage from off-road use would continue and dependent on the magnitude of continued use could potentially increase, resulting in the destruction of native vegetation at the beach, which could be a severe adverse impact. In addition to vegetation destruction through crushing, continued impacts on soils would remove the ability of soils to provide suitable conditions for vegetation communities (Switalski and Jones 2008), further restricting the ability of vegetation to exist in the area. Continued off-road use would also increase the likelihood for the spread of nonnative, invasive species.

Lone Rock Beach Play Area

At the Lone Rock Beach Play Area there is unrestricted use by all types of motor vehicles - conventional motor vehicles, OHVs, and street-legal ATVs. Under alternative A, impacts on vegetation would continue to occur with ongoing unrestricted motor vehicle use. Vegetation communities in the play area have historically been physically impacted by unrestricted off-road use through crushing, as well as being impacted by the loss of the ability of soils to provide habitat for remaining vegetation species. Due to these impacts, minimal vegetation communities remain. However, for those that do exist, damage would continue and potentially increase, resulting in the destruction of all vegetation in the area, which would be a severe adverse impact. In addition to vegetation destruction through crushing, continued impacts on soils would remove the ability of soils to provide habitat for vegetation communities, further restricting the ability of vegetation to exist in the area. Continued off-road use would also increase the likelihood for the spread of nonnative, invasive species.

Accessible Shorelines

The no-action alternative would result in continued impacts on vegetation at approximately 5,900 acres of open accessible shorelines; however, this is a relatively small area in comparison to the entire approximately 2,000 miles of shoreline in Glen Canyon. Impacts would be primarily to blackbrush (416 acres), sand sagebrush (933 acres) and shadscale (612 acres), however similarly to above this is a relatively small portion of the overall amounts of these vegetation types in comparison to the approximately 291,180 acres, 101,440 acres, and 203,730 acres respectively for each vegetation type. Under alternative A, 13 accessible shorelines would remain open to off-road use by conventional motor vehicles only (Blue Notch, Bullfrog North and South, Copper Canyon, Crosby Canyon, Dirty Devil, Farley Canyon, Neskahi, Paiute Canyon, Red Canyon, Stanton Creek, Warm Creek, Hite Boat Ramp, and White Canyon). The operation of any OHVs or street-legal ATVs would continue to be prohibited in the 13 shoreline areas. However, because alternative A would maintain current management practices related to the accessible shorelines, there could be occasional off-road use of unauthorized areas, further impacting vegetation in the following ways: direct physical impacts from off-road use through crushing on vegetation species, and indirect

impacts from altering the soil structure to a level that cannot support vegetation and possibly transporting nonnative, invasive species into areas where they currently do not exist.

Many vegetation communities in the area of the accessible shorelines are newly colonized and primarily consist of a number of exotic vegetation species as identified in chapter 3, as previous native vegetation was eliminated when the lake was inundated. The new vegetation has then been previously disturbed and considerably impacted by off-road use. Disturbance has ranged from minimal impacts, such as minor physical damage (e.g., light vegetation crushing where the survival of the individual vegetation plants [or local survival of the vegetation species] is not in question), to vegetation being completely destroyed. Although the majority of vegetation in these areas has been removed or destroyed as a result of off-road use and lake fluctuations, some vegetation communities do still exist. These communities typically consist primarily of native blackbrush, sand sagebrush, and shadscale. Because conventional motor vehicles are permitted to travel off-road, depart Glen Canyon roads and drive directly to the shoreline, and park in designated areas, the vegetation communities that exist in these areas would continue to be directly physically impacted through being crushed, with severe adverse impacts such as complete vegetation destruction possible.

Continued off-road use and potential use would likely negatively impact soils through compaction, the creation of gullies in the soil and the increased potential for erosion, and therefore the prevention or weakening of the soil's ability to distribute minerals and water to vegetation communities. The weakening of the soil structure also weakens the physical support of vegetation, causing further damage to vegetation, with the severity of the impacts depending on the severity of the impacts on soils. Continued off-road use also leaves open the possibility of nonnative, invasive species being brought into the areas, causing further stresses to existing native species and resulting in further adverse impacts on vegetation. In addition, there is some damage to vegetation at several shorelines above 3,700 feet by illegal off-road use, especially at Farley Canyon. The potential for illegal off-road use at these areas could continue to result in vegetation crushing and destruction to primarily blackbrush and shadscale equating to adverse impacts on vegetation.

The accessible shoreline areas were established at a time when Lake Powell was at or near full pool. When the water level of Lake Powell is at these higher elevations, each designated ORV area is bounded by natural topographical features, resulting in a confined space for off-road use. Because the Lake Powell water level has dropped in recent years, more topography has been exposed at the ORV areas. In some instances the designated ORV area is no longer bounded by natural features, resulting in land beyond the designated area being accessed by ORVs as off-road recreational visitors seek access to the lake.

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue the off-road use of shoreline areas. Currently off-road use has been temporarily discontinued at Warm Creek, Crosby Canyon, and Bullfrog North and South due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. Such closures would curtail the potential for additional acres of vegetation to be impacted by off-road driving. In areas that have previously not been affected by off-road use, vegetation is often present and undisturbed. Off-road use in these areas when lake levels decrease would cause damage to these vegetation communities, with impacts ranging from minimal, such as limited areas of vegetation being crushed by vehicles but not to the extent where the survivability of the species is impacted, to more intense, such as the complete destruction and removal of a species in the area. The Paiute Farms and Nokai Canyon accessible shorelines (approximately 1,400 acres of the approximately 5,900 acres of accessible shoreline) are not officially open, although they are currently being accessed. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access resulting in beneficial impacts on vegetation.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on approximately 72 miles of paved GMP roads and all unpaved GMP roads, approximately 365 miles, at Glen Canyon, with the exception of the Orange Cliffs Unit, where street-legal ATVs are not authorized for use. ATVs that do not meet the street-legal requirements under Utah and Arizona code would not be authorized to operate on any unpaved GMP road in Glen Canyon

No impacts on vegetation would result from vehicle use occurring on paved GMP roads, because paved roadways contain no vegetation. It is assumed that all vehicles will remain on the roadways during travel and will not impact vegetation that exists along the roadway edges. Impacts on vegetation along designated Glen Canyon unpaved GMP roads would likely be contained to already disturbed areas, where there is currently minimal vegetation, with the highest proportion of impacts directly within 33 feet (10 meters) of the road centerlines. Indirect impacts would occur between 33 feet (10 meters) and approximately 200 feet (60 meters) on either side of the road centerline. Vegetation that exists along roadway edges could be physically impacted through crushing or destruction from vehicle pass-bys and shoulder pull-offs. Impacts as a result of these actions would be minimal as long as the vehicles remain on the existing roads. Direct and indirect impacts on soils on either side of the road would continue and would reduce the ability of soils to provide habitat for vegetation. However, because the vegetation in the area has been previously impacted and motor vehicle use (conventional motor vehicles and street-legal ATVS) would continue to be contained to the already disturbed unpaved GMP designated roads where minimal vegetation exists, no new notable harm to vegetation would occur. Direct impacts would occur primarily to blackbrush and shadscale, impacting approximately 791 and 595 acres respectively. However, when compared to these vegetation types as a whole as presented above for accessible shorelines, the overall amount of vegetation impacted is relatively small.

Ferry Swale

In Ferry Swale, in the area of Vermilion Cliffs there are areas with unauthorized user-created routes over which ORVs travel before crossing onto federal lands administered by the BLM. Under the no-action alternative, approximately 53 miles of these user-created ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs.

Under alternative A, approximately 1 acre of shadscale and 1 acre of fourwing saltbush would be adversely impacted by vegetation crushing, destruction, the reduced ability of soils to provide habitat for vegetation species along the 53 miles of designated ORV routes. However, vegetation in the area of the designated ORV routes is limited, as much of the area consists of rock outcrops and previously existing vegetation is scarce based on prior disturbance and destruction from previous off-road use. Based on soil compaction and the established nature of existing ORV routes, impacts on vegetation would likely be contained to the edges of already disturbed areas. As a result, the continued use of conventional motor vehicles, OHVs, and street-legal ATVs would not result in notable harm to soils on these surfaces.

Cumulative Impacts

Other past, present, and planned future activities within Glen Canyon have the potential to affect vegetation. A number of these activities have led to beneficial impacts on vegetation, and these impacts would continue into the future from the development and implementation of the following plans or actions.

- The 1979 Glen Canyon GMP and a planned new GMP, which set forth to appropriately manage Glen Canyon resources, including native vegetation.

- The release and effects of tamarisk beetles to control the invasive tamarisk, and the Escalante Watershed Partnership, which is removing the invasive species Russian Olive.
- 1981 Environmental Assessment/Development Concept Plan for Lone Rock Beach (Lone Rock Beach EA/DCP), 1988 Environmental Assessment/Development Concept Plans for Lake Powell's Accessible Shorelines (Accessible Shorelines EA/DCP), 1986 Environmental Assessment/Development Concept Plan for San Juan Marina at Paiute Farms (EA/DCP), 2008 Uplake Development Concept Plan/Environmental Assessment (Uplake DCP/EA) which provide guidance for development and use in various locations across Glen Canyon and work to control invasive vegetation species and minimize impacts on natural vegetation.
- Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan which determines how the backcountry areas of Glen Canyon should be managed and provides direction on the management and protection of vegetation.
- Development of the Interim Management Plan for Lone Rock Beach Play Area, which determined the existing use of the play area by ORVs.

Site-specific adverse impacts may also result from these management plans that physically impact vegetation or reduce the ability of vegetation to survive, primarily through including where ORVs can be operated and which accessible shoreline areas are open to visitor use. For vegetation communities in areas where off-road use is permitted, those vegetation species may experience adverse physical impacts from crushing and adverse impacts from the loss of the ability of soils to provide for these species, which can occur through off-road and visitor use and as a result of the tamarisk beetles.

Additional actions include the development of the BLM Arizona Strip Office Travel Management Plan, development and operation of the Amangiri Resort, and the Lake Powell Pipeline Project. These actions physically impacted and continue to impact vegetation in the footprint of construction and through visitor activities, measurably reducing the amount of native vegetation species in the vicinity of Glen Canyon, resulting in severe site-specific adverse impacts.

Current and future BLM projects include the update and implementation of resource management plans and travel management plans for the Monticello and Hanksville field offices. These projects would have beneficial impacts on vegetation, similar to the existing management plans.

The Programmatic EIS for Oil Shale and Tar Sands Development in Utah would lead to adverse impacts on vegetation in and around the footprint of the sites and associated activities of the sites. Current and future projects within Glen Canyon include the development and implementation of group use permits for Hole-in-the-Rock Road. Such projects would provide beneficial impacts by limiting the amount of users and ORVs in the area and their potential impacts on vegetation. Severe site-specific adverse impacts would result from allowing access to the area, potentially impacting vegetation.

Actions like the installation of Portable Decontamination Facility for zebra mussels and Fee Station Improvements at Lone Rock Beach would likely provide some site-specific severe adverse impacts on vegetation, through the physical removal or damage to vegetation in or around the footprint of the sites. It is expected however, that all sites would avoid existing natural vegetation to minimize potential adverse effects. The new GMP, interim ORV plan, and experimental and management plan for Glen Canyon Dam would provide both beneficial and adverse impacts on vegetation depending on the amount of vegetation affected and the amount protected.

Improvements to road and ORV routes for utility access by the Coconino County, Arizona DOT, special use permits for filming and photography, illegal off-road use both at Glen Canyon and on adjacent lands, the reintroduction of bighorn sheep, grazing, associated vehicle use, and administrative off-road use all have the potential to have site-

specific adverse impacts on vegetation in the footprints of grazing and animal movements, route improvements, and in the footprint of off-road use.

Rising and falling water levels as a result of natural fluctuation and dam operations exposes both more and less of the shorelines. When the shoreline is exposed, vegetation is exposed and subjected to possible severe site-specific adverse impacts from off-road use. When the shoreline submerged, severe adverse impacts result from submerging and destroying vegetation.

The potentially adverse impacts resulting from activities and actions as noted above would likely be severe, although site specific, and not significant to the overall region. These actions, in combination with the continuation of adverse impacts on vegetation by ORV activities under alternative A, would result in long-term adverse cumulative impacts on vegetation within Glen Canyon, with alternative A slightly contributing.

ALTERNATIVE B: NO OFF-ROAD USE

Lone Rock Beach

Under alternative B, off-road use at Lone Rock Beach would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs; and the area restored to natural conditions. Vegetation at Lone Rock Beach would benefit by having the opportunity to recover in the absence of motor vehicle disturbance. Previously disturbed vegetation communities would have the opportunity to recover and beneficial impacts on soils would further benefit vegetation communities, allowing new communities the opportunity to grow in the improved soil conditions. These benefits would extend to approximately 250 acres at Lone Rock Beach. However, because of the severity of previous disturbance, primarily from the vegetation communities being eliminated by fluctuating water levels and from off-road use, beneficial impacts on vegetation may not be realized for a substantial length of time, if at all. In addition, the spread of nonnative, invasive species to these areas through ORVs would be reduced by the prohibition of these vehicles, resulting in further long-term beneficial impacts.

Lone Rock Beach Play Area

Similar to Lone Rock Beach, off-road use at the Lone Rock Beach Play Area would be discontinued permanently to conventional motor vehicles, OHVs, and street-legal ATVs; and the area restored to natural conditions. Impacts at Lone Rock Beach Play Area would be similar to those at Lone Rock Beach.

Accessible Shorelines

Discontinuing off-road use at all 15 accessible shorelines (approximately 7,300 acres in total) at Glen Canyon under alternative B would allow for vegetation that has historically been impacted by off-road use to recover. Currently existing vegetation is primarily made up of exotic species because previous vegetation has been eliminated when the lake was inundated. However, both exotic and native vegetation that remains and that has been impacted would no longer be crushed by motor vehicle use. In addition, soil that has been previously impacted would regain the ability to provide habitat for native vegetation, though recovery time would depend on vegetation type as well as amount and degree of previous disturbance. Beneficial effects from the removal of motor vehicle disturbance would vary between shorelines based on the amount of previous impacts from off-road use to vegetation. However, it is expected that because of the already sparse vegetation in these areas and the difficulty of survival for vegetation in the climate of Glen Canyon while competing with exotic species, beneficial impacts on native vegetation may not be realized for a substantial length of time.

Travel on GMP Roads in Glen Canyon

Under alternative B, conventional motor vehicles and street-legal ATVs would be allowed to operate on all paved and unpaved GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit, where street-legal ATVs would not be allowed. Vegetation would continue to be impacted as described for alternative A.

Ferry Swale

No off-road use would be allowed in Ferry Swale to access adjacent BLM lands. Vegetation that has historically been impacted by off-road use, primarily consisting of fourwing saltbush and shadscale, would recover. In the same way as described previously in this section for Lone Rock Beach, Lone Rock Beach Play Area, and the accessible shorelines, vegetation in Ferry Swale would benefit from the recovery time provided by the cessation of off-road activities in Glen Canyon u. It is important to note that the cessation of off-road use could result in the increase of exotic species in the area as these species would also benefit from the recovery time. In the event of exotic species colonizing the area, there could be severe adverse impacts on native vegetation.

Cumulative Impacts

Under alternative B, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described under alternative A. The impacts of these actions, in combination with the adverse impacts on vegetation under alternative B, would result in long-term, site-specific severe adverse cumulative impacts on vegetation, with alternative B having a minimal contribution. Under alternative B, beneficial impacts on vegetation would occur, and when combined with the beneficial impacts of the cumulative actions, would provide long-term cumulative benefits to vegetation.

Alternative C: Increased Motorized Access

Lone Rock Beach

Impacts on vegetation at Lone Rock Beach under alternative C would be similar to the impacts described for this area under the no-action alternative. However, impacts would be somewhat reduced with the implementation of mitigation measures including an ORV permit, improved signs, communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, closures, and additional restrictions on vehicle type or other alterations to use. Under this alternative, impacts on vegetation would continue to occur with ongoing off-road use, resulting in long-term adverse impacts.

Lone Rock Beach Play Area

Impacts on vegetation at Lock Rock Beach Play Area under alternative C would be similar as those described under the no-action alternative. Under this alternative, long-term adverse impacts on vegetation would continue to occur with ongoing unrestricted off-road use at the play area. Similar to Lone Rock Beach, impacts on vegetation at the play area would be somewhat reduced with the implementation of mitigation measures including an ORV permit, improved signs, communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, closures, and additional restrictions on vehicle type or other alterations to use.

Accessible Shorelines

Under alternative C, a total of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open to conventional motor vehicles, OHVs, and street-legal ATVs by permit, subject to water-level closures. This alternative could result in the increased potential for localized impacts on an additional 7,300 acres

of designated shorelines, with some areas containing vegetation, with the greatest impacts on blackbrush (416 acres), sand sagebrush (933 acres) and shadscale (612 acres), all relatively small portions of the overall vegetation community presence as discussed under alternative A. In addition, vegetation at these shorelines is newly colonized and primarily of exotic vegetation species because previous vegetation was eliminated when the lake was inundated. However, some native species do still exist. The degree of impacts could be severe in specific areas with already weakened vegetation that has previously been crushed but still exists, which is therefore more susceptible to being completely destroyed. Similarly, soils that are currently experiencing reductions in their ability to provide habitat for vegetation may have this ability further inhibited. In addition, in areas where high quantities of vegetation exist there is a potential for severe localized adverse impacts based on the larger number of vegetation communities possibly affected.

The addition of OHVs and street-legal ATVs at accessible shorelines, combined with continued off-road use by conventional motor vehicles, would lead to an increase in physical damages through crushing of vegetation, increase the possibility for the spread of nonnative, invasive species, and increase damage to the soil structure, reducing the ability of soils to provide for vegetation. These impacts would occur at and near the accessible shoreline sites.

Under this alternative, impacts on vegetation on accessible shoreline areas would be reduced through mitigation measures, similar to those that would be implemented at Lone Rock Beach and the play area. The implementation of a permit system would result in revenue to provide education and awareness to ORV users regarding proper off-road use, resulting in the potential for a reduction of adverse impacts on vegetation from off-road use.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on all GMP roads in Glen Canyon including the Orange Cliffs Unit. Similar to alternatives A and B, vegetation on and along the unpaved GMP roads would remain physically impacted by ongoing use, resulting in long-term adverse impacts. Primary vegetation types directly impacted are blackbrush (791 acres) and shadscale (595 acres), both relatively small portions when compared to the amount of these vegetation types at Glen Canyon as a whole. The potential for the spread of nonnative, invasive species and the loss of the soil's ability to provide habitat for vegetation communities would continue under this alternative. Impacts under alternative C is expected to be greater than those presented under alternatives A or B due to the addition of OHVs on roads and OHVs and street-legal ATVs in Orange Cliffs Unit. Impacts on vegetation in the Orange Cliffs area would be similar to those presented above; however, because impacts would be spread over a larger area, impacts as a result of this alternative would be more regional than localized when compared to alternatives A or B. No impacts on vegetation are expected as a result of vehicle use on paved GMP roads as these roads contain no vegetation, and it is assumed that vehicles would travel on the roadways and not adversely impact existing vegetation outside the roadway boundaries.

Ferry Swale

Off-road use (by conventional motor vehicles, OHVs, and street-legal ATVs) would be authorized on approximately 15 miles of designated ORV routes in Ferry Swale. The designation of approximately 15 miles of ORV routes could increase damage to vegetation. In areas of designated ORV routes, vegetation would be even more susceptible to physical damage and vegetation that was not previously disturbed would now be disturbed as a result of trail widening, with the highest proportion of impacts directly within 12 feet of the route centerlines, primarily impacting shadscale (approximately 1 acre). In addition, damage to soils and the increased potential for soil erosion as a result of runoff from compacted areas could have further detrimental impacts on vegetation on and adjacent to routes. Under this alternative, designating ORV routes in Ferry Swale would result in continued damage to vegetation in concentrated areas. In addition, there would be an increased risk of nonnative, invasive species

entering the area and of a decline in the ability of the soil to provide habitat for the shadscale and golden buckwheat vegetation communities. Overall impacts would be long-term and adverse.

