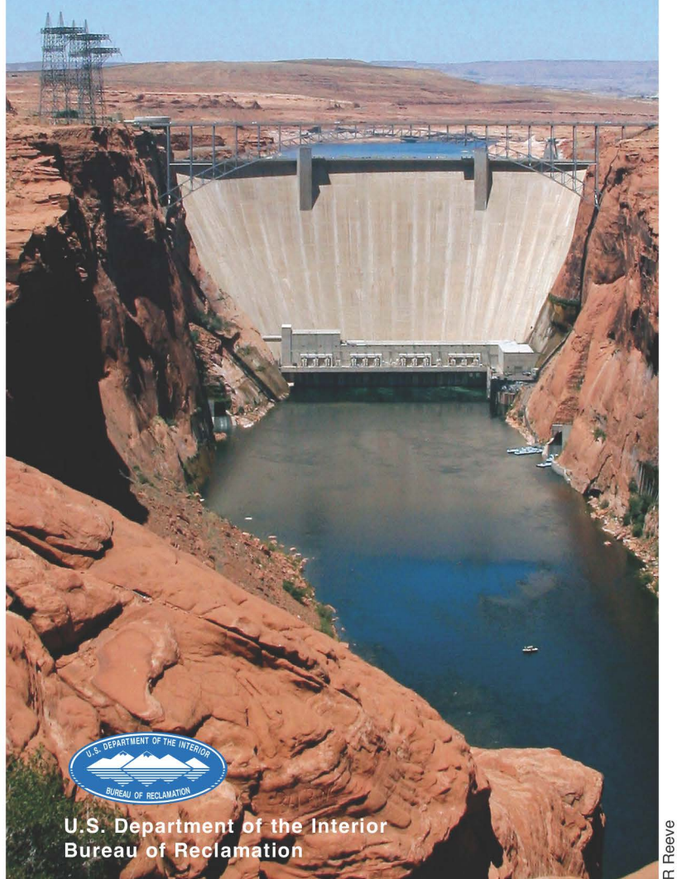
RECLAMATION
Managing Water in the West

Colorado River Storage Project

Glen Canyon Dam and Powerplant Lake Powell



TR Reeve

U.S. Department of the Interior
Bureau of Reclamation

Lake Powell

Glen Canyon Dam impounds Colorado River water to form Lake Powell, one of the most popular and scenic lakes in the world. When full at 3,700 feet (1,100 meters) above sea level, Lake Powell is 186 miles (299 kilometers) long and has an incredible 1,960 miles (3,150 kilometers) of winding shoreline. The lake and more than one million acres (400,000 hectares) of desert and canyon country provide tourists with some of the most spectacular recreational hot spots found anywhere in the nation. Named after Major John Wesley Powell, who in 1869 successfully led the first expedition down the Colorado River through the Grand Canyon, Lake Powell enables many people to view cultural resources and natural wonders that were previously inaccessible.

Gary Ladd

Scenic Lake Powell

Lake Powell started filling on March 13, 1963. In 1980, 17 years after the diversion tunnel gates were closed, Lake Powell filled completely for the first time. Today, millions of people depend on the waters of Lake Powell to sustain life. To meet the intended purposes, the elevation of Lake Powell must fluctuate. During spring runoff, May through July, the lake normally rises. During the remainder of the year, the lake elevation drops, leaving a visible ring along the shoreline. How much or how fast the lake lowers depends on water deliveries to the Lower Basin states of Arizona, Nevada, and California; how much water is carried over from the previous year; and how much runoff water flows into Lake Powell from the Colorado River system. During periods of extended drought, the elevation of Lake Powell could drop by more than 200 feet (60 meters) below its maximum elevation.

Gary Ladd

Waterfall in No-Name Canyon

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Beach at Wahweap

Recreation

The Glen Canyon National Recreation Area, established in 1972 and managed by the National Park Service (NPS), attracts about 2.4 million visitors annually. The hundreds of miles of Lake Powell shoreline provide opportunities for hiking, camping, swimming, boating and fishing. Lake Powell supports some of the nation's finest lake fishing, featuring bass, bluegill, green sunfish, walleye, black crappie, northern pike and catfish. A blue-ribbon trout fishery, located in the 15 miles of river from the dam to Lees Ferry, was developed after the dam was built.

Some of the most spectacular scenery found anywhere in the world can be seen when rafting the Colorado River through Glen and Grand Canyons. Rafters can view the natural beauty of geologic formations, observe wildlife, such as mule deer, desert bighorn sheep, hundreds of species of birds, and see ancient Native American ruins, all while experiencing the thrill of a white-water raft trip.

