

Affected Environment

AFFECTED ENVIRONMENT

INTRODUCTION

This section describes the affected environment or physical and social conditions currently present within the analysis area, which includes the uplake developed areas (Bullfrog, Halls Crossing, and Hite marinas). The analysis area for the affected environment and environmental consequences discussions includes the developed areas plus a 500-foot buffer as shown in the figures depicting the alternatives.

GENERAL DESCRIPTION

Glen Canyon NRA is on the Colorado Plateau and extends more than 200 miles from the Green River in southern Utah downstream to Lees Ferry in Arizona (see figure 1). Lake Powell was formed by the construction of Glen Canyon Dam between 1956 and 1964. Congress authorized the dam construction in the Colorado River Storage Project Act of 1956 (PL 84-485). The primary objectives were to prevent flooding on the Colorado River, create a reservoir to meet downstream water demand, and generate hydroelectric power.

Glen Canyon Dam is managed by the Bureau of Reclamation. It was designed to accommodate lake levels ranging from approximately 3,490 feet to approximately 3,700 feet amsl. As the water level changes, the surface of Lake Powell varies in size from 52,000 acres to 163,000 acres, and the shoreline fluctuates from 990 miles to 1,960 miles in length. Annual fluctuations in lake levels typically are about 25 vertical feet.

The lake level rises in the spring as water from snowmelt runoff and spring storms collects behind the dam. The lake level then declines throughout the rest of the year, particularly during summer and early fall as water is released for electrical power generation and irrigation. In recent years, low snowmelt runoff and decreased rainfall from spring storms have resulted in a decreased lake water surface. By the end of 2006, water levels are predicted to be at an elevation of approximately 3,613 feet (USBR 2006).

In 1972, Congress established Glen Canyon NRA (PL 92-593) to provide public recreation on Lake Powell and adjacent lands. The National Park Service is responsible for managing all federal lands and waters within Glen Canyon NRA. Access to Lake Powell within Glen Canyon NRA is provided at five developed marinas (Bullfrog, Halls Crossing, Hite, Antelope Point, and Wahweap [see figure 2]). The recreation area includes approximately 1,254,306 acres of land and water. At full pool, the water surface of Lake Powell encompasses approximately 13% of the total lands of Glen Canyon NRA; however, the lake and associated marinas and developed areas are the most extensively used portion of the recreation area.

LAND USE

In the 1979 GMP, land use was defined through the creation of four distinct land management zones within the boundaries of Glen Canyon NRA. These zones were designated as natural, recreation and resource utilization, development, and cultural.

The developed areas at Bullfrog, Halls Crossing, and Hite fall into the development zone. The development zone designation allows development of more permanent and elaborate structures to support recreational activities. All types of visitor activities are permitted in this zone, with certain restrictions determined during management planning. Within the defined boundaries for this zone, all types of construction to support visitor services would be acceptable.

SOILS

Soils in the uplake area consist primarily of alluvial or colluvial soils derived from water and wind erosion of the surrounding bedrock. As shown in figure 28, much of Bullfrog lies within the Moffat loamy fine sand and Monue loamy fine sand soils types. Figure 29 shows the soils at Halls Crossing, which include primarily the Moenkopi M warm complex and Bluechief L-N complex soils with minor incursions of the Piute-S rock complex soils. The Hite area includes soils from the Moenkopi rock outcrop and Moenkopi-M warm complex (figure 30). Soils descriptions for each soils type are as follows:

Monue Series

The Monue series soils consist of very deep, well-drained, moderately rapidly permeable soils on alluvial terraces and eolian deposits on structural benches. These soils form from the erosion of sandstone. Soils are loamy fine sand. Slopes range from 1% to 12%. These soils are typically deeper than 60 inches, but may have bedrock at depths of 40 to 60 inches. Soils are typically used for rangeland.

Bluechief Series

The Bluechief series consists of moderately deep, well-drained, moderately to rapidly permeable soils that formed in sandy eolian deposits and alluvium derived from sandstone. These soils are on benches and fan terraces. Soils are fine sandy loam. Slopes range from 1% to 15%. Soil depths are typically 30 to 40 inches, but bedrock can occur at 20 inches. Soils in this series are typically used for rangeland, wildlife habitat, and recreation.

Moenkopi Series

The Moenkopi series consists of very shallow and shallow, well-drained, moderate to moderately to rapidly permeable soils that formed in alluvium and residuum from sandstone and shale. Moenkopi soils are on mesas, hillslopes on structural benches and plateaus. Soils are loamy sand. Slopes are 1% to 30%. Soil depths are typically 9 to 12 inches, but can range from 4 to 20 inches. Soils in this series are typically used for livestock grazing and wildlife habitat.

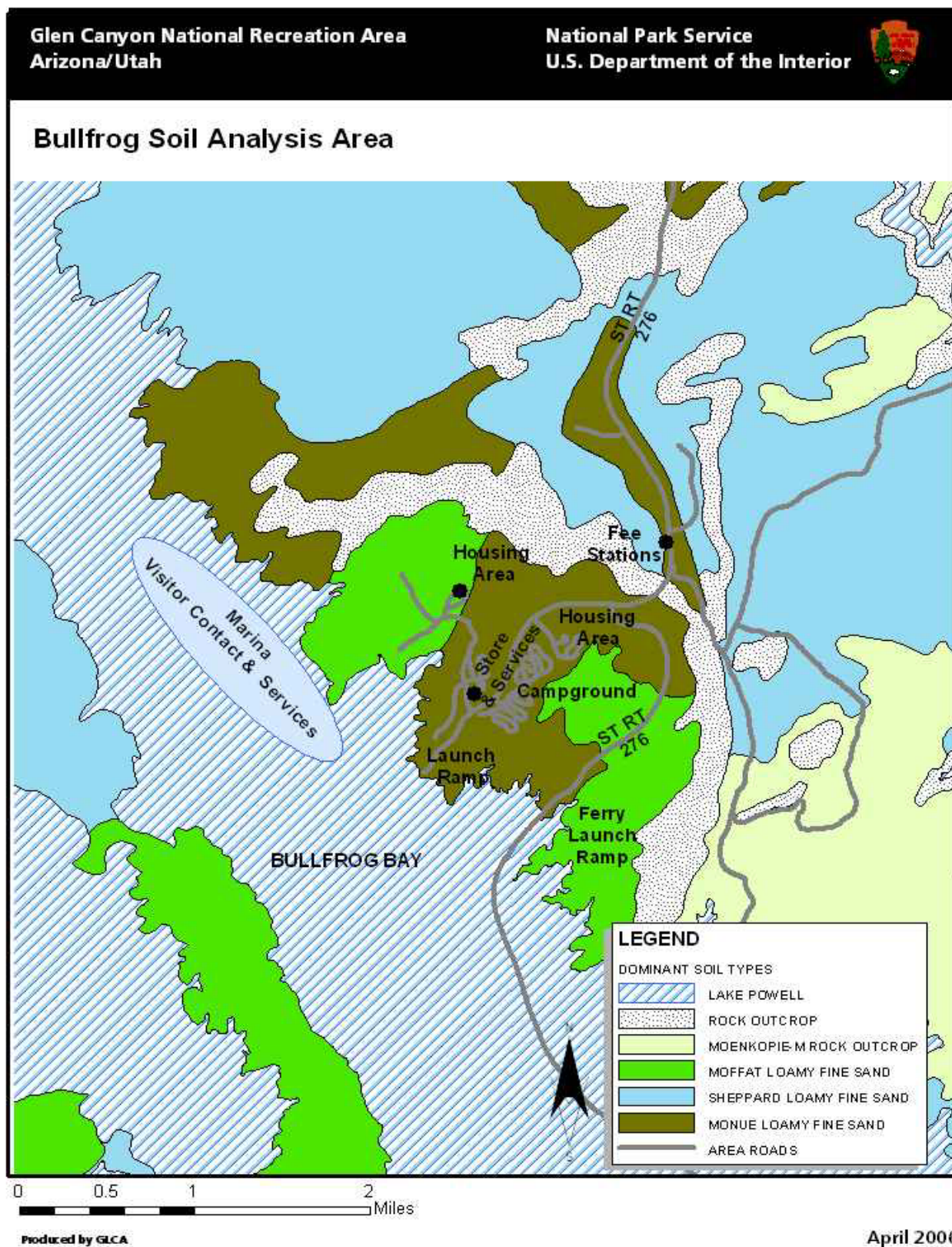


FIGURE 28. SOILS OF BULLFROG DEVELOPED AREA

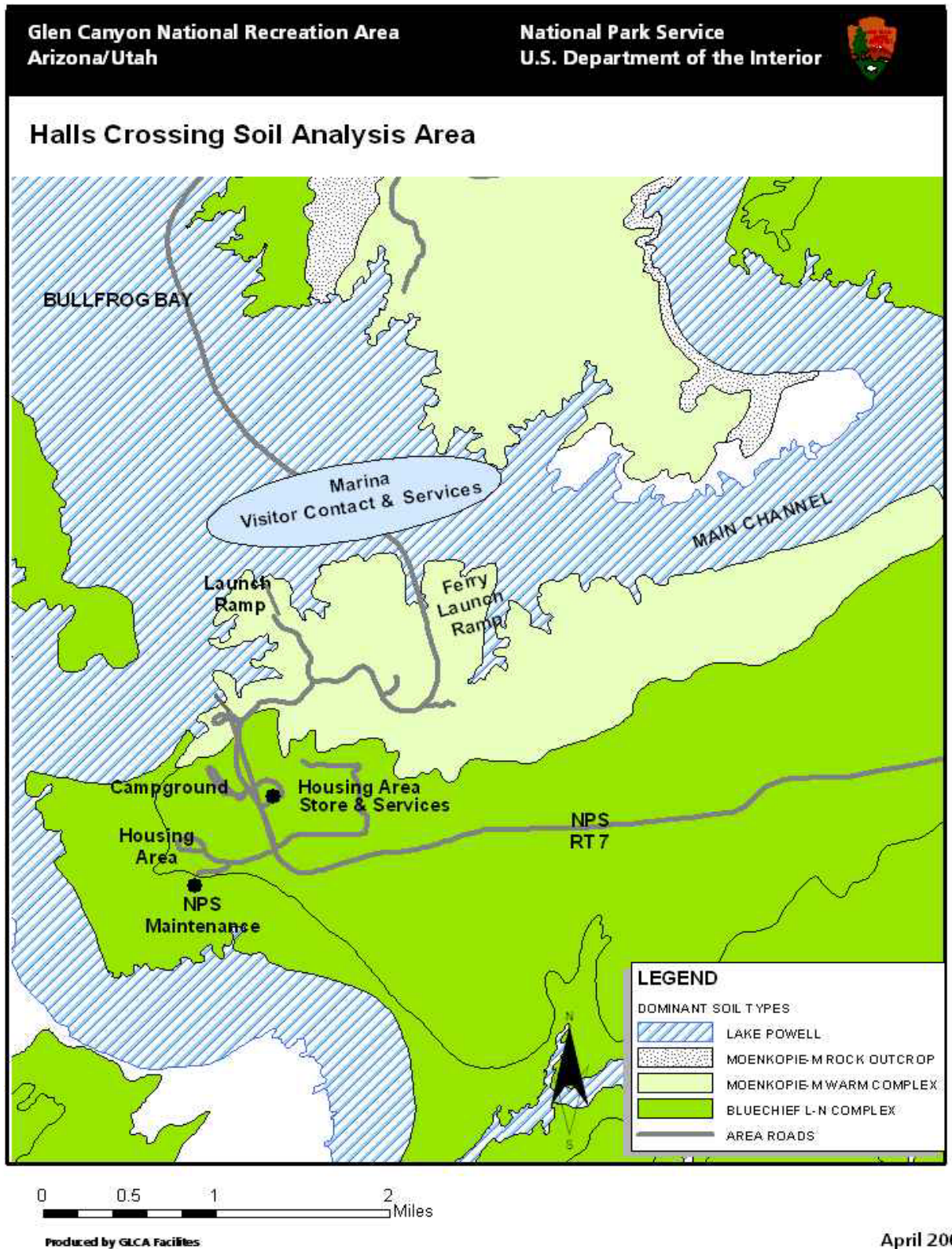


FIGURE 29. SOILS OF HALLS CROSSING DEVELOPED AREA

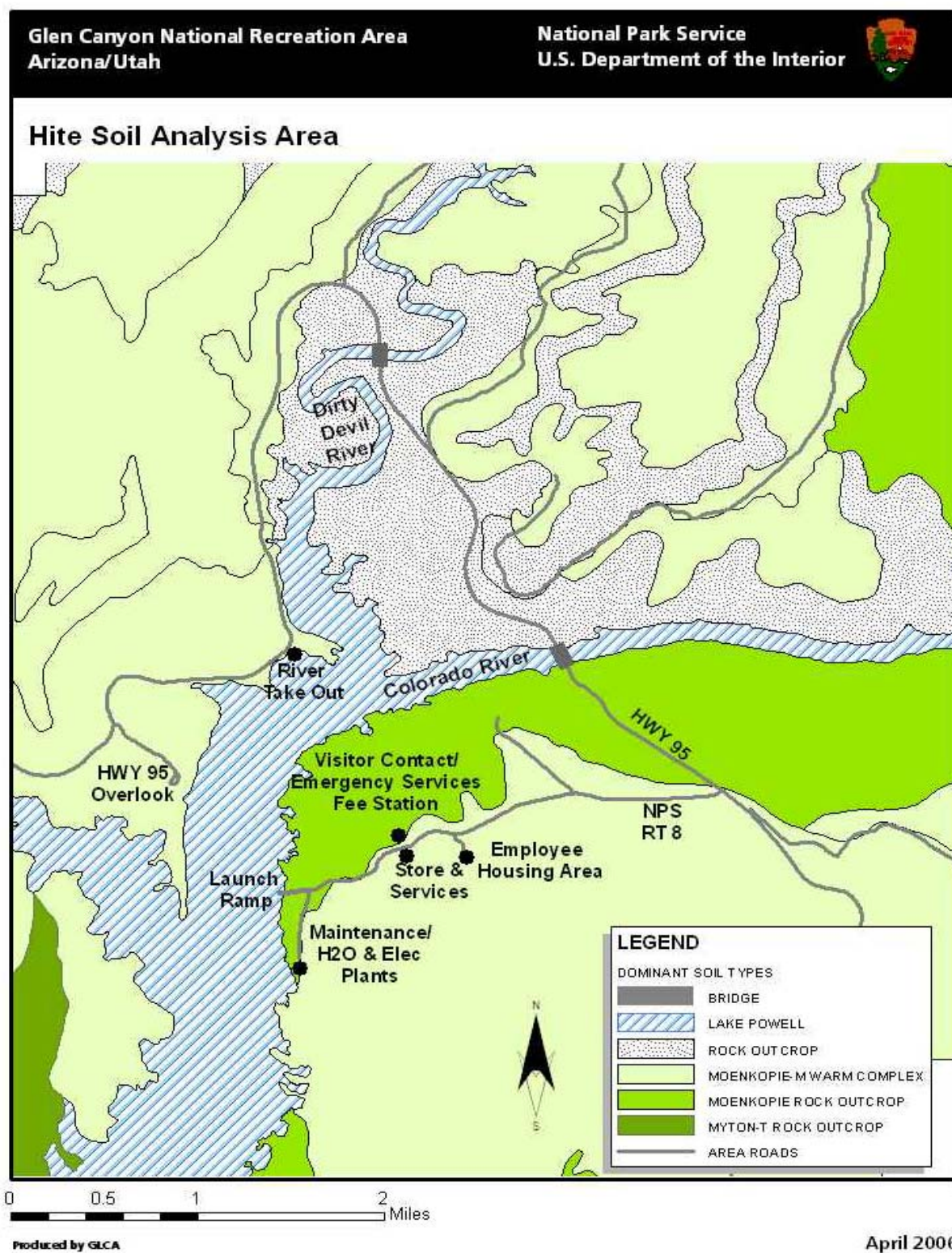


FIGURE 30. SOILS OF HITE DEVELOPED AREA

Moffat Series

The Moffat series consists of very deep, well-drained, moderately rapidly permeable soils that formed in eolian and alluvial sediments. These soils are on plains, plains on structural benches, and alluvial fans, and have slopes ranging from 1% to 25%. Soils are gravelly fine sand. Soil depths are typically 40 to 60 inches. Soils are typically used for rangeland.