Mitigation measures under this alternative would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. An ORV permit would also be required by ORV users. These measures would likely reduce adverse impacts on vegetation to some degree by limiting driving outside of designated ORV routes and thereby limiting the potential for direct physical impacts and limiting impacts on soils. Limiting impacts allows for soils to recover and provide for vegetation communities outside of designated areas. In addition, the restoration of native plants would provide some beneficial impacts as the planting of native plants works to prevent and diminish the presence of exotic plants that would otherwise colonize the area and outcompete native plants.

Cumulative Impacts

Under alternative C, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with localized adverse impacts on vegetation at accessible shorelines, Lone Rock, and Lone Rock Beach Play Area under alternative C, would result in long-term, adverse cumulative impacts on vegetation, with alternative C having a sizeable impact. Under alternative C, no severe adverse impacts would occur at Ferry Swale and on unpaved GMP roads and, when combined with the adverse impacts of cumulative actions, would result in no severe adverse impacts with alternative C having a slight contribution.

Alternative D: Decreased Motorized Access

Lone Rock Beach

Under alternative D, Lone Rock Beach would be open only to conventional motor vehicles, only. OHVs and street-legal ATVs would not be allowed. Vegetation communities at Lone Rock Beach were previously eliminated when the lake was inundated, killing all native species and being recolonized by primarily exotic species. Vegetation at Lone Rock Beach would benefit from a reduction of motor vehicle use. Vegetation in impacted areas of Lone Rock Beach would recover because vegetation could be allowed to reestablish in areas of former impacts and the potential for further impacts would be diminished. Impacts on vegetation at Lone Rock Beach from the continued use of conventional motor vehicles would still occur but would not be expected to be substantial.

Lone Rock Beach Play Area

Under alternative D, off-road use by all motor vehicles would be permanently discontinued in the Lone Rock Beach Play Area and the area would be restored to natural conditions. Impacts on vegetation at the play area would be the same as under alternative B.

Accessible Shorelines

Under alternative D, off-road use at a total of 11 accessible shoreline areas would be discontinued permanently, whereas four accessible shorelines (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp, totaling approximately 1,100 acres) would be open only to conventional motor vehicles by permit, subject to water-level closures. Vegetation at the 11 accessible shorelines is primarily made up of exotic species as native species were previously eliminated when the lake was inundated. Under this alternative, the prohibition of off-road use would allow the vegetation at these 11 locations to recover, resulting in beneficial impacts on vegetation. The ability of the vegetation to recover and the time needed to do so would depend on the amount of damage existing in each of the accessible shoreline areas. The cessation of off-road use would allow vegetation in impacted areas to recover due to the absence of vegetation crushing by vehicles. The removal of disturbance would also have beneficial impacts on

soils, which would increase the ability of the soil to provide habitat for vegetation communities. It can be anticipated, however, that the loss of 11 accessible shoreline areas to off-road use could result in impacts on resources at the four other sites because the demand for access and visitation to those sites would increase. However, because the majority of conventional motor vehicle users typically already use these four sites, the specific impacts from intensified use could include a slightly higher potential for vegetation destruction, as well as an increased amount of vegetation potentially being physically damaged through crushing from increased off-road use. Soil could lose the ability to provide habitat for vegetation and the spread of nonnative, invasive species would increase, resulting in substantial to severe levels of impacts depending on the amount of traffic. Vegetation types impacted in these four accessible shorelines include blackbrush (166 acres), fourwing saltbrush (219 acres), and shadscale (215 acres), all relatively minor portions of these vegetation types when compared to Glen Canyon as a whole.

Mitigation measures for the four authorized accessible shorelines under this alternative would be the same as under alternative C, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on vegetation to some degree by limiting driving outside of designated ORV areas. Overall impacts at the four remaining accessible shorelines would be long-term and adverse, based on the potential of substantial destruction of vegetation species.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on vegetation on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on vegetation from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

Under alternative D, no off-road use would be allowed in Ferry Swale. Impacts would be the same as under alternative B.

Cumulative Impacts

Under alternative D, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described for alternative A. As a result of discontinuation and non-designation of ORV routes, however, adverse impacts on vegetation would be greatly reduced compared to those described under alternative A. The impacts of these actions, in combination with the beneficial impacts under alternative D and when mixed with the beneficial impacts of the cumulative actions, would result in long-term cumulative benefits to vegetation. The severe adverse impacts on vegetation at the three remaining accessible shorelines under alternative D would result in long-term, likely severe adverse cumulative impacts on vegetation, with alternative D having a slight impact.

Alternative E: Mixed Use

Lone Rock Beach

Impacts on vegetation at Lone Rock Beach under alternative E would be similar to the impacts described for the area under alternative C. The designation of 20 acres of the beach as a vehicle-free zone would provide a slight beneficial impact on vegetation, but no substantial beneficial effects on vegetation on the whole would accrue over time from this restriction as much of the vegetation has been previously destroyed, leaving little vegetation remaining for recovery. The cessation of motor vehicle use in these 20 acres would produce benefits to soils from the loss of physical destruction and allow for greater soil productivity in the area.

Lone Rock Beach Play Area

Impacts on vegetation at Lone Rock Beach Play Area under alternative E would be the same as the impacts described for the area under alternative C.

Accessible Shorelines

Under alternative E, off-road use would be permanently discontinued at one accessible shoreline area (Warm Creek), and 14 areas would be open to motor vehicle use by permit (12 existing areas plus Paiute Farms and Nokai Canyon which would be open to conventional motor vehicles and street-legal ATVs only [approximately 6,000 acres]) subject to water-level closures. At these areas vegetation communities are primarily made up of exotic species because previous vegetation communities were eliminated when the lake was inundated. Under this alternative, the permanent discontinuation of vehicle entry into the Warm Creek shoreline access site would allow vegetation at this location to recover. In addition, at these locations the likelihood of nonnative, invasive species spreading could be reduced and the soil would regain its ability to provide habitat for vegetation communities.

The loss of only one shoreline access area is not anticipated to result in substantial impacts on resources at the 14 other sites as a result of increased demand for access and visitation to those sites. Damage to vegetation at the 12 accessible shoreline areas, as well as Paiute Farms and Nokai Canyon, would not intensify notably beyond current levels. However, with the continued off-road use at the accessible shoreline areas, vegetation would remain physically impacted and damaged, the likelihood of nonnative, invasive species spreading would be increased, and the ability of soil to provide habitat for vegetation would decrease. The additional mitigating measure of a permit system and associated components to better control off-road use and educate users would reduce the intensity of such impacts. Primary vegetation types impacted include blackbrush (688 acres) and shadscale (1,561 acres), both relatively small portions of these vegetation groups when compared to Glen Canyon as a whole.

Mitigation measures under this alternative would be the same as under alternatives C and D, and would include improved signs and communication/education with partners and users, physical barriers, enhanced NPS presence, restoration of native plants, and closures. These measures likely would reduce impacts on vegetation to some degree by limiting driving outside of designated ORV areas.

Travel on GMP Roads in Glen Canyon

Under alternative E conventional motor vehicles and street-legal ATVs would be authorized to operate on all paved GMP roads in Glen Canyon. OHVs and street-legal ATVs would also be authorized on unpaved GMP roads, with the exception of the Orange Cliffs Unit where OHVs and street-legal ATVs would not be allowed. Vegetation in these areas would remain physically impacted from ongoing off-road use, the inclusion of OHVs and street-legal ATVs in addition to conventional motor vehicles, and the crushing of vegetation, with the highest proportion of impacts directly within 33 feet of the road centerlines. The highest intensity of impacts would occur on blackbrush (791 acres) and shadscale (595 acres), both relatively small amounts when compared to Glen Canyon as a whole. The likelihood of nonnative, invasive species spreading through motor vehicle use would be increased and the ability of soils to provide habitat for vegetation would be decreased. Overall impacts on vegetation would be long-term and adverse. No direct impacts on vegetation are expected as a result of vehicle use on paved GMP roads as these roads contain no vegetation and it is assumed that vehicles would travel on the roadways and not adversely impact existing vegetation outside the roadway boundaries.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 15 miles of designated ORV routes in the Ferry Swale area. Impacts on vegetation would be the same as those under alternative C.

Cumulative Impacts

Under alternative E, the same past, present, and planned future activities within Glen Canyon that have the potential to affect vegetation would occur, and impacts would be the same as described for alternative A. The impacts of these actions, in combination with the severe adverse impacts on Lone Rock Beach and Lone Rock Beach Play Area and the adverse impacts on Ferry Swale and unpaved GMP under alternative E, would result in severe adverse cumulative impacts on vegetation with alternative E having a slight affect. The severe beneficial impacts on vegetation at the two accessible shorelines where off-road use would be discontinued and the beneficial impacts on unpaved GMP roads under alternative E, when combined with the beneficial impacts of cumulative actions would results in beneficial impacts with alternative E having a slight affect.

Conclusion

Table 30 provides additional detail regarding the acres of various vegetation types disturbed under each alternative.

Table 30: Summary of Impacts on Vegetation Communities*

Select Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Accessible Shorelines (acres impacted)					
Blackbrush	416	0	688	166	Same as alternative C
Blackbrush-Shadscale	58		Same as alternative A	0	Same as alternative A
Fourwing Saltbrush	345		Same as alternative A	219	288
Fremont Cottonwood	279		Same as alternative A	0	Same as alternative A
Shadscale	612		1,684	215	1,561
Sand Sagebrush	933		Same as alternative A	0	Same as alternative A
Total	**2,643**	**0**	**3,987**	**601**	**3,808**
Unpaved GMP Roads (acres impacted)					
Big Sagebrush	Direct: 8 Indirect: 38	Same as alternative A	Same as alternative A	0	Same as alternative A
Blackbrush	Direct: 791 Indirect: 3,857	Same as alternative A	Direct: 916 Indirect: 4,479		Same as alternative A
Blackbrush-Shadscale	Direct: 135 Indirect: 734	Same as alternative A	Same as alternative A		Same as alternative A
Fourwing Saltbrush	Direct: 410 Indirect: 1,934	Same as alternative A	Direct: 581 Indirect: 2,750		Same as alternative A
Mat Saltbrush	Direct: 98 Indirect: 484	Same as alternative A	Same as alternative A		Same as alternative A
Pinyon-Juniper	Direct: 425 Indirect: 2,095	Same as alternative A	Direct: 744 Indirect: 3,665		Same as alternative A
Sand Sagebrush	Direct: 53 Indirect: 266	Same as alternative A	Same as alternative A		Same as alternative A

Select Vegetation Type	Alternative A	Alternative B	Alternative C	Alternative D	Alternative E
Shadescale	Direct: 50 Indirect: 237	Same as alternative A	Direct: 99 Indirect: 470		Same as alternative A
Shadscale	Direct: 595 Indirect: 2,855	Same as alternative A	Direct: 639 Indirect: 3,084		Same as alternative A
Torrey-Mormon-Tea	Direct: 19 Indirect: 76	Same as alternative A	Direct: 37 Indirect: 151		Same as alternative A
Total	**Direct: 2,821 Indirect: 14,091**	**Direct: 2,821 Indirect: 14,091**	**Direct: 3,310 Indirect: 16,121**	**0**	**Direct: 2,821 Indirect: 14,091**
Ferry Swale (acres impacted)					
Fourwing Saltbush	Direct: 1 Indirect: 23	0	Direct: 0 Indirect: 0	0	Direct: 0 Indirect: 0
Shadscale	Direct: 1 Indirect: 20		Same as alternative A		Same as alternative A
Total	**Direct: 2 Indirect: 43**	**0**	**Direct: 1 Indirect: 20**	**0**	**Direct: 1 Indirect: 20**

*Note: For the purpose of supporting the narrative discussion, only pertinent vegetation types are provided in the table. These are the most common and highly representative of vegetation generally found within the park unit. Direct impacts apply to vegetation contained within 12 feet (3.6576 meters) on either side of designated ORV route centerlines at Ferry Swale and within 33 feet (10.0584 meters) on either side of road centerlines on paved and unpaved GMP roads. Indirect impacts apply to vegetation contained within an area between 12 feet (3.6576 meters) and 196.85 feet (60 meters) on either side of route centerlines at Ferry Swale and between 33 feet (10.0584 meters) and 196.85 feet (60 meters) on either side of road centerlines on GMP roads.

As described above, impacts to vegetation from off-road use and on-road OHV use, may include crushing of foliage, root systems and seedlings, the uprooting of small plants, and the disruption of large plant root systems by shearing and compaction of desert soils (Luckenback and bury 1983). The severity of impacts to vegetation varies by type of use, vegetation, and location. Understanding the significance of these impacts requires a closer look at the context in which these intense impacts occur.

Impacts to vegetation, like soils, is not expected to be severe or significant on paved and unpaved GMP roads, because roadways have been designed and engineered to be driven upon, and vegetation existing along these routes have been disturbed previously through blading, compaction, and other earthmoving activities required for road construction and routine maintenance. Impacts would continue to vegetation remaining in the roads and along the roadway edges and would further reduce the ability of soils to provide habitat. Primary vegetation types impacted include blackbrush and shadscale, however the amount of area impacted (916 acres and 639 acres respectively) is relatively small.

Off road use at accessible shorelines would also cause adverse impacts described above to vegetation. These impacts would be highly noticeable, apparent, and severe at the higher use accessible shorelines, such as Bullfrog North and South and Stanton Creek. Past off-road use at these areas contribute to degraded soils and vegetation and make impacts at these locations more severe. Vegetation types with the highest impacts would be blackbrush, sand sagebrush, and shadscale. Impacts along accessible shorelines are concentrated to certain authorized areas within authorized accessible shorelines where few vegetation communities remain and those that do remain are typically nonnative, with use generally not extending beyond authorized areas.

Impacts to vegetation at Lone Rock Beach and Play area are extremely severe. Farb–Pagina type soils found in these areas are subjected to repeated disturbance and the soil structure has been significantly altered. Because of the significant damage to the soil structure, limited vegetation is found in this area. For this reason, Glen Canyon

has intentionally confined off-road use of this type to the play area in order to ensure that this level of impact does not occur in any other location in Glen Canyon. Off-road use at the play area severely impacts roughly 120 acres.

Impacts on vegetation in Ferry Swale under alternative A, where approximately 53 miles of ORV routes would be designated, are not likely to be significant because, while the direct impacts of off-road use would continue, vehicle travel would be constrained to formalized routes and illegal use would be monitored. Similarly, impacts on vegetation as a result of alternatives C and E (where 15 miles would be designated as ORV routes) are not anticipated to be significant. Although there is vegetation in these ORV routes, the amount impacted would be exceptionally small, approximately 1 acre, when compared to the remainder of Glen Canyon.

In conclusion, in some areas, like the Ferry Swale and the Lone Rock Beach areas soils are likely significantly degraded from past and present uses such as grazing and legal and illegal off-road use. Future uses in this area, such as the Lake Powell Pipeline construction and ongoing maintenance of existing utilities have created and would likely continue to create severe impacts to vegetation. Significant adverse impacts on vegetation are likely already occurring regardless of whether any off-road use is authorized. Alternatives A, C, D, and E, which would authorize off-road use, would contribute to those significant impacts on vegetation. However, the authorization of off-road use and on-road OHV use within Glen Canyon by itself is not significant, because adverse impacts to vegetation from these uses would contribute only a small fraction of the overall adverse vegetation impacts. The total footprint of impacts on vegetation from off-road use estimated under alternative C, the alternative authorizing the most use, (from direct and indirect impacts along unpaved GMP and ORV routes in Ferry Swale and at accessible shorelines) is 19,970 acres. This represents less than 2% of the total 1,249,934 acres of soils within the park unit. Impacts to vegetation along accessible shorelines make up a tiny part of the 2,000 mile shoreline of Lake Powell. And finally, narrowing the context to vegetation type, the vegetation type most impacted by off-road use and on-road OHV use under any alternative is the blackbrush, sand sagebrush, and shadscale vegetation types. Even under the alternative authorizing the most use, less than 1% any of these vegetation types are impacted by use that would be authorized under this plan.

WILDLIFE AND WILDLIFE HABITAT

GUIDING REGULATION AND POLICIES

The NPS Organic Act, which directs parks to conserve wildlife unimpaired for future generations, is interpreted by the agency to mean that native animal life should be protected and perpetuated as part of a park's natural ecosystem.

As with plants, NPS *Management Policies 2006* directs NPS to maintain all native animal populations in parks as part of the natural ecosystem, including the natural abundance, diversity, dynamics, distribution, habitats, and behaviors of native wildlife (NPS 2006a, Section 4.4.1). The Park Service is directed to minimize human impacts on native animal populations, communities, and ecosystems, as well as the biological and evolutionary processes that sustain them (NPS 2006a, Section 4.4.1.2).

The Glen Canyon Strategic Plan (NPS 2007e) states, "The climate and physical features of Glen Canyon NRA have created local environments favorable to the reservation of scientifically important objects, sites, populations, habitats or communities that are significant in and of themselves or provide opportunities to add to our understanding of past or ongoing events."

METHODOLOGY AND ASSUMPTIONS

For the purposes of this analysis, only those wildlife species and their habitats known to be present in Glen Canyon and that may experience some level of impact as a result of management actions are addressed in this section. The

primary method for assessing impacts on wildlife species was to determine which species may inhabit areas likely to be affected by the management actions described in this plan/DEIS.

For each alternative, potential impacts on wildlife and wildlife habitat were evaluated based on the pattern of proposed use at Glen Canyon National Recreation Area, resulting from what areas are open to off-road use and other recreational uses and for what duration, and the nature of habitats and species present. Primary steps in assessing impacts on wildlife and wildlife habitat were to determine (1) the potential for species to occur in habitats likely to be affected by management actions described in the alternatives; (2) current and future use and distribution of ORVs by alternative and their adherence to NPS rules and regulations; (3) habitat impact or alteration caused by the alternatives; and (4) disturbance potential of the action and the potential to directly or indirectly affect wildlife or wildlife habitat as a result of off-road use activities.

The professional judgment of NPS staff, published literature, and information from scientists from NPS, U.S. USFWS, and Utah Division of Wildlife Resources was used to determine the likely effects on species present in Glen Canyon. Although not specific to Glen Canyon, the analysis relied on documentation of impacts of relatively early use of ORVs in desert ecosystems similar to those at Glen Canyon. Acreages, miles, and percentages presented in the following analysis are estimates and are based on the best available GIS information the park has acquired to date. These numbers may change slightly as new GIS information becomes available allowing more refined analysis.

Federally and state-listed species (including state species of concern) are addressed in the “Special-status Species” section of this chapter.

Context

The geographic study area for wildlife and wildlife habitat is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

Alternative A: No Action

Relatively early use of ORVs in desert ecosystems, like those found at Glen Canyon, can be destructive, causing long-lasting damage to terrestrial and aquatic ecosystems, wildlife, soils, and hydrologic flows (New Mexico EMNRD et al. 2008). Studies of off-road use in the southwest have reported adverse impacts on wildlife and wildlife habitat due to fragmentation, habitat destruction, harassment, noise, and direct mortality. For example, amphibians and reptiles have been crushed to death or injured by off-road use on public lands (Bury and Luckenbach 2002). In desert ecosystems, reptiles, especially snakes, are known to favor roads and trails as thermoregulation sites, which puts them at risk of death from vehicles running over them (Rosen and Lowe 1994; Rudolph 2000). ORVs have been demonstrated to decrease population densities of reptiles, small mammals, and bird populations. In general, habitat fragmentation reduces the size of patches of desert, forest, shrublands, wetlands, and grasslands. This reduces the total area of contiguous habitat available for wildlife species, especially birds, and increases the isolation of the habitat (Campbell and Johns n.d.), resulting in changes to forage and cover, flows of energy and nutrients, and even the microclimate of the area. Other adverse effects of habitat fragmentation include genetic effects and the potential for local extinctions, shifts to invasive species, and increased likelihood of uncharacteristic predation as well as increased exploitation by humans (New Mexico EMNRD et al. 2008).