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Antelope Marina

The Carl Hayden Visitor Center, located 700 feet (213 meters) above the Colorado River, overlooking Glen Canyon Dam and Bridge, accommodates between one-half to one million visitors annually. Tours of the dam and powerplant, park ranger presentations, exhibits, audio-visual programs and an educational bookstore are available.

Hydroelectric Power

To generate electricity at a dam, water must be in motion. This is called kinetic (moving) energy. When flowing water turns the blades in a turbine, the energy form is changed to mechanical energy. The turbine turns a generator rotor which then converts the mechanical energy into another energy form — electricity. Since water is the initial source of energy, it is called hydroelectric power, or hydropower for short.

Glen Canyon Powerplant has eight electric generators that can operate at a combined output of 1,320,000 kilowatts. Each of the eight turbines requires about 4,000 cubic feet per second (117 cubic meters per second) of water flow from Lake Powell to operate the generator at its full capacity. With all eight generators operating at full output, about 15 million gallons (57 million liters) of water passes through the powerplant's penstocks each minute.

Glen Canyon Powerplant produces five billion kilowatt-hours of hydroelectric power a year. This electricity goes to help supply the electrical needs of about 5.8 million customers. The power is marketed by the Western Area Power Administration and is sold to municipalities, rural electric cooperatives, Native American tribes and governmental agencies in Wyoming, Utah, Colorado, New Mexico, Arizona, Nevada and Nebraska. Interconnecting transmission lines, both private and public, carry the power to major metropolitan areas and to rural areas in the West. Revenues earned from the sale of the power from Glen Canyon Powerplant and other Colorado River Storage Project (CRSP) facilities are used to pay for the construction, operation, and maintenance of the CRSP water storage units. Power revenues are also used to help pay for irrigation construction costs of CRSP participating projects.

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Transmission towers and switchyard on canyon rim

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Generators, Glen Canyon Powerplant

Management

Glen Canyon Dam and Powerplant are operated and administered by the Bureau of Reclamation.

Address inquires to:
Manager, Glen Canyon Field Division
Bureau of Reclamation
P. O. Box 1477
Page, Arizona 86040, (928) 645-2481
For more information on the Bureau of Reclamation visit: www.usbr.gov

The Glen Canyon National Recreation Area is managed by the National Park Service.
For information contact:
Superintendent, Glen Canyon National Recreation Area
P.O. Box 1507
Page, Arizona 86040, (928) 608-6200
www.nps.gov/glca

To learn more about recreational opportunities on federal land, visit www.recreation.gov

Tours
Tours of Glen Canyon Dam and Powerplant are offered year-round at the Carl Hayden Visitor Center. Visitors to the dam must go through security before beginning the tour. The visitor center is open daily except Thanksgiving, Christmas, and New Year's days.

Regulations and Safety: Always check with state, U.S. Coast Guard, and NPS rangers for current information of boating and safety regulations within the Glen Canyon Recreation Area which includes Lake Powell.

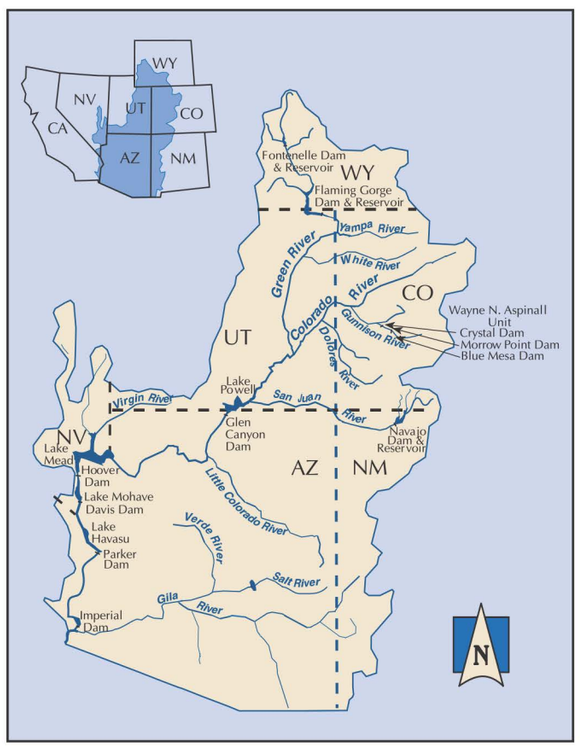
The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

