

Grand Valley Project

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1994

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The Grand Valley Project

In the early morning hours of September 4, 1881, the sound of a bugle echoed across the valley of the Grand River in western Colorado, signaling the opening of the valley to settlers. Early explorers to the area had described the flat, desert-like, valley as unsuited for agriculture. They would soon be proven wrong. Within a year of its opening, settlers had begun to turn the valley into an agricultural paradise. Irrigation water diverted from the Colorado and Gunnison Rivers turned the desert into an oasis.¹ Almost immediately upon the opening of the valley, irrigation systems began converting the landscape, bringing thousands of acres of fertile land into production. In 1907, Secretary of the Interior, James R. Garfield, approved the plan for the construction of the Grand Valley Project by the Bureau of Reclamation, then known as the United States Reclamation Service. This project provided a significant boost to the valley by supplying a reliable source of irrigation water to thousands of acres of farmlands and orchards.²

Project Location

The Grand Valley, located in western Colorado, is a broad valley about 12 miles wide and 35 miles long. The steep cliffs that flank its side have been cut by the Colorado River that slices through the valley on its way to the Gulf of California. About mid-way through the valley, the river, with origins in the high mountains of Rocky Mountain National Park, is joined by the Gunnison River. At this intersection is the City of Grand Junction, largest of several towns that lie within the valley. Other communities in the valley are Fruita, Palisade, Loma, and Mack.³

The average altitude of the valley is about 4700 feet above sea level. The climate is fairly mild, with a mean temperature of 53 degrees. Highs may reach over 100 degrees in the summer, with temperatures occasionally falling below zero in the winter. Annual precipitation is just over 8 inches, and the growing season is about 190 days. The primary crops are corn, alfalfa, wheat, beans, and sugar beets. In the eastern end of the valley, near Palisade, where high

1. The Colorado River was known as the Grand River until 1907, when the name was changed by the Colorado Legislature. The change was approved by the U.S. Congress in 1921.

2. Reedy, William W., "The Grand Valley Project," paper presented at the ASCE National Water Resources and Ocean Engineering Convention, San Diego, California, 5-8 April 1976.

3. *Ibid.*

cliffs protect the area from frost, there are many apple, peach, and pear orchards. There is also a large livestock industry in the valley.⁴

Prehistoric Setting

The earliest evidence of human occupation of the Grand Valley region dates back to the Archaic period, about 5,500 B.C. to 1 A.D. Although there have been isolated finds of artifacts that date back to the Paleo-Indian Period, 10,000 B.C. to 5,500 B.C., the nature of these finds suggest that the artifacts were transported into the area by later inhabitants. Some of the oldest evidence of human occupation comes in the form charcoal samples from fire pits. Samples dating back to between 6,100 and 5,100 B.C. have been located in west central Colorado. Numerous others suggest an almost constant occupation from around 300 B.C. Most of the evidence is in the form of charcoal and tree ring analysis, but a sample of human bone has been dated to sometime between A.D. 1035 to 1255.

It is believed the Ute Indians entered western Colorado sometime around A.D. 1000. The earliest reference to the Ute appears in historic Spanish documents from the 17th century, and members of the Dominguez-Escalante Expedition observed the Ute in west central Colorado in 1776. Throughout the historic period, the Ute were the sole inhabitants of the plateau region of western Colorado until they were removed to reservations in Utah in 1881.⁵

Historic Setting

Prior to settlement in the 1880's, the valley was part of the Ute Indian Reservation. What little that was known of the region came from the reports of early pioneers and the Hayden Expedition of the 1870's. A geologist with the Hayden Expedition named Beall, wrote of the valley: ". . . for the most part a desert, covered with a sparse growth of stunted sage brush, which grows in a stiff alkaline soil made from the debris washed from the Book Cliffs". In August of 1881, the Indians were removed to the Uintah Reservation in Utah, and in September, 1881, the

4. U. S. Department of Interior, Water and Power Resources Service, *Project Data, 1981*, (Denver: Government Printing Office, 1981) pp. 516-7; Reedy, William W., "The Grand Valley Project."

5. Reed, Alan D., *West Central Colorado Prehistoric Context*. (Denver: Colorado Historical Society), 14, 25, 43, 52-6.

valley was opened for settlement.⁶

A great number of homesteaders waited in the towns along the frontier, and when word of the opening arrived, there was a rush to secure the best lands. Before long the city of Grand Junction had been founded, and the land north of the river had all been claimed. This land was most desirable because it could more easily be irrigated.

Construction began on the first irrigation projects in 1882 with construction of the Pacific Slope Ditch to supply Grand Junction with water, and the Pioneer or Mesa County Ditch. Soon work began on the Independent Ranchman's Ditch, to supply water for the town of Fruita, and on the Grand Valley Canal, the largest and most comprehensive system in the valley. Development of the valley was rapid, and by 1886, there were over 10,000 acres under cultivation. In 1886, the Pacific Slope, Independent Ranchman's, and Mesa County Ditches were joined with the Grand Valley Canal and the combined irrigated area reached approximately 45,000 acres.⁷

Following consolidation of the Grand Valley Canal, all lands that could be irrigated at minimum cost were covered. The remaining irrigable land in the valley was at a higher altitude than the canal system, and could only be reached by pumping water: an expensive process. In spite of the cost, a number of projects were completed that pumped water to ditches that served higher lands. The Price Ditch was completed in the early 1890's, and the Stub Ditch in 1903. Both systems operated well into the 1900's when they ceased to function due to failures of their pumping systems.⁸ Systems that pumped water to higher ground worked, but they were expensive and unreliable. Seeking to avoid pumping, an attempt to construct a gravity fed ditch along the "high line" was made in 1896, when George Smith and Alexander Struthers built the Smith and Struthers Ditch. Their ditch took its water from Plateau Creek, just above its confluence with the Colorado River. While this project showed promise, the creek did not provide a sufficient flow of water, and much of the ditch was washed away by heavy rains. The

6. Denver. National Archives and Records Administration: Rocky Mountain Region. "Annual Project Histories: Grand Valley Project." 1913, 28. (Annual Project History hereafter cited as Project History, followed by year and page.