Other risks range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Havlick (2002) cited studies that indicated wildlife including birds, reptiles, and large ungulates respond to disturbance with accelerated heart rate and metabolic function, and suffer from increased levels of stress. These factors can lead to displacement, mortality, and reproductive failure. For example, it is possible that an increase in the frequency of tail loss among lizards could result from stress caused by increased off-road use. Tail loss is an escape mechanism usually correlated to predator density and stress. This impact is significant because females without tails produce fewer eggs than those with tails. Thus, tail loss could likely lead to reduced

survivorship and fecundity (Luckenbach and Bury 1983). Further research regarding the adverse effects of human recreational activities among bird species has shown nest desertion and temporary abandonment, and changes in foraging habits (Joslin and Youmans 1999). Bowles (1995, cited in New Mexico EMNRD et al. 2008) notes that noise is an environmental stressor that can induce startle responses, aversion, and maladaptive behaviors; cause changes in habitat use, communication, predation, foraging, energetic, courtship, breeding, and reproduction; and produce stress responses such as changes in heart rate and energy consumption, and hearing loss.

Luckenbach and Bury (1983) explored the effects on wildlife by comparing ORV areas with areas that excluded off-road use. They found non-ORV areas had 1.8 times the number of species, 3.5 times the number of individuals, and 5.8 times more biomass of reptiles than the ORV-impacted areas. Similar results were reported for rodent populations. Brooks (1999, 2000) similarly reported that nocturnal rodent density and diversity, breeding bird abundance and species richness, and lizard abundance and species richness were higher in areas that restricted off-road use compared to areas open to off-road use. ORV-related impacts on amphibian and reptile species were identified in Montana and include indirect impacts on populations via habitat destruction, chemical contamination and sedimentation, and the creation of migration barriers. Studies of small mammals have reported adverse effects from motorized vehicle use, including population reduction, habitat modification, forage/cover removal, echolocation disturbance, and energy expenditure (Joslin and Youmans 1999).

ORV noise has been shown to damage hearing sensitivity and predator detection in kangaroo rats and fringe-toed lizards (Brattstrom and Bondello 1983). In addition, spadefoot toads are known to be sensitive to ORV noise activity, because they can break aestivation, or "summer sleep," based on sounds that mimic thunderstorm activity, such as engine noises (Schubert and Smith 2000). Noise from ORVs has been found to interfere with songbird breeding and territorial displays (Berry 1980), as well as inhibiting the senses of other animals that depend on hearing and vibration detection to survive (Berry 1980; Bury 1980); for example, bats and certain reptiles.

Additional research has focused on the effects of erosion and trampled vegetation due to visitors, and the associated impacts on wildlife habitat values (Joslin and Youmans 1999; Monz et al. 2003). Based on these results, wildlife groups found within Glen Canyon of particular interest and deemed likely to be affected by off-road use include nesting and feeding shore and wading birds, nesting and foraging raptors, and small reptiles, amphibians, and mammals.

Lone Rock Beach

Off-road driving has occurred at Lone Rock Beach since before formal establishment of the recreation area in 1972, resulting in long-term adverse impacts on wildlife from permanent changes in species' ranges and foraging/breeding habits. Therefore, new disturbances from continued off-road use may be detectable, but would not be considerable as many species avoid areas of heavy off-road use. Adverse impacts at Lone Rock Beach would be localized and limited to designated ORV areas. Within these areas, species and habitat disturbance would continue to be apparent and species mortality could occur, especially for smaller mammals, amphibians, and reptiles.

The no-action alternative would result in localized adverse impacts on approximately 250 acres of wildlife and wildlife habitat at Lone Rock Beach from continued off-road use, by conventional motor vehicles, OHVs, and street-legal ATVs. Motor vehicles may only be operated from the operator's camping location to the Lone Rock Beach Play Area only to access the play area. Off-road use at Lone Rock Beach could result in species disturbance and displacement, as well as habitat destruction and vehicle-wildlife collisions.

Birds nesting on or near the ground at Lone Rock Beach (e.g., black-throated sparrow, sage sparrow, mourning dove, loggerhead shrike) would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Vehicle-wildlife collisions or frequent escape response events (e.g., flushing) could increase species injury or mortality. Shorebirds that use Lone Rock Beach for

foraging and resting are at particular risk because they are some of the longest distance migratory birds and, as such, the energy demands of migration are extreme (Madsen 1995). Disturbance results in birds being forced to flush while they are foraging or resting. Frequent escape flights result in a reduction in time spent foraging and a reduction in fuel stores spent during times of flying (Stolen 2003). The level of impact this causes is dependent upon the species and the level of disturbance. Although some species may be deterred from using the beach area in heavy off-road use areas, there is ample habitat throughout the rest of the area that is suitable for foraging and resting to minimize the overall impacts on shorebirds.

Peregrine falcons are known to nest on Lone Rock Beach and occasionally forage over the ORV area (Spence n.d.). Lone Rock Beach includes potential habitat for burrowing owl, which is a sparse summer resident of deep sandy slopes and rock outcrops in the Wahweap area (NPS n.d.a; Spence n.d.).

Short- and long-term adverse impacts on birds in the area would result from the noise created by ORVs. As described above, noise is an environmental stressor that can induce startle responses, aversion, and maladaptive behaviors; cause changes in habitat use, communication, predation, foraging, bioenergetics, courtship, breeding, and reproduction; and produce stress responses such as changes in heart rate and energy consumption.

Lone Rock Beach Play Area

The no-action alternative would result in localized adverse impacts on wildlife and wildlife habitat at the Lone Rock Beach Play Area from the continued high-intensity unrestricted use of conventional motor vehicles, OHVs, and street-legal ATVs at this 180-acre area. Impacts on wildlife from off-road use include species disturbance and displacement, habitat destruction, and vehicle-wildlife collisions causing species injury or mortality. Birds nesting or foraging in the area (e.g., peregrine falcon, burrowing owl) would be more vulnerable to the effects of motorized vehicles at the play area, due to exposure of nests and young to visitors and noise from motorized vehicles. Similar to Lone Rock Beach, ORVs have been used at Lone Rock Beach Play Area since before formal establishment of the recreation area in 1972, resulting in long-term adverse impacts on wildlife from permanent changes in species' ranges and foraging/breeding habits. Therefore, new disturbances from continued off-road use may be detectable, but would not be considerable as many species avoid areas of heavy off-road use.

Accessible Shorelines

Off-road use under alternative A would result in continued impacts on a relatively limited portion of the Lake Powell shoreline in comparison to the entire approximately 2,000 miles of shoreline available at Glen Canyon. Alternative A, would result in localized adverse impacts on wildlife and wildlife habitat at accessible shorelines from continued off-road use. Under alternative A, 13 accessible shoreline areas would remain open to conventional motor vehicle use (approximately 5,900 acres), subject to water level closures. The operation of any OHV or street-legal ATV would not be allowed at the 13 shoreline areas. These accessible shoreline areas are not play areas (climbing hills in vehicles, driving at high speeds, and similar behavior would not be authorized), but rather areas intended to provide public conventional motor vehicle access to the Lake Powell shoreline for purposes of primitive recreational use. The public would be allowed to depart the road and drive directly to the shoreline and park in designated areas. As a result, adverse impacts on wildlife and wildlife habitat would be localized within ORV areas.

A variety of common species have the potential to occur at or near all shoreline areas, including rodents, lizards, snakes, rabbits, coyotes, foxes, and bobcats. Impacts on wildlife from off-road use include species disturbance and displacement, habitat destruction, and vehicle-wildlife collisions causing species injury or mortality. Birds nesting on or near the ground at accessible shoreline areas would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Some of the more vulnerable species include the lark sparrow, horned lark, burrowing owl, and lesser nighthawk that build their nests on the ground or use rodent burrows, as well as loggerhead shrikes and black-throated sparrows that build their nests in

low shrubs (Medin 1986 and Berry 1980). Migratory shorebirds could be vulnerable to motorized vehicle disturbance, resulting in birds being forced to flush while they are foraging or resting. Although some species may be deterred from using the accessible shoreline areas with heavier vehicle use, adverse impacts are expected to be limited because there is ample undisturbed habitat available in other areas along the shoreline and within Glen Canyon. Bird species would likely use those areas and avoid areas of known disturbance. For shorebirds, in particular, most accessible shorelines are associated with mud flats, sandy sites, and other areas (side canyons) that support a significant portion of available migratory shorebird habitat around Lake Powell.

Locally, along open areas, species and habitat disturbance would continue and species mortality could occur, especially for smaller mammals (e.g., mice, rats, rabbits, chipmunks) and amphibian and reptile species (e.g., lizards, snakes). As indicated in studies of off-road use in other arid ecosystems, even if all ORV users stay on designated routes, ORVs can cause erosion and stream sedimentation, transport invasive species, raise dust clouds, and disrupt and damage wildlife, as well as reduce effective habitat (New Mexico EMNRD et al. 2008). In general, routes created by ORV users can cause a patchwork of disrupted habitat often correlated with reduced ecosystem productivity (Trombulak and Frissell 2000; New Mexico EMNRD et al. 2008).

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue use of shoreline areas. Currently, Warm Creek, Crosby Canyon, and Bullfrog Creek North and South are temporarily closed due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. Reopening these areas could result in adverse impacts similar to those described above; however, the temporary closure of shoreline areas would minimize impacts on wildlife and wildlife habitat from off-road use by temporarily removing a source of localized disturbance. The Paiute Farms and Nokai Canyon accessible shorelines are not officially open, but are currently being accessed. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access, resulting in beneficial impacts on wildlife and wildlife habitats.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on all GMP roads in Glen Canyon (there are approximately 365 miles of unpaved GMP roads and 72 miles of paved GMP roads at Glen Canyon), with the exception of the Orange Cliffs Unit, where street-legal ATVs are prohibited. Alternative A would result in long-term adverse impacts on wildlife and wildlife habitat from the use of conventional motor vehicles and street-legal ATVs on GMP roads. However, because habitat in the area has been previously impacted and would continue to be contained to the already disturbed GMP roads, impacts would be localized and minimal. Locally, along open roads, habitat disturbance and fragmentation would continue and species mortality could occur, especially for smaller mammals (e.g., mice, rats, rabbits, chipmunks) and amphibian and reptile species (e.g., lizards, snakes). Even if motor vehicles stayed on the unpaved GMP roads, they could cause erosion and stream sedimentation, transport invasive species, raise dust clouds, disrupt and damage wildlife, and reduce effective habitat (New Mexico EMNRD et al. 2008). In addition, an increase in the ambient noise level caused by traffic can reduce the distance over which acoustic signals uses for communication, navigation, avoiding danger, and finding food against a background of noise, can be detected (Parris and Schneider 2009). In general, the higher the ambient noise level, the shorter the distance from which other sounds can be heard. This concept is expressed in terms of listening area and alerting distance. In terms of impact metrics, a 3 decibels (dBA) increase in the natural ambient level is an important indicator of potential impact because it results in a 30% reduction in alerting distance for wildlife. For example, under natural ambient conditions, an owl perched in a tree may be able to hear a mouse scurrying through the brush anywhere within an area of 100 square meters of the perch. If a noise event increases the ambient level by 3 dBA, the area in which the owl can hear a mouse would decrease to approximately 70 square meters. A more detailed discussion on noise impacts is described in the “Soundscapes” section of this plan/DEIS. Prohibiting street-legal ATV use in the Orange Cliffs Unit would reduce noise-related impacts and could benefit birds (e.g., lesser nighthawk) and other species that use the wilderness habitat.

Ferry Swale

In Ferry Swale, in the area of Vermilion Cliffs, there are zones with unauthorized user-created routes over which ORVs travel before crossing onto federal lands administered by the BLM. Under alternative A, approximately 53 miles of unauthorized ORV visitor-routes would be authorized and designated for use by conventional motor vehicles, OHVs, and street-legal ATVs.

Under alternative A, wildlife in Ferry Swale would continue to experience habitat disturbance and fragmentation and species mortality could occur, especially for smaller mammals, amphibians, and reptiles. In general, routes created by ORV users can cause a patch of disrupted habitat often correlated with reduced ecosystem productivity (New Mexico EMNRD et al. 2008). Travel along the routes could cause erosion and stream sedimentation, transport invasive species, raise dust clouds, increase noise disturbances, or disrupt and damage wildlife (e.g., vehicle-wildlife collisions) (New Mexico EMNRD et al. 2008). In addition, the ability of soils along these open routes to provide suitable vegetated habitat for certain species along the 53 miles of designated ORV routes would be reduced. However, vegetation in the area of the designated ORV routes is limited, as much of the area consists of rock outcrops and existing vegetated habitat is scarce based on prior disturbance and removal from previous off-road use. Impacts on wildlife and their habitat would likely be contained to the edges of already disturbed areas. As a result, the continued use of conventional motor vehicles, OHVs, and street-legal ATVs would not result in notable harm to wildlife along these designated ORV routes.

Cumulative Impacts

Other past, present, and reasonably foreseeable future actions within and around Glen Canyon have the potential to impact wildlife and wildlife habitat. In recent years, the rising and falling water levels as a result of natural fluctuations and dam operations have exposed more or less of the accessible shoreline areas, impacting habitat available for native wildlife. Following these events, several popular accessible shoreline areas have been closed due to accessibility issues, resulting in beneficial impacts on wildlife and wildlife habitat by temporarily removing a source of disturbance (i.e., off-road use) in affected areas. Due to fluctuating lake levels, several vegetative communities are not able to establish along the shoreline; thus, limiting shoreline habitat. A wide variety of activities exist in Glen Canyon that have resulted in and continue to result in adverse impacts on wildlife and wildlife habitat. These activities include unauthorized off-road use on adjacent lands, recreational hunting and livestock grazing as allowed by the enabling legislation for Glen Canyon National Recreation Area, and special use permits for filming and photography. Unauthorized off-road use leads to disrupted and fragmented habitat, species disturbance, and direct mortality of wildlife. Recreational hunting and grazing also result in localized habitat and species disturbance (and direct mortality in the case of recreational hunting). Grazing activities, if not properly managed, can result in the reduction and degradation of available wildlife habitat due to damage or loss of vegetation resources, soil compaction, and erosion. The adverse impacts of special use permits on wildlife and wildlife habitat are much less considerable than unauthorized off-road use, since these activities are monitored and managed by NPS staff. Military overflights from nearby bases can also result in short-term limited adverse impacts on wildlife and wildlife habitat, depending on the duration and elevation of flights. Impacts may range from minor behavioral responses, such as flight/fright response, to severe changes in habitat utilization (Radle 2007).Future fee station improvements at Lone Rock Beach could result in short-term localized adverse impacts on wildlife in that area from construction-related noise, staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Wildlife commonly habituates to constant noise and human disturbance levels, provided they are not harassed by people working at the site. Most wildlife would be expected to return once construction activities diminish and work is completed. Because habitat in this area has already been disturbed, few remaining species would be injured or disturbed during construction.

Short-term adverse impacts on wildlife and wildlife habitat likely resulted from the 1986 Paiute Farms/San Juan Marina DCP/EA and the 2008 Uplake DCP/EA from implementation of these plans, including construction-related noise, staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Adverse

impacts such as injury, mortality, and habitat disturbance/avoidance, were localized and likely had more effect on species that occur along the shoreline (e.g., shorebirds, smaller mammals).

Beneficial impacts on wildlife and wildlife habitat have occurred, and continue to occur, from development and implementation of the 1979 Glen Canyon GMP, which identifies four management zones and management strategies for resource protection and visitor use in these zones. Planning for a new GMP would further benefit wildlife and wildlife habitat over the long term by implementing improved strategies for resource protection. Development and implementation of the 1988 Accessible Shorelines EA/DCP and 1981 Lone Rock Beach EA/DCP have resulted in long-term benefits for wildlife and wildlife habitat within Glen Canyon. These plans manage Lake Powell's shorelines in order to reduce resource degradation, visitor use conflicts, and safety hazards, resulting in long-term benefits for wildlife and wildlife habitat at accessible shoreline areas (including Lone Rock Beach). Similarly, there are several plans that describe management of recreational use within Glen Canyon—uses that could result in short-term adverse impacts on wildlife and wildlife habitat—but also share the goal of protecting resources and educating visitors on these resources, resulting in long-term benefits to wildlife and wildlife habitat:

- 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan, which determined how the backcountry areas of Glen Canyon should be managed.
- Interim off-highway vehicle (OHV) management plans at Lone Rock Beach and play area, and at accessible shorelines (2007).
- Programmatic EA for Organized Group Activities along Hole-in-the-Rock Road, which will analyze the environmental consequences of organized group activities that exceed existing group size limits along the Hole-in-the-Rock Road corridor.

Other park plans and projects have resulted in or have the potential to result in both adverse and beneficial impacts on wildlife and wildlife habitat within Glen Canyon. These include the release of tamarisk leaf beetles (*Diorhabda* spp.) to control tamarisk (*Tamarix* spp.). The tamarisk leaf beetle was released as a biological control agent in certain areas of the west in 2001 to help manage tamarisk, which is a highly invasive plant that grows along the Colorado River and in riparian habitats throughout the southwest (NPS 2009d). Although the beetle was not released in Glen Canyon, it has arrived and thrives at various locations throughout Glen Canyon. Tamarisk is known to displace native trees like cottonwood and willow, create poor habitat for birds and other wildlife, increase soil salinity, and increase risk of fire; therefore, continued defoliation of tamarisk will result in long-term beneficial impacts on wildlife and wildlife habitat (NPS n.d.g). However, there are concerns in managing tamarisk: defoliation may lead to site conditions that favor the establishment of other invasive nonnative plants, defoliation may negatively impact some insect and wildlife species, and an increased short-term fire hazard may result if the majority of tamarisk is killed in an area and dense stands of dead stems remain (NPS n.d.g). Therefore, although beneficial impacts would result over the long term, localized short-term adverse impacts on wildlife and native habitat are likely to result from the removal of tamarisk.

Similar to tamarisk, Russian olive (*Elaeagnus angustifolia*) was brought into the area as erosion control after the Dust Bowl in the 1930s. Since then, this species has spread, replacing native vegetation in Escalante and Boulder, and along the Escalante River. In general, Russian olive causes river channelization and is shading the river corridor, cooling the water temperature. Since 2000, volunteers have been working on Russian olive removal and restoration of the Escalante River watershed (Escalante River Watershed Partnership 2011). Although short-term adverse impacts are likely to result from removal efforts (i.e., noise and physical disturbances from volunteers removing trees), beneficial impacts have resulted and will continue to result for native wildlife and habitat from the removal of Russian olive along the Escalante River.

