GRACE DAM

HISTORIC CONTEXT

Prepared by TAG Historical Research & Consulting, November 2016

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Grace Dam Historic Context Study

Introduction

This history of the Grace Dam Hydroelectric Power Plant at Grace, Caribou County, Idaho, was prepared by TAG Historical Research & Consulting (TAG) under contract with the Idaho Transportation Department. The detailed history was prepared in association with the replacement of the Turner Road Penstock Bridge, located approximately ¼ miles west of the city of Grace.

This study is stipulated by a Memorandum of Agreement (MOA) signed in 2015 pursuant to Section 106 of the National Historic Preservation Act of 1966 (36 CFR 800). The MOA mitigates the adverse effect from the replacement of the Turner Road Penstock Bridge, a National Register of Historic Places Eligible resource.

The Turner Road Penstock Bridge was determined eligible under Criterion C. The bridge exhibits an engineering design of significance. It is of a unique design, engineered and constructed specifically to span the penstocks for the Grace Dam Power Plant, a hydroelectric plant that converts water to electricity and is considered historically significant as one of the first power grids in the Intermountain West.

The Grace Power Plant is one of three hydroelectric power plants, collectively known as the Bear River Project, in Caribou County owned by PacifiCorp a subsidiary of Berkshire Hathaway Energy.

Construction of the Bear River Project was authorized by the U.S. Secretary of Interior in 1907 to provide irrigation, flood control, and hydroelectric generation. The Grace Development was built in and upgraded between 1906 and 1951. It includes a 51-foot-high timber crib dam, a 250-acre fore bay, a 26,000-foot-long flowline (4.9 miles), and a powerhouse with a total installed capacity of 33 megawatts. The Turner Road Penstock Bridge, located between the Grace Dam and Grace Powerhouse, was built in the 1920s for local farm-to-market traffic over two original Grace Development flowlines.

The other two hydroelectric developments that make up the Bear River Project (Figure 1.1) include the Soda Development which is a 103-foot-high concrete dam, the Soda reservoir (also known as Alexander reservoir), and powerhouse with a total installed capacity of 14 megawatts, and the Oneida Development, a 111-foot-high concrete dam, the Oneida reservoir, a 2,240-foot-long flowline, and a powerhouse with a total installed capacity of 30 megawatts.

In this study TAG has prepared historic context information specifically about the Grace Dam Development. The other developments within the Bear River Project are not addressed in detail in this document. This study is based primarily on historical research and does not involve inventory of buildings, structures, objects, sites, or districts. An extensive inventory was completed in 1998 and 2008 documenting all of these features.

The final products of the study consist of this final report and the draft of two interpretive signs that addresses the history and significance of the Grace Dam complex, including the minor role of the Turner Road Penstock Bridge.

Sources and Methods

Background research began with a review of previous cultural resource inventories and reports, including the Turner Road Penstock Bridge draft overview prepared by Taylor Planning, Chartered in 2015.. Local histories, particularly *Gems of Our Valley* (1977) by Vivian Simmonds and Ruth Varley and *The Last Chance Canal Company* (1987) by Max McCarthy, were useful for their descriptions of the region and provided detailed information regarding early settlement of Grace and the surrounding towns along with specific information about the dam. Several cultural resource surveys, including *A Cultural Resources Survey and Inventory of the Soda, Grace/Cove, and Oneida Hydroelectric Power Plants in Caribou and Franklin Counties, Idaho* (1999) prepared by Sagebrush Consultants, LLC and *A Cultural Resource Assessment in Compliance with PacifiCorp's Bear River Project Historic Properties Management Plan in Caribou County, Idaho* (2008) prepared by SWCA Environmental Consultants provide detailed information about the Grace Dam Development and associated buildings and structures. *Hydroelectric Development in the United States, 1880-1940* (1991) by Duncan Hay is a source to understand the national overview and roots of hydroelectric power. Two studies, *Electric Power Plants of Utah, a Multiple Property National Register Nomination* (1989) prepared by Mark Fiege and Janet Ore, and *Legacy of Light: A History of Idaho Power Company* (1999) by Susan M. Stacy, provide essential information about hydroelectric plants. Fiege and Ore cover Utah and Idaho, while Stacy focuses on the history of hydroelectric power in Idaho, with an emphasis on Snake River developments. John McCormick's *The Power to Make Good Things Happen: Past, Present, and Future: The History of Utah Power and Light Company* (1990) provides information specific to the unique hydroelectric relationship between Idaho and Utah. Finally, several sources were consulted for information about Lucien L. Nunn, including a recently published book by L. Jackson Newell, *The Electric Edge of Academe: The Saga of Lucien L. Nunn and Deep Springs College* (2015). Stephen A. Bailey's, *L. L. Nunn: A Memoir* (1933) also provides information about Nunn.