7. *Ibid.*, 28-30.

8. Reedy, William W., "The Grand Valley Project"

ditch was abandoned soon after it was completed.⁹

On the south side of the river, two ditches provided water to the Orchard Mesa area. These ditches relied on water pumped from the river about one mile south of the town of Fruita, and began operation in 1910. In 1907, a diversion dam was constructed on the Gunnison River to provide water for the Redlands Mesa Power Canal. In 1917, this canal also provided water to 3,800 acres of land on Redlands Mesa, on the southern bank of the Colorado River.¹⁰

Project Authorization

The Grand Valley Project was one of the first six projects to have lands withdrawn following passage of the Reclamation Act of June 17, 1902. The act created the United States Reclamation Service as a branch of the U.S. Geological Survey, and provided for establishment of a fund to finance the construction of irrigation projects in 16 states west of the 100th meridian.¹¹ Sale of public lands and resources that were mostly located in the states that would benefit from the act provided the funds. Water-users would replenish the fund through interest-free repayment of the cost of construction of projects. The withdrawal of lands from settlement prevented them from being dispersed before project construction.¹²

Following withdrawal of land, the Reclamation Service conducted a survey and plans were drawn up in preparation for the beginning of construction. In 1903, a Grand Junction group proposed that the project be constructed by a private party using private financing. Not wanting to interfere with the practice of private enterprise, the Reclamation Service discontinued work on the project.¹³

After several years, it became apparent that the plan for private construction would not proceed, and the Grand Junction Chamber of Commerce approached the Secretary of Interior about the possibility of the Government continuing with the project. The Secretary agreed pending approval by the citizens of Grand Valley. On November 25, 1907, following the

9. "Project History," 1913, 31-2.

10. Reedy, William W., "The Grand Valley Project."

11. The United States Reclamation Service became the Bureau of Reclamation in 1923. See Warne page 27.

12. William E. Warne, *The Bureau of Reclamation*, (Boulder: Westview Press, 1985), pp. 9-14, 27.

13. "Project History," 1913, 33-8.

"unanimous approval" of the people of Grand Valley, the Secretary approved the continuation of the project by the Reclamation Service.¹⁴

On March 10, 1909, the Director of the Reclamation Service gave the Supervising Project Engineer authority to begin limited construction, but the approval was withdrawn in May 1909 after questions were raised regarding the legality of the cooperative agreement between the Federal Government and the Water Users Association. As a result, construction was again delayed for several years.¹⁵

On June 25, 1910, the U. S. Congress passed a bill that provided \$30,000,000.00 for reclamation projects. Acting under authority of the act, Secretary of the Interior, James R. Garfield appointed a board of Army engineers to visit the projects, examine the data, make recommendations as to the distribution of funds. The Board met in Grand Junction in September of 1909, and their findings were released the following January. The report determined that the project was feasible and allocated \$1,500,000.00 to the project.

On September 23, 1912, after a series of lengthy delays, the Secretary of Interior gave the Reclamation Service authorization to begin construction.¹⁶

Construction History

The Grand Valley Project consists of a single, 14 foot high, concrete diversion weir on the Colorado River with a movable crest that provides water to four canals that stretch over 90 miles through the region. The Government High Line Canal, completed in 1917, is 55 miles long and carries 1,675 second feet (s/f) of water. Major features of the canal are three tunnels of 1,655 feet, 3,723 feet, and 7,486 feet. There are also several major siphons that carry canal water under stream beds and across other obstacles along the canal's route. These include the Jerry Creek, Asbury Creek, and Coal Creek siphons.¹⁷

The Orchard Mesa Power Canal diverts 800 s/f of water from the Government High Line Canal via the Colorado River Siphon between tunnels No. 2 and 3, and delivers it to two canals,

14. *Ibid.*, 39-46.

15. *Ibid.*, 63, 68.

16. *Project Data*, 515.

17. *Ibid.*, 517-8.

the Orchard Mesa Canal No. 1, and the Orchard Mesa Canal No. 2, that service the Orchard Mesa Division on the south side of the Colorado River. The Orchard Mesa Canal No. 1 is 15.5 miles long and carries 85 s/f of water, while the Orchard Mesa Canal No. 2 is 16.1 miles long and carries 65 s/f of water. There are also a number of siphons on the Orchard Mesa Canal system. The Orchard Mesa Division was completed in 1924.¹⁸

There is also one power plant associated with the project. The Grand Valley Power Plant was built using funds advanced by Public Service Company of Colorado, and began operations in 1933. The plant is located about 1 mile south of Palisade, and has a capacity of 3,000 kilowatts.¹⁹

In addition to the features noted, there are also over 160 miles of laterals, 100 miles of drains, and two pumping stations associated with the project.²⁰

In 1897, surveyor C. D. Page of Greeley, Colorado, who surveyed the unsuccessful Smith and Struthers Ditch, established a line beginning at a point on the Colorado River above the mouth of Plateau Creek and running west to the Excelsior Divide on the Colorado/Utah border. Page reported that his line would provide water for irrigation to a significant area without the expense of complex pumping systems. Although Page's line seemed feasible and several engineers agreed with his assessment, the costs were too high for private construction, and no work was done on the plan until the Reclamation Act of 1902 was passed.²¹

Within days of the passage of the Reclamation Act, the lands in the valley that had been surveyed were withdrawn from entry. This protected the lands from being claimed or put into use for other projects. Gerard H. Matthes was placed in charge of a survey team that would investigate the proposed canal alignment. Assisting Matthes and his team was A. J. McCune, an engineer from the Grand Valley Canal and future State Engineer for Colorado. Matthes and his crew began work on September 18, 1902, and worked through the winter of 1902-03. The survey covered a broad area as to allow for a number of possible locations for the canal. Matthes

18. *Ibid.*, 518-9.