In 2007, zebra mussels, an aquatic invasive species known to significantly alter aquatic ecosystems, were discovered in Lake Mead, Utah (NPS n.d.f). This invasive species aggressively spreads and readily establishes on hard

substrates and surfaces, causing food chain disruption and economic damage by clogging intake pipes of water treatment and power plants as well as boat engine cooling systems (NPS n.d.f). Since their discovery in Lake Mead, zebra mussel infestations have been discovered in Lakes Mohave and Havasu. Currently, Lake Powell and the upper Colorado River basin are believed to be free of zebra mussels; however, quagga mussels have been located in Lake Powell. Mussels would pose a major threat to Lake Powell and the upper Colorado River if they were to become established in those areas. Mussel decontamination stations are already in place at all of the marinas within Glen Canyon (NPS n.d.f). Additionally, there is planned installation of a portable decontamination facility. Although installation/construction of decontamination facilities can temporarily disrupt wildlife nearby, ensuring that mussels are not introduced in Lake Powell and the upper Colorado River basin results in long-term beneficial impacts on wildlife and wildlife habitat, especially wildlife that depend on aquatic habitats for foraging and/or breeding (e.g., shorebirds, other local mussel populations).

Christmas bird counts within Glen Canyon result in long-term benefits for wildlife and wildlife habitat. Although the presence of NPS staff and researchers in the field likely results in minimal short-term adverse impacts (e.g., noise and crushing of vegetation), tracking population trends and species presence in Glen Canyon results in improved species management for future plans and projects.

The USFWS designation of critical habitat for the Mexican spotted owl in 2004, which includes habitat within Glen Canyon, benefits other wildlife within Glen Canyon by protecting species that utilize the same habitat as the owl. Similarly, the Utah DNR Statewide Pronghorn Management Plan (Utah DNR 2009) and BLM's updated resources management plans benefit wildlife and wildlife habitat in Glen Canyon by guiding management of natural resources and habitat in the region.

Other projects and planning actions by federal and state agencies have resulted in or would likely result in short-term adverse impacts on wildlife and wildlife habitat from implementation, including an update to the 1996 Long Term Experimental and Management Plan for Glen Canyon Dam (Bureau of Reclamation), development and update of the BLM's Travel Management Plan, and road/ORV route improvements for utility access by the Arizona DOT (Coconino County); however, over the long term, these projects and actions result in beneficial impacts for wildlife and wildlife habitat from improved management and protection of resources.

Short- and long-term adverse impacts are likely to result from future planning efforts by the state of Utah and the BLM. These future actions include a draft programmatic EIS and possible land use amendments for allocation of oil shale and tar sands resources on lands administered by the BLM in Colorado, Utah, and Wyoming, which would analyze several alternatives for land allocation and resource management. Additionally, the Utah State Board of Water Resources is proposing to build approximately 160 miles of pipeline between Lake Powell Glen Canyon dam and Cedar City. Although both plans/projects would include mitigation to protect wildlife and wildlife habitat, they could result in short- and long-term substantial impacts on wildlife and wildlife habitat from habitat destruction and fragmentation, species disturbance and mortality, and habitat avoidance.

Current and future operations of the Amangiri Resort, located on 600 acres in Canyon Point, Utah, would likely result in adverse impacts on wildlife and wildlife habitat in Glen Canyon. Construction of the resort led to habitat destruction and likely species displacement, resulting in long-term, less than considerable impacts. The resort offers a wide variety of activities for guests, and all visitors to the resort can partake in all the visitor use opportunities Glen Canyon offers. Some visitor activities (e.g., hiking, scenic flights) would continue to result in short-term adverse impacts on wildlife and wildlife habitat within Glen Canyon from species and habitat disturbance. However, impacts would be localized and minimal, because the resort occupies only a small area (in comparison to Glen Canyon as a whole) on the western edge of Glen Canyon.

The overall impact of these past, present, and reasonably foreseeable future actions would be short- and long-term adverse and considerable, as well as long-term beneficial. When combined with the long-term detectable adverse

impacts of alternative A, considerable long-term adverse and long-term beneficial cumulative impacts would result for wildlife and wildlife habitat in the area of analysis.

ALTERNATIVE B: NO OFF-ROAD USE

Lone Rock Beach

Alternative B would result in long-term beneficial impacts on wildlife and wildlife habitat at Lone Rock Beach from the discontinued use of this area to off-road use. Discontinuing off-road use at Lone Rock Beach would remove an existing source of disturbance for wildlife and wildlife habitat, allowing these areas to be restored to natural conditions. For the peregrine falcon and other birds in the area (e.g., burrowing owl, black-throated sparrow, sage sparrow, mourning dove, loggerhead shrike), considerable long-term beneficial impacts would result from reduced noise disturbance. Although these beneficial impacts would be localized at Lone Rock Beach at first, as the area recovers to more natural conditions, long-term beneficial impacts could be experienced Glen Canyon-wide as increased habitat becomes available for wildlife within Glen Canyon (e.g., lizards, snakes, rodents, rabbits, birds, coyotes, foxes, bobcats).

Lone Rock Beach Play Area

Alternative B would result in long-term beneficial impacts on wildlife and wildlife habitat at Lone Rock Beach Play Area from the discontinued use of this area to off-road use. Discontinuing off-road use at the play area would remove an existing source of disturbance for wildlife and wildlife habitat (including noise from ORVs), allowing these areas to be restored to natural conditions. The beneficial impacts would be localized at first, but over the long term, beneficial impacts could be experienced Glen Canyon-wide as potential habitat become available for wildlife within Glen Canyon (e.g., lizards, snakes, rodents, rabbits, birds, coyotes, foxes, and bobcats).

Accessible Shorelines

Alternative B would result in long-term beneficial impacts on wildlife and wildlife habitat at accessible shoreline areas from the discontinued use of 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) to off-road use (approximately 7,300 acres). The permanent closure of these accessible shoreline areas would remove an existing source of disturbance for wildlife and wildlife habitat (including noise from ORVs), allowing these areas to be restored to natural conditions. The beneficial impacts would be localized at first, but over the long term, beneficial impacts could be experienced Glen Canyon-wide because potential habitat would be available for wildlife within Glen Canyon (e.g., lizards, snakes, rodents, rabbits, birds, coyotes, foxes, bobcats).

Travel on GMP Roads in Glen Canyon

Impacts on wildlife from use of unpaved GMP roads under alternative B would be similar to those under alternative A, where conventional motor vehicles and street-legal ATVs would continue to operate on unpaved GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be authorized. No additional impacts on wildlife or habitat would result from vehicle use on paved GMP roads as these roads have an asphalt top and no new soils or vegetation would be disturbed. It is assumed that vehicles will travel on the roadways and will not contribute to disturbances along roadway edges. Speed limits would be established whereby reducing the speed limit on unpaved GMP roads to 25 miles per hour (mph) (or as posted) from the current 45 mph. This action may help lessen some of the adverse impacts of motor vehicle use along GMP roads by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, studies have shown that enforcing speed limits of 25 mph or less on gravel roads has a dramatic impact on lessening the fine particles (dust) that higher speeds kick up into the atmosphere (Countess 2006). Dust is harmful to living things and can inhibit the growth of plants (Trombulak

and Frissell 2000). Additionally, dirt settling into wetlands, creeks, and irrigation ditches adds to measurable sediment buildup, which can impact species habitat as the sediment is moved downstream into rivers and streams (Bratvold 2011). Prohibiting street-legal ATV use in the Orange Cliffs Unit would reduce noise-related impacts (see discussion of noise reduction benefits in the "Soundscapes" section of this plan/DEIS) and could benefit birds (e.g., lesser nighthawk) and other species that use the wilderness habitat from noise-related impacts.

Ferry Swale

Off-road use would not be authorized in Ferry Swale to access adjacent BLM lands. This would lead to a reduction in habitat disturbance and fragmentation and species mortality, especially for smaller mammals and amphibian and reptile species. Additionally, there would be a reduction in erosion and stream sedimentation, the transport of invasive species, and dust clouds.

Cumulative Impacts

Impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as those described for alternative A. The overall impact of these past, present, and future actions on wildlife and wildlife habitat would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the long-term beneficial impacts under alternative B, would result in slight long-term adverse and considerable long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

Alternative C: Increased Motorized Access

Lone Rock Beach

The impacts of alternative C on wildlife and wildlife habitat at Lone Rock Beach would be similar to those described for alternative A. The speed limit would remain at 15 mph and quiet hours would be implemented. Enforcing the speed limit of 15 mph and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., common kingsnake, night snake, owls) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing motor vehicle user education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

The impacts of alternative C on wildlife and wildlife habitat at Lone Rock Beach Play Area would similar to those described for alternative A. Impacts on wildlife and wildlife habitat would be localized and adverse from continued off-road use from conventional motor vehicles, OHVs, and street-legal ATVs to include species disturbance and displacement, as well as habitat destruction and vehicle-wildlife collisions. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Accessible Shorelines

The impacts of alternative C on wildlife and wildlife habitat at accessible shorelines would be similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be open (approximately 7,300 acres) to conventional motor vehicles, OHVs, and street-legal ATVs,

subject to water level closures. Although Paiute Farms and Nokai Canyon are not officially open under the 1988 EA, they are currently being accessed. Therefore, adverse impacts of officially opening these two shorelines may be detectable, but would not be considerable, because many species in those areas have likely adapted to some level of off-road use, resulting in few new disturbances. As described for alternative A, species and habitat disturbance would continue and species mortality could occur, especially for smaller mammals (e.g., mice, rats, rabbits, chipmunks) and amphibian and reptile species (e.g., lizards, snakes).

Under alternative C, enforcing a speed limit of 15 mph at shoreline areas and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., common kingsnake, night snake) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Travel on GMP Roads in Glen Canyon

Under alternative C, conventional motor vehicles, OHVs, and street-legal ATVs would be allowed to operate on all GMP roads resulting in adverse impacts on wildlife and wildlife habitat that are similar to those described for alternative A, but at potentially greater levels as a result of the addition of OHVs allowed on roads and OHVs and street-legal ATVs being allowed in Orange Cliffs Unit. Impacts on wildlife and habitat in the Orange Cliffs area would be similar to those presented above; however, because impacts would be realized over a larger area, impacts of this alternative would be more regional than localized.

Similar to alternative B, under alternative C, speed limits would be established on unpaved GMP roads. Setting the speed limit on unpaved GMP roads at 25 mph (or as posted) may help lessen some of the adverse impacts of motor vehicle use along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). By allowing OHV and street-legal ATV use in the Orange Cliffs Unit would increase noise-related impacts and could adversely impact birds (e.g., lesser nighthawk) and other species that use the wilderness habitat.

Ferry Swale

Under alternative C, approximately 15 miles of ORV routes would be designated. This would likely result in additional impacts on wildlife and wildlife habitat in the vicinity of those designated routes due to increased traffic. Adverse impacts would be localized and more detectable in areas where fewer disturbances have occurred. Short-term impacts of legalizing additional routes at Ferry Swale include species injury and mortality, as well as the physiological effects of escape responses. Long-term impacts include continued habitat disturbance and fragmentation, as well as potential changes in nesting and foraging habits.

The speed limit on designated ORV routes, for all vehicles, would be 25 mph or as posted, which may help lessen some of the adverse impacts of off-road use along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Permits would be required for use on all designated ORV routes, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Cumulative Impacts

Impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future

actions on wildlife and wildlife habitat would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative C, would result in long-term considerable adverse and long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

ALTERNATIVE D: DECREASED MOTORIZED ACCESS

Lone Rock Beach

The impacts of alternative D on wildlife and wildlife habitat at Lone Rock Beach would be similar to those described for alternative C, except that OHVs and street-legal ATVs would not be allowed on the beach resulting in slightly less adverse impacts on wildlife and wildlife habitat from the decreased use. Prohibiting OHVs and street-legal ATVs at the beach may lessen some of the adverse impacts of off-road use on the beach, but this area would still be accessed by visitors for recreational use resulting in continued disturbance to wildlife and wildlife habitat in the area.

As described for alternative C, enforcing a speed limit of 15 mph and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., common kingsnake, night snake, owls) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

The impacts of alternative D on wildlife and wildlife habitat at Lone Rock Beach Play Area would be the same as those described for alternative B, resulting in long-term beneficial impacts on wildlife and wildlife habitat in the area as a result of the discontinuation of off-road use.

Accessible Shorelines

Under alternative D, off-road use at a total of 11 accessible shoreline areas would be discontinued permanently, whereas four areas (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp, totaling approximately 1,100 acres) would be open only to conventional motor vehicles by permit, subject to water-level closures. Long-term benefits to wildlife and wildlife habitat would result from discontinued off-road use of the 11 accessible shorelines as sources of habitat and species disturbance would be removed. The 11 shoreline areas would be restored to natural conditions and recovery of these areas could eventually reduce habitat fragmentation, especially for less transient species such as smaller mammals, reptiles, and amphibians, resulting in localized beneficial impacts. For the four accessible shorelines that would be open to conventional motor vehicles, the same localized adverse impacts would result as those described for alternative C. Locally, along open routes and areas, species and habitat disturbance would continue and species mortality could occur, especially for smaller mammals, amphibians, and reptiles.

As described for alternative C, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help mitigate some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, nocturnal species (e.g., common kingsnake, night snake) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required

for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Travel on GMP Roads in Glen Canyon

Under alternative D, there would be no direct impacts on wildlife and wildlife habitat on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on wildlife and wildlife habitat from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

The impacts of alternative D on wildlife and wildlife habitat at Ferry Swale would be the same as those described for alternative B, resulting in long-term benefits to wildlife species in the area due to the discontinuation of off-road use in the area. This could lead to a reduction in habitat disturbance and fragmentation and species mortality within Glen Canyon, especially for smaller mammals and amphibian and reptile species. Additionally, there would be a reduction in erosion and stream sedimentation, the transport of invasive species, and dust clouds.

Cumulative Impacts

Under alternative D, impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. As a result of discontinuation and non-designation of ORV routes, however, the overall impacts on wildlife and wildlife habitat would be greatly reduced compared to those described for alternative A. The impacts of cumulative actions, in combination with the detectable long-term beneficial impacts on wildlife resources under alternative D, would result in long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

Alternative E: Mixed Use

Lone Rock Beach

Impacts of alternative E on wildlife and wildlife habitat at Lone Rock Beach would be the same as those described for alternatives C, except that approximately 20 acres of the beach would be designated as a vehicle-free zone. Restricting vehicle use within this zone could minimize some of the adverse impacts of off-road use on the beach by reducing noise, but this area could still be accessed by visitors for recreational use resulting in continued disturbance to wildlife in the area. Impacts on wildlife and wildlife habitat would still be long term, localized and adverse from continued use of the beach and ORVs accessing the area, to include species disturbance and displacement, as well as habitat destruction and vehicle-wildlife collisions.

Enforcing a speed limit of 15 mph and implementing quiet hours after 10:00 p.m. may also help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, nocturnal species (e.g., common kingsnake, night snake, owls) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

Impacts of alternative E on wildlife and wildlife habitat at Lone Rock Beach Play Area would be the same as those described for alternative C. Impacts on wildlife and wildlife habitat would be localized and adverse from continued off-road use, to include species disturbance and displacement, as well as habitat fragmentation and vehicle-wildlife

collisions. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Accessible Shorelines

The impacts of alternative E on wildlife and wildlife habitat at accessible shorelines areas would be similar to those described for alternative C, except that off-road use at Warm Creek would be discontinued, and Paiute Farms Nokai Canyon would be officially authorized for off-road use. Under alternative E, conventional motor vehicles and street-legal ATV use would be permitted at all accessible shoreline areas (approximately 6,000 acres). Prohibiting off-road use at Warm Creek would likely result in beneficial impacts from reduced traffic, noise, and emissions. Habitat near Warm Creek would be restored to natural conditions over the long term, resulting in localized, long-term benefits to wildlife occurring in that area. The authorized use of Paiute Farms and Nokai Canyon, would result in adverse impacts on wildlife occurring in those areas; however, the impacts would be minimal because these areas are currently being accessed so new disturbance is not likely to occur. A variety of common species have the potential to occur at or near all shoreline areas, including rodents, lizards, snakes, rabbits, coyotes, foxes, and bobcats.

As described for alternative C, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, nocturnal species (e.g., common kingsnake, night snake) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Travel on GMP Roads in Glen Canyon

Under alternative E, conventional motor vehicles and street-legal ATVs would be authorized to operate on paved GMP roads while conventional motor vehicles, OHVs and street-legal ATVs would be authorized to operate on unpaved GMP roads. No OHVs or street-legal ATVs would be allowed on any road segments of the Orange Cliffs Unit. The impacts of alternative E on wildlife and wildlife habitat from the use of motor vehicles on GMP roads would be similar as those described for alternative C. No additional impacts on wildlife habitat would result from vehicle use on paved GMP roads because these roads have an asphalt top and no new soils or vegetation would be disturbed. It is assumed that vehicles will travel on the roadways and not contribute to disturbances along roadway edges.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 15 miles of designated ORV routes in the Ferry Swale area. Impacts of alternative E on wildlife and wildlife habitat would be the same as those described for alternative C. Permits would be required for all designated ORV routes, further enhancing benefits to wildlife by increasing education about resource protection and compliance with permit conditions.

Cumulative Impacts

Impacts on wildlife and wildlife habitat from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on wildlife and wildlife habitat would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative E, would

result in long-term detectable adverse and long-term beneficial cumulative impacts on wildlife and wildlife habitat in the area of analysis.

CONCLUSION

Compared to alternative A, alternative B would provide the most protection to wildlife and wildlife habitat through the prohibition of all off-road use. Under alternative B, the discontinuation of off-road use of the accessible shoreline areas, Lone Rock Beach, the Lone Rock Beach Play Area, and in Ferry Swale would allow previously disturbed areas the opportunity to recover and would increase the amount of habitat available for wildlife in Glen Canyon. Similarly, alternative D would result in a lower potential for impacts on wildlife and habitat through the prohibition of OHVs and street-legal ATVs throughout Glen Canyon by reducing physical and noise disturbance and, in some cases, mortality to wildlife in these areas.

Under alternative C, although a permitting system would result in the better management of motorized access, increased off-road use and on-road use could result in the potential for more widespread adverse impacts on wildlife and habitat through increased motorized access by conventional motor vehicles, OHVs, and street-legal ATVs, including access to the Orange Cliffs Unit. Compared to all other alternatives, alternative C would result in slightly more adverse impacts on wildlife and wildlife habitat. By officially authorizing off-road use at Paiute Farms and Nokai Canyon, designating ORV routes in Ferry Swale, and opening up GMP roads to OHVs and street-legal ATVs additional habitat and species disturbance would be detectable. The impacts of alternative E on wildlife and wildlife habitat from the use of motor vehicles on GMP roads would be similar those described for alternative C with a slight benefit of not allowing OHVs on unpaved GMP roads in the Orange Cliffs.

A variety of common species have the potential to occur in the study area including nesting and feeding shore and wading birds, nesting raptors, desert reptiles and mammals, and birds. Impacts on these wildlife from off-road use could include species disturbance and displacement, habitat destruction, and vehicle-wildlife collisions causing species injury or mortality. Species mortality would continue, especially for smaller mammals, amphibians, and reptiles. Species disturbance and displacement and vehicle-wildlife collisions would continue along roadways and edge habitat. Birds nesting on or near the ground at accessible shoreline areas would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Impacts in some areas would be highly noticeable, apparent, and severe, especially at specific accessible shorelines and Lone Rock Beach and Play area where soils have been severely damaged and habitat is limited.

Available wildlife habitat in Glen Canyon has been significantly impacted from past and present grazing, natural fluctuations in water levels, and illegal off-road use in isolated locations. Grazing activities, if not properly managed, can result in long-term impacts to available wildlife habitat from damage or loss of vegetation, soil compaction and erosion, and overall habitat degradation. Future uses, such as the Lake Powell pipeline construction, fee station improvements at Lone Rock Beach, and ongoing maintenance of existing utilities have physically removed or damaged existing wildlife habitat and would continue to do so in the localized respective areas regardless of off-road use or on-road vehicle travel.