Recycled Paper

Revised 2008

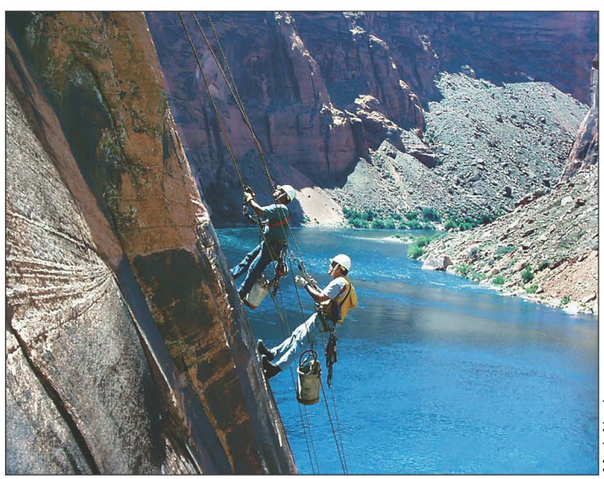
Colorado River Storage Project

Glen Canyon Dam is the key unit of the Colorado River Storage Project (CRSP). From Lake Powell, Colorado River water flows through the Grand Canyon in Arizona to Lake Mead behind Hoover Dam. The CRSP was authorized by Congress in 1956. Other water storage units of the CRSP include the Wayne N. Aspinall Unit on the Gunnison River in Colorado (Blue Mesa, Crystal, and Morrow Point Dams); Navajo Dam on the San Juan River in New Mexico; and the Flaming Gorge Unit on the Green River in Utah and Wyoming. CRSP participating projects, also authorized by Congress, deliver irrigation water to farms and provide municipal and industrial water to communities. The purposes of the CRSP are to regulate the flow of the Colorado River; provide for storage and delivery of water for irrigation, municipal, industrial, and other beneficial purposes; provide for flood control; generate electrical power; and improve water quality. The CRSP also provides for recreation and improves conditions for fish and wildlife.



Colorado River Basin


Bird's eye view of Glen Canyon Dam


Mark Neeley

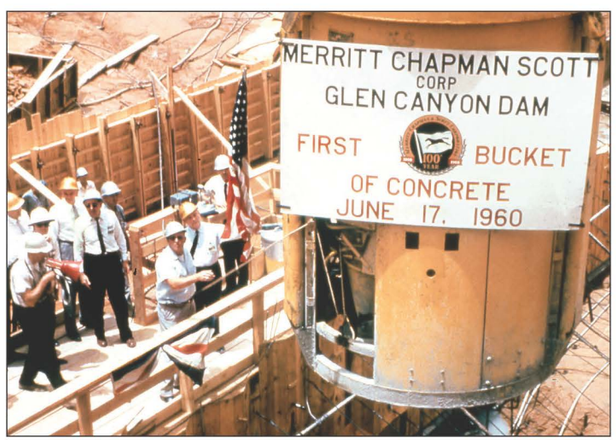
Highscalers descending canyon wall downstream from Glen Canyon Dam

Glen Canyon Dam

Glen Canyon Dam, completed in 1964, was built and is operated and maintained by the Bureau of Reclamation. The construction of the dam, built in a virtually inaccessible area on the Colorado River eight miles below the Utah-Arizona border, is one of the major engineering and construction achievements in the United States.

Investigations for a damsite on the Colorado River began as early as 1920 when the lower region of Glen Canyon was first considered. The final site for Glen Canyon Dam was carefully examined and selected by a group of Reclamation engineers and geologists working from 1946 to 1948. Factors considered in selecting the dam site were: the proposed reservoir basin could hold a large volume of water, the canyon walls and bedrock foundation were stable and strong enough to safely support a tall dam, and a good source of rock and sand for making concrete to build the dam was located close by, on Wahweap Creek, just eight miles from the construction site.


Colorado River Bridge construction, February, 1958



First bucket of concrete

On October 15, 1956, President Dwight D. Eisenhower pushed a button from the White House triggering the initial blast that signaled the start of construction. The prime construction contract was awarded to Merritt-Chapman and Scott in April 1957. Workers began excavating tunnels for re-routing the river, blasting to bedrock for the foundation and carving into the canyon walls for the abutments of the dam. The canyon was actually shaped to fit the dam. Concrete placement began in June 1960 and continued 24-hours a day until the final bucket of concrete was placed three years later, on September 13, 1963. In all, it took over 400,000 buckets, each holding 24 tons of concrete, to build the dam.