Caribou County historic newspapers on microfilm at the Idaho State Archives were also consulted. These sources include a Grace newspaper, the *Gem Valley Chronicle*, along with several published in Soda Springs--the *Caribou County Sun*, the *Soda Springs Chieftain*, and the *Soda Springs Sun*. Internet sources include annual reports of Utah Power and Light Company, and engineering and electricity trade journals. The Lucien L. Nunn Collection, in the Division of Rare and Manuscript Collections, Cornell University was another source of information. Mark Stenberg, PacifiCorp Hydro License Program Manager provided background information and historic maps and permission to use historic images of the Grace Dam Complex available on the PacifiCorp website.

Chapter 1

Setting the Stage

The Grace Dam Complex and Turner Penstock road are located in Caribou County, Idaho, near the town of Grace, approximately 33 miles north-northeast of the town of Preston and eight miles southwest of Soda Springs. (Figure 1.2) The Grace Dam was completed in 1908 by the Telluride Power Company, which originally sold its power to distant mining operations in Bingham and Eureka, Utah. The dam sends water via a large pipe called a flowline to a power plant 4.5 miles to the southwest and 525 feet lower in elevation at the end of the Black Canyon. The flowline, follows the top of the plateau above the river, but before making the final drop to the power plant it connects to a surge tank to purge air before sending the water through another pipe called a penstock to the power generation turbines below. The system was purchased by Utah Power and Light Company (UP&L) in 1929. UP&L was purchased by PacifiCorp in 1989.[1]

The Grace Dam Complex sits in the Gem Valley within the Bear River Basin. The Bear River Basin, which is located in northeastern Utah, southeastern Idaho, and southwestern Wyoming, comprises 7,500 square miles of mountain and valley lands, including 2,700 in Idaho, 3,300 in Utah, and 1,500 in Wyoming. The winding Bear River's begins in northeastern Utah and flows northward through Utah and Wyoming, entering Idaho and making a large loop south, flowing south along the west side of the mountains and entering Utah again before emptying into the Great Salt Lake (Figure 1.3). Along this circuitous route it crosses state boundaries five times and is the largest stream in the western hemisphere that does not empty into the ocean. It ranges in elevation from more than 13,000 feet to 4,211 feet and is unique in that it is entirely enclosed by mountains, thus forming a huge basin with no external drainage outlets.[2]

The Middle Bear River Watershed includes all land that drains to the Bear River from below Alexander Dam in Idaho to Cutler Dam in Utah. It is the second largest watershed in the Bear River Basin. After the river leaves Alexander Reservoir, it makes a hairpin turn around Sheep Rock and heads south. At Grace Dam, water is diverted into an aqueduct and delivered to the Grace Power Plant. The river continues through the wide, relatively flat Gem Valley, passes through Oneida Reservoir, and continues south through Cache Valley in Idaho and Utah.[3] Water from the Bear River is ultimately used for irrigation and to generate electricity.

The watershed was first home to Native Americans. By the time of contact with Euromericans, Northern Shoshone and Bannock populations as well as the Northwestern Band of the Shoshone Nations occupied the area. The Northern Shoshone and Bannock inhabited the lands that included most of Southern Idaho below the Salmon River. Today, most of these people live on the Fort Hall Indian Reservation north and east of Soda Springs, Idaho, and on the Duck Valley Indian Reservation near Owyhee, Nevada. The Northwestern Band of the Shoshone Nations occupied many of these same areas.[4]

Exploration and Fur Trade

Euromericans began to explore the Bear River region in the early nineteenth century. The Lewis and Clark Expedition (1804-1806), headed by Meriwether Lewis and William Clark, was the first American overland expedition to the Pacific Coast and back, opening the Pacific Northwest to exploration and the fur trade. Following in the footsteps of Lewis and Clark, fur trappers headed west in search of beaver. Clothing fashions of the early 19th century created a huge demand for beaver fur, which was used to make a popular style of hat. Significant numbers of trappers and traders followed trails and mountain passes into the Rocky Mountains, searching for rich booty in furs.

