The Flaming Gorge Unit

Colorado River Storage Project

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The Flaming Gorge Unit

One of the first sights John Wesley Powell encountered on his journey down the Colorado and Green Rivers in 1869 was a beautiful canyon which he christened Flaming Gorge Canyon because of its fiery colors. Today the canyon retains its fiery colors, undiminished by the waters of the Flaming Gorge Reservoir that lap gently at its walls. Flaming Gorge Dam however, does not span the canyon from which it takes its name, Reclamation built it further downstream. No longer the remote wilderness it once was, Powell's canyon now draws visitors from all over allowing others to see the fiery canyon in all its splendor. The dam stands as a monument to man's ingenuity, while the canyon reminds one that nature remains an inherent part of our lives.

Project Location

Located in Daggett County, Utah, Flaming Gorge Dam spans the Green River in northeastern Utah about thirty-two miles downstream of the Utah-Wyoming border. The dam, actually located in Red Canyon twenty-seven miles below the Flaming Gorge, takes its name from the famous and colorful canyon located just upstream in the river basin. Flaming Gorge Reservoir extends upstream from Utah into Wyoming.

The Uinta Mountains border the project to the east while a large portion of the project, including the dam, community of Dutch John, and over twenty-seven miles of the reservoir lies within the boundaries of the Ashley National Forest. Due to its location within the National Forest Reclamation originally named the construction area the Ashley Damsite. The Green River weaves through the mountains in a rather unusual way meandering in and out of hard formations, but regardless of structure the river cut a deep narrow gorge forming the perfect

damsite. The Reservoir rests on fairly impervious sedimentary rock leaving little possibility for seepage.

The canyon area receives more precipitation and records lower temperatures because of the surrounding mountains. Vegetation in the canyon consists mainly of juniper, piñon pine, ponderosa pine, some cottonwood, and willows. The northern portion of the reservoir area lies in more open country, consisting mostly of rolling hills. A winter sheep range for ranchers, this area has been heavy grazed. Vegetation in the hills consists of sagebrush, some cottonwood and willows near the river, and some scattered juniper on the slopes of the hills. Reports indicate that this area served as a lush cattle grazing area in the nineteenth century, with an abundance of native grasses most of which no longer exist because of grazing in the area.

Prior to the start of construction activities on the project, Daggett County, located in the extreme northeastern corner of Utah could claim only about 350 residents. The Green River and its canyons bisect the county originally making travel between the two areas difficult. The county contains some of the most beautiful and rugged terrain in the state. Reclamation's activities in the area and the establishment of the Dutch John community nearly tripled the county population. In addition, construction activities required adequate roads throughout the county which in turn benefitted the local residents by making transportation between the two sections of the county more convenient in turn drawing the area together.[1]

Historic Setting

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1. Denver Colorado, National Archives and Records Administration: Rocky Mountain Region, Records of the Bureau of Reclamation, Record Group 115, "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume I, 1956, 20-1; United States Department of Interior, Water and Power Resources Service, *Project Data*, (Denver: U.S. Government Printing Office, 1981), 357; "Flaming Gorge," *Reclamation Era* 45, no. 3 (August 1959): 69; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume IV, 1959, 15-6.

Prehistoric Setting

Petroglyphs and other artifacts suggest that Native Americans hunted game near Flaming Gorge for many centuries. Later, the Ute tribes, whose members spread throughout the mountains of present day Colorado and Utah visited the area to hunt big game animals, but there were no permanent Native American settlements in the area.[2]

The Eastern Shoshone occupied western Wyoming and adjoining areas for nearly three-thousand five-hundred years. It was here that the earliest explorers discovered them.[3]

Historic Setting

Most of the early exploration of the Colorado River centered on the southern portion of the river. Spanish expeditions to the area began as early as 1549, however none of these early explorers traveled much further upstream than the present-day site of Lees Ferry, Arizona. During his expedition of 1776, the Spanish padre Francisco Garcés first used the name "Colorado" largely because it drained red country and was sometimes tinted a rich muddy red by silt.[4]

In 1805, Meriwether Lewis and William Clark reported from hearsay the existence of the Shoshone on both sides of the Rockies from the Missouri to the Arkansas Rivers. According to their accounts the Shoshone were divided into three large tribes each wandering at a considerable distance from the others. Other explorers of the early-nineteenth century encountered the Shoshone, often in the company of other tribes, inhabiting a wide area. Several

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2. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume XVI, 1988, iv; Flaming Gorge Natural History Association, *Flaming Gorge*, text by Tom Williams (Dutch John, Utah: Flaming Gorge Natural History Association, 1981), 34.
3. William C. Sturtevant, ed., *Handbook of North American Indians*, Vol. 11, *Great Basin*, Warren L. D'Azevedo, ed. (Washington, D.C.: Smithsonian Institution, 1986), 308-10.
4. Marion V. Allen, *Rio Colorado & Parker Dam*. (Redding, California: River City Printing and Publishing, 1987), 9-19.

reports placed Shoshone territory in the regions of the headwaters of the Green and Bear Rivers and the eastern and southern headwaters of the Snake River. Largely a nomadic tribe, observers reported they rarely stayed in one place for more than ten days at a time.