Glen Canyon Dam is the second tallest concrete-arch dam in the United States. The benefits provided by the dam are numerous and vital to life in the Western United States. The dam stores approximately 26.2 million acre-feet (32.3 billion cubic meters) of Colorado River water that is critical to the survival of cities, industries, and agriculture throughout the West and Mexico. Hydroelectic power produced by the dam's generators helps meet the electrical needs of the West's population. Lake Powell, the reservoir behind the dam, is not only an important recreation

area, but it serves as a “savings account” of water that can be drawn upon during dry years.

Page, Arizona, a thriving desert town, began in 1957 as a construction camp for the thousands of men and women and their families associated with the construction of Glen Canyon Dam. The town was named after John C. Page, the Commissioner of Reclamation from 1937 to 1943. At the peak of Glen Canyon Dam construction, Page had approximately 7,500 residents.

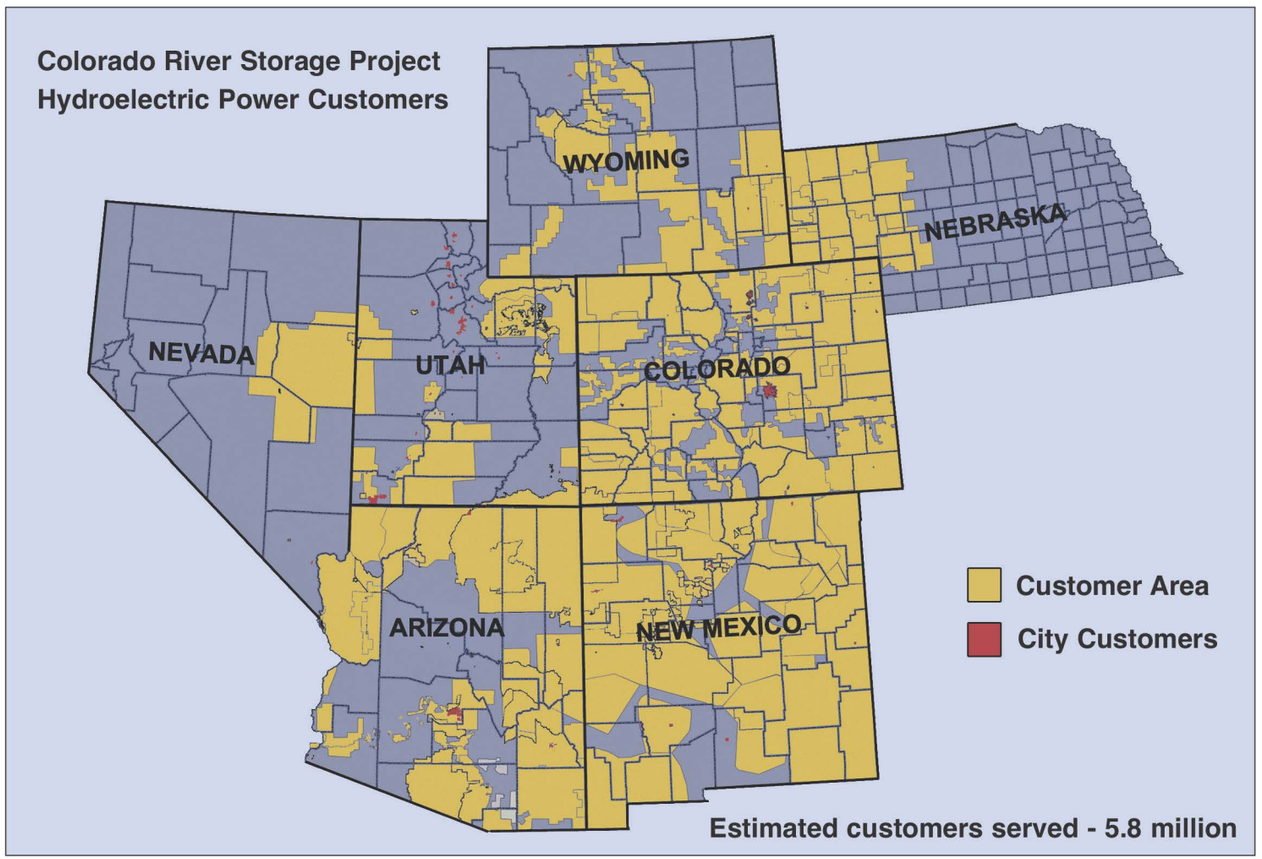
First Lady, Mrs. Lyndon B. Johnson dedicates Glen Canyon Dam, September 22, 1966