However intense these impacts may be, evaluating context is necessary in order to understand the significance of the impact. For example, under alternative C, the alternative with the most use, 17 accessible shorelines would be designated, along with Lone Rock Beach and play area. Wildlife would likely be displaced at the high use areas. However, these shoreline areas make up a tiny fraction of the 2,000 miles of Lake Powell shoreline, leaving ample habitat for wildlife that chose shoreline areas. Additionally, many of the shoreline areas are likely infrequently visited, and in those areas disturbance and displacement would be limited. Additionally, impacts to wildlife from use in the Ferry Swale area constitutes approximately 1 acre of habitat in the context of the 1,249,934 acres of Glen Canyon. Finally, when evaluating the significance of impacts to wildlife on a habitat scale, it is clear that a very limited portion of habitat is impacted by uses evaluated in the plan. As noted in the vegetation section, less than 1 percent of Glen Canyon's blackbrush, sand sagebrush, and shadscale vegetation communities are impacted under

the highest use alternative. Therefore, impacts to wildlife and wildlife habitat under this plan are likely noticeable and may be severe at isolated locations, but are not likely significant in all other contexts.

SPECIAL-STATUS SPECIES

GUIDING REGULATIONS AND POLICIES

The Park Service has a responsibility to meet its obligations under the NPS Organic Act and the federal Endangered Species Act of 1973 to conserve listed species and prevent detrimental effects on listed, threatened, or candidate species as a result of any proposed action. The Endangered Species Act mandates that all federal agencies consider the potential effects of their actions on threatened and endangered species and species of special concern. If NPS determines that an action may adversely affect a federally listed species, consultation with the USFWS is required to ensure that the action would not jeopardize the species' continued existence or result in the destruction or adverse modification of critical habitat.

NPS *Management Policies 2006* (NPS 2006a) state that the potential effects of agency actions will also be considered on state or locally listed species. Pursuant to Utah Division of Wildlife Resources Administrative Rule R657-48, wildlife species that are federally listed, are candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the Utah Sensitive Species List. In addition to these species, the list includes "wildlife species of concern," which are species for which credible scientific evidence exists to substantiate a threat to continued population viability. Arizona lists "wildlife species of concern" for species whose occurrence in Arizona is or may be in jeopardy. Rare plants are listed in Arizona under one of five categories (highly safeguarded, salvage restricted, export restricted, salvage assessed, and harvest restricted).

METHODOLOGY AND ASSUMPTIONS

State- and federally listed species and designated critical habitat were identified through informal consultation with the USFWS and a review of state databases maintained by the Arizona Game and Fish Department and the Utah Department of Natural Resources. A list of species that are known to be present or that may exist in Glen Canyon was requested from the USFWS; the response from the Arizona Ecological Field Services Office and database searches is included in "Appendix A: Consultation and Coordination."

For the purposes of this analysis, only those species known to be present in Glen Canyon and that may experience some level of impact as a result of management actions are addressed in this section. The primary method for assessing impacts on listed species was to determine which species may inhabit areas likely to be affected by the management actions described in this plan/DEIS, and to use the professional judgment of NPS staff, informed by outside experts and available scientific literature, to evaluate the level of potential impacts on these species.

Animal Species

Sensitive animal species of particular interest and deemed likely to be affected by off-road use in Glen Canyon include nesting and feeding shore and wading birds, nesting raptors, desert reptiles and mammals, and birds. A complete list of special-status animal species analyzed in this plan/DEIS and the potential effect of this plan on those species are included in table 31.

Plant Species

Although Glen Canyon possesses a significant variety of sensitive vegetation, species of particular concern are those located below 5,000 feet (1,524 meters), in the areas of off-road use. Vegetation in these areas is dominated by blackbrush, and shadscale, with smaller populations of sandsage grassland and Torrey-Mormon-tea occurring. To

assess potential effects on desert vegetation, the planning team developed a GIS map utilizing vegetative community layers to show which vegetative communities exist in ORV routes and areas and that have the most potential to be affected.

State-listed species determined in chapter 3 to not be affected by the management actions under this plan/DEIS are not included in the impacts analysis (see chapter 3, table 6). However, as stated in chapter 3, all federally listed species were analyzed, including those that would not be affected by management actions. A complete list of special-status plant species analyzed in this plan/DEIS is included in table 31.

TABLE 31: POTENTIAL IMPACTS ON SPECIAL-STATUS SPECIES AT GLEN CANYON NATIONAL RECREATION AREA

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Mammals				
Townsend's big-eared bat	*Corynorhinus townsendii*	State species of concern	Both	
Spotted bat	*Euderma maculatum*	State species of concern	Both	
Western red bat	*Lasiurus blossevillii*	State species of concern	Both	
Western small-footed myotis	*Myotis ciliolabrum*	State species of concern	Both	
Fringed myotis	*Myotis thysanodes*	State species of concern	Both	
Long-legged myotis	*Myotis volans*	State species of concern	Both	
Yuma myotis	*Myotis yumanensis*	State species of concern	Both	
Big free-tailed bat	*Nyctinomops macrotis*	State species of concern	Both	
Desert bighorn sheep*	*Ovis canadensis nelsoni*	State species of concern	Both	MA-NLAA
Silky pocket mouse	*Perognathus flavus*	State species of concern	Utah	
Kit fox*	*Vulpes macrotis*	State species of concern	Utah	MA-NLAA
Reptiles				
Glossy snake*	*Arizona elegans*	State species of concern	Arizona	MA-NLAA
Western banded gecko	*Coleonyx variegatus*	State species of concern	Arizona	
Glen Canyon chuckwalla*	*Sauromalus obesus*	State species of concern	Both	MA-NLAA
Desert night lizard*	*Xantusia vigilis*	State species of concern	Utah	MA-NLAA
Amphibians				
Northern leopard frog	*Rana pipiens*	State species of concern	Both	
Birds				
Southwestern willow flycatcher*	*Empidonax traillii extimus*	Federally endangered	—	NE
California condor*	*Gymnogyps californianus*	Federally endangered	—	MA-NLAA

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Brown pelican*	*Pelecanus occidentalis*	Federally endangered	—	MA-NLAA
Mexican spotted owl*	*Strix occidentalis lucida*	Federally threatened	—	MA-NLAA
Yellow-billed cuckoo*	*Coccyzus americanus*	Federal candidate species	—	NE
Golden eagle*	*Aquila chrysaetos*	State species of concern	Both	MA-NLAA
Burrowing owl*	*Athene cunicularia*	State species of concern	Both	MA-NLAA
Peregrine falcon	*Falco peregrinus*	State species of concern	Both	
Pinyon jay*	*Gymnorhinus cyanocephalus*	State species of concern	Both	MA-NLAA
Bald eagle*	*Haliaeetus leucocephalus*	State species of concern	Both	MA-NLAA
Belted kingfisher	*Megaceryle alcyon*	State species of concern	Arizona	
Long-billed curlew*	*Numenius americanus*	State species of concern	Both	MA-NLAA
Virginia's warbler	*Oreothlypis virginiae*	State species of concern	Utah	
Lucy's warbler	*Oreothlypis luciae*	State species of concern	Both	
Osprey	*Pandion haliaetus*	State species of concern	Both	
American white pelican*	*Pelecanus erythrorhynchos*	State species of concern	Utah	MA-NLAA
Bell's vireo	*Vireo bellii*	State species of concern	Both	
Gray vireo*	*Vireo vicinior*	State species of concern	Both	MA-NLAA
Great blue heron*	*Ardea herodias*	Glen Canyon species of concern	—	MA-NLAA
Dusky flycatcher	*Empidonax oberholseri*	Glen Canyon species of concern	—	
Orange-crowned warbler	*Oreothlypis celata*	Glen Canyon species of concern	—	
Plants				
Brady pincushion cactus*	*Pediocactus bradyi*	Federally endangered	—	NE
Navajo sedge*	*Carex specuicola*	Federally threatened	—	NE
Jones' cycladenia*	*Cycladenia humilis* var. *jonesii*	Federally threatened	—	NE
American spikenard	*Aralia racemosa*	State species of concern	Both	
Harrison's milkvetch	*Astragalus harrisonii*	State species of concern	Utah	
Copper Canyon milkvetch*	*Astragalus cutleri*	State species of concern	Utah	MA-NLAA
Ferron's milkvetch	*Astragalus musiniensis*	State species of concern	Utah	

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Atwood's camissonia	*Camissonia atwoodii*	State species of concern	Utah	
California sawgrass	*Cladium californicum*	State species of concern	Utah	
Higgins biscuitroot	*Cymopterus higginsii*	State species of concern	Utah	
Hole-in-the-Rock prairie clover	*Dalea flavescens* var. *epica*	State species of concern	Both	
Zion shooting star	*Dodecatheon pulchellum* var. *zionense*	State species of concern	Utah	
Kachina daisy*	*Erigeron kachinensis*	State species of concern	Utah	MA-NLAA
Alcove daisy	*Erigeron zothecinus*	State species of concern	Utah	
Paria spurge*	*Euphorbia nephradenia*	State species of concern	Utah	MA-NLAA
Cataract gilia*	*Gilia imperialis*	State species of concern	Utah	MA-NLAA
Tropic goldeneye*	*Heliomeris soliceps*	State species of concern	Utah	MA-NLAA
Satintail grass	*Imperata brevifolia*	State species of concern	Utah	
Western hophornbeam*	*Ostrya knowltonii*	State species of concern	Both	MA-NLAA
Alcove rock daisy*	*Perityle specuicola*	State species of concern	Utah	MA-NLAA
Howell's phacelia*	*Phacelia howelliana*	State species of concern	Both	MA-NLAA
Nipple phacelia*	*Phacelia mammillarensis*	State species of concern	Both	MA-NLAA
Alcove bog-orchid	*Platanthera zothecina*	State species of concern	Both	
Mojave indigo-bush	*Psorothamnus arborescens* var. *pubescens*	State species of concern	Both	
Whiting's indigo-bush*	*Psorothamnus thompsoniae* var. *whitingii*	State species of concern	Both	MA-NLAA
New Mexico raspberry*	*Rubus neomexicanus*	State species of concern	Utah	MA-NLAA
Jane's globemallow*	*Sphaeralcea janeae*	State species of concern	Utah	MA-NLAA
Rocky Mountain maple	*Acer glabrum*	Glen Canyon species of concern	—	
Bigtooth maple	*Acer grandidentatum*	Glen Canyon species of concern	—	
Desert mountain lilac*	*Ceanothus vestitus var. franklinii*	Glen Canyon species of concern	—	MA-NLAA
Red-osier dogwood	*Cornus sericea*	Glen Canyon species of concern	—	

Common Name	Scientific Name	Status	State (Utah, Arizona, or both)	Potential Overall Effect of this plan/DEIS
Utah brittle-fern	*Cystopteris utahensis*	Glen Canyon species of concern	—	
Cotton top	*Echinocactus polycephalus*	Glen Canyon species of concern	—	
Ross's spurge	*Euphorbia aaron-rossii*	Glen Canyon species of concern	—	
Rice cutgrass	*Leersia oryzoides*	Glen Canyon species of concern	—	
American bugleweed	*Lycopus americanus*	Glen Canyon species of concern	—	
Dunebroom	*Parryella filifolia*	Glen Canyon species of concern	—	
Tompkins phacelia*	*Phacelia pulchella* var. *sabulonum*	Glen Canyon species of concern	—	MA-NLAA
Floating pondweed	*Potamogeton natans*	Glen Canyon species of concern	—	
Hoptree	*Ptelea trifoliata*	Glen Canyon species of concern	—	
Douglas fir*	*Pseudotsuga menziesii*	Glen Canyon species of concern	—	MA-NLAA
Smooth sumac	*Rhus glabra*	Glen Canyon species of concern	—	
Blue-eyed grass	*Sisyrinchium demissum*	Glen Canyon species of concern	—	

Source: Spence 2012a; Sweatland pers. comm. 2010a.

*Species carried forward for analysis in chapter 4, including all federally listed species and state-listed species with the potential to be affected by the ORV Management Plan alternatives (Spence pers. comm. 2012b).

— = Species not listed in either Utah or Arizona.

NE = no effect

MA-NLAA = may affect, not likely to adversely affect

Context

The geographic study area for special-status animal and plant species and their habitats is contained within the areas of Glen Canyon that would be affected by management decisions under this plan/DEIS.

Alternative A: No Action

As described in the "Wildlife and Wildlife Habitat" section, documentation of relatively early use of ORVs in desert ecosystems, like those at Glen Canyon, found that ORVs were destructive, causing long-lasting damage to land and aquatic ecosystems, wildlife, soils, and hydrologic flows (New Mexico EMNRD et al. 2008). Studies of off-road recreation in the southwest have reported adverse impacts on sensitive species due to fragmentation, habitat destruction, harassment, noise, and direct mortality (Bury and Luckenbach 2002). ORVs have been demonstrated to decrease population densities of reptiles, small mammals, and bird populations. In general, habitat fragmentation reduces the size of patches of desert, forest, shrublands, wetlands and grasslands. This reduces the

total area of contiguous habitat available for wildlife species, especially birds, and increases the isolation of the habitat (Campbell and Johns n.d.), resulting in changes to forage and cover, flows of energy and nutrients, and even the microclimate of the area.

Other risks range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Further research regarding the adverse effects of human recreational activities among bird species has shown nest desertion and temporary abandonment, and changes in foraging habits (Joslin and Youmans 1999). As described in the "Wildlife and Wildlife Habitat" section, noise is an environmental stressor that can induce startle responses, aversion, and maladaptive behaviors; cause changes in habitat use, communication, predation, foraging, energetic, courtship, breeding, and reproduction; and produce stress responses such as changes in heart rate and energy consumption, and hearing loss.

Brooks (1999, 2000) reported that breeding bird abundance and species richness, as well as lizard abundance and species richness were higher in areas that restricted off-road use compared to areas where off-road use is allowed. Off-road use-related impacts on amphibian and reptile species include indirect impacts on populations via habitat destruction, chemical contamination and sedimentation, and the creation of migration barriers. Studies of small mammals have reported adverse effects from motorized vehicle use, including population reduction, habitat modification, forage/cover removal, and energy expenditure (Joslin and Youmans 1999).

ORV noise has been shown to damage hearing sensitivity and predator detection in small mammals and reptile species (Brattstrom and Bondello 1983). Noise from ORVs has also been found to interfere with songbird breeding and territorial displays (Berry 1980).

As described in the "Vegetation" section, off-road use affects desert vegetation in two ways: (1) As soils are damaged they lose the ability of to support desert vegetation; and (2) ORVs cause direct damage that includes crushing of foliage, root systems, and seedlings, uprooting of small plants, and disruption of large plant root systems by shearing and compaction of desert soils.

Deserts and arid regions are generally considered areas of low productivity. Vegetation is slow growing and sparse, a reflection of the environmental stresses present in arid and semi-arid environments. Damage to desert vegetation can be immediate and long lasting. For example, some plant species, such as those found in sagebrush-steppe communities, may take decades to reestablish after a disturbance (Allen 1995).

Scientific studies have reported a highly negative response by perennial desert vegetation to most types and intensities of off-road use. Smaller plants can be destroyed at very low levels of off-road use, and larger, more resilient plants will succumb to damage following repeated impacts (Bury 1980; Luckenbach and Bury 1983).

The introduction and spread of invasive species by ORVs is also a concern. Invasive species are a significant threat, displacing native flora and threatening biodiversity and overall productivity of the desert environment. Off-road use has been shown to contribute to the introduction and establishment of invasive or nonnative species by expansion or creation of routes; disturbance to previously undisturbed soils; and direct transportation of seeds into new areas (Switalski and Jones 2008). In general, ORVs may not account for ecologically significant nonnative seed dispersal, but they have been shown to transport seeds (Rooney 2005).

Lone Rock Beach

Lone Rock Beach is currently open to conventional motor vehicles, OHVs, and street-legal ATVs. Vehicles may be operated from the operator's camping location to the Lone Rock Beach Play Area only to access the play area. The impacts of off-road use on special-status species that occur at Lone Rock Beach would result in habitat destruction, vehicle-wildlife collisions, and species disturbance and displacement (Bury 1980).

Mammals

Off-road use at Lone Rock Beach could result in disturbance and displacement of kit foxes, which are known to occur in the Lone Rock Beach area (Utah DNR n.d.a), as well as continued habitat destruction and potential vehicle-wildlife collisions, though these occurrences are currently rare. However, this species is primarily nocturnal and typically avoids humans and human-made noise (NatureServe 2009). Therefore, adverse impacts would be localized and limited.

As described in the "Wildlife and Wildlife Habitat" section in chapter 3, important habitat for desert bighorn sheep within Glen Canyon includes Red, White, and Gypsum Canyons, as well as Waterpocket Fold east of the Escalante River (Singer et al. 2000). As a result, continued off-road use at Lone Rock Beach is not expected to affect desert bighorn sheep.

Reptiles

Off-road use-related impacts on reptile species include both direct (e.g., vehicle-wildlife collisions and noise-related impacts) and indirect impacts on populations (e.g., habitat destruction, chemical contamination and sedimentation, and the creation of migration barriers). The only special-status reptile with the potential of being impacted by off-road use at Lone Rock Beach is the chuckwalla (NPS 2011b). Locally, habitat disturbance and fragmentation would continue and species mortality could occur, resulting in adverse impacts that may be detectable, but not considerable. As described in the "Special-status Species" section in chapter 3, distribution of desert night lizard within Glen Canyon is limited and does not include the Lone Rock Beach (NPS 2011b); therefore, off-road use at Lone Rock Beach would not affect this species. Similarly, the glossy snake is known to occur in the Wahweap area near Ferry Swale (NPS 2011b), therefore, off-road use at Lone Rock Beach is not expected to affect this species.

Birds

The no-action alternative would result in localized short- and long-term adverse impacts on special-status birds at Lone Rock Beach. Motorized vehicle use can result in adverse impacts on bird species, including physiological disturbance, displacement, nest abandonment, and habitat avoidance and destruction (Bury and Luckenbach 2002; Campbell and Johns n.d.; and Joslin and Youmans 1999). Special-status bird species likely to occur (or with the potential to occur) in the area of Lone Rock Beach include golden and bald eagle, long-billed curlew, burrowing owl, brown and American white pelican, great blue heron, and California condor (NPS n.d.a). As described in chapter 3, the golden eagle may occasionally forage over the Lone Rock Beach ORV area because there is a territory on Castle Rock. However, it is unlikely that off-road use at Lone Rock Beach would have substantial impacts on raptors, including the golden and bald eagle, in this particular area as there are extensive areas around Lone Rock Beach that are off limits to off-road use that provide suitable habitat for use by raptors (Spence n.d.). Similarly, California condors, burrowing owls, great blue heron, and American white pelicans are considered rare at Lone Rock Beach (Spence n.d.), and adverse impacts would likely be slight. The long-billed curlew typically occurs at Lone Rock Beach during spring migration and avoids contact with people, resulting in minimal impacts from off-road use (Spence pers. comm. 2012b). Any ORV-related impacts on affected special-status bird species at Lone Rock Beach may be detectable, but would be localized and not considerable.

Alternative A would result in no effect to the southwestern willow flycatcher, Mexican spotted owl, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach (NPS n.d.a).

Plants

Impacts of off-road use to special-status plants at Lone Rock Beach are expected to be negligible or undetectable because there are no special-status plants known to occur in this area due to lack of suitable habitat (Spence pers. comm. 2012b).

Lone Rock Beach Play Area

The play area is a fence-enclosed 180-acre area that is open to high-intensity off-road use. It is the only location in Glen Canyon where all vehicles (conventional motor vehicles, OHVs, and street-legal ATVs) can be operated in an unrestricted manner. As described in the "Vegetation" section of this plan/DEIS, much of the vegetation and habitat in this area has been destroyed from constant motorized vehicle use.