GEOLOGY

Geology of the Bullfrog Area

Upper Jurassic formation rocks dominate the landscape at Bullfrog. During the Jurassic period approximately 180 million years ago, ancient oceans began to retreat. The Carmel formation is present at Bullfrog in lower areas closer to the lake. The Carmel formation was deposited under shallow marine conditions and consists of beds of limestone and sandy limestone. Above the Carmel formation lies the Kayenta formation. Streams flowing into the shallow oceans deposited the limey, thinly layered sandstone of the Kayenta formation. The cliffs and ledges are present in the elevated segments of the developed area. At the highest points of the developed area, the Summerville formation may be exposed. The Summerville formation contains sedimentary rocks deposited primarily by river flows, with some thin layers that may have been deposited by wind. Rocks are typically thinly bedded siltstones and mudstones with occasional thin beds of white sandstone. Holocene gravels, dunes, and soils are scattered in the area (Gillette 2004).

Geology of the Halls Crossing Area

The geology of Halls Crossing and surrounding areas is dominated by Upper Jurassic age sandstones. Navajo sandstone resulted from a period of time when a massive windswept dunefield covered what is now the Colorado Plateau. Navajo sandstone is a colorful unit of red, orange, and white sandstone that can be as thick as 2,400 feet. At Halls Crossing, the Navajo sandstone is believed to be approximately 1,200-feet thick, but not all of the formation is exposed. Navajo sandstone forms the lowest lying rocks in the area. Page sandstone may lie above the Navajo sandstone; however, this unit is difficult to distinguish because it is similar to Navajo sandstone. When Page sandstone is difficult to distinguish, geologists generally map this unit as part of the Navajo sandstone. The Navajo/Page sandstone layer can be found above the Carmel formation previously described, but it has limited exposure. Entrada sandstone lies above the Carmel formation. Like Navajo sandstone, the Entrada formation is a wind-driven deposit. However, the Entrada sandstone generally forms a thinner layer than the Navajo sandstone, and is typically a white or off-white to cream color. Above the Entrada sandstone lie Quaternary sediments consisting of unconsolidated silts and sands deposited mainly by wind (Gillette 2004).

Geology of the Hite Area

The rocks in the Hite area are older than the rocks at Bullfrog and Halls Crossing. The geology at Hite is dominated by rocks of Permian and early Triassic age. Cedar Mesa sandstone is the lowest formation present in the area. Cedar Mesa sandstone accumulated in a coastal dune system, which was periodically inundated by water. The Organ Rock formation overlies the Cedar Mesa sandstone and consists of shale, silt, and sand deposited by rivers with occasional dry land sand deposits. White Rim sandstone forms the vertical cliffs in the area and is sandstone derived from both ocean and dry land wind deposits. The highest formation is the Moenkopi. This formation caps the exposures in the Hite vicinity. The Moenkopi formation is comprised of mudstones from a riverine environment (Gillette 2004).

PALEONTOLOGY

In accordance with NPS *Management Policies 2001*, section 4.8.2.1, *Paleontological Resources and Their Contexts*, paleontological resources in national parks “will be protected, preserved, and managed for public education, interpretation, and scientific research.” The paleontological resources at the three uplake developed areas were evaluated as part of an initial site survey that provided a general overview of geologic formations in the analysis area and research into the paleontological resources that might be present in each formation. The following discussions describe the findings for each developed area (Gillette 2004).

Potential Paleontological Resources at Bullfrog

Three formations are exposed at Bullfrog. The potential for paleontological resources at each site is described as follows:

- While fossils (mostly invertebrates) are occasionally found in the Carmel formation, finding any fossil in this formation is considered rare. The upper layers of the Entrada sandstone preserve abundant dinosaur tracks. Prior to the time of deposition of the Entrada sandstone, sauropod (long-neck) dinosaurs were absent in North America. There is some evidence in the Entrada sandstone track record that sauropod populations expanded from Asia to North America at this time, setting the stage for the spectacular evolution of dinosaurs found in great abundance in the Morrison formation.
- The Summerville formation seldom produces fossils; however, because of its stratigraphic position, it may contain fossils at Bullfrog.

Potential Paleontological Resources at Halls Crossing

Five formations are exposed at Halls Crossing. The potential for paleontological resources in each formation is described as follows:

- The Navajo sandstone has extensive, but poorly recorded dinosaur tracks on horizontal bedding planes that represent ancient stabilized dune surfaces, perhaps temporary wet ground that would form shallow interdune lakes under the right climatic conditions. Some beds of very local extent in the Navajo sandstone have impressive petrified logs, occasionally associated with dinosaur tracks, under conditions generally interpreted as oasis deposits. The petrified logs can be substantial in size, but are likely to be broken and difficult to recognize where erosional effects caused by fluctuations of the lake have produced wave action and otherwise left the logs exposed.
- The Page sandstone has a poor fossil record, if any.
- The Carmel formation fossils are generally marine invertebrates with spotty distribution. Vertebrate fossils and plants are possible and, if found, would be considered rare.
- The uppermost beds of Entrada sandstone occasionally yield exceptional dinosaur footprints, in some places by the millions (e.g., in the vicinity of Arches National Park). These sites have been called dinosaur freeways and probably represent north-south migratory routes for herding species.
- Eolian Quaternary sediments, on rare occasion, yield extinct flora and fauna in association with early human occupation (e.g., Clovis and Folsom technologies), overlapping with archeological resources.

Potential Paleontological Resources at Hite

Four formations are exposed at Hite. The potential for paleontological resources at each site is described as follows:

- Fossils are not common in the Cedar Mesa formation, but this formation has yielded critically important plant fossils that provide details of terrestrial plant species that existed here prior to the catastrophic extinction event at the end of the Permian period.
- The Organ Rock formation represents terrestrial conditions where Permian reptiles dominated the landscape and may contain reptile or reptile-related fossils.
- White Rim sandstone in the Hite area forms nearly vertical cliffs that are difficult to examine and are not likely to be disturbed during any construction.
- The Moenkopi formation contains the earliest record of Triassic fauna and flora of the southern Colorado Plateau. The fossil record represents the recovery stage following the catastrophic end-Permian extinction event that nearly extinguished all life on earth. Reptilian ancestors to dinosaurs and all other reptiles are contained in the Moenkopi formation. There is some evidence that the oldest dinosaurs in the world occur in this formation.

AIR QUALITY

The EPA and the Utah Department of Environmental Quality regulate air quality in Utah through implementation of the Clean Air Act. The Clean Air Act is a federal air quality law that is intended to protect human health and the environment by reducing emissions of specified pollutants at their source. In accordance with this law, permits are required for any stationary facility that qualifies as a “major source.” Further, the Clean Air Act outlines three types of airshed classification areas: class I, II, and III. Glen Canyon NRA is located within a class II airshed in which the demonstrated impact of a new stationary source facility may emit no more than 100 tons of a regulated pollutant annually before needing a permit.

The EPA has established primary and secondary National Ambient Air Quality Standards (NAAQS) for six criteria pollutants: carbon monoxide, nitrogen dioxide, particulate matter, ozone, sulfur dioxide, and lead. Primary standards are adopted to protect public health, while secondary standards are adopted to protect public welfare. Air quality data for four of the six criteria pollutants that are regulated by the EPA are measured and recorded by the Salt River Project at Glen Canyon Dam next to the Carl Hayden Visitor Center. There are no air quality monitoring sites at or near the uplake developed areas. No data is available for carbon monoxide or lead within Glen Canyon NRA as these pollutants are not monitored due to historically low concentrations in the area—no exceedances have been recorded for the last five years. Ambient air quality data at the downlake monitoring site for Glen Canyon NRA from 1996 through 2001, when compared to the federal standards for those pollutants, indicate that all pollutants monitored are well below established standards.

WATER RESOURCES

Introduction

Although Lake Powell reached full capacity at an elevation of approximately 3,700 feet on June 22, 1980, the average lake elevation for 1980 was approximately 3,680 feet amsl (figure 31). At full capacity, Lake Powell extends 186 miles up the Colorado River from the dam, and 75 miles up the San Juan River from its confluence with the Colorado. The design surface area at full capacity is 251.2-square miles with 1,960 miles of shoreline (USBR 1988). The lower Colorado River watershed, including the analysis area, has experienced a severe drought six of the last ten years. The lake level dropped to its lowest annual average elevation (since reaching full capacity in 1980) in 2005. The projected water level for Lake Powell at the end of water year 2006 is 3,618 feet. At 3,618 feet lake elevation, the surface area is 140.7-square miles. Predictions of elevation provided by the Bureau of Reclamation are based on factors related to snowpack, melt rate, contributing rain, and releases from Glen Canyon Dam. Predictions are updated monthly and will likely change slightly during the preparation of this report.

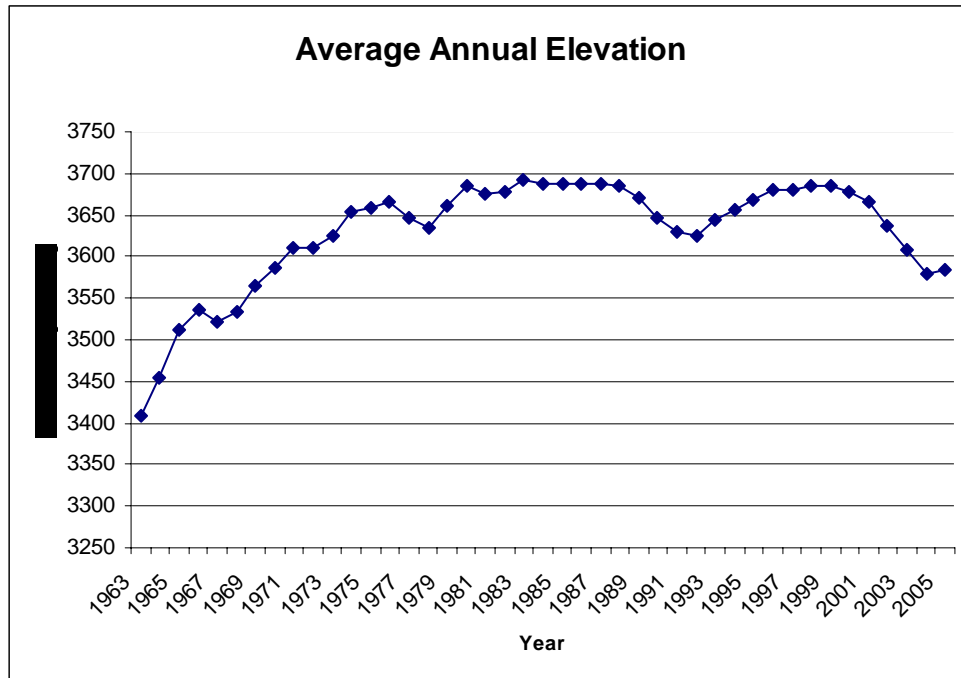


FIGURE 31. ANNUAL ELEVATION

The Bureau of Reclamation manages water levels in Lake Powell within the constraints of supply provided through precipitation and runoff. The National Park Service manages the recreational facilities within and surrounding Lake Powell. The uptake developed areas of Bullfrog, Halls Crossing, and Hite have modified available services in response to the decrease in water levels. Boat ramps have been extended or relocated and moorings at wet slips and buoy fields have been moved. These circumstances have been aggravated at Hite by the increased levels of sediment. Hite marina facilities were permanently relocated to Bullfrog and Halls Crossing in 2004.

The Uplake DCP provides an evaluation of potential changes to the uptake developed areas to accommodate future use. Water supply, distribution, and treatment are components of the planning for development changes. The EPA, State of Utah, and Glen Canyon NRA do not allow discharges from surface facilities into the lake. Impacts from recreational users are managed to maximize water quality.

Bullfrog is located near the inlet of Bullfrog Creek. Halls Crossing is south of Bullfrog on the south shore of the Colorado River, north and upstream of Lake Canyon, and west and downstream of Moqui Canyon. Hite is located downstream of Dirty Devil Canyon and slightly north of the confluence of North Wash and the Colorado River.

Lake Powell has a contributing watershed of 107,700-square miles. The major tributaries to Lake Powell are the Colorado, San Juan, Dirty Devil, and Escalante rivers. Lake Powell is part of the Colorado River Storage Project, a federal program designed to store seasonal flood waters for beneficial water uses at later periods. The project has a storage capacity of 34 million acre-feet of water (USBR 2006) in Lake Powell, Flaming Gorge Reservoir on the Green River

in Utah, Navajo Reservoir on the San Juan River in New Mexico, and Blue Mesa Reservoir on the Gunnison River in Colorado. Lake Powell serves as a recreation destination for boaters, nature lovers, and fishermen, and also produces hydroelectric power.

Lake Powell was filled using upper basin flows over a 21-year period. During this time, outflows to downstream water rights holders averaged 12.07 million acre-feet per year and inflows averaged 15.18 million acre-feet per year. Storage stayed within 94% of the full capacity of 23.35 million acre-feet for the six-year period from 1984 through 1989, before larger fluctuations based on annual inflows began. Inflow matched or exceeded outflow until 2000, when the minimum outflow obligation exceeded the inflow. If the annual amount of water flowing into the lake is less than that lost to dam releases (and evaporation), the reservoir surface elevation drops.

Water obligations to Lower Colorado basin states and Mexico are 8.23 million acre-feet per year, and discharges from Glen Canyon Dam have averaged 13.75 million acre-feet in the last 10 years. The Bureau of Reclamation prepares an annual operating plan at the end of every water year for consultation and consensus by Upper Colorado River basin states, Lower Colorado River basin states, American Indian tribes, water delivery contractors, contractors for the purchase of federal power, appropriate federal agencies, and others with interests in Colorado River operations. The annual operating plan for 2006 (USBR 2005) couples a 24-month water supply forecast with the operating criteria developed by the secretary of the interior entitled “Criteria for Coordinated Long Range Operation of Colorado River Reservoirs Pursuant to the Colorado River Basin Project Act of September 30, 1968.” In 2004, the *Interim 602(a) Storage Guideline* was adopted, which sets the minimum storage of Lake Powell at 14.85 million acre-feet. This operating protocol will guide releases from Lake Powell during the 2006 water year. In the event that the capacity of Lake Powell exceeds this value, storage equalization criteria between the active storage volumes in Lake Mead and Lake Powell will control releases for the year.

Lake Level Analysis

Six years of drought, coupled with anticipated inlet sedimentation have resulted in new challenges for recreation management at Lake Powell. Between 1999 and 2004, the average annual water level dropped over 100 feet, modifying the perimeter, area, and elevation of Lake Powell. The reservoir surface area at 3,600 feet of 149-square miles is 40% less than the area at 3,700 feet (full capacity) of 251-square miles. A drop in the elevation of Lake Powell another 20 feet to 3,580 feet would decrease the reservoir surface area to 133-square miles. This dramatic decrease in surface area as the lake elevation drops has substantial implications for the lake’s recreational carrying capacity.

Normal average annual variation has been approximately 25 feet, with the highest levels occurring in July following snowmelt runoff, and the lowest levels occurring in April, after the winter, but prior to high-country runoff. The Bureau of Reclamation predicts that the water level will rise to its highest point for 2006 (3,624 feet) in July.

Water Quality

Inflow water quality near Hite was measured prior to the construction of Glen Canyon Dam. Assuming no changes in the intervening year, the water at Hite was characterized as hard (average calcium carbonate hardness of 420 mg/l), moderately alkaline (pH ranging from 7.1 to 8.2, and averaging 7.77), and with an average salinity (specific conductance ranging from 399 mg/l to 2060 mg/l) (USGS 2006). The water quality of Lake Powell varies seasonally. The Grand Canyon Monitoring and Research Center performs quarterly water quality assessments at as many as 15 stations on the main channel of the Colorado River. Elevated spring runoff and large upstream storm events bring in elevated sediment concentrations as well as higher levels of dissolved oxygen. Lake Powell also exhibits traditional thermal stratification with some mixing in the fall as the water surface cools and in the spring when large inflows occur. Water quality varies with distance from Glen Canyon Dam and water depth.

Lake Powell is located on the boundary between Arizona and Utah, and consequently both states regulate water quality. However, Lake Powell waters within the analysis area are within Utah and are thus regulated by Utah state standards. Utah's antidegradation policy is included in the Utah Administrative Code, Rule R317-2, *Standards of Quality for the State*. The policy establishes a plan to maintain and improve the quality of state waters for public water supplies; the propagation of wildlife, fish, and aquatic life; and agricultural, industrial, recreational, and other legitimate uses. The policy states that no waste will be discharged into any waters of the state that would compromise the beneficial uses of the receiving waters. Glen Canyon NRA water quality management objectives are focused toward this central premise.