Page, Arizona in 1983 with Lake Powell at full elevation of 3,700 ft (1,128 m)

Damsite, May 1963

Andrew Pernick

Damsite, July 2004



Glen Canyon Unit Data

Glen Canyon Dam

Type	Concrete arch
Construction period	1957-1964
Height above bedrock	710 ft (216 m)
Height above original river channel	583 ft (178 m) at lowest point
Crest length (arc at axis of dam)	1,560 ft (475 m)
Volume of concrete	4,901,000 cu yds (3,750,000 m^3)
Initial cost of dam, powerplant and appurtenant structures	$245 million

Glen Canyon Powerplant

Generating Units	8
Installed capacity	1,320,000 kW

Lake Powell

Water storage begins	March 13, 1963
Completion of initial filling	June 22, 1980
Total capacity when full at elevation 3,700 ft	26.2 maf (32.3 billion m^3)
Length of lake	186 miles (299 km)
Depth of water at dam	560 ft (171 m)

Milestones

Construction authorized	April 11, 1956
First construction contract awarded (right diversion tunnel excavation)	October 1, 1956
Diversion of Colorado River around dam site	February 11, 1959
First bucket of concrete	June 17, 1960
Last bucket of concrete	September 13, 1963
First power generation	September 4, 1964
Dedicated by Mrs. Lyndon B. Johnson	September 22, 1966

Environmental Issues

As a result of the construction and operation of Glen Canyon Dam, the Colorado River ecosystem below the dam changed significantly from its pre-dam natural character. Before the dam was built, the Colorado River was a sediment-laden river that fluctuated in flow according to the seasons, rainfall, and inflows from side canyons. Now, the water released from the dam runs clear and cold without the spring time floods that once transported sediment, built beaches, and provided habitat for native species. Downstream from the dam, a new ecosystem emerged consisting of a mixture of native and non-native plant and animal communities.

Following its construction, Glen Canyon Dam was operated to meet the fluctuating demand for electrical power. Since the need for power varies greatly depending on the time of day and season, releases of water from Glen Canyon Dam were adjusted hourly to respond to changes in electrical demand.

Recognizing that this type of operation was impacting the downstream Colorado River environment, Reclamation launched the Glen Canyon Environmental Studies Program in 1982. By the late 1980s, sufficient scientific evidence was gathered to demonstrate that significant impacts on the downstream environmental and cultural resources were occurring as a result of daily fluctuating water releases from the dam.

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Petroglyphs in Glen Canyon

These findings led to a July 1989 decision by the Secretary of the Interior directing the Bureau of Reclamation to prepare an environmental impact statement (EIS) on the operation of Glen Canyon Dam. In addition, Congress enacted the Grand Canyon Protection Act of 1992. This act requires the Secretary to operate Glen Canyon Dam consistent with existing law and in such a manner as to "protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including but not limited to natural and cultural resources and visitor use." The EIS would provide the necessary information and analysis for a Secretarial decision on how to best operate the dam to balance the competing interests of hydropower generation and downstream resource protection.

The resulting EIS was prepared with an unprecedented amount of scientific research, public involvement, and stakeholder cooperation. Revenues from power generation funded the environmental studies and preparation of the EIS at a cost of about $104 million over an approximate 13-year period. Seven public hearings were held and more than 33,000 public comments were received, reflecting the national attention and intense interest in the EIS process.

The 1996 EIS Record of Decision (ROD) established new dam operating criteria that constrained daily minimum and maximum releases from Glen Canyon Dam and limited the hourly rate at which the flows could fluctuate. The ROD also established the Adaptive Management Program to advise the Secretary of the Interior as new scientific information from monitoring and research efforts becomes available. Both the EIS and adaptive management processes demonstrate the value of a cooperative, integrative approach in dealing with complex environmental issues, and resulted in an inclusive stakeholder process that provides input on the operations of Glen Canyon Dam today.

Biologists checking fish populations

Larry Riley, AZGFD

Juvenile endangered humpback chub

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Horseshoe Bend, Colorado River, downstream from Glen Canyon Dam

Frequently Asked Questions

Which is taller, Glen Canyon Dam or Hoover Dam? Which is larger, Lake Powell or Lake Mead?