Mammals

As described for Lone Rock Beach, off-road use in the play area could result in disturbance and displacement for kit foxes, which are known to occur in the Lone Rock Beach Play Area (Utah DNR n.d.a), as well as continued habitat destruction and potential vehicle-wildlife collisions. As a result, the impacts of continued off-road use in this area may be detectable, but would be localized and would not be considerable because kit foxes typically avoid areas of heavy off-road use (NatureServe 2009).

As described above for Lone Rock Beach, effects to bighorn sheep would be negligible, because this area is not preferred habitat for this species.

Reptiles

It is unlikely that off-road use at Lone Rock Beach Play Area would adversely affect special-status reptile species within Glen Canyon. As described above for Lone Rock Beach, distribution of night lizard within Glen Canyon is limited and does not include the Lone Rock Beach Play Area, so off-road use at the play area is not expected to affect this species. Similarly, the chuckwalla is common along shorelines, but not known to occur in desert habitat because it prefers rocky sites (NPS 2011b). As described above for Lone Rock Beach, the glossy snake is known to occur in the Wahweap area near Ferry Swale; therefore, although impacts of off-road use to this species are possible, they are unlikely at the Lone Rock Beach Play Area.

Birds

As described above for Lone Rock Beach, the no-action alternative would result in localized short- and long-term adverse impacts on special-status birds at Lone Rock Beach Play Area. Continued off-road use could result in physiological disturbance, displacement, and habitat avoidance and destruction for the golden and bald eagle, burrowing owl, and California condor. Impacts on burrowing owl, California condor, and American white pelican are expected to be slight, because these species are considered rare in this area of Glen Canyon (Spence, LaRue, and Grahame 2011). Similarly, adverse impacts are expected to be minimal to the golden and bald eagle, because these species are more likely to avoid areas of heavy use. Therefore, any ORV-related impacts on affected special-status bird species may be detectable, but would be localized and not considerable at Lone Rock Beach Play Area.

Alternative A would result in no effect to the southwestern willow flycatcher, brown pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach Play Area (NPS n.d.a).

Plants

Impacts of off-road use to special-status plants at Lone Rock Beach Play Area are expected to be negligible because there are no special-status plants known to occur in this area due to lack of suitable habitat.

Accessible Shorelines

Under alternative A, 13 accessible shoreline areas would remain open, subject to water level closures, to off-road use by conventional motor vehicles. The operation of OHVs or street-legal ATVs would not be authorized in the 13 ORV areas. The 13 ORV areas would not be play areas (climbing hills in vehicles, driving at high speeds, and similar behavior would not be authorized), but rather areas intended to provide public conventional motor vehicle access to the Lake Powell shoreline for purposes of primitive recreational use. The public would only be allowed to depart the road and drive directly to the shoreline and park in designated ORV areas. However, because alternative A would maintain current management practices related to accessible shorelines, the shorelines would not be marked and defined in a manner consistent with the control of off-road use for the protection of resources.

In order to protect resources and promote public safety, Glen Canyon would retain the authority to administratively discontinue use of shoreline areas. Currently Warm Creek, Crosby Canyon, and Bullfrog Creek North and South are temporarily closed due to low water conditions, but they would be reopened if future conditions allow and Glen Canyon staff deems it appropriate. Reopening these areas would result in adverse impacts on mammals, reptiles, birds, and plants as described below; however, the temporary closure of shoreline areas would minimize impacts on affected special-status species from off-road use by temporarily removing a source of localized disturbance. The Paiute Farms and Nokai Canyon accessible shorelines are not officially open, although they are currently being accessed by users. Under alternative A, off-road use of these two areas would be discontinued and management action taken to prevent access, resulting in beneficial impacts on special-status species.

Mammals

Impacts on kit foxes would be localized and adverse from the continued use of conventional motor vehicles at accessible shorelines, to include species disturbance and displacement as well as habitat destruction and potential vehicle-wildlife collisions. However, the only shorelines where adverse impacts on this species are anticipated are Crosby Canyon and Warm Creek (Spence pers. comm. 2012b). Additionally, this species is highly adaptive and tends to avoid humans and human-made noise (NatureServe 2009). Therefore, off-road use at accessible shorelines would result in very limited, localized adverse impacts on kit foxes.

As described in the “Wildlife and Wildlife Habitat” section in chapter 3, desert bighorn sheep prefer rocky cliffs away from human activity. However, this species is known to occur at lower elevation areas, which provide temporary access to foraging and lambing resources (Singer et al. 2000). Accessible shorelines in Glen Canyon where bighorn sheep are more likely to occur include White Canyon, Red Canyon, Blue Notch, and Farley Canyon; however, it is possible for them to occur at any accessible shoreline area. Although alternative A may result in continued habitat avoidance and temporary disturbance, overall long-term impacts on bighorn sheep from continued off-road use at accessible shorelines would be limited because it is likely that desert bighorn sheep avoid shoreline areas with heavy use. This area of avoidance constitutes a small percentage of the approximately 2,000 miles of available Lake Powell shoreline.

Reptiles

As described above for Lone Rock Beach, continued off-road use at accessible shorelines could result in localized adverse impacts on sensitive reptiles within Glen Canyon. ORV-related impacts on reptile species include both direct (e.g., vehicle-wildlife collisions and noise-related impacts) and indirect impacts on populations (e.g., habitat

destruction, chemical contamination and sedimentation, and the creation of migration barriers). As described in the "Special-status Species" section in chapter 3, the chuckwalla is very common along rocky shorelines. Therefore, short- and long-term adverse impacts on this species are expected from direct mortality, disturbance, and habitat loss and fragmentation; however, impacts would be localized. Dirty Devil is the only accessible shoreline where the night lizard may occur; however, this species is nocturnal and suitable habitat exists elsewhere in undisturbed areas. Therefore, overall adverse impacts on this species from off-road use at accessible shorelines would be localized and limited. As described above for Lone Rock Beach, the glossy snake is known to occur in the Wahweap area near Ferry Swale, so off-road use at Lone Rock Beach is not expected to affect this species.

Birds

The no-action alternative could result in short- and long-term adverse impacts on special-status birds at accessible shorelines within Glen Canyon. As described above, risks to birds from off-road use range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Birds can respond to disturbance with accelerated heart rate and metabolic function, and suffer from increased levels of stress, which can lead to displacement, mortality, and reproductive failure (Taylor n.d.). Additionally, noise from ORVs can cause changes in communication, predation, foraging, courtship, breeding, and reproduction (Bury 1980). Adverse impacts would be localized at accessible shoreline areas. Special-status birds with the potential to occur near accessible shoreline areas include the long-billed curlew, great blue heron, brown and American white pelican, and golden and bald eagle (Spence 2012a, b). However, these species likely avoid areas of heavy use. The California condor has the potential to occur at any location within Glen Canyon; however, this species is considered rare in Glen Canyon and likely avoids areas of heavy use. Any adverse impacts on this species at accessible shorelines would likely be slight, localized, and short term. The pinyon jay is a common widespread permanent resident in pinyon-juniper woodlands of Glen Canyon and may potentially occur in the Orange Cliffs region. The gray vireo is considered an uncommon, but widespread summer resident. These species would likely avoid areas of disturbance and therefore, any adverse impacts on these species at accessible shorelines would likely be slight, localized, and short-term.

Four accessible shorelines in Glen Canyon are within designated critical habitat for the Mexican spotted owl (Bullfrog North and South, Stanton Creek, and Dirty Devil). Although off-road use would continue at these shorelines under the no-action alternative, the owl is not known to use habitat in these areas (NPS 2007a; Spence 2012a). Adverse impacts on this species may be detectable, but would be localized and would be limited to noise-related impacts.

Alternative A would result in no effect to the southwestern willow flycatcher and yellow-billed cuckoo because these federally listed species are not known to occur at accessible shoreline areas (NPS n.d.a). Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance would continue. Adverse impacts on these species may be detectable, but would be localized and would be limited to noise-related impacts.

Plants

Many vegetative communities in the area of the accessible shorelines have been previously disturbed and substantially impacted by off-road use. Disturbance has ranged from limited impacts (i.e., localized trampling) to vegetation being completely destroyed or removed. Although the majority of vegetation in these areas has been removed or destroyed as a result of off-road use, some vegetative communities do still exist. The only special-status plant species with the potential to be impacted by off-road use at accessible shorelines is Paria spurge, which may occur at Bullfrog North and South (Spence pers. comm. 2012b) and possibly within Wayne, Garfield, and Kane counties. However, impacts would be localized and in the context of Glen Canyon, impacts on this species would be limited.

Travel on GMP Roads in Glen Canyon

Under current conditions, conventional motor vehicles and street-legal ATVs are authorized to operate on all GMP roads in Glen Canyon (there are approximately 365 miles of unpaved GMP roads and 72 miles of paved GMP roads at Glen Canyon), with the exception of the Orange Cliffs Unit where street-legal ATVs are prohibited.

Mammals

The continued use of conventional motor vehicles and street-legal ATVs on the majority of paved and unpaved GMP roads within Glen Canyon could result in adverse impacts on bighorn sheep and kit foxes. Locally, along roads, habitat disturbance and fragmentation would continue and species mortality could occur. Motor vehicles can raise dust clouds, disrupt and damage wildlife, and reduce effective habitat (New Mexico EMNRD et al. 2008). However, because habitat in Glen Canyon has been previously impacted and vehicle use would continue to be contained to the already disturbed GMP roads, impacts would be localized. Additionally, kit foxes are rare during the day and tend to avoid humans and human-caused noise; therefore, any adverse impacts on this species are expected to be limited. Bighorn sheep routinely cross the Warm Creek Road between Big Water and Warm Creek to access the lake. Although this species prefers rocky cliffs away from human activity, impacts on bighorn sheep may occur, but would likely be minimal. This area of avoidance constitutes a small percentage of the approximately 2,000 miles of available Lake Powell shoreline.

Reptiles

The continued use of conventional motor vehicles and street-legal ATVs on GMP roads within Glen Canyon could adversely affect the desert night lizard. Locally, along roads, habitat disturbance and fragmentation would continue and species mortality could occur, resulting in adverse impacts. However, recorded distribution for this species is limited to small portions of the Warm Creek-Grand Bench, Wilson Mesa, and Orange Cliffs regions of Glen Canyon (NPS n.d.c). Additionally, this species is nocturnal. Therefore, any adverse impacts that would result are limited to only a few unpaved GMP roads within Glen Canyon. As described above for Lone Rock Beach, the glossy snake is known to occur in the Wahweap area near Ferry Swale (NPS n.d.c), so motor vehicle use on GMP roads is not expected to affect this species. Similarly, the chuckwalla prefers shoreline habitat, so motor vehicle use on GMP roads is not expected to affect this species.

Birds

Alternative A would result in short- and long-term adverse impacts on several special-status bird species from the continued use of conventional motor vehicles and street-legal ATVs on GMP roads within Glen Canyon. Locally, along roads, habitat and species disturbance would continue, and species mortality could occur. Bird species with the potential to be impacted include the California condor, burrowing owl, bald and golden eagle, and Mexican spotted owl. Motor vehicles can raise dust clouds, disrupt wildlife, and reduce effective habitat.

Several GMP roads within Glen Canyon cross designated critical habitat for the Mexican spotted owl. This species is known to occur in a small area south of the Orange Cliffs region. Prohibiting street-legal ATV use in the Orange Cliffs Unit could benefit the Mexican spotted owl and other bird species in the area, by limiting habitat disturbance and noise-related impacts.

Alternative A would result in no effect to the southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur along unpaved GMP roads.

Plants

Alternative A would result in short- and long-term adverse impacts on special-status plants from the continued use of conventional motor vehicles and street-legal ATVs on GMP roads. Species likely to be affected by motorized vehicle use on GMP roads include tropic goldeneye, Copper Canyon milkvetch, Kachina daisy, cataract gilia, Western hophornbeam, alcove rock daisy, Howell's phacelia, nipple phacelia, Whiting's indigo-bush, New Mexico raspberry, Jane's glowbemallow, desert mountain lilac, and Tompkins phacelia. Several of these species are known to occur along or near Warm Creek Road, including tropic goldeneye, Tompkins phacelia, and nipple phacelia. Others occur in the Clay Hills Crossing area (e.g., Copper Canyon milkvetch and Whiting's indigo-bush). Impacts on these species would likely be contained to previously disturbed areas, resulting in localized effects that may be detectable. Continued impacts on soils would reduce the ability of soils to provide for vegetation; however, because vegetation in the area has been previously impacted and vehicle use would continue to be contained to the already disturbed GMP roads, no new notable harm to vegetation would occur, including at the Orange Cliff Unit.

Ferry Swale

Under alternative A, approximately 53 miles of ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs. Wildlife and wildlife habitat in Ferry Swale would continue to experience adverse impacts from continued disturbances related to off-road use occurring along the 53 miles of designated ORV routes. However, because habitat in the area has been previously impacted and vehicle use would continue to be contained to the already designated routes, no new notable harm to wildlife or habitat would occur.

Mammals

In general, routes created by ORV users can cause a patchwork of disrupted habitat often correlated with reduced ecosystem productivity (Trombulak and Frissell 2000; New Mexico EMNRD et al. 2008). For the kit fox, impacts of authorized off-road use along designated ORV routes in Ferry Swale may be detectable (e.g., habitat fragmentation, species disturbance, and vehicle-wildlife collisions), but would be localized and would not be considerable as kit foxes tend to avoid humans and human-made noise (NatureServe 2009). Additionally, kit foxes are nocturnal and are rarely seen during the day, which is when the majority of off-road use occurs.

Although a herd of desert bighorn sheep lives in the Paria Canyon-Vermilion Cliffs area, less than 15 miles southwest of Ferry Swale, impacts from authorized off-road use at Ferry Swale would likely not affect desert bighorn sheep, because this species typically avoid Highway 89 and areas of Ferry Swale east to Lake Powell.

Reptiles

As described in the "Special-status Species" section in chapter 3, snakes are known to favor roads and trails as thermoregulation sites, which put them at risk of being injured or killed by motorized vehicles. Off-road use at Ferry Swale could result in adverse impacts on the glossy snake. Locally, along designated ORV routes, habitat disturbance and fragmentation would continue and species injury or mortality could occur, resulting in adverse impacts. Distribution of the night lizard within Glen Canyon is limited and does not include the Ferry Swale area, so off-road use at Ferry Swale would have no effect on this species. Similarly, the chuckwalla prefers shoreline habitat, so off-road use at Ferry Swale would have no effect on this species.

Birds

Alternative A could result in localized short- and long-term adverse impacts on special-status birds at Ferry Swale (e.g., burrowing owl, golden and bald eagle, and California condor). The burrowing owl often occurs on corral posts or at stock ponds in the Ferry Swale area (NPS 2007a); therefore, it is expected that species disturbance

would result from off-road use (i.e., noise-related impacts). However, any resulting short- and long-term adverse impacts would be localized and minimal due to their limited distribution in the Ferry Swale area. Although it is possible for the condor to occur at any location within Glen Canyon, it is a rare species in Glen Canyon. Standard mitigation measures (as mentioned for Accessible Shorelines above) would be used if this species were to appear in an area with off-road use. Therefore, any adverse impacts that could result for the condor are expected to be localized and negligible. Although the long-billed curlew has been recorded in the Wahweap area, this species prefers shoreline habitat, so impacts on this species are unlikely (NPS n.d.a; Spence, LaRue, and Grahame 2011).

Alternative A would result in no effect to the southwestern willow flycatcher, brown and American white pelican, Mexican spotted owl, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Ferry Swale.

Plants

Impacts of off-road use to special-status plants at Ferry Swale are expected to be negligible because there are no special-status plants known to occur in this area due to lack of suitable habitat (Spence, pers. comm., 2012).

Cumulative Impacts

Other past, present, and reasonably foreseeable future actions within and around Glen Canyon have the potential to impact special-status species. In recent years, the rising and falling water levels as a result of natural fluctuations and dam operations have exposed more or less of the accessible shoreline areas, impacting habitat available for sensitive species. Following these events, several popular accessible shoreline areas have been closed due to accessibility issues, resulting in beneficial impacts on special-status species by temporarily removing a source of disturbance (i.e., off-road use) in affected areas. However, falling water levels also result in short-term adverse impacts on special-status species by limiting water resources. Due to fluctuating lake levels, several vegetative communities are not able to establish along the shoreline; thus, limiting shoreline habitat.

A wide variety of activities exist in Glen Canyon that have resulted in and continue to result in adverse impacts on wildlife and wildlife habitat. These activities include unauthorized off-road use on adjacent lands, recreational hunting and livestock grazing as allowed by Glen Canyon's enabling legislation, and special use permits for filming and photography. Unauthorized off-road use leads to disrupted and fragmented habitat, species disturbance, and direct mortality of special-status wildlife and plants. Recreational hunting and grazing also result in localized habitat and species disturbance (and direct mortality in the case of recreational hunting), but the adverse impacts of special use permits on special-status species and their habitat are much less considerable than unauthorized off-road use, since these activities are monitored and managed by NPS staff. Military overflights from nearby bases can also result in short-term limited adverse impacts on special-status species and their habitat, depending on the duration and elevation of flights. Impacts may range from minor behavioral responses, such as flight/fright response, to severe changes in habitat utilization (Radle 2007).

Future fee station improvements at Lone Rock Beach could result in short-term localized adverse impacts on special-status species in that area (e.g., kit fox, chuckwalla, golden eagle, long-billed curlew, California condor, burrowing owl) from construction-related noise, staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Wildlife commonly habituate to constant noise and human disturbance levels, provided they are not harassed by people working at the site. Most wildlife would be expected to return once construction activities diminish and work is completed. Because habitat in this area has already been disturbed, few remaining species would be injured or disturbed during construction.

Short-term adverse impacts on special-status species likely resulted from the 1986 Paiute Farms/San Juan Marina DCP/EA and the 2008 Uplake DCP/EA from implementation of these plans, including construction-related noise,

staging of equipment, and the increased presence of NPS staff and workers in areas of construction. Adverse impacts such as injury, mortality, and habitat disturbance/avoidance, were localized and likely had more effect on special-status species occurring along the shoreline species (e.g., kit fox, chuckwalla, sensitive shorebirds).

Beneficial impacts on special-status species have occurred, and continue to occur, from development and implementation of the 1979 Glen Canyon GMP, which identifies four management zones and management strategies for resource protection and visitor use in these zones. Planning for a new GMP would further benefit special-status species over the long term by implementing improved strategies for resource protection. Development and implementation of the 1988 Accessible Shorelines EA/DCP and 1981 Lone Rock Beach EA/DCP have resulted in long-term benefits for special-status species within Glen Canyon. These plans define management of Lake Powell shorelines in order to reduce resource degradation, visitor use conflicts, and safety hazards, resulting in long-term benefits for special-status species at accessible shoreline areas (including Lone Rock Beach). Similarly, there are several plans that direct management recreational use within Glen Canyon—uses that could result in short-term adverse impacts on special-status species—but also share the goal of protecting resources and educating visitors on these resources, resulting in long-term benefits to special-status species:

- 1995 Canyonlands National Park and Orange Cliffs Unit of Glen Canyon National Recreation Area Backcountry Management Plan, which determined how the backcountry areas of Glen Canyon should be managed.
- Interim OHV management plans at Lone Rock Beach and play area, and at accessible shorelines (2007)
- Programmatic EA for Organized Group Activities along Hole-in-the-Rock Road, which will analyze the environmental consequences of organized group activities that exceed existing group size limits along the Hole-in-the-Rock Road corridor.