Human waste is a potential threat to recreation area resources because it can be a source of pathogens in water. Lake Powell water quality has been monitored for human waste since 1988. The monitoring periodically shows high concentrations of fecal coliform bacteria, which indicate the presence of untreated sewage. In the early 1990s, several beaches were temporarily closed because of high fecal coliform bacteria levels. There were 12 beach closures for the same reason in 1995. In response to these conditions, the National Park Service has addressed sanitation issues by implementing the Strategic Plan to Protect Water Quality in Lake Powell (NPS 2005f). With implementation of the Strategic Plan to Protect Water Quality in Lake Powell, beach closures due to high concentration of fecal coliform bacteria were reduced to three in 1996, and one in 1999.

Glen Canyon NRA continues to actively perform a beach monitoring program and implement management actions to protect water quality in an effort to exceed levels recommended by the State of Utah. Since 2002, all monitoring of fecal bacterial pollution has used the *Escherichia coli* bacteria Coli-ert system to protect public health. Data was collected in six uplake zones, including Bullfrog and Halls Crossing located in zone 11, and Hite located in zone 13. Zone 11, near Bullfrog and Halls Crossing, had several instances of high levels of fecal bacterial pollution in 1997 and 1998. *E. coli* levels in zone 11 peaked in 1998, but have dropped since that time. A similar pattern is seen for zone 13 (Hite), which had several instances of high levels of fecal bacterial pollution in 1998, but levels have subsequently dropped. Improvements in water quality may be a result of implementation of the aforementioned Strategic Plan to Protect Water Quality in Lake Powell.

Other Water Resources

Other water resources that occur in or adjacent to the analysis area for Glen Canyon NRA include ephemeral washes, intermittent streams, springs, tinajas, and groundwater. Ephemeral washes are fed by the limited precipitation events that occur in or upstream of the NRA. Intermittent streams are fed both by very limited precipitation events and by flow from spring sources within or upstream of the NRA. Tinajas are created when precipitation is captured in depressions on the surface of rock formations within the NRA. These features are intermittent and may contain unique and diverse assemblages of plant and animal life. Groundwater resources of the analysis area may typically be found at varying depths within sandstone formations or in alluvial deposits associated with the Colorado River or its tributaries. The degree to which these hydrologic features may be impacted by proposed development is unknown at this time and would require survey data to adequately define the quantity, quality, and location of these resources relative to the analysis areas.

Implementation of standard NPS BMPs for control of sedimentation (as specified in the mitigation measures located in the “Alternatives” section) would mitigate adverse effects to these water resources.

Siltation

Rivers move weathered sediments during high flows. These form deltas at the inlets of lakes and reservoirs when the velocity of the river decreases. Several estimates of sedimentation have been prepared over the years of operation of Glen Canyon Dam. The most thorough study to date, a 1986 Bureau of Reclamation survey, concluded that 868,231 acre-feet of sediment had been deposited in Lake Powell between March 1963 and September 1986, or 36,946 acre-feet per year, with 54% derived from the Colorado River arm. This would suggest that on average 19,951 acre-feet of sediment per year would enter the reservoir near Hite. A smaller study of the Hite area in June 2001 estimated that 183,400 acre-feet of sediment entered the Colorado River arm between 1986 and 2001, with an average sedimentation rate of 12,200 acre-feet per year (Musetter 2001). Sediment depth measurements in the Hite vicinity suggest that the lake bottom has risen at an average rate of 4 feet per year over the life of the reservoir (Musetter 2001).

Sediment deposition will continue to play a role in the use of uplake facilities at Hite. At water levels near full pool, the sediment deposited in the vicinity of Hite could eventually reach a high enough elevation to cause concern for the long-term use of Hite. During lower lake levels, sediment deposition occurs at the lake inlet downstream of Hite, and some cutting by the river and flood flows moves previously deposited sediment downstream. Currently, Hite is basically silted in.

Effects of Sedimentation

Sediment carried by the rivers emptying into Lake Powell is deposited on the lake bottom and along the shoreline. The effects of sedimentation relative to these supplemental calculations are most noticeable in zone 13. In figure 32, the red lines indicate approximate locations where

the free-flowing river ends and the pooling of water begins at various elevations. The figure also displays estimates of sediment deposits in zone 13. These estimates were prepared based on a sedimentation study of Lake Powell (Mussetter 2001). It should be noted that sedimentation is an ongoing process, and its effects will vary over time; therefore, the effects described for zone 13 are only estimates.

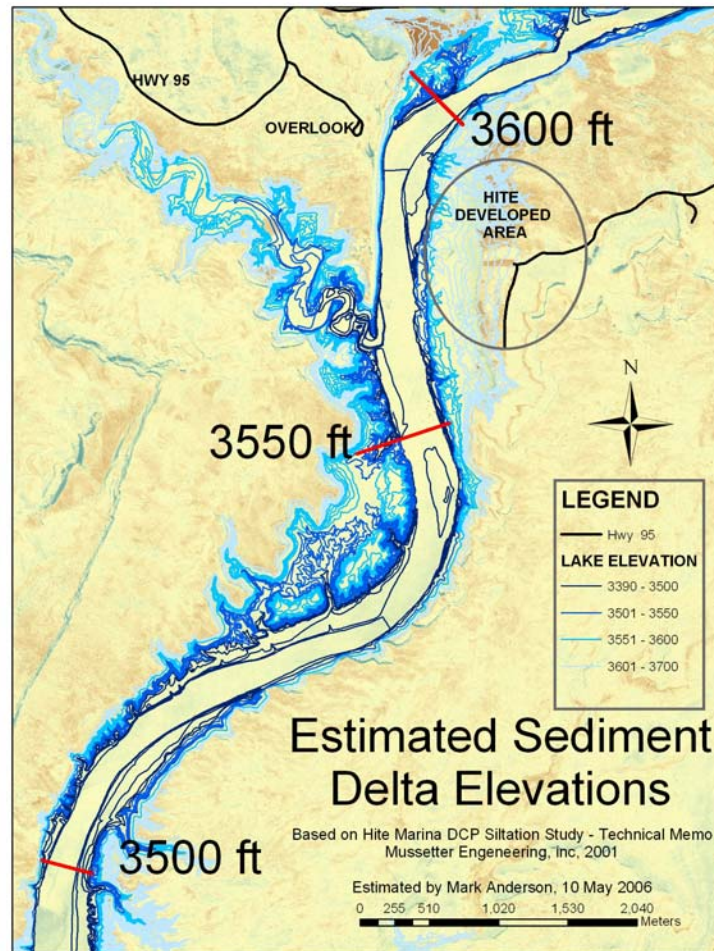


FIGURE 32. ESTIMATE OF SEDIMENT

Sediment deposits will reduce the amount of accessible shoreline and surface area of the lake in zone 13, particularly between lake elevations 3,500 and 3,550. Figure 32 provides a visual representation of the estimates. The impacts of sedimentation are not numerically factored into the supplemental calculations presented in this document.

FLOODPLAINS

The 100-year floodplain has been established at the 3,700-foot elevation by the Federal Emergency Management Agency. Additionally, small areas of floodplain occur at the deltas of tributaries to the lake. The elevation of these floodplains is determined by the elevation level of the lake during the flood event. The principle tributaries within or adjacent to the developed areas include the Dirty Devil River, North Wash, Bullfrog Creek, Halls Creek, and Stanton Creek. All of these enter the lake and deposit sediments at this interface. NPS policy requires that permanently occupied structures should not be located in a floodplain. Additionally, any facilities (temporarily occupied structures, e.g., water-based stores, or nonoccupied structures, e.g., ramps, roads, parking lots) that are located within floodplain areas should be designed and/or located adequately to protect them during flood events.

WATERS OF THE UNITED STATES, INCLUDING WETLANDS

The USACE has jurisdiction over protecting waters of the United States, including wetlands under section 404 of the Clean Water Act. Waters of the United States are defined as waters that are navigable for interstate commerce and their tributaries. The Colorado River has been identified as a navigable waterway. Additionally, wetlands are defined as “areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328.3[b]). Wetlands have three diagnostic characteristics: (1) over 50% of the dominant species present must be classified as obligate, facultative wetlands, or facultative; (2) the soils must be classified as hydric; and (3) the area is either permanently or seasonally inundated (USACE 1987).

The National Park Service classifies, delineates, and maps wetlands using the USFWS’s Cowardin classification system (USFWS 1979). This system is based on the more inclusive definition, e.g., “lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.” Under this classification, wetlands must have one or more of the following characteristics: (1) the land supports, at least periodically, predominantly hydrophytes (i.e., plants adapted to growing in water or in saturated soils that are oxygen deficient), (2) the substrate is comprised of predominantly undrained hydric (anaerobic) soils, and (3) the substrate is saturated with water or covered by shallow water at some time during the growing season of each year (USFWS 1979).

Both wetlands definitions and classification systems (USFWS and USACE) recognize three parameters: hydrophytic vegetation, hydric soil, and wetlands hydrology, but differ from each other in how much habitat is considered wetlands. The Cowardin system defines more habitat types as wetlands and also recognizes many unvegetated sites such as mudflats, or areas without soil such as rocky or sandy banks, stream shallows, saline lakeshores, playas, and deepwater or sites lacking soil.

The jurisdictional limits of waters of the United States have been established by the USACE as occurring at the 3,700-foot elevation along the shoreline of Lake Powell. Due to fluctuating water input, the actual level of the water is oftentimes much lower. A variety of mostly nonnative noxious weeds typically grow in this band of soil between 3,700 feet and the actual waterline. These plants are generally not recognized as wetlands plants and this area does not contain appropriate hydric soils. While there may be some inundation during certain times of the year, this area does not meet the definition of a wetlands by either the USACE or USFWS standards and therefore is only protected as waters of the United States, not as “wetlands.” Small areas of wetlands do occur within the footprint of Bullfrog and Halls Crossing. Additionally, wetlands may also occur along the banks of the Colorado River in the Hite area.

VEGETATION

Introduction

Glen Canyon NRA and Lake Powell lie within the Colorado Plateau Semidesert province (Bailey 1995). The Colorado Plateau Semidesert province includes tablelands with moderate to considerable topographic relief in the vicinity of Glen Canyon NRA. Elevations range from 3,100 feet in the deeper canyons up to 7,500 feet on canyon rims and mesa tops. Generally, four vegetation zones can be used to describe regional flora and wildlife habitats of the Glen Canyon NRA region. They are (1) arid grassland, (2) xeric shrublands, (3) woodlands, and (4) montane communities (Bailey 1995). Of these zones only arid grasslands and xeric shrublands occur in the analysis area. Arid grasslands are composed of sod-forming grasses and bunch-grasses that are typically widely spaced, with open areas often covered by a well-developed cryptobiotic crust between grass patches and shrubs. Xeric shrublands can grow in open stands within arid grassland communities, but may also form extensive, sparse to moderately dense shrublands on appropriate habitats. In addition to these two major community types, riparian vegetation occurs in washes and along the banks of creeks and rivers throughout the NRA and in the analysis area.

In 1988, a report on the vegetation and relict communities of Glen Canyon NRA was completed (Tuhy and MacMahon 1988) (figures 33, 34, and 35). The 1988 report used existing regional information sources along with field observations and limited data collection. The report classified, described, and delineated 21 vegetation cover types in Glen Canyon NRA. Major types are illustrated in figure 33. Fourteen of the cover types likely occur in the analysis area of this DCP/EA:

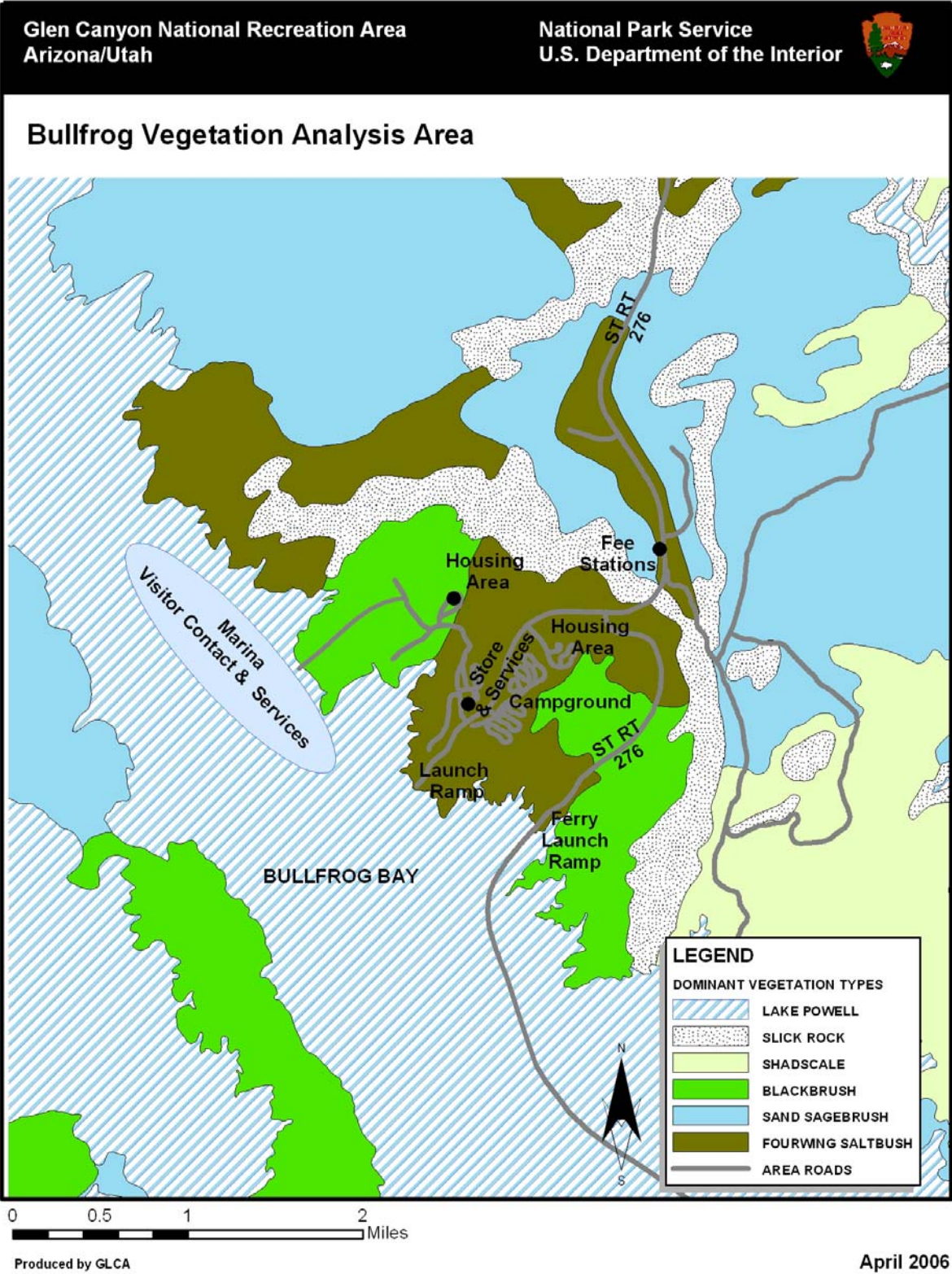
1. *Stipa* [*Achnatherum*, *Hesperostipa*] – *Hilaria* [*Pleuraphis*] Grassland (Indian ricegrass, Needle-and-thread – Galleta) community type
2. Sand-shrub community type
3. *Coleogyne ramosissima* (Blackbrush) cover type
 - *Coleogyne ramosissima* / *Stipa* [*Achnatherum*] *hymenoides* (Blackbrush / Indian ricegrass) community type
 - *Coleogyne ramosissima* / *Hilaria* [*Pleuraphis*] *jamesii* (Blackbrush / James’ Galleta) community type

4. *Atriplex confertifolia* (Shadscale) cover type
 - *Atriplex confertifolia* / *Hilaria* [*Pleuraphis*] *jamesii*– *Stipa* [*Achnatherum*] *hymenoides* (Shadscale / James' Galleta – Indian ricegrass) community type
 - *Atriplex confertifolia* / *Hilaria* [*Pleuraphis*] *jamesii* (Shadscale / James' Galleta) community type
5. *Atriplex gardneri* var. *cuneata* (Gardner saltbush) cover type
6. *Atriplex corrugata* (Mat saltbush) cover type
7. *Ceratoides* [*Krascheninnikovia*] *lanata* (Winterfat) cover type
8. Talus slopes with mixed shrubs, below piñon -juniper zone
9. Hanging gardens
10. Perennial riparian
11. Ephemeral washes and higher terraces
12. *Sarcobatus vermiculatus* (Black greasewood) cover type
13. *Atriplex canescens* (Four-wing saltbush) cover type
14. *Artemisia tridentata* ssp. *tridentata* (Basin big sagebrush) cover type

Analysis Area Vegetation

Plant communities that have become established in the analysis area consist of seral communities of disturbed sites, introduced landscape species, and climax native communities of more stable wetlands and upland sites. Disturbed sites include those that are subject to foot traffic and vehicle access and those of the Lake Powell low-water zone. Plant species typically present on high-traffic recreation sites include purple threeawn (*Aristida purpurea*), cheatgrass (*Bromus tectorum*), Bermuda grass (*Cynodon dactylon*), witchgrass (*Panicum capillare*), storksbill (*Erodium cicutarium*), knotweed (*Polygonum aviculare*), Russian thistle (*Salsola iberica*), purslane (*Portulaca oleracea*), prostrate vervain (*Verbena bracteata*), and puncture vine (*Tribulus terrestris*). Native and nonnative landscape plantings have been introduced or otherwise became established in campgrounds, around marinas, and elsewhere in the developed portion of the recreation area. Landscape shade trees include Fremont cottonwood (*Populus fremontii*), Gooddings willow (*Salix gooddingii*), box-elder (*Acer negundo*), hackberry (*Celtis* sp.), juniper (*Juniperus* sp.), Russian-olive (*Elaeagnus angustifolia*), ash (*Fraxinus* sp.), elm (*Ulmus* sp.), western redbud (*Cercis occidentalis*), pinyon pine, Utah juniper, and sycamore (*Platanus* sp.).