Hoover Dam, which stands 726 feet (221 meters) tall, is 16 feet (4.9 meters) taller than Glen Canyon Dam which stands 710 feet (216 meters) tall. When full, Lake Mead, which holds 28.5 million acre-feet (35.2 billion cubic meters) of water, is larger than Lake Powell which holds 26.2 million acre-feet (32.3 billion cubic meters) of water when full.

Was anyone buried in the concrete during construction of Glen Canyon Dam?

During construction of Glen Canyon Dam, 18 workers died in various kinds of accidents. All of the bodies were recovered and accounted for and no one was buried inside the dam. Because of the construction techniques used to build the dam, it was impossible for a worker to be buried in the concrete. The enormous quantity of concrete used could not be placed all at one time. Instead, the dam was constructed as a series of concrete blocks, some as large as 60 by 210 feet (18 by 64 meters). Many buckets of concrete were dumped one at a time to fill each block. As each bucket load was released, workers smoothed out the concrete with special equipment. Once the concrete was placed within each block, the maximum depth of fresh concrete that a worker could have fallen into was only 12 inches (30 centimeters). It was not possible for someone to become buried in such a shallow depth of concrete.

Why is it so cold inside the dam?

The water that flows into Lake Powell originates as snowpack high in the mountains of Colorado. This icy water flows into the lake where it is so deep it cannot be warmed by the sun. As a result, the temperature of the water deep below the lake's surface is about 44 degrees F (7 degrees C) year-round, keeping the dam cold inside. The temperature inside the dam remains fairly constant at 50 degrees F (10 degrees C) year-round.

What is the purpose of the rock bolts in the canyon walls?

Hundreds of rock bolts were installed by high scalers to reinforce the canyon walls and prevent rock slabs from falling. The high scalers, suspended from long cables attached to windlasses on the rims of the canyon walls, drilled holes from 15 to 75 feet (4.6 to 23 meters) into the Navajo sandstone, inserted the bolts with expansion anchors, then forced concrete grout around them to secure them within the walls.

How much water from Lake Powell is lost into the atmosphere because of evaporation?

About two to three percent of the lake's water evaporates into the atmosphere each year. However, this water returns to the earth in the form of precipitation, so it is not lost, it is recycled.

How much water seeps through the dam?

The sandstone walls of Glen Canyon contain natural fractures that allow water from Lake Powell to seep through them and into various tunnels in the dam. About 2,600 gallons per minute (9,841 liters per minute) seep into the dam (not a large amount of water for a structure this size). All water that seeps into the dam is routed through measurement weirs, then diverted to troughs at the base of the dam and discharged to the river below. No dam or foundation for a dam is absolutely impervious to seeping water. If the seepage is controlled to prevent erosion, it is not only tolerable, but normal.

Is water in Lake Powell absorbed into the rock of the canyon walls?

As Lake Powell filled, water absorbed into the rock of the canyon walls. As the reservoir level drops during periods of drought, most of the absorbed water returns to the reservoir. Known as "bank storage," the availability of this water for use during drought periods is difficult to quantify.

What are the benefits of using hydroelectric power?

Hydroelectric power is a clean renewable form of energy that does not pollute the air, land, or water. Hydroelectric powerplants have low failure rates, low operating costs, and are very reliable. In addition, the use of hydropower reduces our dependence on other more environmentally polluting energy sources.

Can the electricity produced at Glen Canyon Powerplant be stored for use at a later time?

One drawback to electricity is that it cannot be stored for future use. Consequently, a utility company must have the capacity to provide power instantly to meet public needs. But since power demand varies greatly during the day and night, this job becomes quite complex. Hydroelectric generators can be started and stopped quickly, so hydropower is more responsive than other energy sources in meeting changing power demands.

How many kilowatt-hours of power does Glen Canyon Dam's powerplant produce annually?

Approximately five billion kilowatt-hours.

How much coal would it take to produce annually the same amount of power?

It would take 2.7 million tons of coal or 8.6 million barrels of oil to generate the same amount of power that Glen Canyon Dam's generators produce in one year. By using water instead of fossil fuel, Glen Canyon Dam Powerplant eliminates seven million pounds of carbon dioxide emissions each year.

Why does the lake look so blue and the river below the dam look so green?

Lake Powell's deep blue color results from the fact that it is a relatively clear body of water that reflects the color of the sky. The river below the dam looks green due to the feathery algae called cladophora that thrives in the river. This algae forms the basis of a highly productive food chain and is an important source of nutrients for many species living below the dam.

Are there tunnels inside Glen Canyon Dam?

Yes. Many long and narrow corridors called galleries were built inside the dam to allow for inspection of various inner sectors. These galleries are not open to the public.