By the time of Anglo contact the Shoshone adopted large-scale buffalo hunting and attained high competence as a militaristic, buffalo hunting people. At the start of the eighteenth century the Shoshone acquired horses and turned toward widespread raiding on the Plains. Near the end of the eighteenth century, tribal fortunes shifted. Defeated by smallpox and the Blackfeet, who possessed firearms, the Shoshone retreated to the west. Beginning in the nineteenth century the tribe began showing signs of renewed vitality and began fostering Anglo alliances. Due in large part to their Anglo alliances, the Eastern Shoshone retain the distinction of being the only group in the Great Basin that the United States did not conquer militarily, displace, encroach upon, or totally ignore during the early reservation period. In 1867, Chief Washakie requested a reservation in the Wind River Valley. The Treaty of Fort Bridger set aside the Wind River Reservation in 1868, the first cession of reservation lands in the Great Basin; in 1872, due to a surveying error, Washakie signed away a large tract of reservation lands on which a number of previously homesteaded ranches already existed. After 1868, the Eastern Shoshone withdrew to their new reservation with a minimum of difficulty where they continued a life based on hunting buffalo and other game, gathering, and fishing.[5]

Following Lewis and Clark's expedition of the early nineteenth century, men began searching the western mountains for beaver. In 1825, William H. Ashley, organizer of a large fur trading company, arrived on the Green River in Wyoming. He loaded trade goods into buffalo hide boats and set out on the epic first exploration of the Green.

5. Sturtevant, 308-10, 329-34, 529-31.

Soon after Ashley embarked on his journeys down the Green, in November of 1826, the first American crossed the southern portion of the Colorado River. Jedediah Smith crossed the Colorado and entered Nevada about the same place that Garcés had in 1776. Not interested in defending an American claim on the river basin, Smith chose instead to explore the river. Much of his information eventually reached John Frémont, who crossed the Colorado several times in his five trips across Nevada, between 1842 and 1853.

In 1854, early pioneers established Fort Supply in Wyoming on the Emigrant Trail, marking the start of Anglo settlement in the basin. Realizing the importance of a water supply for the fledgling settlement, the settlers of Fort Supply diverted water from the Blacks Fork River to the adjacent lands, beginning the long tradition of diverting water from the Colorado River and its tributaries.

In 1859, miners and prospectors pushing over the mountains from older mining districts on the eastern slope of the continental divide established the town of Breckenridge, Colorado, making it one of the oldest existing towns in the basin. Within the next decade miners established other mining camps nearby. In the meantime, unsuccessful miners turned to farming and supplying agricultural products to the mining communities. Generally settlement grew westward and downward from the mountains to the valleys, however conflicts with the local Indian inhabitants slowed the Anglo advance somewhat. In 1882, settlement began in Grand Junction, Colorado, now the largest community in the upper drainage basin. Settlement of the greater part of the Uinta Basin in northeastern Utah started in 1905 when all lands not occupied were opened for settlement; previously the area had been designated as an Indian reservation and made unavailable to Anglo settlement. All of the settlers of the upper basin capitalized on the

accessible water sources, they diverted numerous tributary streams in the upper drainage basin to irrigate mountain meadows and valleys, farmlands, and broader valleys at the base of the mountains.[6]

On May 24, 1869, the Powell Geographic Expedition set out on the Green River in Wyoming. Led by Major John Wesley Powell the expedition consisted of four wooden dories and ten men. On this journey Powell christened: Flaming Gorge Canyon, Red Canyon, the Canyon of Lodore, Desolation Canyon, Gray Canyon, Labyrinth Canyon, Stillwater Canyon, Cataract Canyon, Glen Canyon, Marble Canyon, Soap Creek Rapids, Badger Creek Rapids, Crystal Creek Rapids, Lava Falls, and Lava Cliffs. Three months later, at Grand Wash Cliffs, Powell and his remaining men--three had opted to leave the expedition several days earlier--reached the confluence of the Colorado and the Virgin River. They were met by a Mormon group sent by Brigham Young to watch for the Powell expedition, though they were primarily looking for wreckage and information as Powell had been reported dead several times in the newspapers. The knowledge that the Mormons gained from Major Powell and his expedition allowed them to continue with their plans to settle the Colorado.[7]

The erratic nature of the Colorado—it was prone to floods, droughts, and even to carving itself new banks and channels when the mood struck it—made it the perfect beneficiary of the Bureau of Reclamation. By damming the Colorado, Reclamation could tame the wild river and use it to benefit the settlements that had grown up around the Colorado. The first major obstacle to be constructed in the Colorado's path, Hoover Dam.

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6. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol IX, 1973-1975, 2.
7. Marc Reisner, *Cadillac Desert: The American West and Its Disappearing Water* (New York: Viking, 1986; reprint, New York: Viking Penguin Books, 1993), 26-34 (page citations are to the reprint edition).