19. *Project Data*, 519.

20. *Ibid.*, 517.

21. "Project History," 1913, 31-3.

concluded that the flow of the river was sufficient to supply 2,000 acre/feet (ac/ft) of water during the irrigation season. He also concluded that it was not practical to attempt to extend the system beyond the Excelsior Divide into Utah as some had envisioned.²²

In June 1903, a consulting board met in Grand Junction to review Matthes' report. They agreed with his report and concluded that, although it was not practical to attempt to transport water west of the Excelsior Divide, it would be beneficial to construct a canal to serve lands east of the divide. The board determined that the benefits of such a canal would outweigh the costs. Their analysis determined that 51,000 acres could be irrigated over and above that already under irrigation. They further concluded that the cost would be about \$27.00 per acre. The board forwarded the plan for a final survey and cost estimate, but before the board's recommendations could be acted upon, a group representing a number of private interests in the valley came forth hoping to profit from the work done by the Reclamation Service. This group, using the favorable reports of the Government, hoped to raise the necessary capital for the project and therefor profit as the project's promoters. At the end of 1903, the Reclamation Service suspended all work on the project pending consideration of the matter.²³

No further work was done on the project until 1907, when Secretary of the Interior James R. Garfield visited the area. At that time, the proposed project caught his attention, and he ordered the Reclamation Service to check the previous surveys and estimates and report to him on the feasibility of the project. J. H. Quinton, the supervising engineer for the district, selected E. E. Sands, who had been a member of the Matthes survey team, to conduct the investigation and submit a report. Sands spent the entire month of September 1907, conducting his research, and on October 21, 1907, he presented his report to Quinton. Sands' report supported the findings of the previous investigations. Sands further estimated that in addition to the 60,000 acres to be supplied by gravity, an additional 6,000 acres could be serviced by pumped water. Sands estimated the cost to be about \$40.00 per acre, and that the value of the lands in question

22. *Ibid.*, 1913, 33-5.

23. *Ibid.*, 1913, 36-8.

was high enough to warrant completion of the project.²⁴

In November of 1907, Interior Secretary Garfield sent a letter to D. W. Aupperle, Secretary of the Grand Junction Chamber of Commerce, expressing his views on the proposed project. In the letter, Garfield stated that the Department of Interior was interested in the project, but that the funds were not available for construction at that time. He suggested that Aupperle present the people of the Grand Valley with two proposals:

1. The Department of Interior release all lands currently withdrawn and abandon the project completely, or:
2. Prepare surveys, proceed with acquiring rights-of-way, and begin preparation of detailed plans with the understanding that the work would be completed as funds become available.

On November 14, 1907, a meeting of the citizens, landowners, and homesteaders of Grand Valley was held in Grand Junction, and the second proposal was unanimously accepted. On November 25, Secretary Garfield wrote the Chamber of Commerce:

"I have received your letter . . . advising me of the action of the Grand Junction Chamber of Commerce . . . in accepting the second proposition made by the Department regarding the irrigation project. . . . The Reclamation Service will now proceed as rapidly as possible in accordance with the proposition made."

On December 13, \$50,000.00 was allotted for project work, office space was leased in Grand Junction, and field work was scheduled to begin in March of the following year.²⁵

In February of 1908, E. E. Sands was appointed Chief Engineer, and Junior Engineer, S. O. Harper, was placed in charge of field work. On March 10, a field camp was located in the Grand River Canyon, northeast of Palisade, and detailed mapping of the canal route began. Because of a possible conflict over rights-of-way between the Government and the newly formed Orchard Mesa Irrigation District, surveys of the first six miles of the canal route were carried with utmost haste. The Orchard Mesa Irrigation District was formed for the purpose of construction of a system to serve lands on Orchard Mesa, on the south side of the Colorado River between Palisade and the Gunnison River. The District proposed the use of private capital for the construction of the system, not wanting to wait for construction of the Government system.

24. *Ibid.*, 1913, 39-42.

25. *Ibid.*, 1913, 42-6.

The system was surveyed in 1907-08 by the firm of Field, Fellows and Hinderlider, and was to be constructed by the Magenheimers of Chicago. The district was to advertise for bids for the construction of the system with it being understood that only firms organized by the Magenheimers would be selected. The Grand Mesa Land, Canal, and Power Company, and the Orchard Construction Company were formed to secure water filings and rights-of-way over Federal lands. Following the approval of Secretary Garfield's proposal, George S. Henry, acting for the Grand Mesas Land, Canal, and Power Company filed claims to 1200 s/f of water on the Colorado River. The company also claimed rights to over 1000 s/f held by other organizations in the area.²⁶

The plans for the Orchard Mesa system threatened to interfere with Reclamation plans. Seeking to protect the interests of the government, Secretary Garfield denied all applications for rights-of-way over the government held lands. This led to prolonged negotiations between the Federal Government and the Magenheimers that led to an agreement that awarded the rights-of-way with certain conditions that were designed to protect completely the interests of the Government. The conditions reduced the amount of water available to the Magenheimers, awarded all remaining water claims to the Government, and gave the Government usage priority during periods of water shortages. On May 16, 1908, the agreement was signed by Secretary Garfield, for the U. S. Government, and C. C. Magenheimer, for the Orchard Construction Company.²⁷

Field work began April 11, 1908, and continued through the summer. By October, the final location of the main canal from the headgate to Palisade had been staked out with several alternative locations determined, and a topographic survey of the entire project area had been completed. Also during this period, the final location for the main canal from Palisade west to the Little Salt Wash was surveyed, test pits dug, and test drilling was begun at several proposed dam sites.²⁸

26. *Ibid.*, 1913, 47-9.