How is the Colorado River controlled?

The Colorado River is administratively controlled by numerous statutes, compacts, decrees, and a treaty with Mexico, collectively referred to as the "Law of the River." In 1970, the Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs was prepared in accordance with these formal regulations to form the rules by which the Colorado River reservoir system is operated. A plan is prepared each year by the Bureau of Reclamation to guide the operations of the Colorado River Basin reservoirs.

Does the elevation of Lake Powell drop during experimental high flows?

The level does decrease by a few feet in the short term, but by the end of the water year the level is unchanged.

Are there any federally-listed endangered species living in the Grand Canyon below Glen Canyon Dam?

Yes. Federal endangered species living in the Grand Canyon below the dam include the humpback chub, razorback sucker, southwestern willow flycatcher, peregrine falcon, and the Kanab ambersnail.

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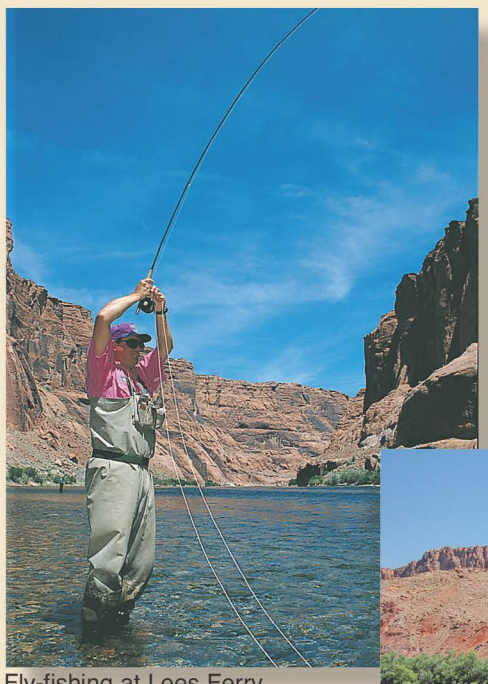
Night view of jet tubes during the March 2008 high-flow test

Sandy beach in the Grand Canyon

TR Reeve

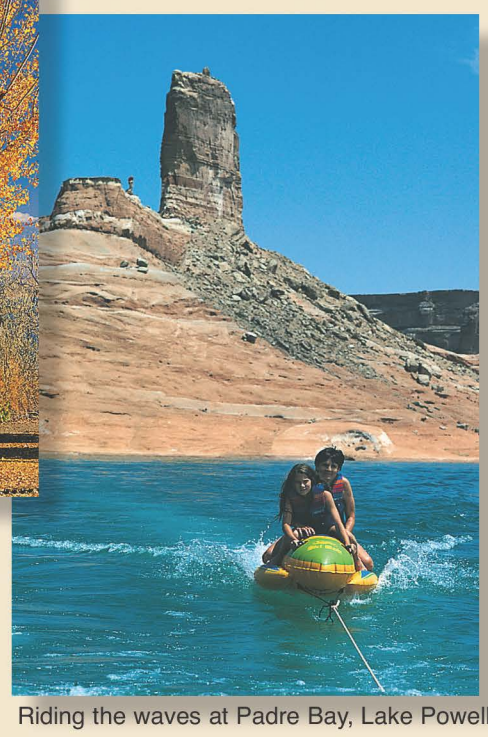
Researchers gather data during the 2008 test flow