In December 1928, Congress passed the Boulder Canyon Project Act authorizing construction of a dam at either Black Canyon or Boulder Canyon.[8] Construction of the four diversion tunnels for Hoover Dam at Black Canyon began May 12, 1931, signaling the beginning of the end of the free-flowing Colorado. President Franklin D. Roosevelt dedicated Hoover Dam, then called the Boulder Canyon Dam, on September 30, 1935.[9] The filling of Lake Mead behind Hoover Dam resulted in river regulation and power generation, paving the way for construction of Parker Dam, 155 miles downstream, beginning in 1933.[10] Davis Dam followed in 1944, further corralling the mighty river. In 1956, Congress authorized large scale development of the Upper Colorado River Basin resources with the passage of the Colorado River Storage Project Act.

Project Authorization

Reclamation began investigations, with an eye for development, of the Upper Colorado River system in 1902. In 1904, Reclamation began investigating the Flaming Gorge area looking to provide flood control storage in the Upper Colorado River Basin to prevent flooding of the Lower Basin below Black Canyon, the present site of Hoover Dam. Reclamation continued investigating in more detail in 1914, drilling at several potential damsites in Horseshoe Canyon and the reservoir area. Nothing came of these investigations and Reclamation discontinued them.

By 1922, and negotiation of the Colorado River Compact,[11] Reclamation began

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8. Allen, 28-35.
9. Department of the Interior, Bureau of Reclamation, *The Boulder Canyon Project: Hoover Dam*, by Wm. Joe Simonds, project history, Bureau of Reclamation History Program. (Denver, Colorado: Bureau of Reclamation, 1995), 26, 58.
10. *Project Data*, 769.
11. The Colorado River Compact divides the waters of the Colorado River and its tributaries between seven states, Arizona, California, Colorado, New Mexico, Nevada, Utah, and Wyoming. The Compact divided the

(continued...)

envisioning a need for the Colorado River Storage Project. The allocation of 7.5-million acre-feet of water per year to both the upper and lower basins, as divided in the Compact, hinged on the upper basin's delivery of an average of 7.5 million acre-feet of water annually in any period of ten consecutive years, with additional water for use in Mexico.

Reclamation was not alone in its investigations of the Flaming Gorge area. In 1923 and 1924 a public utility in Utah investigated the possibility of power development in the area. They would have transmitted the power to the Salt Lake City area, some 140 miles distant. The company's investigation determined that development in the area would provide few engineering difficulties, making the project entirely feasible. For unknown reasons the company discontinued its investigations and abandoned all plans for power development on the Green River.

In 1946, Reclamation resumed its investigations in the area.[12] Soon after, in 1949, Congress approved the Upper Colorado River Basin Compact, which allocated the 7.5-million acre-feet of water among the four upper basin states (Colorado, New Mexico, Utah, and Wyoming). The Upper Colorado River Basin Compact paved the way for further development

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11. (...continued)
Colorado River Basin into two smaller entities, the upper (Colorado, New Mexico, Utah, and Wyoming) and lower basins (Arizona, California, and Nevada) with the dividing point located at Lee Ferry, Arizona. According to the Compact, each basin would receive 7.5 million acre-feet yearly, with an additional one million acre-feet allotted the lower basin from its tributaries. Negotiated in 1922, representatives from the seven states signed the Compact in Santa Fe, New Mexico, on November 24, 1922. The Compact then went to the State Legislatures and the Congress of the United States for approval; before becoming binding and obligatory all seven states and the Congress had to approve the Compact. Arizona refused to approve the Compact without a further division of the waters of the lower basin to keep California from taking the lion's share of the allocation. The stalemate between Arizona and California continued for six more years, when at the urging of the upper basin states Congress ratified the Compact. The revised Compact limited California's allocation of the lower basin's share of the water to 4.4 million acre-feet per year and allowed the Compact to become binding after passage by Congress and only six of the seven State Legislatures. Six of the seven Legislatures had already passed the Compact and on December 21, 1928, Congress passed the Boulder Canyon Project Act, which included the modified Colorado River Compact. Arizona did not ratify the Compact for another thirty-five years.

12. United States Department of the Interior, Bureau of Reclamation, *Flaming Gorge Dam and Powerplant: Technical Record of Design and Construction* (Denver: U.S. Government Printing Office, 1968), 5-6.

of the Colorado.

As with most western rivers, the flow of the Colorado varies erratically from year to year, ranging from four to twenty-two million acre-feet per year at Lees Ferry. In addition, high and low years tend to follow one another, accentuating problems of river regulation and use. Prolonged dry periods pose problems for the upper basin, both in meeting their Lower Basin requirements and utilizing their allocation. Wet years do not pose the same problem as flows easily meet both requirements. In order to fully use the Upper Basin's allocation, large storage reservoirs needed to be built. Filling reservoirs during wet years would allow the Upper Basin to meet its delivery requirements to the Lower Basin in dry years while still providing for basin water development.

Reclamation worked in conjunction with the Upper Colorado River Commission and other Federal agencies to prepare a formal report in 1950 describing plans for a series of dams and reservoirs to augment development in the upper basin. This plan included power development and other services. The report outlined plans for an initial group of participating projects to develop water for irrigation and other purposes. These projects would link financially with the developing Colorado River Storage Project by using revenues from hydropower developed at the CRSP units (Glen Canyon, Flaming Gorge, and Wayne Aspinall[13]) to fund smaller participating irrigation projects.