Much of the analysis area that occurs below the ordinary high water line of Lake Powell has been inundated historically and reexposed as water levels have receded in the past decade. This exposed shoreline habitat often supports both native and nonnative annual and perennial plant species that grow in distinct bands relative to soil moisture and include cocklebur (*Xanthium strumarium*), horseweed (*Conyza canadensis*), curly gumweed (*Grindelia squarrosa*), Fremont and narrowleaf goosefoot (*Chenopodium fremontii* and *C. leptophyllum*), yellow and white sweetclover (*Melilotus officianalis* and *M. alba*), tumble

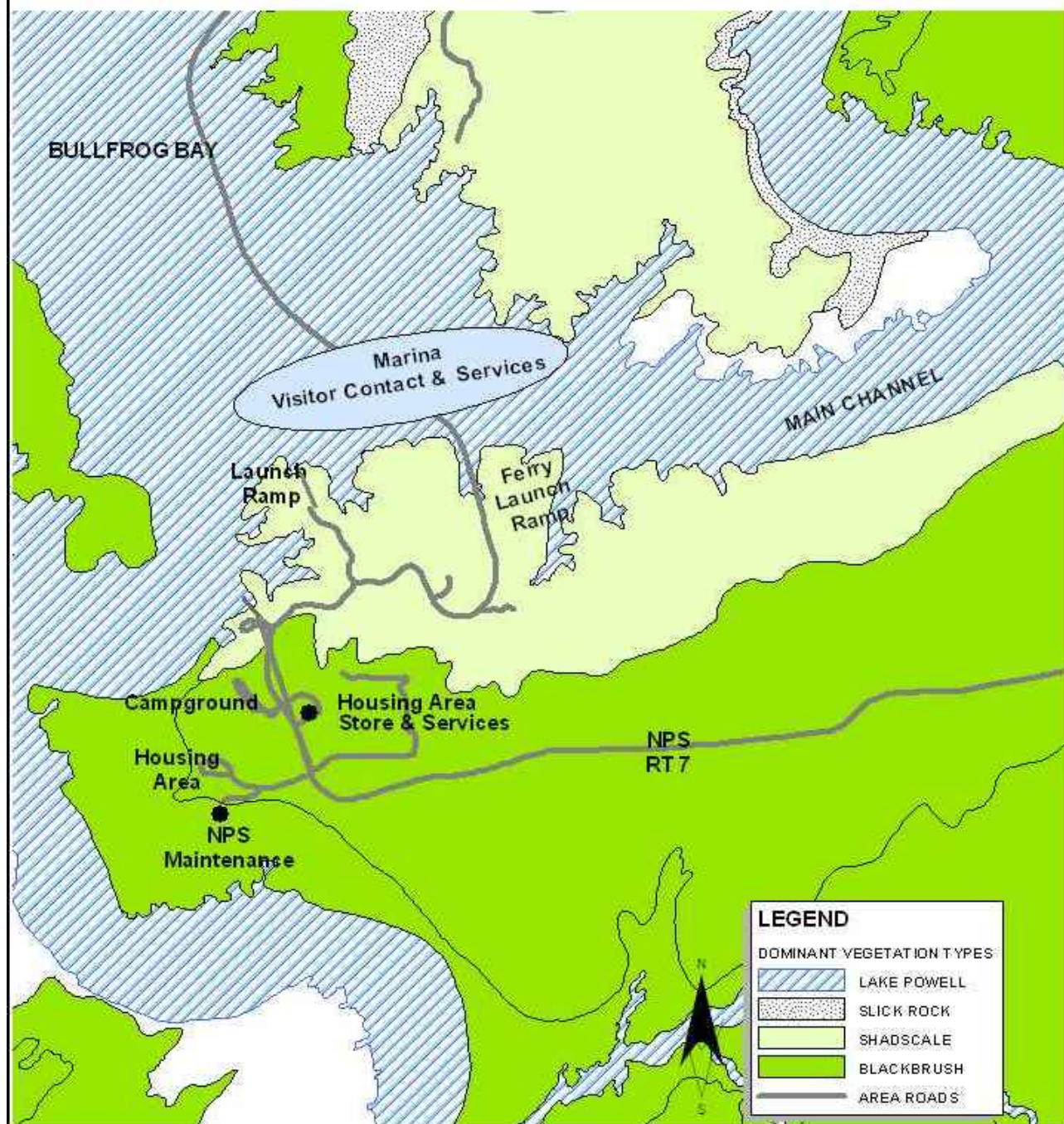


Glen Canyon National Recreation Area
Arizona/Utah

National Park Service
U.S. Department of the Interior



Halls Crossing Vegetation Analysis Area



0 0.5 1 2 Miles

Produced by GLCA

April 2006

FIGURE 34. VEGETATION OF HALLS CROSSING DEVELOPED AREA

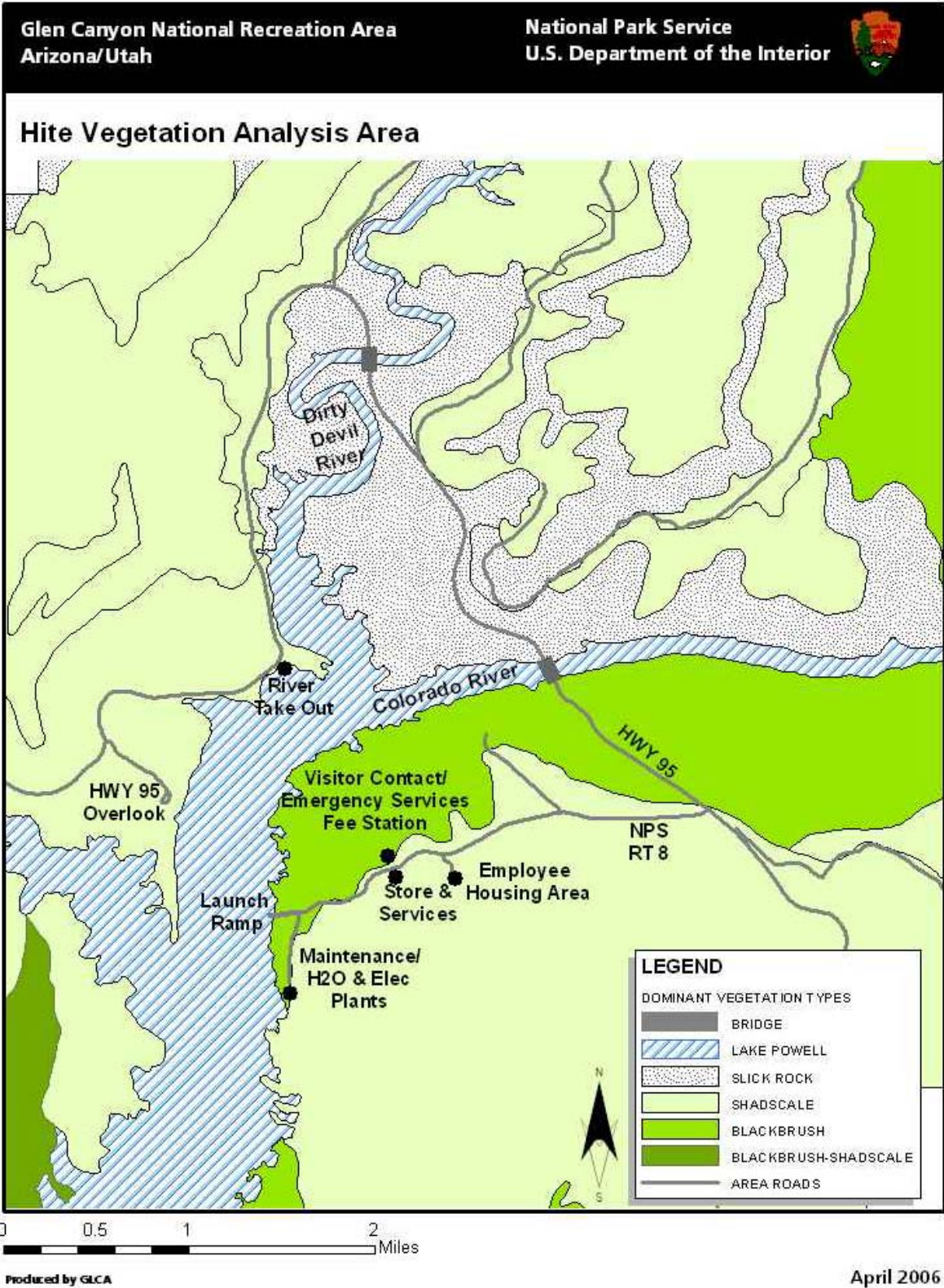


FIGURE 35. VEGETATION OF HITE DEVELOPED AREA

mustard (*Sisymbrium altissimum*), Russian thistle, tumbling orach (*Atriplex rosea*), bassia (*Bassia hyssopifolia*), tarragon (*Artemisia dracunculus*), common sunflower (*Helianthus annuus*), poverty-weed (*Iva axillaris*), dropseeds (*Sporobolus* spp.), and redroot, and prostrate pigweed (*Amaranthus retroflexus* and *A. blitoides*). On more mesic shoreline sites, stands of nonnative tamarisk (*Tamarix chinensis*) and native seepwillows (*Baccharis* spp.) become established (Waring 1993).

WILDLIFE

Glen Canyon NRA supports a surprisingly diverse number of wildlife species, which is partly due to the presence of Lake Powell. Within the boundaries of the recreation area, 438 wildlife species have been identified including 311 species of birds, 64 species of mammals, 27 species of fish, 29 species of reptiles, and 7 species of amphibians (NPS 2005j). Threatened and endangered species and state species of concern that may be affected by the proposed projects will be discussed in a later section.

Mammals

The areas that surround the marinas provide limited habitat to the large, mobile mammals of the recreation area. These areas may be briefly used by species that are searching for food and water while they are moving through the area. These species include the desert bighorn sheep (*Ovis canadensis*) and mule deer (*Odocoileus hemionus*). Predators are prevalent in all of the vegetation communities where abundant prey is available and include the bobcat (*Felis rufus*), mountain lion (*Felix concolor*), gray fox (*Urocyon cinereoargenteus*), badger (*Spilogale gracilis*), kit fox (*Vulpes velox*), and coyote (*Canis latrans*) (NPS 2003a).

The riparian areas of the analysis area provide sufficient forage and shelter for a diverse population of rodents. A survey of shoreline salt cedar (*Tamarix chinensis*) shrublands noted the following rodents: deer mouse (*Peromyscus maniculatus*), Ord's kangaroo rat (*Dipodomys ordii*), little pocket mouse (*Perognathus longimembris*), long-tailed pocket mouse (*Chaetodipus formosus*), western harvest mouse (*Reithrodontomys megalotis*), canyon mouse (*Peromyscus crinitus*), brush mouse (*Peromyscus boylii*), piñon mouse (*Peromyscus truei*), northern grasshopper mouse (*Onychomys leucogaster*), and desert woodrat (*Neotoma lepida*) (NPS 2003a).

Desert shrublands and herbaceous communities are found inland from the riparian areas and provide a diversity of vegetation for habitat and forage. Mule deer and pronghorn browse on the shrubs, forbs, and grasses present in these desert communities. Shrublands and herbaceous communities include a variety of small mammals such as Ord's kangaroo rat, deer mouse, piñon mouse, northern grasshopper mouse, white-tailed antelope squirrel (*Ammospermophilus leucurus*), and desert woodrat (Rosenstock 1996). Rabbits are common and include the desert cottontail (*Sylvilagus audubonii*) and the black-tailed jackrabbit (*Lepus californicus*). Several species of bats use these areas to forage at night including several *Myotis* sp., western pipistrelle (*Pipistrellus hesperus*), big brown bat (*Eptesicus fuscus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), and pallid bat (*Antrozous pallidus*) (NPS 2004b).

Birds

The majority of wildlife species found within Glen Canyon NRA are birds. Shorebirds, waterfowl, and other water-associated bird species frequently use Lake Powell for resting, security, and foraging purposes, and constitute 101 of the 311 bird species found in Glen Canyon (Spence et al. 2006). Species commonly observed along the shoreline and on the lake include grebes, cormorants, herons, egrets, coots, and ducks. These species concentrate at Lake Powell during the winter and during the peak migration months of late fall, winter, and early spring, especially at bays such as Bullfrog Bay (Spence 1998, Spence & Bobowski 2003).

Birds also use the dense shrublands of the riparian zones during both migration and breeding for shelter, food, and reproduction. During a survey of salt-cedar stands within the recreation area, the following birds were observed: the horned lark (*Eremophila alpestris*), common raven (*Corvus corax*), mourning dove (*Zenaida macroura*), yellow warbler (*Dendroica petechia*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), and the house finch (*Carpodacus mexicanus*). Songbird density, abundance, and species richness increased toward the northern portion of Lake Powell where Bullfrog, Halls Crossing, and Hite marinas are located (Spence et al. 2006).

Desert shrub and grassland communities host a variety of wintering, migrant, and resident bird species including the house finch, northern mocking bird (*Mimus polyglottos*), lesser nighthawk (*Chordeiles acutipennis*), Say's phoebe (*Sayornis saya*), the white-crowned sparrow (*Zonotrichia leucophrys*), rock wren (*Salpinctes obsoletus*), and the black-throated sparrow (*Amphispiza bilineata*), which is the characteristic breeding bird of Glen Canyon NRA (LaRue and Spence 2001). Several permanent residents of these areas include the common raven, loggerhead shrike (*Lanius ludovicianus*), and the canyon wren (*Catherpes mexicanus*) (Spence et al. 2006). Most of these species can be seen in the vegetation found in and around the analysis area.

The diversity of small rodents, songbirds, fish, and reptiles, combined with the proximity of nesting cliffs, explains the large diverse number of raptors in the analysis area. Species include the osprey (*Pandion haliaetus*), northern harrier (*Circus cyaneus*), red-tailed hawk (*Buteo jamaicensis*), great horned owl (*Bubo virginianus*), and the peregrine falcon (*Falco peregrinus*) (NPS 2003a).

Reptiles and Amphibians

Systematic surveys of reptile and amphibian species have not been conducted since the creation of Glen Canyon Dam (Plattenberg et al. 2003). However, reptiles and amphibians have been observed and recorded in the ecological systems found within the analysis area. During a survey of salt-cedar (tamarisk) stands, seven species of reptiles and amphibians were documented including the orangehead spiny lizard (*Sceloporus magister cephaloflavus*), side-blotched lizard (*Uta stansburiana stejnegeri*), desert short-horned lizard (*Phrynosoma platyrhinos calidiarum*), western whiptail (*Cnemidophorus tigris septentrionalis*), western rattlesnake (*Crotalus viridis*), longnose leopard lizard (*Gambelia wislizenii*), and the Glen Canyon chuckwalla (*Sauromalus obesus multiforaminatus*) (Platenberg et al. 2003). Additionally, Arizona glossy snake (*Arizona elegans*) was observed in the Bullfrog area in 2005.