Early fur companies included The Missouri Fur Company, founded in 1810 by William Clark, Manuel Lisa, Jean Pierre Chouteau, and Andrew Henry. Henry led the company's first group of trappers west and established the first American fur post west of the Rocky Mountains, Fort Henry, on the Snake River near the modern town of St. Anthony. A few years later, in 1818, Donald Mackenzie and a company of North West Company fur trappers from Montreal followed the Bear River into Cache Valley on the Idaho/Utah border. North West Company member Michel Bourdon is credited with naming Bear River, supposedly due to the presence of numerous black bears in the area.[5]

Between 1824 and 1828 Cache Valley and Bear Lake served as a major base for William Ashley's Rocky Mountain Fur Company. Early in 1826 the region became a rendezvous site when several parties moved out of base camp for spring hunts: William L. Sublette and David E. Jackson took an expedition northwest to Payette Lake and John Weber, Jim Bridger and another group went north to the Portneuf River, all returning for the 1826 rendezvous held in Cache Valley.[6]

In 1826 Ashley sold the Rocky Mountain Fur Company to Jedidiah Smith, David E. Jackson, and William L. Sublette. As part of the deal, Ashley agreed to bring supplies to the next rendezvous at Bear Lake. On June 13, 1827, when he returned to Bear Lake with supplies for the trappers' rendezvous, Ashley brought along small, wheeled cannon for protection. His successful trip proved that the route of the later Oregon Trail was suitable for wagons as far as Bear River. [7]

Although there was no wagon traffic during this period and packhorses were the sole means of transportation, the constant search for furs began to mark out the main arteries of travel, particularly the route from the Great Salt Lake to the Beaverhead and Bitterroot regions via the Portneuf-Snake River complex and Monida Pass.[8]

An 1828 rendezvous was the last time the Rocky Mountain trappers gathered at Bear Lake for a summer celebration and trade fair. After this rendezvous, fur hunting shifted away from Bear Lake. An exception was Peter Skene Ogden, who extensively explored the region between 1824 and 1830 for the Hudson's Bay Company (Figure 1.4). He brought his expedition back to Bear River, where he camped near what would become the town of Grace in February 1829.[9]

Soda Springs, at the northern bend of Bear River, was a trading spot for trappers coming through that part of the country. Northwest of Soda Springs, Fort Hall was established in 1834 by Nathaniel Wyeth as an American outpost. It occupied a strategic position in a key area of Northern Shoshone and Bannock tribal activity and served as the fur trade outlet for the whole region. When beaver trapping diminished in the 1840s, former fur trappers began to serve as emigrant guides. Because the Bear River Valley offered easy passage through some of the mountain ranges of the area, it became an important link in transportation networks of the time. A segment of the Oregon Trail ran from Fort Bridger northwest down the Bear River Valley to Soda Springs and then west to Fort Hall on the Snake River.

Early Settlement Patterns

Emigrants headed to Oregon crossed the region but did not settle. Mormon settlement reached Salt Lake Valley in 1847. Mormons gradually colonized areas around and south of Salt Lake and spread north into Idaho. In April 1860, a small company of settlers journeyed toward the confluence of Worm Creek and Cub River at the northern tip of the Cache Valley. There they founded Franklin, which they named in honor of Mormon Apostle Franklin D. Richards. Settlers from Franklin established Paris in the fall of 1864.

By the end of the 1860s, Mormons settlers had started a number of communities in northern Utah and southern Idaho including Laketown, Garden City, St. Charles, Ovid, Fish Haven, Bloomington, Bennington, Liberty, Montpelier, Weston, Rushville and Malad.[10] Continued colonizing by Mormon emigrants who moved north from Utah would eventually lead to the founding of Grace, located on the south-flowing arm of Bear River.

According to author Max McCarthy, settlement of this arm of Bear River was from south to north for two reasons: new areas were established in proximity to other settled areas; and there was increasing difficulty obtaining desirable river bottom lands in Cache Valley and lower Gem Valley. [11] Grace was one of several communities organized in the Gem Valley, originally called Gentile Valley after non-Mormons (Gentiles) who homesteaded in the southern end of the valley on the west side of Bear River in the 1860s. By the early 20th century the valley was known as Gem Valley. Mound Valley and Cleveland in the southern region of the valley, were settled around 1870. Thatcher was settled in 1881. Trout Creek (Lago), Turner, Bench, and Central were settled in the late 1880s and early 1890s. [12]

The area that would become the town site known as Grace was settled in 1889 by Mormon settlers from South Jordan, Utah. When they arrived in the area, they found two homesteads already established by non-Mormons Robert Kirkham and Jim Mickelson. Slowly over the next four years, more people arrived from Utah and other parts of Idaho to populate the area.