The Colorado River Storage Project Act of April 11, 1956, Congress authorized construction of four storage units in the Colorado River Storage Project and eleven participating projects. The projects authorized were the four original CRSP storage units, Glen Canyon, Flaming Gorge, Wayne Aspinall, and Navajo, as well as the initial phase of the Central Utah

13. Reclamation renamed the Curecanti Unit the Wayne Aspinall Unit October 3, 1980.

Project (CUP), Emery County, Florida, Hammond, La Barge, Lyman, additional works at Paonia, Pine River Extension, Seedskadee, Silt, and Smith Fork. Reclamation later found the La Barge Project in Wyoming infeasible and deleted it from the project. Other participating projects added later included: Animas-La Plata (1968); Bostwick Park (1964); Dallas Creek (1968); Dolores (1968); Eden (1949); Fruitland Mesa (1964); Navajo Indian Irrigation Project (1962), a Bureau of Indian Affairs project constructed by Reclamation; San Juan-Chama (1962); San Miguel (1968); Savery-Pot Hook (1964); and West Divide (1968).[14]

Construction History

Construction on the Flaming Gorge Unit began in July of 1956, when Reclamation appointed Jean R. Walton project engineer. Soon after, in August, Reclamation established the project office south of the damsite in Vernal, Utah. On October 15, 1956, President Dwight D. Eisenhower officially started construction activities on the project by touching off the initial explosion on both Flaming Gorge and Glen Canyon Dams from the White House; at Flaming Gorge the explosion on the left abutment began clearing material at the damsite. Reclamation awarded the first contract to Wangsgaard Construction Company of Logan, Utah, on January 4, 1957, for construction of a temporary access road.[15]

In 1957, Reclamation initiated work on the government community located at Dutch John Flat. Reclamation spent much of the year awarding contracts for erection of prefabricated housing, warehouse, and lab structures, as well as continuing construction work on the access

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14. *Project Data*, 360-1.
15. *Technical Record of Design and Construction*, 501; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume I, 1956, 5; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume II, 1957, 13.

roads necessary for construction of the Dam and initiating construction of a school. Contractors completed most of the work on the Transa-houses by the end of 1957, permitting occupancy at the beginning of 1958. In May of 1958, Reclamation moved the project headquarters from Vernal, Utah, to the temporary office building at Dutch John. To ensure the safety of the workers on the project and living in the area, the Utah State Fish and Game Commission in conjunction with the Upper Colorado Regional Office and the Forest Service, prohibited hunting within one-mile of the Flaming Gorge campsite and damsite and within one-half-mile of the Flaming Gorge access road; at least one hill or ridge lies between the boundary and the protected area eliminating, at least for the most part, ricocheting bullets. The agencies posted signs at strategic points around the area informing visitors of the restrictions.

In July of 1957, to celebrate construction of the dam the citizens of Green River, Wyoming, held "Flaming Gorge Days." In September the Green River Wyoming Chamber of Commerce held the Flaming Gorge Banquet. Both events recognized the importance of the project to the local citizens.

In August of 1957, Reclamation issued invitations to prospective bidders to inspect the construction site for the dam and powerplant. The following April Reclamation issued invitations to bid on Specification Number DC-5045, construction of Flaming Gorge Dam and Powerplant. Reclamation opened bids at Manila High School in Manila, Utah, for construction of the dam and powerplant. On June 18, 1958, Reclamation awarded the prime contract to Arch Dam Constructors, of Omaha, Nebraska, a joint venture composed of Peter Kiewit Sons Company, Morrison-Knudsen Company, Mid-Valley Utility Constructors Inc., and Coker Construction Company. The contractor received notice to proceed on July 2 and began work

immediately. Arch Dam Constructors set up a temporary field office at Dutch John in large semi-trailer type buildings and awarded subcontracts for construction of miscellaneous buildings in the contractor's camp area of the government camp in west Dutch John. In addition, the contractor furnished the services of a doctor and temporary hospital facilities; the specification for construction of the dam and powerplant required that the contractor construct, staff, and operate a permanent ten-bed hospital. The contractor completed the hospital facilities on January 28, 1959. The hospital served the entire community of Dutch John, however priority went to the contractor's employees. In September the contractor began excavation for the diversion tunnel and furnished the first power to the construction site from a temporary diesel plant.

In September of 1958, the United States opened an official post office at Dutch John, Utah, formally recognizing the community. Reclamation named the small community, located at an elevation of about 900 feet above the Green River, after a local pioneer settler, "Dutch" John Hanselena. After serving as headquarters for construction personnel, the town would become the permanent headquarters for operation and maintenance activities on the project. The Utah State Highway Patrol took over enforcement of highway regulations on the Flaming Gorge access road in the State of Utah.[16]

In 1958, as construction progressed on the dam, both the Forest Service and the National Park Service issued reports regarding the development of recreation facilities at the Flaming Gorge Reservoir. The Forest Service report included the impact of the Flaming Gorge Unit on

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16. *Technical Record of Design and Construction*, 501, 504-5;"Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume II, 1957, 1-2, 20; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume III, 1958, 1-2, 9, 11-2, 18-9; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume IV, 1959, 17-8, 62, 69.

the Ashley National Forest. The NPS plan for recreational development focused on areas near the reservoir, while the Forest Service plan concentrated on areas within the Ashley National Forest. The two plans did not overlap, making construction of all proposed recreation areas feasible. Both agencies began construction on their respective recreation areas the following year.[17]

The National Park Service's major recreational developments lie on opposite sides of the reservoir in the vicinity of the confluence of the Green River and Henry's Fork; Lucerne Valley is on the western shore and Antelope Flat is on the eastern shore. Both developments include facilities for boating, swimming, water skiing, picnicking, camping, and other outdoor sports.