In the analysis area, desert shrublands and grasslands host a diverse population of small rodents and other reptile prey species. Within the analysis area, the following reptiles may be present including the yellowhead collared lizard (*Crotaphytus collaris auriceps*), longnose leopard lizard, side-blotched lizard, California king snake (*Lampropeltis getula californiae*), western whiptail, western rattlesnake, and the Great Basin gopher snake (*Pituophis catenifer deserticola*) (NPS 2004b). The Great Basin spadefoot toad (*Spea hammondi intermountana*) has been found in temporary pools within washes that may occur in the analysis area (NPS 2004b). Other species that may be found in temporary pools and scattered springs include the leopard frog (*Rana pipiens*), red-spotted toad (*Bufo punctatus*), Woodhouse's toad (*Bufo woodhousii*), and the canyon treefrog (*Hyla arenicolor*) (NPS 2003a).

Fish

Glen Canyon NRA hosts fish that are adapted to either lakes or flowing rivers. Before the creation of the dam, the free-flowing Colorado River hosted a number of species that have not been able to adapt to the recent lacustrine environment and the invasion of introduced species. Several native species have been extirpated, but other native species such as the Colorado pikeminnow (*Ptychocheilus lucius*), flannelmouth sucker (*Catostomus latipinnis*), bonytail (*Gila elegans*), humpback chub (*Gila cypha*), razorback sucker (*Xyrauchen texanus*), bluehead sucker (*Catostomus discobolus*), and roundtail chub (*Gila robusta*) still occur in extremely reduced populations within the Colorado River, its tributaries, and its interface with Lake Powell (NPS 2003a). Threatened and endangered species that may be affected by the proposed projects will be discussed in the threatened and endangered species section.

Since the creation of Lake Powell, a large sport fishing industry has taken advantage of the excellent quality of the lake's fishery. Introduced species that are adapted to the lacustrine environment are the backbone of this industry. Striped bass (*Morone saxatilis*) and smallmouth bass (*Micropterus dolomieu*) comprise the majority of the annual game fish harvest, but largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), crappie (*Promoxis nigromaculatus*), and bluegill (*Lepomis macrochirus*) are also present. Important nongame fish species include the common carp (*Cyprinus carpio*), red shiner (*Cyprinella lutrensis*), and threadfin shad (*Dorosoma petenense*) (NPS 2003a).

Invertebrates

Along the shoreline of Lake Powell, aquatic invertebrate density and richness is low due to the fluctuating water levels of the reservoir. These fluctuations reduce or eliminate food and/or shelter available to aquatic invertebrates. Invertebrate species that do exist along the shoreline habitat include Asiatic clam (*Corbicula fluminea*) and crayfish, (*Orconectes virilis*), both of which are introduced (NPS 2003a).

Riparian communities and desert shrub communities provide ample food and shelter for a variety of invertebrates that range from microscopic protozoans and nematodes to mites, mollusks, and insects. Insects include various grasshoppers, cicadas, and seed-eating harvester ants.

THREATENED AND ENDANGERED SPECIES AND SPECIES OF CONCERN / DESIGNATED CRITICAL HABITAT

Federally Listed Species Known to Occur in Analysis Area

In accordance with threatened or endangered species consultation and coordination activities, the USFWS identified 19 listed and 1 candidate species for portions of Garfield, Kane, and San Juan counties, Utah (USFWS 2002). Within the analysis area, suitable habitat for one federally listed endangered species (southwestern willow flycatcher) and one federally listed threatened species (bald eagle) occurs (table 15). Species or potentially suitable habitat likely to be present within this analysis area are identified and discussed further. Species listed by the USFWS for which suitable habitat is not present within the analysis area are eliminated from further discussion.

Presence of Designated Critical Habitat for Federally Listed Species

Provisions of the Endangered Species Act require consideration of both species populations and designated critical habitat for species listed or proposed for listing. Critical habitat is defined as a specific geographic area that is essential for conservation of an endangered or threatened species, and is designated as such in the recovery plan for that species, or in subsequent legislation.

Glen Canyon NRA supports designated critical habitat for four endangered fish species (NPS 2003a). These are the razorback sucker (*Xyrauchen texanus*), Colorado pikeminnow (*Ptychocheilus lucius*), humpback chub (*Gila cypha*), and the bonytail chub (*Gila elegans*). Designated critical habitat for these fish occurs in portions of the Colorado, Dirty Devil, and San Juan rivers, including their 100-year floodplains up to the full pool elevation of Lake Powell (50 CFR Part 17, 1994) (table 16) and North Wash. Some of this habitat occurs in the Hite area. The bonytail is no longer present in the upper basin of the Colorado River and is believed to be the most endangered of these four native fish species. Prior to 1996, fewer than 10 bonytails were captured in Lake Powell. At the lowest projected lake level, critical habitat in areas that were previously submerged may increase in the Hite area as the water level lowers and the silt level rises. Within the analysis area, designated critical habitat exists for only two of these fish: the Colorado pikeminnow and the razorback sucker.

TABLE 15. FEDERAL THREATENED, ENDANGERED, OR CANDIDATE SPECIES OF GARFIELD, KANE, AND SAN JUAN COUNTIES, UTAH

Species	County	Status	Habitat	Comments	Species Considered?	Reason for Exclusion / Inclusion
Aquarius paintbrush <i>Castilleja aquariensis</i>	Garfield	Candidate	Subalpine sagebrush-grass meadows and openings in spruce communities. Rocky/gravelly soils. 9,100–11,960 ft elevation.	Known only from Fremont, Escalante, and East Fork Sevier drainages.	No	No known populations or habitat in analysis area.
Autumn buttercup <i>Ranunculus aestivalis</i>	Garfield	Endangered	Hummocks or raised dry areas associated with marshes/bogs along Sevier River.	Known only from west slope of Sevier River valley.	No	No known populations or habitat in analysis area.
Jones cycladenia <i>Cycladenia humilis</i> var. <i>jonesii</i>	Garfield, Kane	Threatened	Salt clay and gypsum soils at 4,400 to 6,000 feet elevation. Communities include mixed desert scrub, juniper, or wild buckwheat-Mormon tea.	This species occurs within the NRA west of the Waterpocket Fold.	No	No known populations or habitat in analysis area.
Maguire daisy <i>Erigeron maguirei</i>	Garfield	Threatened	Exposed mesas; steep, narrow canyons cut into Navajo sandstone; cool, shaded, mesic sites in crevices that collect soil and organic matter; less frequently along canyon bottom washes. 5,250–7,120 ft elevation.	Known from San Rafael, Muddy and Fremont drainages.	No	No known populations or habitat in analysis area.
Ute ladies'-tresses <i>Spiranthes diluvialis</i>	Garfield	Threatened	Moist to very wet meadows along streams or in abandoned stream meanders that still retain ample groundwater; also near 4,265–5,250 ft elevation.	In southeastern Utah, known only from upper reaches of the Escalante watershed.	No	No known populations or habitat in analysis area.
Navajo sedge <i>Carex specuicola</i>	Kane, San Juan	Threatened	Moist, sandy to silty soils of shady seep-spring pockets or alcoves with somewhat limited soil development. 5,700–6,000 ft elevation.	Endemic to the Navajo Nation, Coconino County, Arizona, and San Juan County, Utah; Chinle and Lower San Juan watersheds.	No	No known populations or habitat in analysis area.
Siler pincushion cactus <i>Pediocactus sileri</i>	Kane	Threatened	Limited to southwestern Utah and northwestern Arizona, where it is ecologically restricted to a specific gypsum and salt-rich soil.	Known from the St. George area of Utah.	No	No known populations or habitat in analysis area.
Welsh's milkweed ⁴ <i>Asclepias welshii</i>	Kane	Threatened	Crest and lee slopes of Coral Pink Sand Dunes in sagebrush, juniper, and ponderosa pine communities at 5,580–6,230 ft.	Known from area south and west of the analysis area (Paria and Chinle watersheds).	No	No known populations or habitat in analysis area.

TABLE 15. FEDERAL THREATENED, ENDANGERED, OR CANDIDATE SPECIES OF GARFIELD, KANE, AND SAN JUAN COUNTIES, UTAH

Species	County	Status	Habitat	Comments	Species Considered?	Reason for Exclusion / Inclusion
Kodachrome bladderpod <i>Lesquerella tumulosa</i>	Kane	Endangered	Extremely dry, sparsely vegetated, white shale knolls with thin soils derived from the Windsor Member of the Carmel formation. Associated with scattered Utah juniper within a <i>Bouteloua</i> grassland.	Known from a single population scattered over an area about 2.5 miles wide in western Kane County, Utah (in the Paria watershed).	No	No known populations or habitat in analysis area.
Kanab ambersnail ⁵ <i>Oxyloma haydeni kanabensis</i>	Kane	Endangered	Springs and seeps at base of sandstone or limestone cliffs. Associated with perennially wet surface soil or shallow standing water.	Known only from Kanab drainage in western Kane County and from Grand Canyon National Park in Arizona.	No	No known populations or habitat in analysis area.
Coral pink sand dunes tiger beetle <i>Cincindela limbata albissima</i>	Kane	Candidate	Interdunal swales and dune slopes in Coral Pink Sand Dunes near Kanab.	Known only from a small area in Coral Pink Sand Dunes State Park, and a BLM parcel approximately 3 miles northeast of that park.	No	No known populations or habitat in analysis area.
Bonytail chub ^{4, 10} <i>Gila elegans</i>	Garfield, San Juan	Endangered	In or near deep, swift water in main stream of mid-sized to large rivers; in flowing pools and backwaters, over mud or rocks; also in reservoirs.	Restricted to the Colorado River system, where only a few scattered remnant populations remain; critical habitat designated in Glen Canyon in upstream portions of tributaries to Lake Powell.	No	Species is extirpated from Lake Powell. Critical habitat designated in park is located a considerable distance upstream of the analysis area. No suitable habitat within analysis area.
Colorado pikeminnow ^{4, 10} <i>Ptychocheilus lucius</i>	Garfield, Kane, San Juan	Endangered	Medium to large rivers; young prefer small, quiet backwaters; adults use deep, turbid, strongly flowing water, eddies, runs, flooded bottoms, or backwaters; lowlands inundated during spring high flow appear to be important.	Critical habitat designated in Glen Canyon.	No	Species is extirpated from Lake Powell. Critical habitat in analysis area adjacent to Hite developed area only. There is no suitable habitat at or adjacent to proposed development sites.
Humpback chub ^{4, 10} <i>Gila cypha</i>	Garfield, San Juan	Endangered	Adults use variety of habitats in large rivers; young usually in eddies and runs.	Critical habitat designated in Glen Canyon below the confluence of the Colorado River with the Paria River, below Glen Canyon Dam.	No	Critical habitat designated in the NRA is located on the Colorado River below Glen Canyon Dam, almost 180 miles south of analysis area. There is no suitable habitat in the analysis area.

TABLE 15. FEDERAL THREATENED, ENDANGERED, OR CANDIDATE SPECIES OF GARFIELD, KANE, AND SAN JUAN COUNTIES, UTAH

Species	County	Status	Habitat	Comments	Species Considered?	Reason for Exclusion / Inclusion
Razorback sucker ^{4, 10} <i>Xyrauchen texanus</i>	Garfield, Kane, San Juan	Endangered	Slow areas, backwaters, and eddies of medium to large rivers.	Critical habitat designated in Glen Canyon in upstream portions of the tributaries to Lake Powell.	No	Species is extirpated from Lake Powell. Critical habitat in analysis area adjacent to Hite developed area only. There is no suitable habitat at or adjacent to proposed development sites.
Bald eagle ³ <i>Haliaeetus leucocephalus</i>	Garfield, Kane, San Juan	Threatened	Cliffs, forests, and woodlands with snags and close to open water.	Winter resident only. Common on Lake Powell from November to March. Avoids areas with nearby human activity.	Yes	Migratory winter habitat occurs in or proximal to analysis area. Both adult and immature bald eagles have been seen foraging in Bullfrog Bay and have also been seen roosting on sandstone hilltops north and south of the Bullfrog developed area and north and south of the Hite developed area.
California condor ⁷ <i>Gymnogyps californianus</i>	Garfield, Kane, San Juan	Endangered	Mountainous country, low to moderate elevations, especially rocky and brushy areas with cliffs available for nest sites, foraging also in grasslands, oak savanna, mountain plateaus, ridges, and canyons.	Extirpated from the wild by late 1980s; reintroductions began in 1996, and wild condors hatched in northern Arizona in 2003 and 2004. The population in Arizona is nonessential experimental.	No	Sightings in NRA since reintroduction in Arizona have been limited to the area south of U.S. 89 approx. 180 miles south of the analysis area.
Mexican spotted owl ^{1, 4} <i>Strix occidentalis lucida</i>	Garfield, Kane, San Juan	Threatened	In southern Utah - mesa tops, benches and warm slopes above canyons in fall and winter; relatively cool canyons in summer.	In Utah and Colorado, most nests are in caves or on cliff ledges in steep-walled canyons.	No	While designated critical habitat crosses the analysis area, the nearest suitable habitat is located approx. 25 miles across Lake Powell from Bullfrog and Halls Crossing, and more than 70 miles from Hite.

TABLE 15. FEDERAL THREATENED, ENDANGERED, OR CANDIDATE SPECIES OF GARFIELD, KANE, AND SAN JUAN COUNTIES, UTAH

Species	County	Status	Habitat	Comments	Species Considered?	Reason for Exclusion / Inclusion
Southwestern willow flycatcher <i>Empidonax traillii extimus</i>	Garfield, Kane, San Juan	Endangered	Thickets, scrubby and brushy areas, open second growth, swamps, and open woodland.	No confirmed nesting or breeding in Glen Canyon. The proposed critical habitat for this species has been vacated due to court action; therefore, there is currently no proposed or assigned critical habitat for this species. The one sighting for this species occurred below the dam—not anywhere near the analysis area. However, due to extreme low water at Hite, there is now increasing suitable habitat for this species along the riverbanks at Hite.	Yes	While this species has not been seen in the analysis area, changes in the water level have favored the growth of suitable habitat in and adjacent to Hite.
Yellow-billed cuckoo ¹¹ <i>Coccyzus americanus</i>	Garfield, Kane, San Juan	Candidate	Riparian forests with multiple vegetation layers.	Has been observed near Lees Ferry below Glen Canyon Dam, and at Clay Hills Crossing on the upper San Juan River. This species has only been seen below the dam—far outside the project or analysis area. There is no suitable habitat for this species within or near the analysis area.	No	No suitable habitat within the analysis area.
Gunnison sage grouse <i>Centrocercus minimus</i>	San Juan	Candidate	Upland to mesic habitats, all with sagebrush, esp. <i>L. tridentata</i> (big sage brush).	Known only from extreme eastern Utah.	No	No known populations or habitat in analysis area.
Black-footed Ferret ⁶ <i>Mustela nigripes</i>	San Juan	Endangered	Open habitat of grasslands, steppe, and shrub steppe; prairie dog towns.	Extirpated from the wild by 1987; reintroduced in an experimental area of northwestern Colorado and eastern Utah in 1999.	No	No known populations or habit in analysis area.

TABLE 15. FEDERAL THREATENED, ENDANGERED, OR CANDIDATE SPECIES OF GARFIELD, KANE, AND SAN JUAN COUNTIES, UTAH

Species	County	Status	Habitat	Comments	Species Considered?	Reason for Exclusion / Inclusion
Utah prairie dog <i>Cynomys parvidens</i>	Garfield, Kane	Threatened	Grasslands, in level mountain valleys, in areas with deep well-drained soil and vegetation that prairie dogs can see over or through.	Occurs in western parts of Garfield and Kane counties.	No	No known populations or habitat in analysis area.

¹ Nests in this county of Utah.³ Wintering populations (only four known nesting pairs in Utah).⁴ Critical habitat designated in this county.⁵ Critical habitat proposed in this county.⁶ Historical range.⁷ Experimental nonessential population.¹⁰ Water depletions from any portion of the occupied drainage basin are considered to adversely affect or adversely modify the critical habitat of the endangered fish species, and must be evaluated with regard to the criteria described in the pertinent fish recovery programs.¹¹ "Western" yellow-billed cuckoo = distinct population segment in Utah.