27. *Ibid.*, 1913, 47-51.

28. *Ibid.*, 1913, 51.

On July 30, 1908, Secretary Garfield spent part of the day in Grand Junction. At that time he publicly announced that the government would build the canal, but that the progress of the work would be slow due to a lack of money in the Reclamation Fund. On that same day, an additional \$50,000.00 was allocated to continue work during 1909. In order to speed up the construction, the water users association developed a plan whereby the association would solicit cash and labor from its membership, and the Government would match the value of the water users association's contributions at the same rate. The money and labor supplied by the water users association would be repaid by a face value reduction in charges for water delivery via the Government system. In October of 1908, the water users association secured tentative approval for the cooperative agreement from Secretary Garfield pending a report from the board of engineers on the estimates and plans for the project. The membership of the water users association approved the contract in a special election held in December of 1908.²⁹

On December 10, the consulting board of engineers met in Grand Junction to review the plans and estimates for the project. On December 15, the board submitted their recommendations. Among the recommendations made by the board was that the Secretary sign a contract with the water uses association for construction of the canal; that construction begin by force account and cooperative agreement as soon as funds became available and that work by force account be confined to tunnel No. 3 and by cooperative agreement to land most convenient to the waters use's association; and that negotiations for rights-of-way continue without delay, and that condemnation proceeding should commence immediately if delays in construction should occur.³⁰

Negotiations for water rights and rights-of-way had been in progress for some time. There was a problem with orchard owners in the Palisade area. The canal was to cut through several orchards, and the owners were concerned about damages. On January 26, 1909, the representatives of the Water Users Association and the Mesa County Irrigation District Land Owners Protective Association met to discuss the situation. At that time, the Protective

29. *Ibid.*, 1913, 52-3.

30. *Ibid.*, 1913, 54-9.

Association presented a schedule of damages to the Water Users Association. Although the Water Users Association agreed with the terms and estimates of the Protective Association, the Secretary of Interior refused to accept the terms believing the estimates to be too high. This disagreement led to prolonged negotiations that resulted in investigation of several alternative routes for the canal through the area in question and several threats of condemnation of orchard lands. Negotiations lasted for several years, and on October 1, 1912, rights-of-way through the Mesa District finally passed to the Federal government.³¹

In early February of 1909, D. W. Aupperle, who was now the secretary of the Grand Valley Water Users Association, went to Washington, D.C., to secure the Secretary of Interior's final approval of the cooperative agreement. After much discussion, the Secretary approved the contract with conditions. The Secretary found the damages listed by the Protective association unacceptable and stipulated that negotiations between the Protective Association and the Water Users Association continue or Interior would commence condemnation proceedings. Interior also accepted the cooperative agreement on condition that the Water Uses Association sign a proper contract for repayment of the costs of construction. On February 20, 1909, Secretary Garfield approved the cooperative agreement. This was the last official act regarding the Grand Valley Project that Secretary Garfield performed. On March 4, 1909, Richard A. Ballinger became Secretary of Interior.³²

On March 5, 1909, Supervising Engineer I. W. McConnell wrote the Director of the Reclamation Service, Frederick H. Newell, requesting permission to begin construction on areas of the project not effected by negotiations over rights-of-way. On March 10, the Director replied that construction could begin on tunnel No. 3 and areas to be constructed under the cooperative agreement.³³ In response to that approval, Reclamation printed specifications for the cooperative work, requested bids for the excavations, and commenced preparations for the beginning of work on tunnel No. 3. Work on the construction camp at the tunnel had been underway for several

31. *Ibid.*, 1913, 59-61, 367.

32. *Ibid.*, 1913, 61-2.

33. *Ibid.*, 1913, 63.

days when, on May 4, a telegraph from the Director arrived in Grand Junction ordering that all work be stopped and that rights-of-way negotiations be discontinued until further notice.³⁴

This was Director Newell's response to questions about the legality of the cooperative agreement between the Government and Water Users Association, and the issue was turned over to the Attorney General for review. Upon hearing of the problems, the Magenheimers, already working on the Orchard Mesa Project, submitted a proposal to build the canal for the Water Users Association. This so angered the people of the valley that a mass meeting was held in Grand Junction on May 25, and the Magenheimers were thoroughly denounced.³⁵

On June 2, 1909, the Attorney General declared the cooperative agreement illegal. The opinion focused around problems in the use of funds not part of the Reclamation Fund, and the question of the transfer of water rights from the Orchard Construction Company to the Government in 1908. Secretary Ballinger decided that after negotiating a new agreement with the Water Users Association, and resolution of questions about the transfer of water rights, construction could continue.³⁶

Negotiations with the Water Users Association and the area's irrigation districts continued for several years without agreement being reached. In addition to negotiations with land owners for rights-of-way, negotiations for use of rights-of-way held by the Rio Grande Junction Railroad were also underway. Construction of the canal through the Grand River Canyon would require the railroad's approval of use of land in the railroad right-of-way. In addition, construction of the diversion dam would threaten the tracks during high water. To solve this problem, the Government agreed to raise the tracks five feet at the dam site. Work had to be done without causing any significant delays to rail traffic. After much negotiation and several designs and revisions, the plan was approved and the railroad and Government signed the agreement in August 1913.³⁷

The actual construction began even while negotiations for rights-of-way and water rights

34. *Ibid.*, 1913, 67-9.

35. *Ibid.*, 1913, 69.

36. *Ibid.*, 1913, 70-2.