Other park plans and projects have resulted in or have the potential to result in both adverse and beneficial impacts on special-status species within Glen Canyon. These include the release of tamarisk beetles (*Diorhabda* spp.) to control tamarisk (*Tamarix* spp.). The tamarisk leaf beetle was released as a biological control agent in certain areas of the west in 2001 to help manage tamarisk, which is a highly invasive plant that grows along the Colorado River and in riparian habitats throughout the southwest (NPS 2009d). Although the beetle was not released in Glen Canyon, it has arrived and thrives at various locations throughout Glen Canyon. Tamarisk is known to displace native trees like cottonwood and willow, create poor habitat for birds and other wildlife, increase soil salinity, and increase risk of fire; therefore, continued defoliation of tamarisk will result in long-term beneficial impacts on special-status species (NPS n.d.g). However, there are concerns in managing tamarisk: defoliation may lead to site conditions that favor the establishment of other invasive nonnative plants, defoliation may negatively impact some insect and wildlife species, and an increased short-term fire hazard may result if the majority of tamarisk is killed in an area and dense stands of dead stems remain (NPS n.d.g). Therefore, although beneficial impacts would result over the long term, localized short-term adverse impacts on special-status species are likely to result from the removal of tamarisk.

Similar to tamarisk, Russian olive (*Elaeagnus angustifolia*) was brought into the area as erosion control after the Dust Bowl of the 1930s. Since then, this species has spread, replacing native vegetation in Escalante and Boulder, and along the Escalante River. In general, Russian olive causes river channelization and is shading the river corridor, cooling the water temperature. Since 2000, volunteers have been working on Russian olive removal and restoration of the Escalante River watershed (Escalante River Watershed Partnership 2011). Although short-term adverse impacts are likely to result from removal efforts (i.e., noise and physical disturbances from volunteers removing trees), beneficial impacts have resulted and will continue to result for special-status species from the removal of Russian olive along the Escalante River. In 2007, zebra mussels, an aquatic invasive species known to significantly alter aquatic ecosystems, were discovered in Lake Mead, Utah (NPS n.d.f). This invasive species aggressively spreads and readily establishes on hard substrates and surfaces, causing food chain disruption and economic damage by clogging intake pipes of water treatment and power plants as well as boat engine cooling

systems (NPS n.d.f). Since their discovery in Lake Mead, zebra mussel infestations have been discovered in Lakes Mohave and Havasu. Currently, Lake Powell and the upper Colorado River basin are believed to be free of zebra mussels; however, quagga mussels have been located in Lake Powell. Mussels would pose a major threat to Lake Powell and the upper Colorado River if they were to become established in those areas. Mussel decontamination stations are already in place at all of the marinas within Glen Canyon (NPS n.d.f). Additionally, there is planned installation of a portable decontamination facility. Although installation/construction of decontamination facilities can temporarily disrupt special-status species nearby (e.g., kit fox, chuckwalla, golden and bald eagle, burrowing owl, long-billed curlew), ensuring that mussels are not introduced in Lake Powell and the upper Colorado River basin results in long-term beneficial impacts on special-status species, especially sensitive species that depend on aquatic habitats for foraging and/or breeding (e.g., brown and American white pelican, golden and bald eagle, great blue heron).

Christmas bird counts within Glen Canyon result in long-term benefits for special-status bird species. Although the presence of park staff and researchers in the field likely results in minimal short-term adverse impacts (e.g., noise and crushing of vegetation), tracking population trends and species presence in Glen Canyon results in improved species management for future plans and projects. Similarly, special-status species inventories for bald eagle, Brady's pincushion cactus, and desert bighorn sheep result in long-term benefits for those species by tracking population trends and species presence in Glen Canyon and guiding species management for future plans and projects. Potential closures or seasonal closures in the future for lambing areas for desert bighorn sheep would result in considerable long-term benefits for bighorn sheep by providing relief from recreational disturbances.

The USFWS designation of critical habitat for the Mexican spotted owl in 2004, which includes habitat within Glen Canyon, benefits the Mexican spotted owl, as well as other sensitive species within Glen Canyon by protecting species that utilize the same habitat as the owl (e.g., California condor, burrowing owl, bald and golden eagle). Additionally, reintroduction of the California condor to the Colorado Plateau by the USFWS has resulted in long-term beneficial impacts on this species by providing the opportunity for population recovery.

Utah DNR's Statewide Pronghorn Management Plan and BLM's updated Resources Management Plans benefit special-status species in Glen Canyon by guiding management of natural resources and habitat in the region.

Other projects and planning actions by federal and state agencies have resulted in or would likely result in short-term adverse impacts on special-status species from implementation, including an update to the 1996 Long Term Experimental and Management Plan for Glen Canyon Dam (Bureau of Reclamation), development and update of the BLM's Travel Management Plan, and road/ORV route improvements for utility access by the Arizona DOT (Coconino County); however, over the long term, these projects and actions result in beneficial impacts for special-status species from improved management and protection of park resources.

Short- and long-term adverse impacts are likely to result from future planning efforts by the state of Utah and the BLM. These future actions include a draft programmatic EIS and possible land use amendments for allocation of oil shale and tar sands resources on lands administered by the BLM in Colorado, Utah, and Wyoming, which would analyze several alternatives for land allocation and resource management. Additionally, the Utah State Board of Water Resources is proposing to build approximately 160 miles of pipeline between Lake Powell Glen Canyon dam and Cedar City. Although both plans/projects would include mitigation to protect special-status species, they could result in short- and long-term substantial impacts on special-status species from habitat destruction and fragmentation, species disturbance and mortality, and habitat avoidance.

Current and future operations of the Amangiri Resort, located on 600 acres in Canyon Point, Utah, could result in adverse impacts on special-status species in Glen Canyon. Construction of the resort led to habitat destruction and likely species displacement, resulting in long-term, less than considerable impacts. The resort offers a wide variety of activities for guests, and all visitors to the resort can partake in all the visitor use opportunities Glen Canyon offers. Some visitor activities (e.g., hiking, scenic flights) would continue to result in short-term adverse impacts on

special-status species within Glen Canyon from species and habitat disturbance. However, impacts would be localized and minimal, because the resort occupies only a small area (in comparison to Glen Canyon as a whole) on the western edge of Glen Canyon.

The overall impact of these past, present, and reasonably foreseeable future actions would be short- and long-term adverse and considerable, as well as long-term beneficial. When combined with the long-term detectable adverse impacts of alternative A, considerable long-term adverse and long-term beneficial cumulative impacts would result for special-status species in the area of analysis.

ALTERNATIVE B: NO OFF-ROAD USE

Lone Rock Beach

Mammals

Alternative B would result in long-term beneficial impacts on kit foxes at Lone Rock Beach from the discontinued use of this area to off-road use. The permanent closure of Lone Rock Beach would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing this area to be restored to natural conditions. The beneficial impacts would be localized at Lone Rock Beach, but over the long term, impacts would be experienced Glen Canyon-wide because kit foxes would no longer have to avoid potential habitat in these areas. Beneficial impacts on bighorn sheep may result, but would likely be negligible due to their preference for rocky cliffs and higher-elevation habitat within Glen Canyon.

Reptiles

The closure of Lone Rock Beach would result in localized, long-term benefits for the chuckwalla. The permanent closure of Lone Rock Beach would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing recovery of this area to occur.

Birds

Long-term beneficial effects would result for special-status bird species (e.g., golden and bald eagle, long-billed curlew, burrowing owl, brown and American white pelican, great blue heron, and California condor) from the closure of Lone Rock Beach. As described at the beginning of alternative A, breeding bird abundance and species richness have been found to be higher in areas that restrict off-road use compared to areas where off-road use is allowed (Brooks 1999, 2000). Initial benefits would likely be short-term and localized (i.e., the removal of a form of manmade noise at accessible shorelines); however, benefits to special-status species over the long term would be experienced Glen Canyon-wide from reduced habitat fragmentation.

Alternative B would result in no effect to the southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach.

Plants

The permanent closure of Lone Rock Beach would result in no impacts on special-status plant species because there are no special-status plants known to occur in this area, and even upon recovery, no suitable habitat would exist for these species. However, some long-term beneficial impacts could occur from allowing this area to naturally recover. Removing a source of disturbance to native vegetation and reducing fragmentation would allow native vegetation to reestablish itself in this area and help reduce the potential spread of invasive plants to other areas of the recreation area where special-status species plant species do occur.

Lone Rock Beach Play Area

Mammals

Alternative B would result in long-term beneficial impacts on kit foxes at Lone Rock Beach Play Area from the permanent closure of this area to off-road use. The permanent closure of the play area would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing this area to be restored to natural conditions. The beneficial impacts would be localized, but over the long term, impacts could be experienced Glen Canyon-wide because species would no longer have to avoid potential habitat in these areas. Beneficial impacts on bighorn sheep may result, but would likely be negligible due to their preference for rocky cliffs and higher-elevation habitat within Glen Canyon.

Reptiles

Impacts on the chuckwalla would be similar at Lone Rock Beach Play Area as those described for Lone Rock Beach. The permanent closure of Lone Rock Beach Play Area would remove an existing source of disturbance (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance), allowing this area to be restored to natural conditions. Benefits would be localized at first, but over the long term benefits would be experienced Glen Canyon-wide from reduced habitat disturbance and fragmentation.

Birds

Long-term beneficial effects would result for special-status bird species (e.g., golden and bald eagle, burrowing owl, and California condor) from the closure of the Lone Rock Beach Play Area. As described above for Lone Rock Beach, breeding bird abundance and species richness have been found to be higher in areas that restrict off-road use compared to areas where off-road is allowed (Brooks 1999, 2000). Initial benefits would likely be short-term and localized (i.e., the removal of a form of manmade noise at accessible shorelines); however, benefits to special-status species over the long term could be experienced Glen Canyon-wide from reduced habitat fragmentation.

Alternative B would result in no effect to the southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach Play Area.

Plants

The permanent closure of the Lone Rock Beach Play Area would result in no impacts on special-status plant species because there are no special-status plants known to occur in this area, and even upon recovery, no suitable habitat would exist for these species. However, some long-term beneficial impacts would occur from allowing this area to naturally recover. Removing a source of disturbance to native vegetation and reducing fragmentation would allow native vegetation to reestablish itself in this area and help reduce the potential spread of invasive plants to other areas where special-status species plant species do occur.

Accessible Shorelines

Under alternative B, off-road use at 15 accessible shorelines (approximately 7,300 acres) within Glen Canyon would be discontinued, thereby removing existing sources of disturbance and its resulting impacts (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance) and allowing habitat in impacted areas of accessible shorelines to recover. Because vegetation would be reestablished in areas of former impact, sensitive species will likely occupy those areas over the long term. Although initial benefits would be short-term and localized (i.e., the removal of a form of manmade noise at accessible shorelines), benefits to special-status species over the long-term would be experienced Glen Canyon-wide from reduced habitat fragmentation.

Mammals

As described above, the discontinued use of 15 accessible shorelines would result in both short- and long-term beneficial impacts for kit foxes and bighorn sheep, by removing existing sources of disturbance from off-road use (e.g., noise, habitat destruction, species displacement, species injury and mortality, and habitat avoidance) and allowing habitat in impacted areas of accessible shorelines to recover. Beneficial impacts on bighorn sheep would result from the closure of 15 accessible shoreline areas because more undisturbed habitat (e.g., foraging, drinking) would be available for this species.

Reptiles

The discontinued use of accessible shorelines would result in long-term benefits for the chuckwalla. Benefits would be localized at first (at accessible shorelines), but over the long term benefits could be experienced Glen Canyon-wide from reduced habitat fragmentation. As described for alternative A in the "Accessible Shorelines" section, the night lizard may occur at Dirty Devil. Therefore the closure of this shoreline to off-road use would result in localized long-term beneficial impacts on this species.

Birds

Long-term beneficial effects would result for special-status bird species (e.g., the long-billed curlew, bald eagle, California condor, and Mexican spotted owl) from the discontinued use of 15 accessible shorelines in Glen Canyon. The pinyon jay is a common widespread permanent resident in pinyon-juniper woodlands of Glen Canyon and may potentially occur in the Orange Cliffs region. The Gray vireo is considered an uncommon, but widespread summer resident. These species would likely avoid areas of disturbance and therefore, any adverse impacts on these species at accessible shorelines would likely be slight, localized, and short term. Discontinued use of the accessible shorelines would benefit these species by reducing disturbance and habitat fragmentation.

As described at the beginning of alternative A, breeding bird abundance and species richness have been found to be higher in areas that restricted off-road use compared to areas where off-road use is allowed (Brooks 1999, 2000). Initial benefits would likely be short term and localized (i.e., the removal of a form of manmade noise at accessible shorelines); however, benefits to special-status species over the long term would be experienced Glen Canyon-wide from reduced habitat fragmentation. Alternative B would result in no effect to the southwestern willow flycatcher yellow-billed cuckoo because these federally listed species are not known to occur near accessible shoreline areas.

Plants

Long-term beneficial effects would result for Paria spurge from the closure of 15 accessible shorelines in Glen Canyon. This species only occurs in Bullfrog North and South areas. Closing off Bullfrog North and South would benefit this species by permanently removing a source of continuous disturbance within these ORV areas.

Travel on GMP Roads in Glen Canyon

Impacts of alternative B on special-status species from the use of on GMP roads where conventional motor vehicles and street-legal ATVs would continue to operate on GMP roads throughout Glen Canyon, with the exception of the Orange Cliffs Unit where street-legal ATVs would not be authorized, would be similar to those under alternative A. No additional impacts on wildlife or habitat would result from vehicle use occurring on paved GMP roads because these roads have an asphalt top and no new soils or vegetation would be disturbed. It is assumed that vehicles will travel on the roads and not contribute to disturbances along roadway edges. Speed limits would be established whereby reducing the speed limit on GMP roads to 25 mph (or as posted). This action may help lessen some of the adverse impacts of motor vehicle use along designated routes as slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. reducing the level of noise and impacts related to vehicle travel

at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Ferry Swale

Under alternative B, off-road use would not be allowed in Ferry Swale to access adjacent BLM lands. Beneficial impacts would result from a reduction in habitat disturbance and fragmentation and species mortality for the kit fox, glossy snake, burrowing owl, California condor, and golden and bald eagle, the only sensitive species known to occur in this area.

Cumulative Impacts

Impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on special-status species would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the long-term beneficial impacts under alternative B, would result in slight long-term adverse and considerable long-term beneficial cumulative impacts on special-status species in the area of analysis.

Alternative C: Increased Motorized Access

Lone Rock Beach

The impacts of alternative C on special-status species (including mammals, reptiles, birds, and plants) at Lone Rock Beach would be similar to those described for alternative A, except that speed limits and quiet hours after 10:00 p.m. would be enforced and implemented. Enforcing a speed limit of 15 mph at Lone Rock Beach and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., kit fox) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

The impacts of alternative C on affected special-status species (including mammals, reptiles, birds, and plants) at Lone Rock Beach Play Area would be the same as those described for alternative A.

Accessible Shorelines

Under alternative C, approximately 7,300 acres at 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs by permit. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

The impacts of alternative C on special-status mammals at accessible shorelines would be similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs by permit. As described

under the no-action alternative, Paiute Farms and Nokai Canyon are currently being accessed. Therefore, impacts of officially opening Paiute Farms and Nokai Canyon would likely be negligible because kit foxes and bighorn sheep have likely adapted to some level of off-road use.

Under alternative C, implementing a speed limit of 15 mph at shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use to special-status mammals by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, the kit fox, which is primarily nocturnal, would benefit from the removal of a source of disturbance after 10:00 p.m.

Reptiles

The impacts of alternative C on special-status reptile species at accessible shorelines within Glen Canyon would be the similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be allowed for use by conventional motor vehicles, OHVs, street-legal ATVs. As described above, Paiute Farms and Nokai Canyon are currently being accessed. Therefore, new disturbances would be limited from officially authorizing use at Paiute Farms and Nokai Canyon. As described for alternative A, species and habitat disturbance would continue and species mortality could occur for the chuckwalla; however, this species has likely adapted to some level of off-road use at Paiute Farms and Nokai Canyon. Additionally, implementing a speed limit of 15 mph at shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

The night lizard and glossy snake would not be affected by the official opening of Pauite Farms and Nokai Canyon, because these species are not likely to occur in these areas due to lack of suitable habitat (e.g., low elevations, lack of open sandy sites, and lack of large trees/logs).

Birds

The impacts of alternative C on special-status birds at accessible shorelines (e.g., long-billed curlew, golden and bald eagle, and California condor) within Glen Canyon would be similar to those described for alternative A, except that 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be allowed for use by conventional motor vehicles, OHVs, and street-legal ATVs. Although these areas are not officially open under the 1988 Accessible Shorelines EA/DCP, they are currently being accessed. Therefore, impacts of officially opening Paiute Farms and Nokai Canyon may be detectable for the long-billed curlew, but would not be considerable because this species has likely adapted to some level of off-road use. Risks to birds from off-road use range from injury during escape responses to the more-severe habitat avoidance and nest abandonment; however, impacts would be localized to open routes and areas.

Implementing a speed limit of 15 mph at shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use on special-status birds by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collision, dust particles, and sediment buildup). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Alternative C would result in no effect to the southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur along accessible shoreline areas. Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance could occur, but impacts on these waterbirds would be reduced with implementation of noise and speed restrictions.

Plants

The impacts of alternative C on special-status plants at accessible shorelines within Glen Canyon would be similar to those described for alternative A. Although 15 accessible shoreline areas (13 existing areas plus Paiute Farms and Nokai Canyon) would be opened to conventional motor vehicles, OHVs, and street-legal ATVs, no special-status plant species are known to occur at these locations.

Travel on GMP Roads in Glen Canyon

The impacts of alternative C on affected special-status species (including mammals, reptiles, birds, and plants) from the use of conventional motor vehicles, OHVs, and street-legal ATVs on unpaved GMP roads would be similar to those described for alternative A, except that speed limits would be reduced on GMP roads and OHVs and street-legal ATVs would be authorized for use on GMP roads to include roads in the Orange Cliffs Unit. Decreasing the speed limit on GMP roads to 25 mph (or as posted) may help lessen some of the adverse impacts of off-road use along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Allowing conventional motor vehicles, OHVs, and street-legal ATVs on GMP roads in the Orange Cliffs Unit may affect certain bird and plant species. Habitat for the southwestern willow flycatcher, Mexican spotted owl, pinyon jay, and gray vireo may be present in the Orange Cliffs Unit. Adverse impacts would be localized and more detectable in areas where fewer disturbances have occurred due to prior access restrictions. These species would likely avoid areas of new disturbance (noise, traffic) and therefore, any adverse impacts on these would likely be slight, localized, and short term.

Plant species likely to be affected by motorized vehicle use on GMP roads, including in the Orange Cliffs Unit, include tropic goldeneye, Copper Canyon milkvetch, Kachina daisy, cataract gilia, Western hophornbeam, alcove rock daisy, Howell's phacelia, nipple phacelia, Whiting's indigo-bush, New Mexico raspberry, Jane's glowbemallow, desert mountain lilac, and Tompkins phacelia. Continued impacts on soils would reduce the ability of soils to provide for vegetation; however, because vegetation in the area has been previously impacted and vehicle use would continue to be contained to the already disturbed GMP roads, no new notable harm to vegetation would be expected occur, including in the Orange Cliff Unit.