In 1893 a bridge was built across Bear River, which ran through a deep basalt canyon just north of the current site of Grace. As the population grew, the settlers petitioned for a post office from the federal government. It was officially recognized on January 1, 1895. David D. Sullivan was appointed postmaster and J. Fred Potter was named mail carrier. The name for the post office was selected when Frank Dean, the Blackfoot land office attorney, suggested Grace, his wife's name.[13]

The growth of Grace was dependent upon irrigation from the Bear River. Early farmers engaged in dry farming, but with little success. Although water ran nearby in the Bear River, the deep canyon made it difficult to use for irrigation purposes. Two early attempts to divert water from Bear River were made but with little luck. To move the water from the canyon it was necessary to build a dam and flumes to carry the water to canals and ditches. Attempts made to build two canals initiated by separate parties in the late 1880s and 1890s. Although these efforts failed, a third effort did not.[14]

In 1897 the Last Chance Irrigation Company filed for Bear River water and selected a site for a dam to provide water for farmland north and south of Grace. Construction started in 1898 and the dam was completed around 1900. Initially, the system was burdened with difficulties. There were problems with the upstream dam. Wooden flumes built to carry water from the dam to the fields were destroyed by heavy winter snows. Finally, between 1902 and 1904, the problems were resolved, and the dam and canal were opened. With the completion of the dam and its distribution canals, water was successfully delivered to Gem Valley and Grace began to grow as the center of commerce and trade for the region. [15] In just a few short years Grace would also be the site of a hydroelectric development with importance to both Idaho and Utah. Irrigation and hydropower interests collided in the early 20th century when Utah Power & Light (UP&L) battled the Last Chance Canal Company for water rights. *The Dietrich Degree of 1919* awarded the water rights to the Mormon farmers who had filed on water rights first. [16]