37. *Ibid.*, 1913, 182, 379.

continued. On September 23, 1912, following conditional approval of the contract between the Government and the Water Users Association, Secretary of the Interior Walter L. Fisher, who replaced Ballinger in 1911, authorized construction to begin on Tunnel No. 1. The plans for Tunnel No. 1 were approved on October 8, and construction began on October 22, 1912.³⁸

Tunnel No. 1 is a 3,723 foot long, concrete lined tunnel, with two portal structures of 80 feet and 50 feet. The tunnel section is horseshoe shaped, 14 feet high with a width that varies from 16 feet to 17 feet 6 inches wide. The maximum water depth is 12 feet, and the carrying capacity is 1,425 s/f. The line of the tunnel was established during a revised survey conducted in May and June, 1912, and was selected with the intention of making the line as short as possible while making the bore through solid material.³⁹ Work on Tunnel No. 1 progressed with two shifts per day working inward from both portals. The tunnel was holed through on September 27, 1913.⁴⁰

Reclamation received authorization to begin construction on Tunnel No. 2 on March 3, 1913, and began work the following day. Tunnel No. 2 is 1,655 feet long with the portals each 100 feet in length, for a aggregate total of 1,855 feet. It's design is the same in almost all respects as that of Tunnel No. 1 except that approximately one-third of the tunnel is unlined. The final location was set by a revised survey of January 1913, and was placed to avoid a long, circuitous route that conflicted with the railroad right-of-way. Tunnel No. 2 was holed through on December 27, 1913.⁴¹

The Director authorized construction of Tunnel No. 3 on September 23, 1913, and construction began on October 20, 1913. Similar in design to Tunnels 1 and 2, Tunnel No. 3 was smaller. Tunnel No. 3 is 11 feet high and 11 feet, 6 inches to 12 feet, 2 inches wide. It is 7,486 feet long with a capacity of 730 s/f. Reclamation established the line for Tunnel No. 3 in 1908 with minor changes during surveys conducted in 1912 and again in 1913, just prior to construction. The location of Tunnel No. 3 reduced significantly the length of the canal and avoided a major conflict with the railroad right-of-way through the canyon. Excavation for

38. *Ibid.*, 1913, 17.

39. *Ibid.*, 1913, 222-3.

40. *Ibid.*, 1913, 20.

41. *Ibid.*, 1913, 18, 20, 166-8.

Tunnel No. 3 proceeded from four headings, one from each portal, and two headings working toward the portals from an audit driven into the tunnel line at about mid-point.⁴²

Tunneling can be a very dangerous occupation; cave ins, unexploded charges, gas pockets, and floods are among dangers that a miner must face. Serious injury is not uncommon. On August 31, 1913, a rock fell from the roof of Tunnel No. 1, striking James Pappas, a mucker, and breaking his back. John C. Page, Junior Engineer for the project noted that ". . . at the end of the year he was still receiving attention . . . Little hope is entertained for his recovery".⁴³ Only three serious accidents occurred during driving of the tunnels, and only minor delays encountered.

The weather was a factor during tunnel construction. Cold weather during construction of the portals for Tunnel No. 2 created difficulty with the concrete work. To counteract the cold weather, workers spread manure over the freshly laid concrete to keep it warm until it set.⁴⁴

Excavations for the Grand Valley Diversion Dam began in late 1913 after considerable debate over the design and location of the feature. The final design called for a gated, concrete weir with a crest length of 546 feet. Flow would be accommodated via six roller gates each 70 feet long, and a single sluiceway 60 feet wide controlled by a single roller gate. The headworks for the Government Highline Canal are located on the west abutment of the weir and consist of nine 7-foot by 7-foot slide gates. The amount of water diverted to the canal is 1,675 s/f.⁴⁵

Because of the proximity of the railroad to the dam site, it was necessary to construct a dam with a spillway system that would maintain the water level at approximately the same elevation during both high and low water situations. After much investigation, Reclamation adopted a roller crest design. The six rollers are each 70 feet long and just over 7 feet in diameter. The ends of the rollers have a toothed rim that engages a toothed rack that is set into a pier at each end of the roller. The rollers are raised and lowered by a chain that is attached to, and partly encircles the roller. When lowered, the rollers provide a secure seal against the top of

42. *Ibid.*, 1913, 40; 1914, 198-216.

43. *Ibid.*, 1913, 341.

44. *Ibid.*, 1914, 186.

45. *Project Data*, 517.

the diversion weir. Power for operation of the rollers is provided by a generator driven by a small engine housed at the west end of the dam. In addition, there is a battery backup system.⁴⁶ The advantages of a roller crest design are simplicity of operation and the wide opening provided. When raised, the openings allow for the passage of large objects such as trees and ice flows over the crest of the dam. The rollers may be used in any combination necessary to maintain the proper water level regardless of the rate of flow of the river.⁴⁷

Design of roller crest dams originated in Europe, and at the time of construction of the Grand Valley Dam, the patents were held by the German firm of Maschinenfabrik Augsburg-Nürnberg A. G. The original plan called for design and construction of the rollers by the patent holders, but the outbreak of World War I prevented completion of the contract. After it became evident the German patent holders would not be able to complete the contract, Reclamation Design Engineer Fred Teichman was recruited to design the rollers based on the German design. Reclamation completed the plans and specifications and submitted them for bids in December 1914. The contract for fabrication went to the Riter-Conley Manufacturing Company of Pittsburgh.⁴⁸ Because of the delays in fabricating the rollers, much of the work on the dam was completed before the rollers arrived at the site.

On June 27, 1913, Oliver T. Reedy reported to Grand Junction and assumed the position of Supervising Engineer in charge of construction. The first step in construction was completion of the sluiceway. This was done in order to divert the flow of the river through it during construction of the main portion of the dam. The first concrete was poured in the sluiceway by Reclamation forces on January 9, 1914, with the river diverted through it on the last day of May.⁴⁹

Construction continued through 1914 and into 1915 without major delays. On two

46. S. O. Harper, "Operation of Grand Valley Roller Dam Proves Satisfactory," *Engineering News Record*, June 27, 1918, p. 1225.