TABLE 16. LOCATION OF ENDANGERED FISH SPECIES CRITICAL HABITAT

Species	Critical Habitat Location
Colorado pikeminnow	<p>Glen Canyon NRA Colorado pikeminnow habitat includes the 100-year floodplain of the Colorado River extending to Lake Powell's full pool elevation, Lake Powell's arm of the Dirty Devil River extending upstream of North Wash, and the San Juan River's 100-year floodplain extending to Lake Powell's full pool elevation near Neskahi Canyon. Specific locations are as follows:</p> <p>Grand, San Juan, Wayne, and Garfield counties, the Colorado River and its 100-year floodplain from the Colorado River bridge at exit 90, north off Interstate 70 in T6S, R93W, sec. 16 (6th Principal Meridian) to North Wash including the Dirty Devil arm of Lake Powell up to the full pool elevation in T33S, R14E, sec. 29 (Salt Lake Meridian). San Juan County, the San Juan River and its 100-year floodplain from SH 371 bridge in T29N, R13W, sec. 17 (New Mexico Meridian) to Neskahi Canyon in the San Juan arm of Lake Powell in T41S, R11E, sec. 26 (Salt Lake Meridian) up to the full pool elevation.</p>
Razorback sucker	<p>Glen Canyon NRA razorback sucker habitat includes the 100-year floodplain of the Colorado River extending to Lake Powell's full pool elevation, Lake Powell's arm of the Dirty Devil River extending upstream of North Wash, and the San Juan River's 100-year floodplain extending to Lake Powell's full pool elevation near Neskahi Canyon. Specific locations are as follows:</p> <p>Grand, San Juan, Wayne, and Garfield counties, the Colorado River and its 100-year floodplain from Westwater Canyon in T20S, R25E, sec. 12 (Salt Lake Meridian) to full pool elevation, upstream of North Wash and including the Dirty Devil arm of Lake Powell in T33S, R14E, sec. 29 (Salt Lake Meridian). San Juan County, the San Juan River and its 100-year floodplain from the Hogback diversion in T29N, R16W, sec. 9 (New Mexico Meridian) to the full pool elevation at the mouth of Neskahi Canyon on the San Juan arm of Lake Powell in T41S, R11E, sec. 26 (Salt Lake Meridian).</p>
Humpback chub	<p>Glen Canyon NRA humpback chub habitat includes the 100-year floodplain of the Colorado River along the rapids in Cataract Canyon upstream of Gypsum Canyon. Specific locations are as follows:</p> <p>Garfield and San Juan counties, the Colorado River from Brown Betty Rapid in T30S, R18E, sec. 34 (Salt Lake Meridian) to Imperial Canyon in T31S, R17E, sec. 28 (Salt Lake Meridian).</p>
Bonytail	<p>Glen Canyon NRA bonytail habitat includes the 100-year floodplain of the Colorado River along the rapids in Cataract Canyon upstream of Gypsum Canyon. Specific locations are as follows:</p> <p>Garfield and San Juan counties, the Colorado River from Brown Betty Rapid in T30S, R18E, sec. 34 (Salt Lake Meridian) to Imperial Canyon in T31S, R17E, sec. 28 (Salt Lake Meridian).</p>

Source: *Federal Register* 50 CFR Part 17, Monday, March 21, 1994

Species-Specific Information

Information relevant to the assessment of any potential effect on species considered in detail in this analysis is as follows:

Southwestern Willow Flycatcher (*Empidonax traillii extimus*) is associated with low elevation dense willow, cottonwood, and salt-cedar communities along streams and rivers. This species was observed and recorded about 30 miles from Lake Powell, up the Escalante River, and along the San Juan River near Clay Hills Crossing, but there is no confirmed nesting or breeding habitat present in the recreation area (NPS 2003a). In Arizona, more than 110 pairs of southwestern willow flycatchers occupy 160 territories, including breeding territory along the Colorado River. Smaller populations are known to exist in Utah. Adjacent to the recreation area, breeding habitat typically is present along the larger rivers and lake shorelines at low elevations in areas of dense willow, cottonwood, and salt-cedar (tamarisk), or other woodlands along streams and rivers. Loss of native riparian habitat, combined with predation and brown-headed cowbird nest parasitism, has reduced the species' populations. Due to lowering water levels, the mouth of the Colorado River has moved downstream past the Hite area. This has resulted in increased siltation that has narrowed and moved the active water channel to the western bank and resulted in rapid growth of riparian vegetation (primarily salt-cedar and willow) that may be suitable habitat for this species. Surveys have not been completed for this species in the Hite area, and there is no suitable habitat for this species in or near Halls Crossing or Bullfrog.

Bald Eagle (*Haliaeetus leucocephalus*) habitat is present along the larger rivers in southern Utah. In the recreation area, this includes the San Juan River and the main lake channel upstream from Bullfrog. No nest sites have been observed or recorded along the Lake Powell shorelines.

Bald eagles are present between the months of September to March, in small numbers throughout the Lake Powell area. Observations recorded principally during the November-to-February time periods for the years 1991 through 2002 are summarized in appendix C. Areas of Lake Powell and Glen Canyon NRA that consistently provide suitable wintering habitat include Antelope Island, Bullfrog, Cataract Canyon, Good Hope Bay, Halls Creek, Hite, Wahweap, and Warm Creek; however, there are no known consistently used winter roosts within the recreation area. Bald eagles have been observed feeding at Antelope Island and other portions of Lake Powell (Spence et al. 2002, NPS 2002).

Prior to 1995, 131 bald eagle sightings had been recorded, but recordkeeping was inconsistent (Spence 2002). Annual surveys conducted by the National Park Service report that 18 to 20 bald eagles typically winter in the recreation area and as many as 70 seasonal observations of over-wintering bald eagles have been recorded in recent years. The results recorded during 10 seasons of observations within the recreation area are presented in appendix C (Spence 2002). Potentially favorable bald eagle roosting sites along the rivers and shorelines of reservoirs like Lake Powell are monitored (Spence et al. 2002, NPS 2003a).

Utah State Wildlife Species of Concern

The following species are included on the State of Utah, Department of Natural Resources Division of Wildlife Resources, Utah Sensitive Species List dated May 12, 2006. This list has been prepared pursuant to Utah Division of Wildlife Resources Administrative Rule R657-48. By rule, wildlife species that are federally listed, candidates for federal listing, or for which a conservation agreement is in place automatically qualify for the Utah Sensitive Species List. The additional species on the Utah Sensitive Species List, “wildlife species of concern,” are those species for which there is credible scientific evidence to substantiate a threat to continued population viability. It is anticipated that wildlife species of concern designations will identify species for which conservation actions are needed, and that timely and appropriate conservation actions implemented on their behalf will preclude the need to list these species under the provisions of the federal Endangered Species Act (Utah Division of Wildlife Resources 2006a).

Burrowing Owl (*Athene cunicularia*) breeds in southwestern Canada, the western United States and Florida, northern Mexico, and parts of the West Indies. It winters from the southwestern United States to Honduras, northern populations being migratory. In Utah, it is uncommon during summer in native habitat throughout the state. Burrowing owl habitats comprise open grassland and prairies, but it also uses other open areas such as golf courses, cemeteries, and airports. Its diet consists of terrestrial invertebrates, and also integrates a variety of small vertebrates including small mammals, birds, frogs, toads, lizards, and snakes (Utah Division of Wildlife Resources 2006b).

Burrowing owl nests are found in mammal burrows, usually that of a prairie dog, ground squirrel, badger, or armadillo. If a mammal burrow is not available, the owls will sometimes excavate their own nest burrow. Three to 11 (usually 5 to 9) eggs are incubated by the female, who is fed by the male for 27 to 30 days. The young are tended by both parents and fledge after about 40 to 45 days (Utah Division of Wildlife Resources 2006b).

Burrowing owls are known to nest adjacent to the airstrip that serves Bullfrog. The airstrip is not included in the analysis area for this DCP/EA.

Common Chuckwalla (*Sauromalus ater*) is a fairly large lizard, sometimes reaching over 8 inches in length, not including the tail. Chuckwallas are predominantly found near cliffs, boulders, or rocky slopes where they use rocks as basking sites and rock crevices for shelter. Chuckwallas are primarily herbivorous, although insects are also consumed. Female chuckwallas lay one clutch of 5 to 15 eggs during the summer months. In Utah, the species occurs only in the southern portion of the state. It is included on the Utah Sensitive Species List because of habitat modification and other threats (Utah Division of Wildlife Resources 2006b).

Glossy Snake (*Arizona elegans*) can be found in a variety of habitats throughout its range, but it seems to prefer areas of barren open ground in deserts, sagebrush, and brushy grasslands, usually on sand, loam, or rocks. This snake is especially wary, burrowing in the ground during the day and becoming active at night. Females lay a clutch of 3 to 23 eggs during the summer. The glossy snake typically eats lizards, other snakes, and small mammals. The glossy snake is

often referred to as the “faded snake,” due to the faded appearance of its coloration, which can be light brown to light gray with dull blotches of tan or gray (Utah Division of Wildlife Resources 2006b).

Two subspecies of the glossy snake can be found in Utah. The desert glossy snake (*Arizona elegans eburnata*) occurs in extreme southwestern Utah, while the Painted Desert glossy snake (*Arizona elegans philipi*) occurs in southeastern Utah (Utah Division of Wildlife Resources 2006b).

Big Free-tailed Bat (*Nyctinomops macrotis*) occurs in the western United States and in much of Latin America. The species is rare in Utah, occurring primarily in the southern half of the state and occasionally in northern Utah (Utah Division of Wildlife Resources 2006a).

The big free-tailed bat prefers rocky and woodland habitats where roosting occurs in caves, mines, old buildings, and rock crevices. The species is typically active year-round, spending summers in temperate North America and migrating to warmer areas in North America and South America for the winter. Big free-tailed bats eat insects, primarily moths. Females may give birth to a single offspring each year during late spring or early summer (Utah Division of Wildlife Resources 2006b).

Fringed Myotis (*Myotis thysanodes*) is a small bat that occurs in most of the western United States, as well as in much of Mexico and parts of southwestern Canada. The species is widely distributed throughout Utah, but is not common in the state. The fringed myotis inhabits caves, mines, and buildings, most often in desert and woodland areas. The species commonly occurs in colonies of several hundred individuals (Utah Division of Wildlife Resources 2006b).

Females generally give birth to a single offspring during the summer. Beetles, which are plucked from vegetation or the ground, are the major prey item of the fringed myotis. Because the fringed myotis flies so close to rocks and thick vegetation, its wings are particularly strong and puncture resistant. The species is nocturnal, and individuals hibernate during the cold winter months. The fringed myotis is brown in color, with a characteristic fringe of stiff hairs along the edge of the tail membrane (Utah Division of Wildlife Resources 2006).

Townsend’s Big-eared Bat (*Corynorhinus townsendii*) occurs in western North America, from southwestern Canada to Mexico. Isolated populations of the species also occur in areas of the central and eastern United States. The species occurs statewide in Utah at elevations below 9,000 feet; however, Townsend’s big-eared bat populations in Utah are thought to be declining (Utah Division of Wildlife Resources 2006).

Townsend’s big-eared bat can occur in many habitat types, but is often found near forested areas. Caves, mines, and buildings are used for day roosting and winter hibernation. Consequently, human disturbances of caves and the closures of abandoned mines may constitute threats to the species (Utah Division of Wildlife Resources 2006).

Females congregate in nursery colonies and typically give birth to one young each year. Townsend’s big-eared bats eat flying insects, particularly moths, and individuals are often seen foraging near trees. The species is nocturnal and typically does not leave the roost until well after sunset (Utah Division of Wildlife Resources 2006).

VISUAL RESOURCES

Visual resources include the natural and human-made physical features that give a particular landscape its character and quality. Landscapes are not static, but are always undergoing change as a result of natural environmental processes or external modification. Underlying the character and condition of a landscape are the geological conditions and processes under which the landscape has evolved. These factors, in combination with climate, influence the type and condition of soils and vegetative cover, the type and abundance of wildlife, and the way in which people make use of the land. The resulting landscape character, together with our individual experience and expectations, determine the meaning we attach to the landscape.

The Bullfrog, Halls Crossing, and Hite developed areas are all located along the lakeshore and are characterized by stunning natural landscapes interspersed with human-made structures. The developed areas are comprised of marinas, campgrounds, housing areas, floating marina facilities, and launch ramps, which contrast with the natural environment.

At Bullfrog, the lodge is the largest human-made feature. It was constructed in the southwestern architectural style, which harmonizes well with the desert landscape. This architectural theme is carried out in other land-based facilities including the ranger station / emergency facilities / visitor contact station. Recently constructed facilities (restrooms and showers) in the day-use area are architecturally similar. The government employee housing area's numerous structures also reflect southwestern design. The older structures are of a more traditional design and appearance. Water-based development, floating stores, wet slips, buoy fields, gas docks, and boat rental facilities, however, have a contemporary nautical appearance.

Land-based facilities at Halls Crossing, primarily government facilities including maintenance facilities and NPS and concessioner employee housing, are not as visible, with the possible exception of the dry boat storage area. Much of Halls Crossing construction is older and of a more traditional style—not designed to blend with the natural landscape. As with Bullfrog, the water-based facilities (floating marina store, wet slips, buoy field, and ranger offices) have a contemporary nautical appearance.

Both Halls Crossing and Bullfrog exhibit the results of the recent construction of roads, launch ramps (or extensions), and parking areas. Such construction has disturbed vegetation, however, much of the disturbance would be below the high water line if the lake was at full capacity.

Land-based facilities at Hite are on the south side of the access road in a concentrated area and are generally older than at Bullfrog or Halls Crossing. The newer ranger station / visitor contact station is designed to harmonize with the surrounding landscape. No marina facilities are currently located at Hite.

Although Bullfrog, Halls Crossing, and Hite developed areas contain contrasting elements with the lake and desert landscape, the visual intrusions are mitigated by the fact that Glen Canyon is a national recreation area and visitors expect development and service facilities that will

support their recreational activities. Therefore, facilities that contrast with the natural scenic landscape and create a visual intrusion are expected and accepted in this environment.

SOUNDSCAPES

Preservation of natural soundscapes is an important mission of the National Park Service. Natural soundscapes are defined in NPS *Management Policies 2001* as a combination of all the natural sounds that occur in a park, together with the physical capacity for transmitting natural sounds. Director's Order – 47: *Soundscape Preservation and Noise Management* (NPS 2000a) states that the natural ambient sound level of a park is the basis for determining the affected environment in environmental impact statements and other documents prepared for NEPA compliance.

Natural sounds occur within and beyond the range of sound that humans can perceive, and can be transmitted through air, water, or solid materials. Natural soundscapes would include all naturally occurring sounds such as waves on the shoreline, birds calling, wind blowing, or the sound of thunder. It would also include “natural quiet” that occurs in the absence of natural or human-generated sound. The opportunity to experience natural sounds is an enjoyable part of the experience for some visitors to Glen Canyon NRA.

Human-caused sounds at Glen Canyon NRA include all types of watercraft, automobiles, aircraft, and electronic devices such as radios and horns. Engines are the primary source of human-caused sound at Glen Canyon NRA. Human sounds are not unexpected or necessarily inappropriate at the developed areas, but are part of the overall soundscape in an area where water activities, picnicking, camping, sightseeing, and other recreational uses are part of the activity of the recreation area. Evaluation of the appropriateness of human sounds is evaluated by considering visitor expectation, management guidelines, resource sensitivity, and recreation area purpose.

Noise is generally defined as an unwanted or intrusive sound. Sounds are described as noise if they interfere with an activity or disturb the person hearing them. Sound is measured in a logarithmic unit called a decibel (dB). Because the human ear is more sensitive to middle and high-frequency sounds than to low-frequency sounds, sound levels are weighted to reflect human perceptions more closely. These “A-weighted” sounds are identified by the symbol “dBA.”

For the average human, a 10-dBA increase in the measured sound level is subjectively perceived as being twice as loud, and a 10-dBA decrease is perceived as half as loud. The decibel change at which the average human would indicate that the sound is just perceptibly louder or perceptibly quieter is 3-dBA. There is generally a 6-dBA reduction in sound level for each doubling of distance from a sound source due to spherical spreading loss (e.g., if the sound level at 25 feet from a boat was 86 dBA, the sound level at 50 feet would be expected to be 80 dBA, at 100 feet 74 dBA, etc.). Noise levels from typical construction efforts may reach as high as 89 dBA 50 feet from the source, which would drop off 6 dBA per doubling of distance. So at 100 feet from the sound source the noise level would be 83 dBA and at 200 feet it would

be 77 dBA; this would continue until the sound became indistinguishable from the natural, or ambient noise, whichever is greater (NPS 2003b).