Chapter 1 – Illustrations and Maps

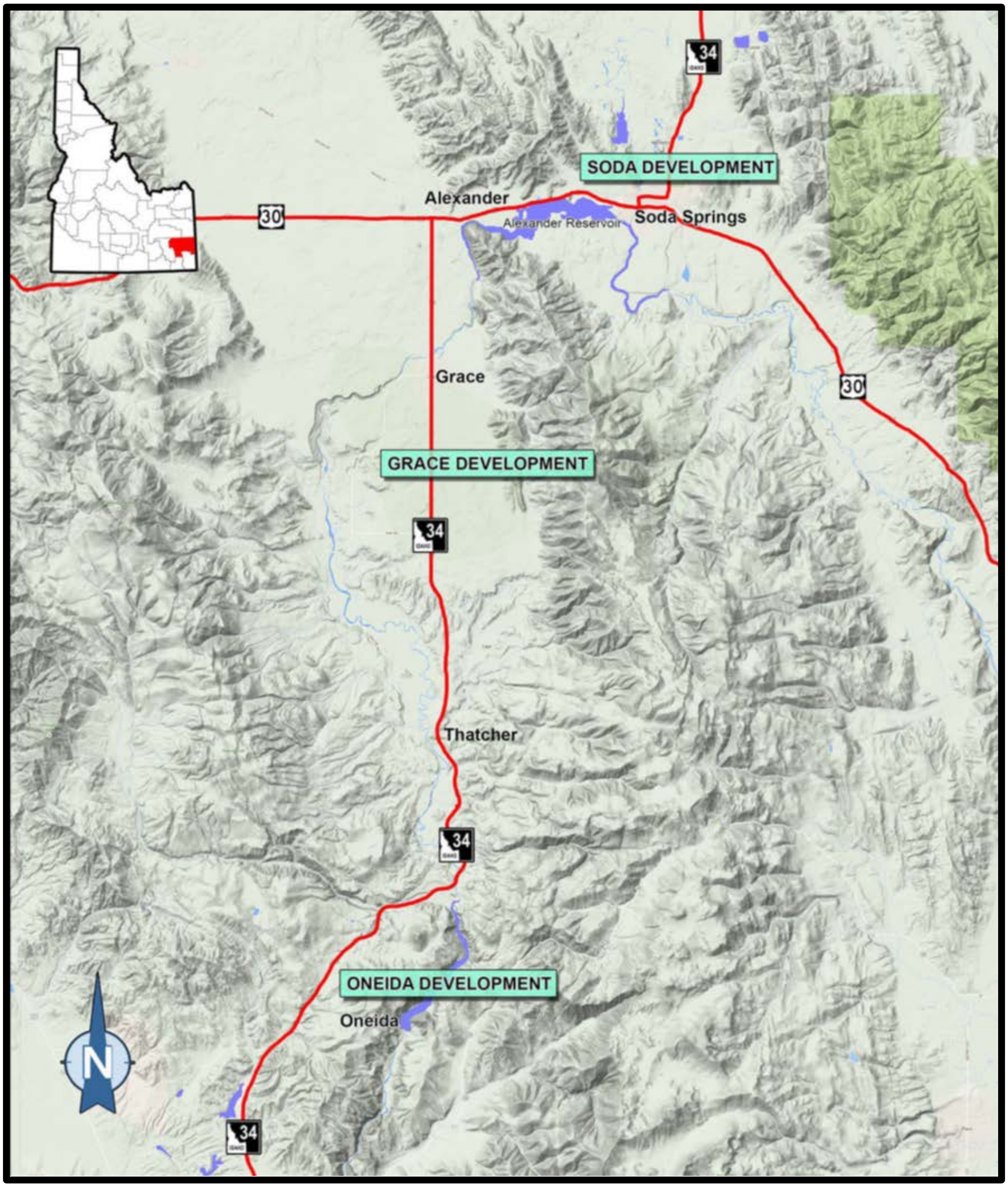

Figure 1.1 The Bear River Project consists of three dams and three powerhouses built from circa 1906 to 1927. (Taylor Planning, Chartered, 2015).

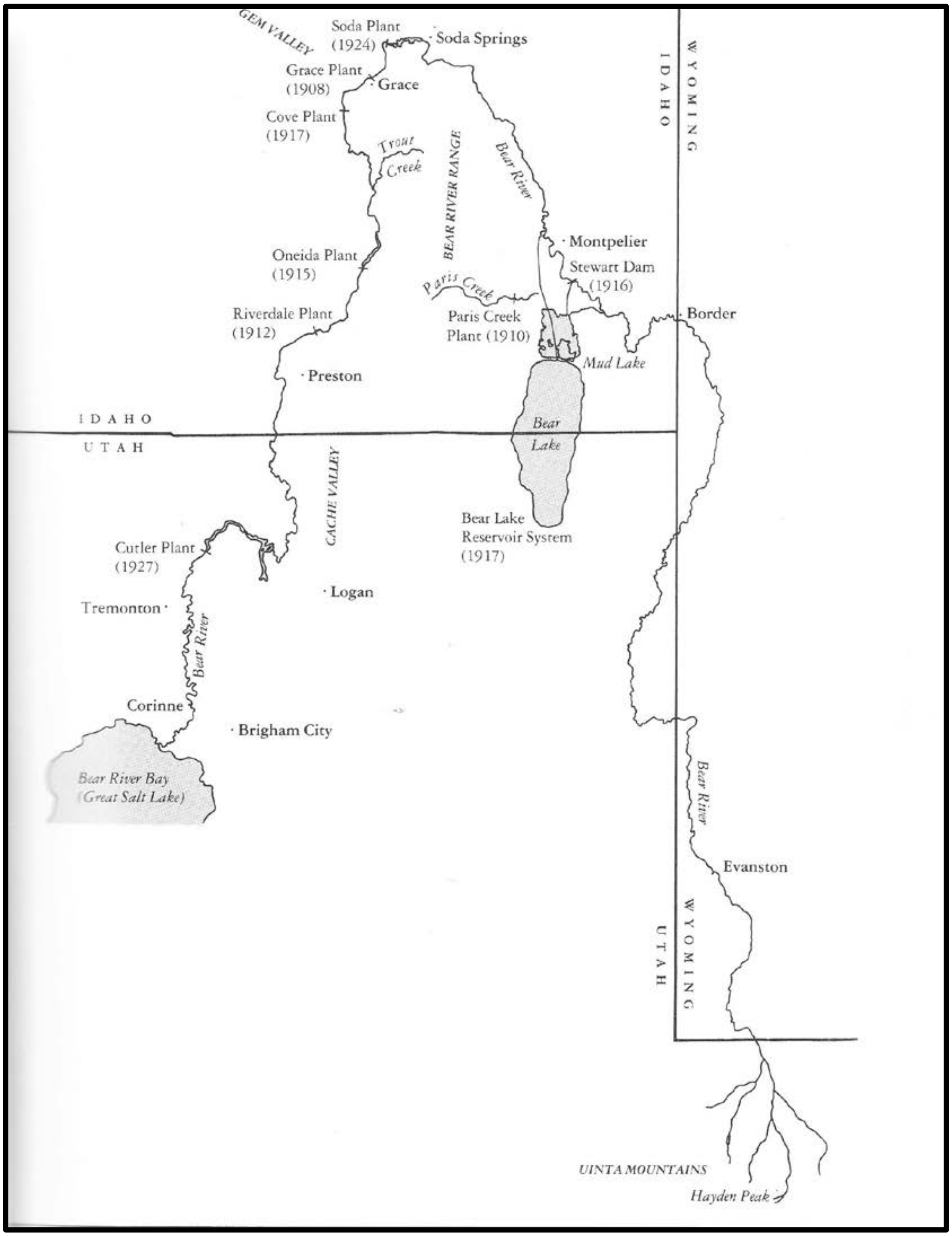

Figure 1.2 Bear River Watershed and Hydroelectric Plants from *The Last Chance Canal Company,* Max R. McCarthy.