The Forest Service constructed picnic areas and campgrounds at Dutch John Ranger Station, Dripping Springs, Little Hole, Green Lakes Lookout, and near Reclamation's sewage evaporation ponds. They also constructed boat ramps at Cedar Springs and Dutch John Draw in the lower reservoir area.[18]

The prime contractor continued working on the diversion tunnel in 1959, which "holed through" on March 2, 1959. However the contractor did not complete excavation of the tunnel until April. On April 27, the contractor placed the first concrete in the tunnel. The contractor completed the concrete lining on August 17, 1959. In November, the contractor began work on the upstream cofferdam and on November 19 diverted the river through the diversion tunnel.

In April, Reclamation issued the specification for initial clearing of the reservoir area.

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17. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume III, 1958, 15-7; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume IV, 1959, 32-3.
18. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume IV, 1959, 18, 32-4; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume VII, 1962, 16-7.

Reclamation opened bids in May. On June 17, 1959, Reclamation awarded the contract for the clearing of the canyon area of Flaming Gorge Reservoir to Herman H. West and Company and Phillips and Jordan of Robinsville, North Carolina. The contractor received the notice to proceed on June 22 and began working on the access roads necessary to reach the construction area, located in some of the most difficult terrain in the area. The contractor substantially completed the project in March of 1960.

The prime contractor began excavating the keyway in the right abutment on September 10, and the keyway and thrust block in the left abutment on October 2, 1959. Excavation in the right keyway progressed rapidly, however, the surface rock there proved to be somewhat weathered and required deeper excavation to reach sound rock than originally anticipated.

Progress on the left abutment excavation proceeded at a much slower rate. Before excavating for the keyway the contractor had to excavate for the spillway approach channel, thrust block, and inlet for the spillway tunnel. In September, surface movement further impeded progress when a rather large quantity of rock slipped out of the wall destroying the line drill holes. The fractured pattern of the rock, a heavy shale seam at the bottom of the displaced material, and heavy rains all contributed to the surface movement. In October, the contractor detected additional movement and after an onsite inspection by Reclamation personnel the contractor removed some slabs of the unstable rock and pinned the remainder with twenty to thirty-five-foot long steel anchor bars which stabilized the area.[19] In June of 1960 the Board of Consultants recommended that additional measures, prestressed bolts and other means, be taken

19. *Technical Record of Design and Construction*, 507-509; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume IV, 1959, 1-4, 24-5, 84-5; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume V, 1960, 1.

to further stabilize the rock.

In February of 1960, the prime contractor completed the upstream and downstream cofferdams. After completion of both cofferdams, the contractor began dewatering and excavating the river channel for the dam foundation. In July, the contractor completed rough excavation in the keyways. By August, the contractor had completed all of the necessary foundation excavation, allowing them to begin drilling and grouting the dam foundation on August 18, 1960. Excavation of the spillway tunnel began a week later on August 24.

The contractor placed the first concrete in the powerhouse structure on September 8, 1960, and in the dam on September 18. The contractor began a concrete cooling program by circulating river water through cooling coils embedded in each placement of concrete. Cooling the concrete more rapidly allowed for more rapid placement of concrete and more uniform structure. Cooling coils were placed horizontally at two and one-half-foot centers on rock and at three and one-half-foot centers on concrete.

At the same time that concrete operations began on the dam and powerplant, Reclamation opened the bid for additional clearing of the reservoir area, schedules 3 and 4, in September. On October 24, 1960, Reclamation awarded the contract to Edman and Company of Denver, Colorado. The contractor began work in November. This portion of the clearing proved much easier than the previous clearing as the upper part of the reservoir area contained only scattered vegetation with relatively easy access and no mountainous areas.[20] The contractor completed all clearing work on February 14, 1961, and Reclamation inspected the work in June and accepted the contract as substantially complete.

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20. *Technical Record of Design and Construction*, 509-10; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume V, 1960, 1-3, 17, 24-5, 63-4, 92-3.

In March of 1961, Reclamation established a field office for the Transmission line division and began awarding contracts for construction of the transmission lines on the project. Soon after, on March 26, 1961, the contractor installed the first section of the penstock in the dam. Work continued on the rest of the powerplant features and in October the contractor placed the first bucket of concrete in the superstructure walls of the powerplant. Work on the powerplant structure continued at a fairly rapid pace and in January of 1962, Reclamation opened bids for the completion of the powerplant and switchyard. On February 2, Reclamation awarded the contract to Gunther and Shirley Company and E. V. Lane Corporation.