47. U. S. Department of Interior, National Park Service, *Gateways of Commerce: U. S. Army Corps of Engineers Nine Foot Channel Project on the Upper Mississippi Project*. (Denver: U. S. Government Printing Office, 1992), pp. 96-7.

48. "Building a Rolling Crest Dam Across Grand River," *Engineering News*, July 13, 1916: pp. 60-1; Reedy, O. T., "The Construction of the Grand River Roller Crest Dam," *Reclamation Record*, August 1919, p. 378.

49. Reedy, O. T., "The Construction of the Grand River Roller Dam," p. 376.

occasions, unexpected high water overtopped the coffer dam and caused minor delays. The most significant problems occurred when large trees became jammed between the supports of the temporary construction bridge. On occasion it was necessary to use dynamite to clear the jam. This was done by lowering a sack containing several sticks of dynamite and a detonator down to the log, and blowing the log apart.⁵⁰

Due to the dangers associated with working around the swiftly flowing river, a boat and crew were stationed downstream to rescue workers who might fall into the river. On one occasion, a workman fell from the bridge, but was able to catch a rope and save himself from falling into the river and being swept away. Although the workman was safe, his hat fell into the river. Had it not been for the swift actions of the crew of the rescue boat, the hat would have surely been lost.⁵¹

Installation of the first roller began on March 25, 1915. The rollers were shipped to the site in several pieces and had to be assembled prior to installation. The final roller, across the sluice way, was installed in early June, and the dam was officially commissioned in late June, 1915, during the visit of the Congressional Appropriations Committee. In October 1916, after several delays, the last of the operating systems for the rollers was delivered to the site and installation was completed.⁵² At the time of its completion, the Grand Valley Diversion Dam was the largest of its type in the world. Although longer rollers had been installed elsewhere, the combination of six, 70-foot long rollers and one 60-foot long roller made the Grand Valley Dam the largest roller crest dam in the world.⁵³

Work to raise the railroad tracks adjacent to the dam site began on April 1, 1914, and continued until completion on June 10. The material used to raise the tracks came from excavations along the main canal. The material was spread over the tracks, then the tracks were raised using jacks, and the material was then spread out beneath the tracks. Track raising work was done by Greek railroad employees who were paid by the Government. Wages ranged from

50. *Ibid.*

51. "Project History," 1914, 139.

52. *Ibid.*, 1916, 84.

53. Reedy, O. T., "The Construction of the Grand River Roller Dam," p. 378.

\$1.75 per day for laborers, to \$80.00 a month for foremen. In all, 19,725 cubic feet of material was placed: enough to raise the tracks one foot for 17,200 feet.⁵⁴

Although dams and tunnels are the more notable features of the project, it is the canals that make it all work: over 90 miles total, stretching over 50 miles from the dam, and serving over 40,000 acres. The first contract for earthwork on the Highline Canal's Canyon Division was let on June 28, 1913, to the Reynolds-Ely Construction Company of Springville, Utah. Among the conditions of the standardized contract were the requirements that the work day be limited to no more than eight hours and that there be no Mongolian labor used on the project. The contract also prohibited importation of foreigners for labor or the use of convict labor. Work on the contract began on July 9, 1913, and was completed on July 14, 1914.⁵⁵

On June 14, 1914, the contract for earthwork on that portion of the canal running east from Palisade for 30 miles was awarded to the Winston Brothers Company of Minneapolis. The contract called for the excavation of almost 1,900,000 cubic yards (cu/yd) of material. By the end of 1914, over 600,000 cu/yd of material had been removed.⁵⁶ Work under the contract was completed June 15, 1915, six weeks ahead of schedule. Assistant Engineer Fred J. Barnes, in writing the project history for 1915, made special note of the high quality of the work performed by the Winston Brothers.⁵⁷

By the end of 1915, work on the canal had progressed to the point that plans were made for the delivery of water in 1916 to Lateral District No. 1, an area of about 15,000 acres northwest of Grand Junction.⁵⁸ A small amount of water was used to sow winter wheat in late 1915, but this water was released during the process of curing the canals and laterals.⁵⁹ On May 4, 1916, the first official delivery of water through the Government Canal reached farms in Lateral District No. 1.⁶⁰ During 1916, 26 farms received water in District No. 1, irrigating a total

54. "Project History," 1914, 332-8.

55. *Ibid.*, 1914, 19; Specification No. 239, p. 14.

56. "Project History," 1914, 17.

57. *Ibid.*, 1915, 193-4.

58. *Ibid.*, 1915, 337; 1916, "Operation and Maintenance" map, p. 3.

59. *Ibid.*, 1916, 11.

60. *Ibid.*, 1916, 12.

of 1,741 acres.⁶¹ In 1917, Lateral District No. 2, north of Loma, and No. 3, northwest of Mack, were ready for delivery of project water, and 5,289 acres in Districts 1, 2, and 3 were supplied with water. By the end of 1917, Reclamation completed the entire system of canals, tunnels, flumes, siphons, and laterals.⁶²

Post Construction History

Almost as soon as water began to run through the canals, problems began to appear. Leaks developed along the canal and efforts were undertaken to solve the problem. Plowing and compacting the canal floor and walls helped some, but a significant amount of water continued to be lost. The problems were worse in areas where the canal had been cut through shale. One attempt to solve the problem involved sluicing clay into the canal in hopes that the clay would seal the leaks. After several seasons, the seepage problem was reduced, although segments of the canal had to be lined with concrete to alleviate the problem.⁶³

When large amounts of irrigation water are placed upon the land, accommodations for proper drainage must often be made. This is especially true where the soil does not allow for natural drainage. As early as 1904, farmers in the valley recognized the need for proper drainage works. The development of the Grand Valley Project, by increasing the amount of irrigation, heightened the need for a proper drainage system. In 1915, even before completion of the water delivery system, the Grand Valley Drainage District was formed with the intention of contracting with Reclamation for construction of a system to drain irrigated lands. In late 1917, a contract between the Drainage District and the Government was signed, and construction began the following May. In 1921, Reclamation completed work on the drainage system, including several miles of closed drains and over 100 miles of open drains.⁶⁴

Since its completion, the Orchard Mesa irrigation system had been unreliable, and the district bondholders wished to bring the system into a condition that would insure its success.