Ferry Swale

Under alternative C, approximately 15 miles of ORV routes would be designated and authorized for use by conventional motor vehicles, OHVs, and street-legal ATVs. Permits would be required for all designated ORV routes, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

Although these user-created routes currently exist, designating ORV routes may likely result in additional impacts on native habitat for kit foxes in the vicinity of those routes because more traffic would be expected. Adverse impacts would be localized and more detectable in areas where fewer disturbances have occurred. Short-term impacts on kit foxes of legalizing additional routes in Ferry Swale include the physiological effects of escape responses. Long-term impacts include further habitat destruction and fragmentation, as well as possible changes in breeding and foraging habits. As described for alternative B, Ferry Swale, setting the speed limit on unpaved GMP roads to 25 mph (or as posted) may help lessen some of the adverse impacts of off-road use to kit foxes along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

As described for alternative A, off-road use at Ferry Swale would likely not affect desert bighorn sheep, because this species typically avoids areas of noise and disturbance. Although a herd of desert bighorn sheep lives in the Paria Canyon-Vermilion Cliffs area, less than 15 miles southwest of Ferry Swale, impacts from designating ORV routes at Ferry Swale would likely not affect desert bighorn sheep, because this species typically avoids Highway 89 and areas of Ferry Swale east to Lake Powell. This area of avoidance constitutes a small percentage of the approximately 2,000 miles of available Lake Powell shoreline.

Reptiles

As described above for mammals, adverse impacts on the glossy snake, the only special-status reptile to occur in the area, would be localized and more detectable in areas where fewer disturbances have previously occurred. Short-term impacts of legalizing additional routes in Ferry Swale on the glossy snake include injury and mortality, as well as the physiological effects of escape responses. Long-term impacts on the glossy snake include additional habitat destruction and fragmentation, as well as changes in breeding and foraging habits. Setting the speed limit on designated ORV routes to 25 mph may help lessen some of the adverse impacts of off-road use to glossy snakes along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Birds

As described above for mammals, adverse impacts on special-status birds (e.g., burrowing owl, golden and bald eagle, and California condor) would be localized and more detectable in areas where fewer disturbances have previously occurred. Short-term impacts of legalizing additional routes in Ferry Swale include species disturbance, as well as the physiological effects of escape responses. Long-term impacts include additional habitat destruction and fragmentation, as well as changes in nesting and foraging habits. Setting the speed limit on designated ORV routes to 25 mph (or as posted) may help lessen some of the adverse impacts of off-road use to special-status birds along designated routes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Alternative C would result in no effect to the Mexican spotted owl, southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur in the Ferry Swale area.

Plants

Impacts are expected to be negligible to none because there are no special-status plants known to occur in the Ferry Swale area due to lack of suitable habitat (Spence, pers. comm., 2012).

Cumulative Impacts

Impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on special-status species would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative C, would result in long-term considerable adverse and long-term beneficial cumulative impacts on special-status species in the area of analysis.

ALTERNATIVE D: DECREASED MOTORIZED ACCESS

Lone Rock Beach

Mammals

The impacts of alternative D on special-status mammals at Lone Rock Beach would be similar to those described for alternatives A and C, except that OHVs and street-legal ATVs would not be authorized resulting in slightly less adverse impacts on the kit fox. Prohibiting OHVs and street-legal ATVs at the beach may mitigate some of the adverse impacts of off-road use on the beach, because OHVs and street-legal ATVs are louder than conventional motor vehicles and the number of vehicles present on the beach would likely be reduced. However, this area would still be accessed by visitors for recreational use resulting in continued disturbance. Impacts on kit foxes would be minimal as there is suitable habitat in other areas nearby and kit foxes typically avoid humans and human-made noise (NatureServe 2009). Additionally, enforcing a speed limit of 15 mph at shoreline areas and implementing quiet hours after 10:00 p.m. would help minimize some of the adverse impacts of off-road use to kit foxes by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Because kit foxes are primarily nocturnal species, creating quiet hours would remove of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Like alternatives A and C, impacts on bighorn sheep at Lone Rock Beach would likely be negligible, because this species prefers habitat in other areas of Glen Canyon.

Reptiles

The impacts of alternative D on special-status reptiles at Lone Rock Beach would be similar to those described for alternatives A and C, except that OHVs and street-legal ATVs would not be authorized on the beach resulting in slightly less adverse impacts on the chuckwalla. Prohibiting OHVs and street-legal ATVs at the beach may minimize some of the adverse impacts of off-road use on the beach because OHVs and street-legal ATVs are generally louder than conventional motor vehicles and the number of vehicles present on the beach would likely be reduced. However, this area would still be accessed by visitors for recreational use resulting in continued disturbance to this species. Enforcing a speed limit of 15 mph at Lone Rock Beach and implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use to the chuckwalla by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Like alternative A, negligible effects would result for the night lizard and glossy snake because these species do not occur in the Lone Rock Beach area.

Birds

The impacts of alternative D on special-status birds at Lone Rock Beach would be similar to those described for alternatives A and C, except that OHVs and street-legal ATVs would not be authorized on the beach resulting in slightly less adverse impacts on affected birds (e.g., golden and bald eagle, brown and American white pelican, burrowing owl, long-billed curlew, great blue heron, and California condor). Prohibiting OHVs and street-legal ATVs at the beach may mitigate some of the adverse impacts of off-road use on the beach, because OHVs and street-legal ATVs are generally louder than conventional motor vehicles and the number of vehicles present on the beach would likely be reduced. However, this area would still be accessed by visitors for recreational use resulting in continued disturbance to sensitive birds in the area. Enforcing a speed limit of 15 mph at Lone Rock Beach and

implementing quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use to special-status birds by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals.

Alternative B would result in no effect to the Mexican spotted owl, southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at Lone Rock Beach.

Plants

The impacts of alternative D on special-status plants at Lone Rock Beach would be the same as those described for alternatives A and C; impacts are expected to be negligible to none because there are no special-status plants known to occur in this area due to lack of suitable habitat (Spence, pers. comm., 2012).

Lone Rock Beach Play Area

Discontinuing off-road use at Lone Rock Beach Play Area under alternative D, would result in the same impacts on special-status species as those described for alternative B, resulting in long-term beneficial impacts on special-status species at Lone Rock Beach Play Area (e.g., kit fox, golden and bald eagle, burrowing owl, California condor).

Accessible Shorelines

Under alternative D, off-road use at 11 accessible shorelines would be discontinued and the ORV areas allowed to recover to natural conditions. Four accessible shoreline areas (Dirty Devil, Farley Canyon, Stanton Creek, and Hite Boat Ramp) would remain open only to conventional motor vehicles by permit, subject to water-level closures. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

Long-term benefits to special-status mammals (i.e., kit fox and desert bighorn sheep) would result from permanent closure of 11 accessible shorelines to off-road use as a source of habitat and species disturbance would be removed, allowing these areas to recover. Recovery of these areas could eventually reduce habitat fragmentation, resulting in localized beneficial impacts. For the four accessible shorelines that remain open (approximately 1,100 acres) to conventional motor vehicles, the same localized adverse impacts would result as those described for alternative A. Locally, along open routes and areas, species and habitat disturbance could occur, but impacts on kit foxes would likely be minimal, because this species is primarily nocturnal and generally avoids humans and human-made noise.

Under alternative D, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use at open shoreline areas by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Additionally, the kit fox, which is primarily nocturnal, would benefit from the removal of a source of disturbance after 10:00 p.m.

Reptiles

Long-term benefits to the chuckwalla would result from permanent closure of these 11 accessible shorelines to off-road use as a source of habitat and species disturbance would be removed, allowing these areas to recover. Recovery of these areas could eventually reduce habitat fragmentation resulting in localized beneficial impacts for the chuckwalla. For the four accessible shorelines that remain open (approximately 1,100 acres) to conventional

motor vehicles, the same localized adverse impacts would result as those described for alternative A. Locally, along open routes and areas, species and habitat disturbance would continue and species mortality could occur.

As described for alternatives A and C, Dirty Devil is the only accessible shoreline where the night lizard may occur. Because this shoreline would remain open under alternative D, the same minimal localized adverse impacts as described for alternative A would result for the night lizard. Implementing a speed limit of 15 mph and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use at open shoreline areas by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, the night lizard, a nocturnal species, would benefit from the removal of a source of disturbance after 10:00 p.m.

Birds

Long-term benefits to special-status birds (e.g., long-billed curlew, golden and bald eagle, and California condor) would result from permanent closure of the 11 accessible shoreline areas to off-road use because a source of habitat and species disturbance (e.g., noise) would be removed, resulting in localized beneficial impacts on sensitive bird species. For the four accessible shorelines that remain open (approximately 1,100 acres) to conventional motor vehicles, the same localized adverse impacts would result as those described for alternative A. Locally, along open routes and areas, species and habitat disturbance could occur, but impacts would be minimal, because it is likely that sensitive birds avoid these areas.

The closure of Bullfrog North and South would contribute to long-term benefits for the Mexican spotted owl, because these shoreline areas occur within the critical habitat for this species. However, Stanton Creek, Dirty Devil, and Hite Boat Ramp shorelines are also within critical habitat and would remain open for use by conventional motor vehicles, resulting in continued disturbance to potential habitat for the Mexican spotted owl.

Implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use at open shoreline areas by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Alternative D would result in no effect to the southwestern willow flycatcher, brown and American white pelican, great blue heron, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur near accessible shoreline areas. Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance could occur, but impacts would be reduced, because it is likely that these species would avoid these areas and relocate to the nearby restored (closed) areas.

Plants

Long-term benefits to Paria spurge could result from permanent closure of Bullfrog North and South because a source of disturbance would be removed, allowing these areas to recover. Recovery of these areas could eventually reduce habitat fragmentation, resulting in localized beneficial impacts. Alternative D would have no effect on the remaining special-status plants, because these species are not known to occur at accessible shoreline areas in Glen Canyon.

Travel on GMP Roads in Glen Canyon

Under alternative D, only conventional motor vehicles would be authorized to operate on all GMP roads in Glen Canyon.

Mammals

Under alternative D, there would be no direct impacts on special-status mammals on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Reptiles

Under alternative D, there would be no direct impacts on special-status reptiles on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Birds

Under alternative D, there would be no direct impacts on special-status birds on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Plants

Under alternative D, there would be no direct impacts on special-status plants on GMP roads because OHVs and street-legal ATVs would not be permitted. Impacts on special-status species from conventional motor vehicles are assessed as a cumulative impact because conventional motor vehicles are not part of the scope of this plan.

Ferry Swale

The impacts of alternative D on special-status species at Ferry Swale would be the same as those described for alternative B because no ORV routes would be designated and off-road use would not be authorized. This would lead to a reduction in habitat disturbance and fragmentation and species mortality for the kit fox, glossy snake, burrowing owl, California condor, and golden and bald eagle, the only sensitive species known to occur in this area.

Cumulative Impacts

Under alternative D, impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. As a result of discontinuation and non-designation of ORV routes, however, the overall impacts on special-status species would be greatly reduced compared to those described for alternative A. The impacts of cumulative actions, in combination with the detectable long-term beneficial impacts on special-status species under alternative D, would result in long-term beneficial cumulative impacts on special-status species in the area of analysis.

Alternative E: Mixed Use

Lone Rock Beach

Although 20 acres of Lone Rock Beach would be designated as a vehicle-free zone, the impacts of alternative E on affected special-status species at the beach would be similar to those described for alternative C. Impacts on special-status species (e.g., kit fox, long-billed curlew, chuckwalla, California condor, burrowing owl, great blue heron, brown and American white pelican, and golden and bald eagle) would be localized and adverse from the continued off-road use by conventional motor vehicles, OHVs, and street-legal ATVs, to include species disturbance and displacement, as well as vehicle-wildlife collisions. Restricting vehicle use at a specific area of the

beach may minimize some of the adverse impacts of off-road use on the beach, but this area would still be accessed by visitors for recreational use, resulting in continued disturbance to sensitive species in the area.

Enforcing a speed limit of 15 mph and implementing quiet hours after 10:00 p.m. may help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006). Slower speeds allow for longer reaction times to break or otherwise avoid collision with the animals. Additionally, nocturnal species (e.g., kit fox) would benefit from the removal of a source of disturbance after 10:00 p.m. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Lone Rock Beach Play Area

Impacts of alternative E on special-status species (including mammals, reptiles, birds, and plants) at Lone Rock Beach Play Area would be the same as those described for alternative C. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Accessible Shorelines

The impacts of alternative E on special-status species at accessible shorelines would be similar to, but less intense, those described for alternative C, because off-road use at Warm Creek would be discontinued and OHVs would not be allowed. Similar to alternative C, Paiute Farms and Nokai Canyon would be authorized for use by conventional motor vehicles and street-legal ATVs. Permits would be required for all off-road use, further enhancing benefits to special-status species by increasing education about resource protection and compliance with permit conditions.

Mammals

Habitat near Warm Creek would be allowed to recover to natural conditions over the long term, resulting in long-term benefits for kit foxes and desert bighorn sheep. The authorization of Paiute Farms and Nokai Canyon for use by conventional motor vehicles and street-legal ATVs would result in negligible effects to both species because neither is common in those areas. Under alternative E, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Reptiles

Habitat near Warm Creek would be restored to natural conditions over the long term, resulting in localized, long-term benefits to chuckwallas occurring in that area from a reduction in traffic, noise, and vehicle emissions. The authorization of Paiute Farms and Nokai Canyon for use by conventional motor vehicles and street-legal ATVs could result in localized adverse impacts; however, new disturbances would be limited because Paiute Farms and Nokai Canyon are currently being accessed.

Under alternative E, implementing a speed limit of 15 mph at open accessible shoreline areas and quiet hours after 10:00 p.m. would help lessen some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Birds

Habitat near Warm Creek would be restored to natural conditions over the long term, resulting in localized, long-term benefits to sensitive birds (e.g., California condor, burrowing owl, long-billed curlew, and golden and bald eagle) occurring in that area. The authorization of Paiute Farms and Nokai Canyon for use by conventional motor vehicles and street-legal ATVs would result in limited adverse impacts, because these areas are currently being accessed. Prohibiting off-road use at Warm Creek would likely result in beneficial impacts than current conditions from reduced traffic, noise, and emissions. Under alternative E, implementing a speed limit of 15 mph at open shoreline areas and quiet hours after 10:00 p.m. would help minimize some of the adverse impacts of off-road use by reducing the level of noise and impacts related to vehicle travel at higher speeds (e.g., vehicle-wildlife collisions, dust particles, and sediment buildup) (Trombulak and Frissell 2000; Countess 2006).

Alternative E would result in no effect on the southwestern willow flycatcher, yellow-billed cuckoo, pinyon jay, and gray vireo because these federally listed species do not occur at accessible shoreline areas. Brown and American white pelican and great blue heron have been observed at accessible shoreline areas where disturbance could occur, but impacts would be reduced, because it is likely that these species would avoid these areas and relocate to the nearby restored (closed) areas.

Plants

The impacts of alternative E on special-status plants at accessible shorelines would be the same as alternatives A and C; no plants exist at these locations except for Paria spurge at Bullfrog North and South.

Travel on GMP Roads in Glen Canyon

The impacts of alternative E on special-status species from the use of conventional motor vehicles and street-legal ATVs on paved GMP roads and conventional motor vehicles, OHVs, and street-legal ATVs on unpaved GMP roads would be similar to, but less geographically dispersed, than those described for alternative C, because no OHVs or street-legal ATVs would be allowed on any road segments of the Orange Cliffs Unit.

Ferry Swale

Under alternative E, conventional motor vehicles, OHVs, and street-legal ATVs would be authorized to operate on approximately 15 miles of designated ORV routes in the Ferry Swale area. Impacts of alternative E on special-status species (including mammals, reptiles, birds, and plants) would be the same as those described for alternative C.

Cumulative Impacts

Impacts on special-status species from other past, present, and reasonably foreseeable future actions within Glen Canyon would be the same as described for alternative A. The overall impact of these past, present, and future actions on special-status species would be short- and long-term adverse and considerable, as well as long-term beneficial, and when combined with the detectable long-term adverse impacts under alternative E, would result in long-term detectable adverse and long-term beneficial cumulative impacts on special-status species in the area of analysis.

Conclusion

Compared to alternative A, alternative B would provide the most protection for special-status species and would increase the amount of habitat available within Glen Canyon. By prohibiting off-road use at accessible shorelines, Lone Rock Beach, Lone Rock Beach Play Area, and Ferry Swale management actions under alternative B would result in Glen Canyon-wide, long-term, beneficial impacts for many special-status species by allowing previously

disturbed areas the opportunity to recover. Improvement to habitat would be most notable in areas of currently heavy off-road use. Alternative D would similarly provide beneficial impacts by limiting areas authorized for off-road driving, thereby increasing available habitat for special-status species. Benefits would especially occur to species such as the chuckwalla, kit fox, desert bighorn sheep, golden and bald eagle, and long-billed curlew.

Compared to alternative A, alternative C could result in slightly more adverse impacts on affected special-status species, due to authorization of additional on-road use by OHVs and street-legal ATVs within Glen Canyon, including the Orange Cliffs Unit. However, alternative C (as well as alternative E) would not designate as many miles of ORV routes in Ferry Swale as under alternative A so special-status species in the Ferry Swale area would benefit under alternatives C and E as compared to alternative A. Additionally, monitoring and mitigation measures such as seasonal closures to protect special-status species, such as Desert Bighorn Sheep, in this area would reduce impacts. However, areas with previous user-created routes would benefit from restoration under alternative C.

Compared to alternatives A, alternative E would be slightly more protective of affected special-status species within Glen Canyon. Discontinuing off-road use at Warm Creek would result in beneficial impacts on certain special-status species (e.g., kit fox, desert bighorn sheep, long-billed curlew, golden and bald eagle, and chuckwalla) in that area by allowing previously disturbed habitat the opportunity to recover. Although Paiute Farms and Nokai Canyon would be officially opened under alternative E, impacts on special-status species occurring in those areas would be comparable to alternative A, because these shorelines are currently being accessed.

As described above, impacts to special-status species include disturbance, displacement, habitat destruction, and vehicle-wildlife collisions which may result in injury or mortality. Other impacts range from injury during escape responses to the more-severe habitat avoidance and nest abandonment. Special-status reptiles and birds nesting or resting on or near the ground at accessible shoreline areas would likely be more vulnerable to the effects of motorized vehicles, due to direct exposure of nests and young to visitors and motorized vehicles. Vehicle-wildlife collisions or frequent escape response events (e.g., flushing) could increase species injury or mortality. Shorebirds that use the area for foraging and resting are at particular risk since they are some of the longest distance migratory birds and, as such, the energy demands of migration are extreme. Disturbance results in a reduction in time spent foraging and a reduction in fuel stores spent during times of flying. The level of impact this causes is dependent upon the species and the level of disturbance. Special-status species with the highest potential for impact would be those that inhabit blackbrush, sand sagebrush, and shadscale vegetation communities like the kit fox, burrowing owl, and chuckwalla. Deserts and arid regions are generally considered areas of low productivity and damage to arid vegetation can be immediate and long lasting, especially for rare, specialized plant species.

Overall, impacts to special-status species will be localized and short-term. When evaluating the significance of impacts to special-status species, the context in which the impact occurs must be considered. While impacts may be very intense in some cases, including morality, none of the adverse impacts under any of the alternatives are expected to impact the population or viability of any of these special-status species. Use along shorelines, roads, and on ORV routes will likely be sporadic. In some cases, such as the remote shorelines, special-status species may not be disturbed for days or weeks at a time. In the context of Glen Canyon, disturbance to special-status species may not be even be detectable. When considering impacts in the context of vegetation types and availability, the impacts remain small. The primary habitat types impacted under the alternative with the most use under this plan are the blackbrush and shadscale habitat. This plan impacts less than 1% of available habitats of this type. Further, substantial unfragmented habitat remains for all of these species, despite use that may be authorized under this plan. In conclusion, none of the impacts to special-status species are expected to be significant. None of the habitats impacted under this plan is especially rare or critical for any special-status species. Disturbance is expected to be isolated to areas of use, many of which have been disturbed by vehicle use since Glen Canyon was established, thereby not creating new disturbance. Species mortality is not expected to be frequent nor will it likely impact viability of any species.