The GMP (NPS 1979) divided Glen Canyon NRA into four management zones. The Bullfrog, Halls Crossing, and Hite developed areas are located in the development zone. Noise from vessels is consistent with the purpose and management direction of the development zone where these areas are located.

Watercraft-generated noise levels vary from vessel to vessel. Noise limits established by the National Park Service require vessels to operate at less than 82 dBA at 82 feet (25 meters) from the vessel (36 CFR 3.7).

ARCHEOLOGICAL RESOURCES

Humans have occupied the Glen Canyon region for at least 11,000 years, spanning four cultural periods, or stages. These include the Paleo-Indian period (11,000 before present [BP] – 9,500 BP), which was dominated by a dispersed mobile hunter-gatherer population that left little evidence in the Glen Canyon area, and the Archaic period (9,500 BP – 1,800 BP), when hunting was supplemented by the collection of a broad spectrum of wild plant and animal foods. As populations adopted the cultivation of squash and maize and settled into somewhat sedentary village life, the Formative period (1,800 BP – 700 BP) began. Regionally, early Formative period residents, also known as Ancestral Puebloans, exploited wild animal and plant food in addition to practicing agriculture. Approximately 700 years ago, the Ancestral Puebloans and their neighbors to the north, the Fremont, abandoned southern Utah and, it is presumed, joined the general Puebloan population living in larger villages in New Mexico and Arizona. This exodus marks the beginning of the Protohistoric period (700 BP – 250 BP) in which the Paiute, Ute, and Navajo peoples occupied the area.

The majority of the prehistoric sites recorded within Glen Canyon date to the Formative period, although evidence for Paleo-Indian and Archaic period occupations have been observed in limited sections of the recreation area. A small number of protohistoric remains are also present, characterized mostly by ephemeral open sherd and lithic scatters, brush shelters, and diagnostic rock art panels. Historic cultural resources are also present in relatively small numbers. Site densities of all site types tend to be relatively low. Approximately 2% of Glen Canyon NRA has been intensively surveyed or tested for cultural resources. As one would expect, the developed areas have received the most attention. Studies have been completed at Hite (Kay 1974, Goetze 1995, Zeir et al. 2002), Halls Crossing (Fowler et al. 1959b, Kay 1974, Tipps 1979, Schroedl 1981, Hurst 1984, Goetze 1995, Neal and Wenker 1997, Tipps and Warburton 2000), and Bullfrog (Fowler et al. 1959a; Kay 1974; Geib 1989; Lefree 1993; Goetze 1995; Neal and Wenker 1997; Huber and Bradley 1998, 1999).

The aggregate of the acreages intensively surveyed indicates that each of the developed areas of concern have had extensive intensive surveys completed, some relatively recently. Two surveys are of particular use in the current planning process: the 1997 surveys of the Halls Crossing and Bullfrog areas (Neal and Wenker 1997) and the 2001 survey of Hite (Zeir et al.

2002). These surveys included the entire area within the boundaries of the current development planning process.

The Glen Canyon project archeologists (noted in textual references as Fowler et al. 1959a and 1959b) surveyed up to the 3,700-foot flood level, where accessible. They did not provide specifics as to which areas were not surveyed and which were. Almost all the subsequent surveys were conducted to the water level, which varied from year to year.

As previously discussed, the Bullfrog, Halls Crossing, and Hite areas have undergone numerous archeological surveys over the years. The most extensive and recent survey at Hite was conducted in support of the development planning process between March 28 and April 1, 2001. The survey encompassed 1,480 acres and was bound on the north and west sides by Lake Powell, on the south by the foot of Brown's Rim, and on the east and northeast by SH 95. Eleven prehistoric sites and 24 isolated finds were recorded (including three previously recorded by Kay in 1974). No historic sites were noted. Sites consisted of lithic scatters (4), lithic scatter/procurement (5), sandstone slab feature / possible pit (1), and a rock shelter with lithic scatter (1). All sites occurred north of the Hite Marina access road. Seven of the sites are considered eligible for the NRHP (42SA3954–3956, 42SA24694–24697). Isolated finds included individual or small clusters of lithic artifacts in a variety of physiographic settings (Zeir et al. 2002).

A recent survey (1997), initiated because of anticipated development projects at Bullfrog and Halls Crossing, identified 25 sites at Halls Crossing. Seven had been previously recorded (three of these were completely rerecorded and three were updated). Of the sites recorded at Halls Crossing, nine (all lithic scatters) were considered NRHP-eligible (42SA3708, 42SA3941, 42SA3952–3953, and 42SA23087–23090). Seventy-two isolated finds were also noted (Neal and Wenker 1997). The same survey located 14 sites at Bullfrog. Four had been previously recorded. Of the sites recorded at Bullfrog, eight (all lithic scatters) are considered NRHP-eligible (42KA2382, 42KA4294, 42KA3467, 42KA4316–4317, 42KA4319, 42KA4321, and 42KA4323). Seventeen isolated finds were also located (Neal and Wenker 1997).

It is expected that because of the level of previous survey and the flexibility of site development that avoidance of known sites would be possible. Surveys would be completed only if undisturbed (and unsurveyed) areas are expected to be affected by development.

ETHNOGRAPHIC RESOURCES

Many Glen Canyon NRA resources are considered sacred by American Indians. These include, but are not limited to, the Colorado and San Juan rivers, their side canyons, and the landscapes in which they occur. Five contemporary American Indian tribes are associated with Glen Canyon: the Hopi, Kaibab Paiute, Navajo, San Juan Southern Paiute, and Ute Mountain Ute. Other groups that have an ethnographic interest in the NRA include the Kanosh and Koosharem bands of the Paiute Indian Tribe of Utah, the Havasupai Tribe, and Hualapai Tribe.

Surveys for, and evaluations of, archeological (prehistoric and/or historic) resources and traditional cultural properties were conducted in August and October 1995 (Goetze 1995). The project was initiated by the anticipated construction of fee stations and associated housing at 13 different locations throughout Glen Canyon. The entire Halls Crossing developed area was declared a traditional cultural property based on consultation and ethnographic evidence (Goetze 1995).

VISITOR USE AND EXPERIENCE

Glen Canyon NRA is one of the premier water-based recreation areas in the country. Lake Powell, its 96 major side canyons, and related natural, cultural, and geologic resources are the primary recreation features of Glen Canyon NRA.

A variety of recreational opportunities exist on and around Lake Powell. Power boating, use of houseboats and personal watercraft, waterskiing, fishing, boat tours, and kayaking are among the many water sports visitors enjoy. Opportunities also exist for hiking in the surrounding canyon areas, many of which are accessible only by water for most visitors. Visitors can also see archeologically and culturally important sites throughout the NRA. Visitors to Lake Powell are primarily interested in water-based activities. The 2005 visitor survey found that 94% of survey respondents participated in motor boating, 57% in fishing, and 51% participated in water sports. Popular land-based activities include hiking (65%) and camping (42%) (NPS 2005g).

Glen Canyon NRA experiences visitation year-round. The peak visitor season is from May 15 to Labor Day. During the “shoulder” seasons, from March 1 to May 15 and from Labor Day through Thanksgiving, the recreation area sees substantial visitation, but not at the levels experienced during the peak season. Total visitation at Glen Canyon NRA in 2005 was 1,928,274. Visitation for the uplake areas within Glen Canyon NRA for the 10-year period from 1995 to 2005 is presented in table 17.

TABLE 17. UPLAKE VISITATION 1995–2005

Year	Bullfrog	Halls Crossing	Hite	Total	% Change from Previous Year
1995	263,966	65,370	133,117	462,453	
1996	239,275	59,648	133,302	432,225	-6.54%
1997	248,041	64,708	127,540	440,289	1.87%
1998	274,120	56,696	132,084	462,900	5.14%
1999	256,875	86,503	154,107	497,485	7.47%
2000	275,919	86,741	147,694	510,354	2.59%
2001	272,195	75,198	143,108	490,501	-3.89%

TABLE 17. UPLAKE VISITATION 1995–2005

Year	Bullfrog	Halls Crossing	Hite	Total	% Change from Previous Year
2002	257,708	62,163	110,065	429,936	-12.35%
2003	214,406	72,579	62,442	349,427	-18.73%
2004	197,928	49,447	50,772	298,147	-14.68%
2005	216,663	58,845	59,405	334,913	12.33%

Source: National Park Service Public Use Statistics Office: <http://www2.nature.nps.gov/mpur/Reports/viewreport.cfm>

After 1996 and prior to the onset of drought in 2001, uplake visitation showed a trend of steady increases.

Visitors can enjoy camping opportunities ranging from remote and undeveloped campsites to fully developed campgrounds (hardened campsites with picnic tables, fire grates, and available restroom facilities) managed by Glen Canyon NRA.

SOCIOECONOMIC ENVIRONMENT

The existing and proposed development associated with the alternatives is located in Kane and Garfield counties, Utah (location of Bullfrog), and San Juan County, Utah (location of Halls Crossing and Hite). However, the affected environment for socioeconomics includes a larger analysis area that may experience direct and indirect socioeconomic change from the proposed alternatives. Socioeconomic effects include those related to visitors traveling to and from the region, those recreating in the area, and the activities of the National Park Service, its concessioner, and NPS and concessioner employees.

In addition to portions of Kane, Garfield, and San Juan counties, the socioeconomic analysis area boundary comprises parts of Wayne County in Utah because of effects to employment, income, and local government revenues, as well as potential indirect effects if prevailing trends in visitation change.

The Kane and San Juan counties school districts are in the analysis area for potential changes to tax revenue and enrollment at the Lake Powell School, which is in Kane County, but operates under an agreement to serve students from both Bullfrog in Kane County and Halls Crossing in San Juan County. Utah state government and the National Park Service at the federal government level are areas for analysis of potential tax and commercial services revenue effects.

Affected Counties

The potentially affected counties each cover thousands of square miles and possess extensive open space; they are some of the most sparsely populated parts of Utah and the United States. Average population density ranges from less than two persons per square mile in San Juan and Kane counties, to one person per square mile or less in Wayne and Garfield counties. Utah's average population density is nine persons per square mile (U.S. Census Bureau 2004a).

Population rose by 5.3% overall in Utah from 2000 to 2003, but fell in the potentially affected counties over the same period. Estimated population in 2003 was 6,039 for Kane County, down 0.1% from 2000, and 13,901 for San Juan County, down 3.6%. Garfield and Wayne counties experienced population declines of 4.1% and 2.2% (table 18).

TABLE 18. DEMOGRAPHIC PROFILE OF THE STATE OF UTAH AND POTENTIALLY AFFECTED COUNTIES

Counties					
	Utah	Garfield	Kane	San Juan	Wayne
Population 2003 (July 1)	2,351,467	4,542	6,039	13,901	2,454
Population 2000 (April 1)	2,233,169	4,735	6,046	14,413	2,509
Population 1990 (April 1)	1,722,850	3,980	5,169	12,621	2,177
Percent change 2000 to 2003	5.3%	-4.1%	-0.1%	-3.6%	-2.2%
Percent change 1990 to 2000	29.6%	19.0%	17.0%	14.2%	15.3%
Race and Ethnicity 2000					
White	89.2%	95.0%	96.0%	40.8%	97.3%
American Indian	1.3%	1.8%	1.6%	55.7%	0.4%
Other races	9.5%	3.2%	2.4%	3.5%	2.3%
Hispanic/Latino (any race)	9.0%	2.9%	2.3%	3.7%	2.0%

Source: U.S. Census Bureau 2004a

Roughly 56% of the population of San Juan County is American Indian (table 18). This group is mostly Navajos and a smaller number of Utes. This reflects the fact that about 23% of the land area of San Juan County is in either the Navajo Nation or Ute Indian reservations.

American Indians are less than 2% of the population in Garfield, Kane, and Wayne counties, and are 1.3% of the state population. Other minority races make up 3.5% or less of the population in the four counties, compared to a 9.5% share in the state. People of Hispanic or Latino heritage are 3.7% or less of the county populations, compared to 9% of the state.

Considerable open space in the analysis area is devoted to agriculture. Farm jobs were almost 15% of the estimated 2002 total employment of 1,640 in Wayne County, 11.5% of 3,008 total

jobs in Garfield County, 5.3% of 5,520 jobs in San Juan County, and 4.3% of 3,826 jobs in Kane County (table 19). Farm jobs averaged only 1.4% of total employment in Utah in 2002.

TABLE 19. ECONOMIC PROFILE OF THE STATE OF UTAH AND POTENTIALLY AFFECTED COUNTIES

Counties					
	Utah	Garfield	Kane	San Juan	Wayne
Total jobs in region 2002(1)	1,395,229	3,008	3,826	5,520	1,640
Agricultural	1.4%	11.5%	4.3%	5.3%	14.8%
Trade, transportation, and utilities (estimated)	18.4%	10.0%	13.2%	12.3%	12.0%
Leisure and hospitality (estimated)	8.5%	26.3%	22.5%	10.6%	11.0%
State and federal government	7.1%	8.2%	4.5%	9.8%	7.7%
Per capita income 2002(2)	\$24,649	\$19,688	\$23,513	\$14,297	\$19,788
Median household income 1999(3)	\$45,726	\$35,180	\$34,247	\$28,137	\$32,000
Persons below poverty line 1999(4)	9.4%	8.1%	7.9%	31.4%	15.4%
Civilian labor force 2003(5)	1,184,400	2,806	2,857	4,644	1,504
As percent of population	50.4%	45.4%	47.3%	33.4%	61.3%
Unemployment rate 2003(6)	5.6%	10.8%	4.6%	10.2%	7.2%
Gross taxable sales per capita 2003(7)	\$13,846	\$14,478	\$15,926	\$6,132	\$10,844
Value of all building permits 2003 (000s)(8)	\$4,560,852.6	\$10,302.8	\$13,088.3	\$8,180.3	\$4,440.8

Note: Some employment sectors are estimated from state data because federal data are undisclosed for certain sectors in small counties.

Sources: U.S. Bureau of Economic Analysis 2004 (1,2); U.S. Census Bureau 2004a (3,4); Utah Department of Workforce Services 2004 (1,5,6,7,8)

However, even in Wayne County, the most agricultural of the four counties, the economic base of the analysis area has shifted away from dependence on agriculture and mining to heavy reliance on tourism and recreation. This distinguishes the area from Utah as a whole, which is still one of the most industrially diversified states in the country. The importance of tourism and recreation in the analysis area is reflected in the importance of jobs in the leisure and hospitality sectors, which comprises from 11% to 26% of county employment in the analysis area, compared to less than 9% in Utah as a whole (table 19).

After years of economic stagnation, tourism and social services jobs have stimulated recent growth in population, home construction, and wages in Wayne County. Garfield County depends more on tourism and recreation for employment than any other county in Utah. Bryce Canyon National Park and Lake Powell are the chief attractions. Kane County also relies heavily on tourism. Lake Powell and Grand Staircase-Escalante National Monument are major attractions.

Kane County has the highest job growth rate in the state since 1997, in part because of growth in tourism and recreation. Similarly, in Garfield County, tourism has resulted in new economic

development, but the county also experiences high unemployment rates because of tourism seasonality. San Juan County's economic base derives its impetus from government, trade, and occasional mining projects in addition to tourism and recreation (Utah Department of Workforce Services 2004).

In 2002, estimated per capita income in San Juan County was \$14,297, or 42% lower than the Utah average of \$24,649. Other indicators of recent economic difficulty in San Juan County are a 2003 unemployment rate of 10.2% in 2003, compared to the state average of 5.6%; labor force participation of 33.4%, compared to 50.4% statewide; and 31.4% of the population below the poverty line in 1999, compared to the state average of 9.4%.

Table 19 shows lower-than-average median household income in 1999 in all four counties, ranging from about 77% of the state average in Garfield County to about 62% in San Juan County. Among the four counties, Garfield and Kane counties have higher than average taxable sales per capita, which may reflect sales to nonresidents, including tourist and recreation visitors.

Lower income levels in the region are partly the effect of the large American Indian populations in San Juan County and elsewhere. This occurs because of the disproportionately high unemployment and low labor force participation that affects some tribes. At the same time, reservations such as the Navajo Nation, which covers much of the southern part of San Juan County, are a source of federally funded government employment (Utah Department of Workforce Services 2004).