61. *Ibid.*, 1916, 16.

62. *Ibid.*, 1917, 6, 11, 18.

63. *Ibid.*, 1916, 21; 1917, 14.

64. *Ibid.*, 1915, 11; 1918, 6; Mary Rait, "Development of Grand Junction and the Colorado River Valley to Palisade from 1881 to 1931" (Masters thesis, University of Colorado, 1931), pp. 139-40.

On August 5, 1916, officials of the Orchard Mesa Irrigation District entered into an agreement whereby the government would investigate the possibility of rebuilding the Orchard Mesa system and supplying it with project water. Field work to develop a solution began on August 19, 1916 and finished on January 30, 1917. It was determined that the best plan would be to remove the Orchard Mesa Diversion Dam and divert all district water at the Government Dam. Water would then be removed from the Government Canal above Tunnel No. 3, and sent by siphon across the river and into the existing Orchard Mesa system. The system from that point would be completely rebuilt. Negotiations between the District and Government continued for several years, and in 1921, work began on the Orchard Mesa Division with first water delivered in May 1923. Construction on the entire project was completed in 1927.⁶⁵

In 1917, officials of the Palisade and Mesa County Irrigation Districts approached the Government with a proposal to receive project water. Their systems used the Price and Stub Ditches, and they were concerned about the reliability of their system. The Stub Ditch was at a higher level than the Government Canal, so it would be necessary to pump water to it. In June of 1918, the Districts and the Government executed a contract for the delivery of project water to the Price and Stub Ditches. The plan called for the pumping of water to the Stub Ditch with the pump to be powered with water running through the Price Ditch feeder canal. In return, the Districts would make their power water rights available to the Government. Construction of the Price-Stub pumping plant began in January 1919, and was completed and delivering water to the ditches by May 1, 1919.⁶⁶

Generation of power using project water had been under consideration from the inception of the project. In 1931, the Government and the Public Service Company of Colorado entered into a contract whereby the Government would design and build a power plant using funds provided by Public Service. The plan called for construction of a plant with two generators, producing 1,500 kilowatts each, to be built on the Orchard Mesa Power Canal adjacent to the

65. "Project History," 1916, 13, 76; 1917, 30; 1923, 6; 1927, 4; Mary Rait, "Development of Grand Junction," p. 137.

66. "Project History," 1917, 19; 1918, 30; 1919, 8.

Orchard Mesa Pumping Plant. Construction of the plant began in March 1932, and was completed in March of 1933. The plant was formally transferred to Public Service on April 1, 1933, and immediately began producing power.⁶⁷

By the mid-1930's, project facilities had begun to show a significant amount of normal deterioration. Wooden structures were beginning to fail, culverts washed out, and canal banks and tunnels were beginning to show signs of wear. In 1935, the Civilian Conservation Corps established camps on project lands and began to repair and rehabilitate project features. In the six years that the CCC worked on the project, they lined and reinforced a significant length of the main canal; replaced flumes, culverts, and drops; installed drains; and participated in weed and rodent control projects. In addition, they rebuilt areas of the canal that were deteriorating and in danger of failure.⁶⁸

In March 1941, significant damage was discovered in Tunnel No. 3. As it was near the start of the irrigation season, it was not possible to make permanent repairs to the structure. Following the end of the irrigation season, permanent repairs replaced temporary timber bracing in the damaged areas. Almost 1000 feet of tunnel had to be completely rebuilt.⁶⁹ Problems with Tunnel No. 3 continued for several years and minor repairs had to be made several times until March 8, 1950, when over 450 feet of the tunnel collapsed completely. This occurred only a few weeks prior to the start of the irrigation season, and the Bureau had to act fast to avoid delays in water delivery. On March 17, the contract for the construction of a new tunnel to bypass the collapsed portion was awarded to Grafe-Callahan and Rhoades-Shofer Construction Companies. The companies started the work on March 18, and the new tunnel was holed through on April 4, 24 days ahead of schedule. Water deliveries began on May 4, and continued without interruption through the season. Reclamation began concrete work in December, and finished the following spring.⁷⁰

67. *Ibid.*, 1931, 9; 1932, 3; 1933, 3, 21.

68. For a detailed history of the activities of the Civilian Conservation Corps on the Grand Valley Project, see *Project Histories, Grand Valley Project 1935-42*.

69. "Project History," 1941, 20.

70. *Ibid.*, 1950, 3,4a.

In the late 1940's the Bureau began a major repair and rehabilitation program on the project. The work lasted almost a decade and involved replacement several flumes and siphons, lining of several miles of canal and laterals, replacement of drops and turnouts, and rehabilitation of the diversion dam and rollers in 1957 and 1958. This work ensured that the project would continue to operate well into the future. In 1960, the Colorado Highway Department announced that Interstate 70 would be built through the canyon, and the construction would involve the relocation of part of the Orchard Mesa Power Canal, part of the Colorado River Siphon, and extension of the lower portal of tunnel No. 3. Construction began in October 1961, and was completed in April 1962.⁷¹

The Grand Valley Project has had a significant impact on the history of the Grand Valley region. By providing a reliable source of water to the districts that it serves, the project helped secure a favorable future for those living in the region. The success of the overall project is due in large part to the success of the Grand Valley Diversion Dam. This unique structure, among the largest of its type in the world, allowed for consistent delivery of water to the system while at the same time protecting the right-of-way of the railroad that shares the valley floor with it. In recognition of its importance to the history of the region and the uniqueness of the dam itself, the dam was nominated to the National Register of Historic Places in June 1991, and was placed on the Register in October 1991.⁷²

As one of the earliest projects undertaken by Reclamation, the Grand Valley Project helped launch the careers of a number of prominent Reclamation officials. Siclair O. Harper joined the Project as a Junior Engineer in 1908, and became Project Manager in 1917. In 1925, he was appointed to the position of Superintendent of Construction for the entire bureau. In 1931, Harper was promoted to Assistant Chief Engineer, and in 1940, he became the Chief Engineer of Reclamation. He continued in that position until his retirement in 1945.⁷³

71. *Ibid.*, 1960, 3-4; 1961, 14; 1962, 17.