Chapter 1 Illustrations and Maps

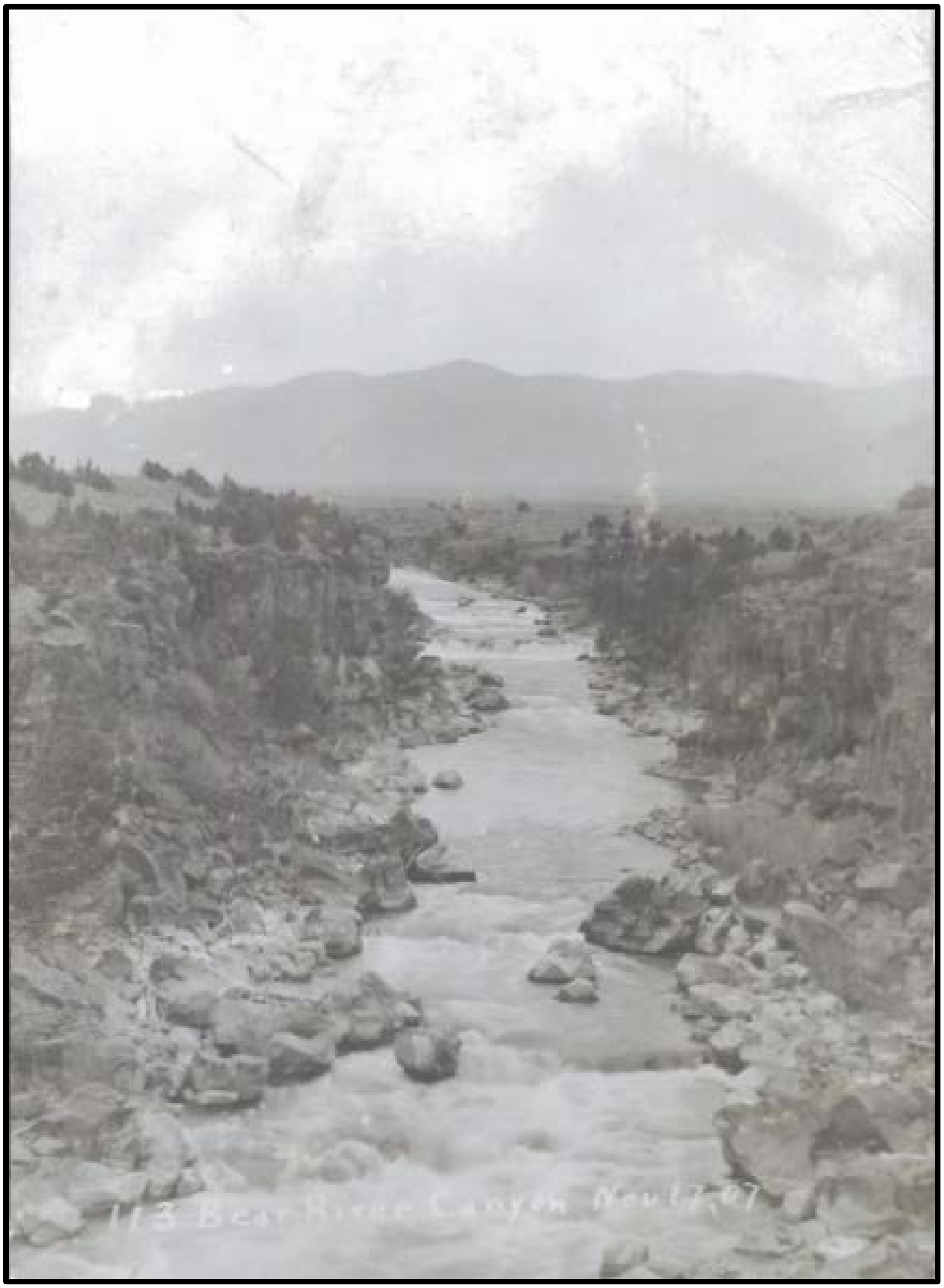

Figure 1.3 Bear River Canyon near Grace, Idaho November 17, 1907. The circuitous river crosses state boundaries five times. It begins in Utah and loops through Wyoming and Idaho before returning to Utah where it empties into the Great Salt Lake. (Courtesy PacifiCorp).