The prime contractor continued excavation on the spillway structure and in August placed the first concrete in the spillway tunnel. Except for the installation of some gates and the hollow jet valves, the contractor completed the river outlets during the year. In the meantime, concrete work continued on the dam for much of the year.[21]

The prime contractor completed much of the work on the project in 1962. In May they completed installation of the penstock structures. In September the contractor completed concrete placement in the powerplant and installed the hollow jet valves and outlet pipes. Reclamation accepted the powerplant portion of the contract as substantially complete on September 14, 1962. The contractor completed concrete placement in the dam proper on November 15, 1962. Just prior to the end of concrete work on the dam, the contractor installed the diversion tunnel stoplogs beginning storage in Flaming Gorge Reservoir. The contractor closed the diversion tunnel bypass gate on December 10 and began releasing water through the river outlet pipes. This initial operation of the outlet pipes indicated that all the valves and gates

21. *Technical Record of Design and Construction*, 511-3; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume VI, 1961, 1-3, 51; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume VII, 1962, 1.

functioned properly. The contractor began concrete placement in the diversion tunnel plug soon after they began releasing water through the river outlet pipes. Workers completed the diversion tunnel plug on January 3, 1963.[22] Reclamation opened the road over the dam and spillway to controlled public traffic on May 18, 1963, and uncontrolled public traffic the following October. Arch Dam Constructors completed the contract for construction of Flaming Gorge Dam and Powerplant on January 10, 1964.

Gunther and Shirley Company and E. V. Lane Corporation made considerable progress on Flaming Gorge Powerplant and Switchyard in 1963. Two of the three power transformers were delivered from Green River, Wyoming in January. The contractor installed all three of the turbine and generator foundations by mid-August. Westinghouse Electric Corporation began installation of the generators as soon as the contractor turned the first generator foundation over to them. Reclamation placed Unit No. 1 in commercial operation on November 11, marking the start of full scale power production on the project. President John F. Kennedy signaled the start of the first generating unit on September 27, 1963, by pressing a key switch from Salt Lake City. Reclamation placed Unit No. 2 in commercial operation on December 18. Unit No. 3 began commercial operation February 12, 1964.

In February of 1963, Reclamation opened the remaining two bids for construction work on the project. Reclamation awarded the first, for final clearing of Flaming Gorge Reservoir to Herman H. West and Company on March 6. The contractor completed the bulk of the work by the end of July with final completion of the contract in October. Reclamation awarded the second contract, for construction of the Flaming Gorge Visitors' Center, to Moe McCullough

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22. *Technical Record of Design and Construction*, 513-6; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume VII, 1962, 1-6, 9-10, 14, 54, 59.

Construction Company of Salt Lake City, Utah on March 13, 1963. Work began on the Visitors' center building on May 20, 1963. The contractor completed the project on February 20, 1964.

In March of 1963, some seepage was observed on the right abutment downstream from the dam. In order to correct the problem, Reclamation instructed the contractor to drill eight right abutment drainage holes from the diversion tunnel. The drainage holes noticeably decreased the surface seepage on the right abutment.

Project officials completed the final construction report and submitted it to the Chief Engineer in July of 1964. Soon after, Reclamation transferred the last construction personnel from the project, signaling the end of construction activities on the Flaming Gorge Unit. Reclamation transferred the dam, powerplant and switchyard to Operation and Maintenance (O&M) status July 1, 1964; Reclamation began staffing for O&M in May of 1963.[23]

On August 17, 1964, Lady Bird Johnson became the first woman to dedicate one of the West's huge Reclamation dams. The First Lady dedicated Flaming Gorge Dam while on a four-day tour of Idaho, Montana, Utah, and Wyoming, accompanied by Secretary of the Interior Stewart Udall. After a brief lake cruise to the east shore of Lucerne Valley the First Lady headed for Green River, Wyoming and a western-style buffalo barbeque where she also dedicated the Flaming Gorge Recreation Area. In her dedication speech the First Lady remembered the pioneers and dreamers, including John Wesley Powell and Brigham Young, that had traveled the area and the west before and urged residents to remember these early dreamers while building the future. Commissioner Floyd Dominy attended the dedication ceremony but

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23. *Technical Record of Design and Construction*, 517-22; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume VIII, 1963, 1-4, 6-7, 28, 44.

did not accompany the First Lady on her western tour.[24]

Flaming Gorge Dam spans the Green River in extreme northeastern Utah just downstream from the Utah-Wyoming border and near the border the two states share with Colorado. A concrete thin-arch structure, the Dam extends 1, 285 feet across Red Canyon with a maximum height of 502 feet. With a maximum base thickness of 131 feet and a top thickness of twenty-seven feet, the structure contains 987,000 cubic yards of concrete.

Flood waters spill through a 675 foot-long tunnel spillway extending through the left abutment. With a maximum capacity of 28,800 cubic feet per second (cfs), the concrete lined tunnel reduces in size from twenty-six and one-half feet in diameter at the upstream portal to eighteen feet in diameter at the downstream portal. Two sixteen and three-quarters by thirty-four foot hydraulically operated fixed-wheel gates control the spillway intake structure.