Gateway Communities

The town of Hanksville (Wayne County), the city of Blanding (San Juan County), and Ticaboo Resort (unincorporated Garfield County) are gateways to Bullfrog, Halls Crossing, and Hite.

The economy of Hanksville depends heavily on mining, ranching, and visitation to Lake Powell. The town, with an estimated population of 206 in 2002 (U.S. Census Bureau 2003), has some lodging, restaurants, and a small store. Hanksville is 45 road miles north of Hite, 68 miles north of Bullfrog, and 70 miles north of Halls Crossing.

Blanding, with an estimated population of 3,004 in 2002 (U.S. Census Bureau 2003), depends economically on tourism and on government institutions, including the state-operated College of Eastern Utah. Because it is located near Lake Powell and many other attractions (e.g., Natural Bridges and Hovenweep national monuments, Goosenecks and Edge of the Cedars state parks, and Monument Valley Navajo Tribal Park), Blanding has a range of lodging, restaurants, and other visitor-oriented business establishments. Blanding's location 80 to 85 miles east of Halls Crossing and Hite enables it to provide medical services for the two developed areas.

Ticaboo Resort, 13 miles north of Bullfrog on SH 276, has a motel, campground, restaurants, and incidental boating services. The population in and around Ticaboo was 73 in 2000 (U.S. Census Bureau 2004b).

Business Activity

Business activity at Lake Powell is driven by tourist and recreation visitation to Glen Canyon NRA. The Lake Powell developed areas are the most heavily visited areas of Glen Canyon NRA. Use is concentrated in the spring, summer, and fall months, and when water levels are highest. Fluctuations in seasonal use affect business activity at the developed areas and NPS and concessioner employment.

One of the primary concessioners at Glen Canyon NRA is ARAMARK Sports and Entertainment Services, Inc. (ARAMARK). Commercial services offered by ARAMARK in the uplake areas include lodging, slip, buoy, and secured storage space rental; a restaurant; snack bars; a liquor store; marina stores and gift shops; water-based fuel stations; land-based fuel stations; boat maintenance and repairs; and boat tours.

ARAMARK operates rental fleets based at each of the three uplake marinas. At low water levels, all rental operations move to Bullfrog. Incidental commercial services (e.g., boat caretaking, repairs, launch and retrieval, fishing guides, and hiking services) are provided by about 130 holders of independent business permits.

ARAMARK operates Bullfrog as a full-service resort, provides a less comprehensive level of service at Halls Crossing, and offers limited visitor services at Hite.

Trends for major commercial services provided by the concessioner were analyzed by looking at activity levels for fleet rentals, lodging, and campsite rentals at the uplake developed areas. Concessioner facility use and visitor trends from 1997 to 2005 show a diverging pattern based on examination of the annual account reports. Both increases and decreases in visitor use, and types of use have affected concessioner receipts and profits. Social, economic, and environmental factors such as a declining economic outlook, decreasing domestic and international travel, the effects of a regional drought, and increasing gasoline prices have decreased the concessioners' ability to make a profit. Specifically, after modest revenue increases occurred from 1997 through 2000, concessioner profits turned downward by almost 2% from 2000 to 2001. Profits continued to drop between 2001 to 2004. However, in 2005 a revenue upswing of about 2% is evident. This modest increase is encouraging, but insufficient to base a long-term projection on the profitability needed to expand facilities and services in the future.

River trips on the Colorado River end at the river takeout at Hite. Commercial outfitters provide a large share of these river trips. National Park Service data indicates a decline in active companies, trips, and visitors. Between the 2000 and 2003 seasons, the number of active companies providing river trips declined, the number of trips declined by 22%, and the number of visitors declined by 27%.

Peak season activity may be an indicator of the adequacy of facilities to meet current and projected future visitor needs.

Table 20 demonstrates that demand for lodge rooms peaked in 1999, prior to several years of severe drought that resulted in record low lake levels. Demand for lodge rooms in 2005 showed a slight increase, possibly resulting from increased lake levels over those of the

previous four years. Prior to the onset of drought and decreasing lake levels, almost all lodge rooms were occupied during the peak month. Even during drought conditions, 90% of lodge rooms were filled during the peak month.

TABLE 20. LODGE ROOM AND PEAK OCCUPANCY

Year	Peak Season ¹ Average Occupancy	Peak Month ²	Peak Month Occupancy Percentage
2005	77%	July	89%
2003	75%	July	90%
1999	89%	August	96%
1997	86%	August	96%

¹Peak season for these calculations is defined as May through September.

²Peak month is the month with the greatest percentage of occupancy.

The occupancy rates in table 21 may indicate that occupancy rates during the peak season dropped in response to the severe drought that resulted in record low lake levels. At Bullfrog, the occupancy rate for family rental units in the peak month was still nearly 90% during the year with the lowest occupancy rate for the peak season. It would appear demand for family rental units at Bullfrog continued to be high despite drought and low lake level conditions.

TABLE 21. HOUSEKEEPING (FAMILY RENTAL) UNIT PEAK OCCUPANCY

Year	No. Unit Nights Available Peak Season	Peak Season ¹ Average Occupancy	Peak Month ²	Peak Month Occupancy (%)
Bullfrog				
2005	1,232	73%	July	89%
2003 – Low ³	1,288	69%	August	87%
2000 – High ⁴	1,250	80%	July	100%
Halls Crossing				
2005	3,080	41%	July	52%
2004 - Low	3,080	36%	July	48%
2000 - High	3,080	71%	August	89%
Hite				
2005 - Low	770	2%	July	5%
2000 - High	770	75%	July	88%

1. Peak season for these calculations is defined as May through September.

2. Peak month is the month with the greatest percentage of occupancy.

3. Low: The year with the lowest percentage of occupancy for the peak season.

4. High: The year with the highest percentage of occupancy for the peak season.

Campground occupancy has decreased over time. At Bullfrog, occupancy peaked at 65% in mid-summer in the early 1990s, then declined through the late 1990s, then dropped sharply during recent drought years. At Halls Crossing, the occupancy percentage during the peak season was in the mid-30% range consistently in the late 1990s leading up to the drought years, and then dropped precipitously. Occupancy at Halls Crossing peaked around 40% in the early 1990s. However, the campgrounds in the uplake area are antiquated because the electrical amperage provided is below the demands of modern RVs, and sites in both the existing campgrounds and RV parks will not accommodate larger RVs. No commercial RV parks are available close to the NRA perimeter because of the remote location of the uplake area.

Peak season (May through September) activity may be an indicator of the adequacy of facilities to meet current and projected future visitor needs. Occupancy of lodge rooms peaked in 1999, with an average peak season occupancy rate of 89%, then declined to a low of 75% in 2003. Despite persistent drought and record low lake levels from 2000 to 2004, lodge room occupancy was nearly 100% in some summer months.

Family rental unit occupancy shows trends similar to that of lodge rooms. Occupancy of family rental units during the peak season reached all-time highs in 2000, and declined through the subsequent drought years. Yet, occupancy of family rental units continued to reach nearly 90% during some summer months, particularly at Bullfrog. Occupancy at Halls Crossing showed the greatest decline with peak occupancy of only 48% in August of 2004.

Slips and buoys available for long-term rental are fully rented. There are waiting lists for both slips and buoys, with names of customers interested in long-term rentals should any vacancies occur.

Occupancy of houseboat rentals peaked in 2000. In the month of August, occupancy peaked at 97.5%. Overall occupancy for 2000 was 39.3%. Rental houseboat occupancy declined to an overall low of 23.3% in 2004, with just 64.9% in August. In 2005, occupancy rates for rental houseboats increased to an overall rate of 29.2%, with 81.6% of rental houseboats occupied in July.

Lake Powell School

Children of families living in housing at Bullfrog and Halls Crossing attend the Lake Powell School at Bullfrog, which is operated by the Kane County School District.

Tax Revenue

Facilities and activities at the uplake developed areas generate tax revenues for the State of Utah and for local governments. All sales and watercraft and lodging rentals at Bullfrog, Halls Crossing, and Hite are taxed. Revenues go to the State of Utah and to Kane and San Juan counties. The county sales tax includes a special levy for county hospital services.

Local governments also levy a property tax or a privilege tax on facilities, fleet, and equipment at each developed area. Taxable property located at the developed areas includes federal

property used for business by the concessioner, and private boats moored or stored at the lake, but it excludes federal property used by NPS personnel. Property and privilege tax revenues go to Kane County and San Juan County governments and school districts. Other revenue generated by business activity at the uplake developed areas comes from state taxes on fuels and special Kane County excise taxes for tourism promotion levied on lodging rentals and food service sales.

Visitors going to and from Lake Powell also generate tax revenue for state and local government. Purchases of fuel, food, lodging, and other goods and services in the gateway communities of Hanksville, Blanding, and Tropic yield sales and excise taxes for the State of Utah; Wayne, San Juan, and Garfield counties; the town of Hanksville; and the city of Blanding. The State of Utah also earns revenues from sales tax on purchases of commercial river trips and from a special tax on rental cars.

Fee Revenue

The National Park Service charges entrance and any applicable enhanced amenity fees (e.g., camping, boating) including concessioner franchise fees at Lake Powell. The NPS Recreation Fee Program allows Glen Canyon NRA to retain 80% of the total revenue collected. These revenues from cost-of-collection and franchise fees are used for projects that enhance visitor enjoyment of Lake Powell.

PARK OPERATIONS

Glen Canyon NRA staff provide the full scope of functions and activities to accomplish management objectives and meet requirements of law enforcement, emergency services, public health and safety, science, resource protection and management, visitor services, interpretation and education, community services, utilities, housing, and fee collection. Management of the recreation area requires the participation of seven recreation area divisions. They include the superintendent's office, administration, visitor protection, interpretation, maintenance, concessions, and resource management.

The superintendent is responsible for the full scope of managing the area; its staff and residents; all of its programs; and its regulations with persons, agencies, and organizations interested in Glen Canyon NRA. The division of administration provides management, services, and technical expertise in all areas of administrative support. The superintendent's office and the administration division do not expend resources directly to manage park unit operations and resources. Instead, they provide support for the other divisions in their management of the recreation area.

The visitor protection division normally employs permanent rangers who patrol; enforce boating laws, including personal watercraft regulations; provide emergency medical services; and conduct search and rescue operations. In addition, during high visitor use periods, the NRA typically hires seasonal employees to support existing enforcement staff.

Development and dissemination of materials related to Glen Canyon NRA resources, visitor activities, and visitor safety and conflict is provided by the interpretive division. Information pertaining to Glen Canyon NRA resources and visitor activities also is available through nonpersonal media such as Glen Canyon NRA newspapers and brochures. These are available to visitors at all entry points and at developed sites throughout Glen Canyon NRA.

Maintenance employees perform a variety of services related to recreational use including, but not limited to, facilities and infrastructure upkeep and repair, sign construction and repair, dock repair, maintenance and placement of navigational devices such as buoys according to changes in lake levels, and sanitation services. NRA maintenance operations are responsible for water supply and wastewater treatment systems operations and maintenance.

The business division manages the concessions program, including concessions contracts, special-use permits, right-of-way permits, and commercial-use authorizations and fee remittances at Glen Canyon NRA.

The resource management division protects and manages natural and cultural resources. Its staff includes terrestrial and aquatic biologists, archeologists, and geographic information system specialists. Among other responsibilities, this staff provides monitoring, evaluation, and planning to ensure the protection of NRA resources for future generations.

A primary concessioner, ARAMARK, employs staff providing visitor service and operational support for services such as boat rentals, overnight accommodations, food service, fueling stations, and boat maintenance and repair.

Glen Canyon NRA staff manages housing in conjunction with the concessioner. Per the NPS Housing Management Plan (a management action common to all alternatives), the current direction is to provide only the minimum number of housing units necessary to support the mission of the National Park Service. To comply with this policy, the National Park Service is currently evaluating existing housing and providing recommendations for the appropriate amount and types of housing.

The concessioner is responsible for power generation and maintenance of the power facilities at the uplake developed areas. The NPS maintenance staff is responsible for water supply, treatment, and distribution systems, and maintenance of wastewater treatment systems. The National Park Service, in conjunction with the concessioner, is responsible for the wastewater collection system.

Glen Canyon NRA operations have been particularly stressed during the last several years of low water levels. The decrease in water elevation has resulted in changes to many water-based services and facilities. NPS maintenance staff have been responsible for ensuring that the public launch ramps are extended and that ferry launch ramps are maintained. The ferry service is operated by UDOT. The National Park Service has worked closely with the concessioner to relocate water-based facilities such as the wet slips and buoy fields, to ensure that these remain in operation. Construction of new parking areas and access roads have been the result of a collaborative effort between NPS maintenance staff and the concessioner.

PUBLIC HEALTH AND SAFETY

Public health and safety facilities in the area are located at Bullfrog, Halls Crossing, and Hite. The uplake district ranger's office at Bullfrog coordinates law enforcement and emergency response, fire protection, and visitor information for all three developed areas. Ranger staff are assigned to Bullfrog, Halls Crossing, and Hite subdistricts. Jurisdiction for handling public safety issues (i.e., law enforcement) generally lies with NPS rangers, although other law enforcement entities may also respond. The medical clinic at Bullfrog provides emergency medical care through a staff of physician's assistants and ranger staff with varying levels of medical certification ranging from first responders to emergency medical technicians and paramedics.

Boating safety requirements are enforced by several agencies including the National Park Service, U.S. Coast Guard, Utah State Parks and Recreation, and the Utah Department of Natural Resources. Glen Canyon NRA normally employs between 25 and 30 permanent rangers who patrol and enforce boating laws. The distribution of enforcement staff is based on levels of visitor use and the frequency of problems. About 50% of the law enforcement staff is assigned to the uplake district, which accounts for slightly less than 25% of watercraft use at Lake Powell (NPS 2003b).

Typically during the summer months, approximately nine NPS law enforcement officers are assigned to the Bullfrog area, four to Halls Crossing, and two to Hite. NPS rangers are responsible for ensuring the safety of visitors and for protecting NRA resources on both land and water. This presents a challenge because most visitor activity is water-based, while about 85% of the recreation area is dry land. Land-based areas of concentrated visitor activity such as the boat launches and campgrounds require disproportionate commitments of NPS law enforcement staff (NPS 2003a).

TABLE 22. RESOURCE AND VISITOR PROTECTION ACTIVITY IN GLCA NRA 2005

Activity	Level
Law Enforcement	
Part I Offenses Investigated	54
Part II Offenses Reported	2711
Emergency Medical Services	
Total Medical Incidents	371
Deaths (accidental)	9
Search and Rescue Incidents	77

Source: NPS 2005k

Appropriate state and federal regulatory permits would be obtained prior to the start of any new construction projects.

TRANSPORTATION

The main entrance to Bullfrog is via SH 276, entering the recreation area from SH 95, approximately 70 miles south of Hanksville, Utah. The Bullfrog area has a well-developed road system. Once inside the recreation area entrance, most secondary roads at Bullfrog are paved roads. Some of the newer roads created to maintain access to the lake under current low water conditions are packed dirt or gravel. In addition, access roads to shoreline camping areas at North and South Bullfrog and Stanton Creek are dirt roads.

Bullfrog can also be accessed by The Notom – Bullfrog Road, which is paved for approximately 25 miles north of Bullfrog and is dirt northward from the intersection with SH 24. The Burr Trail Road from Boulder, Utah, intersects the Notom – Bullfrog Road as well.

The main entrance to Halls Crossing is via SH 276, entering the recreation area from SH 95, west of Natural Bridges National Monument, and approximately 45 miles west of Blanding, Utah. Most of the secondary access roads at Halls Crossing are paved roads. Some of the newer roads created to maintain access to the lake under current low water conditions are packed dirt or gravel.

A Utah state-owned toll ferry provides access between Bullfrog and Halls Crossing, and alternate entrances to both marinas. The ferry can accommodate most vehicles and runs every other hour from each location (i.e., even hours from Halls Crossing and odd hours from Bullfrog). Hours of operation vary from winter to summer with winter hours being more restricted. The ferry is also used to transport school children to the Lake Powell School at Bullfrog. A school bus picks up the children on the Bullfrog side and transports them to the school building.

Hite is accessed from SH 95. The main access to Hite is a paved road that runs from SH 95 to the main launch ramp. Most of the secondary roads are paved roads. Some shoreline camping accesses are packed dirt.