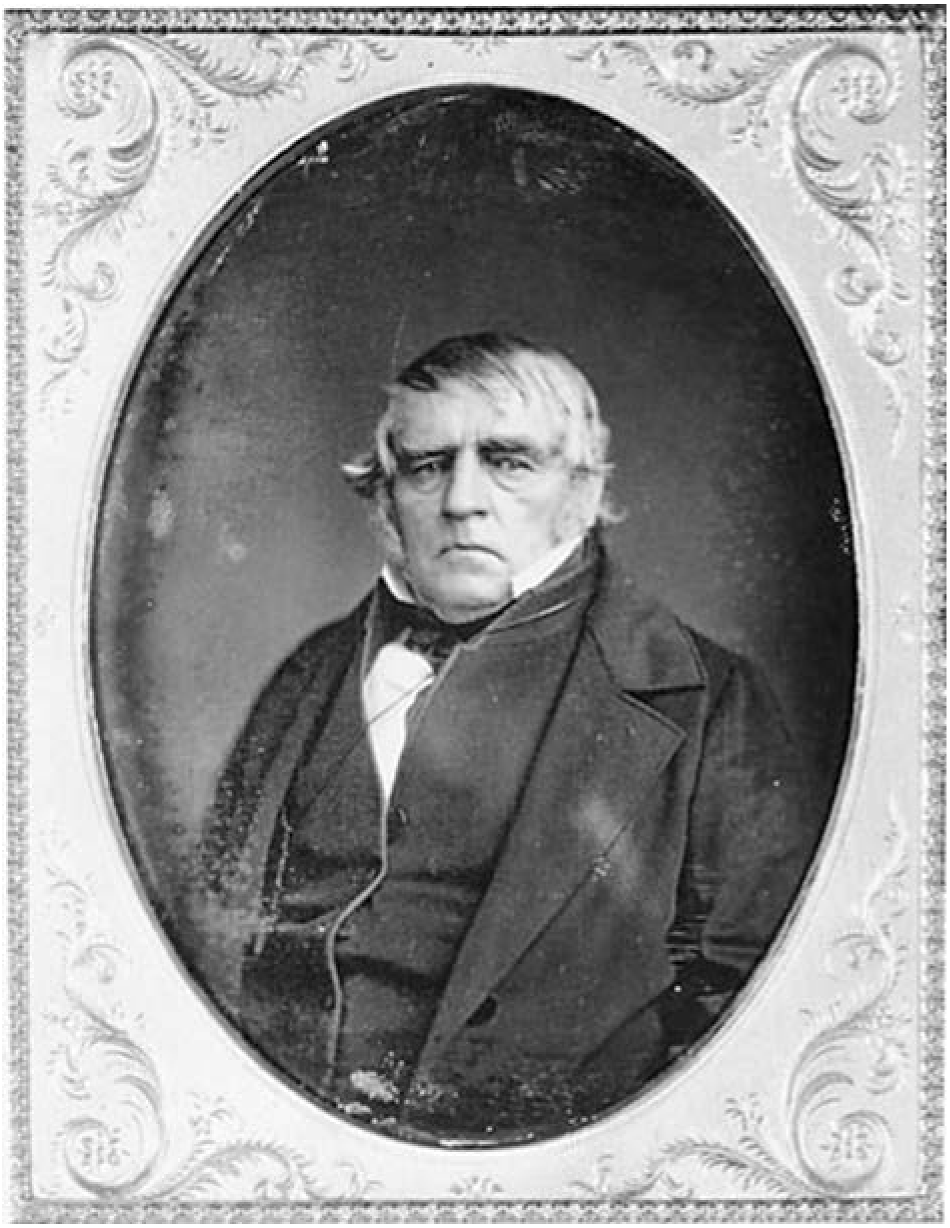

Figure 1.4 Peter Skene Ogden (1790-1854), shown here circa 1850 was an experienced fur trapper and mountain man who camped at the site of the town of Grace. (Public Domain).

Chapter 2

Innovations in Waterpower and Electricity

In the late 19th century the stage was set for rapid and innovative development in hydropower. Water was an abundant resource in the country east of the Rocky Mountains. Falling water supplied a significant part of America's industrial power requirements. Water in motion, such as a river or a waterfall, creates kinetic (or moving) energy. The amount of kinetic energy depends on the speed of the water, which varies depending on factors such as streamflow and change in elevation (head).[17] Waterpower spurred the industrialization of the United States and was the major source of power until the Civil War. Towns were located on riverfronts near falls. Water flowed through specially constructed channels that delivered water to prime movers (waterwheels or turbines) that powered small textile mills. During the 18th and 19th centuries early industrialists developed techniques for harnessing waterpower, which eventually led to large-scale waterpower development. [18]