The outlet works consist of two seventy-two-inch steel pipes extending through the Dam. The pipes narrow to sixty-six inches at the toe of the dam and continue downstream to a valve structure on the left riverbank which directs discharge into the river channel. A sixty-six inch hydraulically operated ring-follower gate at the downstream toe of the dam controls each outlet and a sixty-six inch hydraulically operated hollow-jet valve controls the outlets at the valve structure. Discharge capacity of the outlet works at elevation 6,045 feet is 4,000 cfs.

The Flaming Gorge Reservoir extends up the Green River into Wyoming. It is the second largest reservoir of the CRSP. With a total capacity of 3,788,900 and an active capacity of 3,515,700, the Reservoir covers a surface area of 42,020 acres. A generally narrow reservoir,

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24. "President Johnson's Wife Dedicates Flaming Gorge Dam—A First for the First Lady," *Reclamation Era* 50, no. 4 (November 1964): 77-8.

with a maximum width of about nine miles near Linwood, Utah, the reservoir extends ninety-one miles upstream to within about four or five miles of Green River, Wyoming.

Flaming Gorge Powerplant, located on the downstream toe of the Dam, houses three 36,000-kilowatt generators driven by three 50,000-horsepower Francis-type turbines. In 1991 and 1992, Reclamation uprated each generator to 50,650 kilowatts. Three ten-foot-diameter penstock pipes near the center of the dam carry water to the powerplant.[25]

Post-Construction History

In 1968, a slide developed in the switchyard. To correct the problem, Reclamation installed a buried pipe drain on the uphill side of the switchyard. After installation of the pipe drain, Reclamation found no additional evidence of seepage or moving of the switchyard embankment. In 1973, Reclamation personnel again noticed seepage in the switchyard area directly attributable to a rise in reservoir elevation. Reclamation opted to deepened the interception and drainage ditches along the fences. They also excavated the moister areas along the north fence and backfilled the area with coarse gravel to accelerate seepage withdrawal. The measures taken in 1973 seemed to correct the problem and Reclamation encountered no further difficulties with the area.[26]

In 1976, Reclamation completed designs for modifications to the intakes to the power penstocks at the dam. Reclamation designed the modifications, a shutter system of three selective withdrawal structures, to establish temperature control for water released into the river below the dam to reduce the stress on local fish caused by releases of cold water from the

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25. *Project Data*, 357-8; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Volume IV, 1959, 15-6.
26. United States Department of the Interior, Bureau of Reclamation, "*Flaming Gorge Dam and Power Facilities: Operation and Maintenance Report*," Upper Colorado Region, Denver Office: Operation and Structural Safety Group, 1964-1984), 4, 7.

reservoir. The selective withdrawal structures affect the downstream water temperatures by withdrawing water from the warmer surface level of the reservoir. Soon after completion of the design modifications Reclamation awarded a contract for construction. The modifications went into operation June 20, 1978. After the modifications went into operation, Reclamation and the Utah Division of Wildlife began a joint study of the downstream effects of the modifications on the fish. The modifications functioned as intended resulting in some apparent changes in the downstream fishery. Fish growth improved significantly in the 1978 season. The water temperature increase caused the fish to feed more actively which in turn resulted in larger fish.[27]

In 1983 and 1984, fish and wildlife in and near the CRSP reservoirs faced new and dramatic changes to their environment. High spring flows decreased average water temperature, increased the stage and velocity of most tailwater discharges, and inundated hundreds of acres of stream side terrestrial habitat. In some areas, water velocities removed substrate materials eliminating riparian areas and sandy beaches adjacent to tailwater reaches. Fortunately, deposition of much of the suspended material following the high water formed new beaches allowing reestablishment of riparian growth. Despite the dramatic changes in their habitat caused by the flooding, fish and wildlife remained resilient.

In 1983 and 1984, all of the reservoirs within the Upper Colorado River Basin received greater total inflows than in previous years; record flows broke the pre-1922 recorded flows dating back to 1897, marking two years of the worst flooding along the upper Colorado mainstream in more than fifty-years. The major storage reservoirs made large flood control releases as they filled to capacity and began to spill in late June and early July of 1983.

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27. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol X, 1976-1978, 36-7; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol XI, 1979-1981, 7-8.

Reclamation, in conjunction with the Corps of Engineers, operated all of the reservoirs in accordance with established operating criteria and flood control regulations. Though both Flaming Gorge and Glen Canyon (Lake Powell) Reservoirs do not have any specific flood control requirements, Reclamation used them to reduce flood flows; Reclamation operates both reservoirs to reduce spills. In 1984, Lake Powell completely filled due to high inflows, consequently Reclamation utilized Flaming Gorge to reduce inflows into Lake Powell; by the end of June, Flaming Gorge Reservoir was brought to a nearly full condition. Despite efforts to reduce flooding, the Upper Colorado Region incurred considerable flood damage. Flooding affected private businesses, residences, farmland, roads, bridges, and Federal Government facilities.