Dixie National Forest
Boulder
Anasazi Village State Park
Deer Creek Campground
Circle Cliffs
Burr Trail Road
Long Canyon
WATERPOCKET FOLD
Tarantula Mesa
Mount Pennell x 11371
HENRY MOUNTAINS
Cass Creek Peak
Maidenwater Sands
Trachyte Creek
Dirty Devil River
Rock Canyon
Narrow Canyon
Colorado River
Hite
Trachyte Point
The Box
Sand Creek
Death Hollow
King Bench
Studhorse Peaks
No Man Mesa
Mount Hillers 10728
Indian Spring Benches
Escalante Petrified Forest State Park
Calf Creek Recreation Area
Steep Creek
Horse Canyon
Wolverine Petrified Wood Area
Muley Creek
Ant Knoll
Capitol Reef National Park
GRAND GULCH
Coal Bed Mesa
Shitamaring Creek
Mount Holmes
The Horn
Scorup Canyon
Castle Butte
Escalante
Boynton Arch
Escalante Natural Bridge
Philipps Arch
Little Death Hollow
Escalante River
Colt Mesa
Big Bowns Bench
The V
Halls Creek Overlook
Deer Pt 7242 ft
Purple Hills
Hansen Creek
Ticaboo
Mount Ellsworth 8235
Lake Powell
Good Hope Mesa
Alvey Wash
Cedar Wash Arch
Covered Wagon Natural Bridge
Harris Wash
Tenmile Flat
Seep Flat
ESCALANTE RIM
Devils Garden
Egypt
Glen Canyon
East Moody Canyon
Bullfrog Creek
Cane Spring Desert
Tapestry Wall
Chocolate Drop
Mancos Mesa
Cedar Canyon
Hall Mesa
Right Hand Collet Canyon
Left Hand Collet Canyon
Hole - in - the - Rock Road
Twentyfive Mile Wash
Early Weed Bench
Big Sage
Visitor Center
Defiance House
Forgotten Canyon
Bullfrog
Halls Creek Bay
Ferry
Halls Crossing
North Gulch
Moki Canyon
Grand Staircase
Collet Top
Scorpion Gulch
National
Cal Black Memorial Airport
Iron Top Mesa
Lake Canyon
Annies Canyon
Slick Rock Canyon
Iceberg Canyon
WARNING:
DO NOT USE THIS MAP FOR NAVIGATION!
Shoreline dangers are too numerous to mark and can appear quickly after a storm or change in the weather. Flash flooding can occur on roads and in canyons in drainage areas.
Always use caution!
Escalante
National Monument
KAIPAROWITS PLATEAU
STRAIGHT CLIFFS
FIFTYMILE BENCH
Jacob Hamblin Arch
Stevens Arch
Cow Canyon
Chimney Rock
Coyote Natural Bridge
Cliff Arch
Hurricane Wash
Dance Hall Rock
Three Roof
Recreation
Drip Tank
East of the Navajo
Navajo Canyon
Sooner Rocks
Broken Bow Arch
Bement Arch
Pollywog Bench
The Rincon
Clay Hills Crossing
Mikes Mesa
San Juan River
Note: Most unpaved roads require high clearance or 4-wheel drive. Roads may be impassable during inclement weather. Off road travel prohibited. Check locally for current road conditions. For more specific road information use detailed area map.
Little Valley
Burning Hills
Woolsey Arch
Hole-in-the-Rock
Fiftymile Point
Area
Wilson Mesa
Great Bend
Monitor Butte
Rock House Gulch
Last Chance Creek
Spencer Point
Harveys Fear
Dry Rock Creek
Navajo Point
Twilight
Sit Down Bench
Kelly Grade
Tibbet Canyon
Nipple Bench
Grand Bench
Rock Creek Bay
Dangling Rope Marina
Nasja Mesa
San Juan Arm
Zahn Bay
Meskahi Wash
No Mans Mesa
Jacobs Monument
Padre Canyon
Last Chance Bay
Kane Point
Padre Bay
Warm Creek Bay
Wahweap Creek
Wahweap Bay
Lone Rock
Lake Powell
Crossing of the Fathers
Dungeon Canyon
West Canyon
Wetherill Canyon
Mountain Sheep Canyon
Forbidding Canyon
RAINBOW BRIDGE NATIONAL MONUMENT
Navajo Mountain 10388
Piute Wash
PIUTE MESA
NOKAI
Oljeto
The Sand Hills
Utah
Arizona
Navajo Nation Lands
Antelope Island
Labyrinth Canyon
Face Canyon
Navajo Canyon
Carl Hayden Visitor Center
Glen Canyon Dam
Antelope Point
All back country travel and recreation on Navajo land requires a permit from:
Navajo National Parks and Recreation
P.O. Box 9000
Window Rock, AZ 86515
(520) 871-6647
Hoskinnini Mesa
Big Point
Lees Ferry
Colorado River
Page
Glen Canyon
Horseshoe Bend
Leche-e
Leche-e Rock
Antelope Canyon
Navajo Creek
Echo Peaks
Navajo Bridge Interpretive Center
Marble Canyon
Zilnez Mesa
Skeleton Mesa
Paved Highways
Unpaved - gravel or dirt
Marina
Boat Launch
Restaurant
Campground
Primitive Campground
Ranger Station
0 5 10 Kilometers
0 5 10 Miles


Fly-fishing at Lees Ferry
George Andrejko, AZGFD


Rafters at Lees Ferry
TR Reeve


Fall color at Wahweap Marina
Gary Ladd


Riding the waves at Padre Bay, Lake Powell
Gary Ladd