72. Telephone interview with Dale Heckendorn, National and State Register Coordinator, Colorado Historical Society, 22 July 1994.

73. "Project History," 1913, 190; 1917, 64; 1925, 23; Abstract Guide "S. O. Harper," Collection No. 2089, American Heritage Center. (University of Wyoming: Laramie).

John C. Page joined the Grand Valley Project in 1909 as a chainman and topographer. In 1912, he was promoted to Junior Engineer, and in 1917 he became the Office Engineer. In 1925, following the promotion of Harper, Page became the Project Manager, a position he held until 1930 when he was transferred to the Boulder Canyon Project where he served as Office Engineer. In 1935, Page was promoted to the head of the Engineering Division, and in 1937, he was appointed Commissioner of Reclamation. Page served as Commissioner until 1943. The Town of Page, Arizona, is named for him.⁷⁴

Settlement of the Project

Prior to the completion of the Grand Valley Project, the Grand Valley was already a growing and thriving region. The City of Grand Junction and the Towns of Fruita and Palisade were already well established and growing. The Denver and Rio Grande Railroad provided reliable transportation and ensured the region a constant supply of goods and a means to ship the products of farms and orchards to markets in the east. Although townsites had been set aside on project lands, no towns were founded due to the already well established social and business centers in the valley. Settlement on project lands was slow and somewhat disappointing during the years following completion of the project. In 1916, the Grand Valley Water Users Association contracted with a colonization agent in Kansas City to promote the region and secure settlers for the project, but this effort met with only limited success. By 1921, the number of units applying for project water reached 402, with a total of 12,290 acres irrigated in that year.⁷⁵

Reasons for the slow pace of settlement include the effects of World War I, fluctuating agricultural prices, and the Great Depression. By 1940, 19,700 acres of a possible 40,400 acres of Project land were under cultivation, and the number of farms on project lands totaled 526. Following World War II, agricultural prices rose to a level 75% higher than that of pre-war

74. "Project History," 1913, 199; 1917, 64; 1925, 23; William E. Warne, *The Bureau of Reclamation*, pp. 238-40.

75. "Project History," 1916, 14; 1921, 11, 87.

years, and the demand for Project lands increased with the return of servicemen from Europe.⁷⁶ By the mid-1940's most large tracts of within Project lands had been occupied. In 1965, farmers cultivated 34,160 acres with an average crop value of \$180.75 per acre. In 1976, the area under cultivation dropped to 31,875 acres, but the value of crops per acre rose to \$374.97. In 1982, the area under cultivation had decreased further, with only 29,707 acres under cultivation, while crop values climbed to \$506.75 per acre. In 1989, 25,544 total acres on 803 farms with a total population of 3,552, were under irrigation, with an average crop yield of \$512.52 per acre. In addition, over 21,000 non-farm individuals received Project water in 1989.⁷⁷

Uses of Project Water

The mission of the Grand Valley Project was to supply a reliable source of water for irrigation. This remains the primary purpose of the Project today. Project waters are used to irrigate a large variety of crops and orchards. Crops grown on irrigated project lands include corn, beans, alfalfa, onions, squash, and tomatoes. Fruits raised on project lands include apples, pears, peaches, and grapes. In addition to irrigation, project water is used for the generation of power. The Orchard Mesa Power Plant has produced power from its two 3,000 k/w generators since 1933, and the Cameo Power Plant, built by Public Service Company in the late 1950s, has used project water for cooling since it was constructed.⁷⁸ In recent years, the use of project water for municipal and industrial use has increased due to the number of people moving into the valley.⁷⁹

Conclusion

In the almost 80 years that it has been supplying water for the crop lands and orchards of the Grand Valley, the Project has been one of the most successful reclamation projects constructed. In the years since its construction, the project has seen the modification or

76. *Ibid.*, 1947, 14; United States Department of Interior, *Summarized Data on Federal Reclamation Projects*, November, 1941.

77. United States Department of Interior, Bureau of Reclamation, *Summary Statistics*, (Washington D. C.: U.S. Government Printing Office, 1966) p. 105; 1974, 115; 1983, 141; 1989, 212.

78. Information on the Cameo Power Plant provided by the Media Relations Office of the Public Service Company of Colorado.

79. *Ibid.*, 1991, 218; Telephone interview with Steve McCall, Acting Project Manager, Grand Valley Project, Grand Junction, Colorado, 3 August 1994.

replacement of almost every major structure of the system. The only major features which remain relatively unchanged are the Grand Valley Diversion Dam, Tunnel No. 1 and Tunnel No. 2. All of these changes and modifications insure that the project will continue to serve the needs of the people of the Grand Valley well past the 100th anniversary of the Bureau of Reclamation. While most people see such structures as the Boulder and Grand Coulee Dams as the greatest works of the Bureau of Reclamation, the farmers on the Grand Valley Project, and dozens of other projects like it, may have a strong case for disagreement.

About the Author

William Joe Simonds was born and raised in Colorado and has a solid understanding of the importance of water in the American West and its effect on the development of that region. He attended Colorado State University where he received a BA in History in 1992 and a Masters in Public History in 1995. He lives with his wife and two children in Fort Collins, Colorado.

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