In May of 1982, minor repair work, necessitated by cracking, began on the spillway outlet tunnel. The contractor later declared bankruptcy and terminated the contract. Reclamation re-awarded the contract and accepted work on the spillway tunnel repair as substantially complete in 1983. Additional work was planned during the summer, however the above average flows necessitated the use of the spillway, delaying the repairs until a later date. The remaining repairs were completed in 1985, readying the spillway for use during the 1986 spring runoff.[28]

At approximately 6:00 p.m., on the evening of Saturday, June 21, 1997, one of the two sixty-six-inch river outlet pipes at the dam ruptured. The rupture allowed reservoir water to quickly flood the outlet works gatehouse and the adjacent powerplant causing the remotely controlled generating units to automatically shutdown. The shutdown sequence in turn, closed

28. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol XII, 1982-1984, 7-8, 46-9; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol XIII, 1985, 23.

the penstock gates which significantly reduced the flow in the Green River below the dam. Reclamation personnel were forced to close the ring-follower gate upstream of the rupture to stop the flooding and uncontrolled release of reservoir water. Reclamation personnel sent to inspect the incident concluded that the event should not have occurred. Earlier Safety Evaluation of Existing Dams (SEED) and Review of Operation and Maintenance (RO&M) inspections did not identify damage to the interior of the outlet pipe as cavitation; inspectors consistently reported the damage as corrosion and Reclamation treated the pipe accordingly.[29]

Reclamation let the contract for repairs to the outlet pipe on December 7, 1997 to Nielsons Inc., of Cortez, Colorado. The contractor began work soon after. Work under the contract included replacement of the damaged sections of the outlet tube. In addition, the contractor was responsible for installation of new controls for the ring-follower gates, and the spillway gate to be tied together with the temperature control equipment at the dam. The controls allow Reclamation to control the river outlet works and spillway gate and observe all operations from one location; currently control of the river outlet works and spillway gate remains at Flaming Gorge. Reclamation anticipated a completion date in June of 1998. The failure of the outlet pipe did not affect operation of the dam and reservoir in addition, the powerplant has operated at full capacity since the incident. In addition, the failure caused an imperceptible effect on the downstream fish populations.[30]

As of 1998, the Bureau of Reclamation retains operational and maintenance responsibilities towards the Flaming Gorge Unit. The Flaming Gorge Field Division, an

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29. United States Department of the Interior, Bureau of Reclamation, *Flaming Gorge River Outlet Pipe Failure Incident Report*, (Upper Colorado Region: September 1997), 2-3, 16-21.
30. *Flaming Gorge River Outlet Pipe Failure Incident Report*, 29-30; Painter, Jeff, Upper Colorado Regional Office, Salt Lake City, Utah, telephone conversation with author, 10 March 1998.

organizational entity of the Upper Colorado Region's Power Office in Salt Lake City, Utah, operates and maintains the Flaming Gorge Dam and Powerplant. The Glen Canyon Dam Control Center, also an element of the Power Office, remotely controls the powerplant.[31]

Settlement of the Project

Except for the Navajo Unit, which provides supplemental irrigation waters to the Navajo Indian Irrigation Project, the CRSP Units do not provide irrigation waters to surrounding lands. As such the Flaming Gorge Unit does not include project lands for settlement. The project did facilitate settlement of the small community of Dutch John in Daggett County, Utah, due to its proximity to the construction site.

Uses of Project Water

The Flaming Gorge Unit helps to provide necessary long-term regulatory storage of the Green River. This assists the States in the Upper Basin of the Colorado River in meeting their flow obligations at Lees Ferry, Arizona, as required under the terms of the Colorado River Compact and the various other compacts governing the River. Flaming Gorge also permits the Upper Basin to use their apportioned share of the river. The powerplant located at the dam produces a portion of the electrical energy needed in the Upper Basin. Revenues from power development on the project assist with repayment costs of the project; any remaining funds are then applied to irrigation costs, beyond the repayment abilities of the project irrigators, incurred on the participating projects.[32]

The Flaming Gorge Unit also provides recreational opportunities for nearby residents and

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31. *Flaming Gorge River Outlet Pipe Failure Incident Report*, 14.
32. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol II, 1957, 10; "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol IV, 1959, 13-4.

visitors from around the United States. Currently, the United States Forest Service administers the recreation area, a National Recreation Area, as part of the Ashley National Forest.[33] Stocked with various varieties of fish, the reservoir provides excellent fishing opportunities for anglers. Additionally, the reservoir offers areas for boating, swimming, picnicking, camping, and other outdoor activities.

Conclusion

Flaming Gorge Dam stands as a tribute to man's ingenuity, while the fiery canyon behind it reflects the beauty and expressiveness of nature and its integral part in our lives. Today visitors safely recreate in the same canyons that John Wesley Powell traversed somewhat hazardously so long ago. Helping to regulate the waters of the Colorado and Green Rivers, Flaming Gorge Dam and Reservoir help provide the Upper Colorado River Basin states with necessary waters for development while still allowing them to meet their flow obligations to the Lower Colorado River Basin as dictated by the Colorado River Compact.

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33. "Annual Project History, Flaming Gorge Unit, Colorado River Storage Project, Utah-Wyoming" Vol XVI, 1988, 8.

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