Alexander Hamilton initiated America's first planned industrial center in 1791 at Paterson, New Jersey. At that time America was dependent on British manufacturers. Hamilton and a group of investors wanted independence from those manufacturers, so they founded the Society for Establishing Useful Manufactures (S.U.M.) to exploit the power of the Great Falls of the Passaic River. Another large-scale waterpower development was Lowell, Massachusetts (Figure 2.1). Lowell was created in the 1820s where falling water from Pawtucket Falls on the Merrimack River was utilized to power textile mills. Lowell became a textile manufacturing center and was the model used for large-scale waterpower development for the next 50 years.[19]

Under the Lowell model, water was diverted from a large river into a system of power canals (used to transport water for hydraulic power, but not for transportation) that provided water to individual mills throughout the community. The development and sale of waterpower was handled by independent companies that built the dams and canals and contracted to supply water for power and other manufacturing purposes. This model is used today by modern public utilities that provide electricity and gas.[20]

Western Waterpower

Waterpower in the mountain west varied from the east. Differences in rainfall, topography, and the demand for waterpower required a new system of waterpower management. Unlike the east, where hydropower was used for manufacturing purposes (mainly textile manufacturing), in the west hydropower became important to mining. Thousands of gold seekers moved west after the discovery of gold in California in 1848. Trees were cleared and used for fuel and shelter and soon there was little fuel to power steam engines. Coal was expensive and miners began to search for a cheaper source of power. Miners who moved west from eastern cities were familiar with the use of water power for industrial uses. Some enterprising miners adapted eastern methods or developed unique methods to harness the water from flowing streams and rivers to power mining equipment. Instead of turbines, water was moved by a device called a "hurdy gurdy" wheel. This wheel was propelled by a stream of water striking buckets mounted around the outside of the wheel axis. Later known as "impulse wheels," they were cheap and easy to maintain. Lester Allen Pelton, a California millwright, improved the impulse wheel, with the addition of twin buckets that split the stream of water, multiplying the speed, power, and efficiency of the wheel. He patented the wheel in 1880 and incorporated the Pelton Water Wheel Company in San Francisco in 1888 (Figure 2.2). Other inventors made improvements on the Pelton Wheel over the years. The refined, simple, and inexpensive wheel was used in early hydropower plants worldwide.[21]

After the discovery of gold by Elias D. Pierce and the rush to the Clearwater region in 1861, mining was big business in Idaho and directly tied to the development of the region. As was common in other mining districts, waterpower was first used and directed through ditches and flumes to pipelines and to nozzles known as "giants" to wash gold-bearing sand and gravel from hillsides. The advent of electricity and electrical generation spurred creative and innovative ways to power equipment needed for mining, including ore processing tools, pneumatic drills, hoists, pumps, ventilation systems, and lights inside the mines. Hydropower offered new opportunities for expanding mining operations. As Duncan Hay notes in *Hydroelectric Development in the United States*, waterwheels, dams, canal, and penstock technologies developed for waterpower were adopted and utilized when electrical generation began to be used in the 1880s.

The Electrical Revolution

Scientists experimented with electricity during the 18th and19th centuries. The invention of the arc lamp by Sir Humphrey Davy in 1808,[22] and motors and generators built during the 1820s and 30s by scientists in France, Britain, and the United States stimulated interest and spurred rapid technological development in electricity. The invention of carbon arc lights, the first widely-used type of electric light and the first commercially successful form of electric lamp, increased experimentation in electricity.

America led the world in electrical system development. In the 1870s Thomas Alva Edison and his experimentation with incandescent lighting revolutionized the world. Edison's laboratory at Menlo Park, New Jersey, was center stage in December 1879 when he held a public demonstration and illuminated it with over 50 lamps. Early in 1881 Salt Lake City became the fifth city in the world to be electrified (after London, New York, San Francisco, and Cleveland) when the Salt Lake Light, Heat, and Power Company built a power station in the heart of downtown (Figure 2.3). The plant had the capacity to electrify central downtown streets and businesses, but only within a half mile. One year later in Idaho the Philadelphia Mining and Smelting Company installed an electric light plant west of Ketchum. In 1886 the Logan Electric Light and Power Company began supplying electricity for lights from a small hydro plant in Utah.[23] Street light systems were established in Boise, Portland, Seattle, and other towns throughout the Northwest. [24]

Many of the new electric systems were established through the Edison Illuminating Company, which Edison formed to deliver power and light to cities throughout the United States. Sales agents travelled throughout the country, including Idaho, selling electrical systems. These early systems generated electricity using direct current (DC), a form of electrical energy in which electrons all flow continuously in one direction. Edison quickly made a fortune as towns and cities throughout the country (particularly in the east and Midwest) rushed to build hydroelectric plants.

There was a limitation with direct current though--it was difficult to transmit over long distances without loss of power. In the late 19th century a number of inventors were working on alternating current (AC) as a means to transmit power over longer distances. Alternating current reverses direction (or oscillates) in the circuit at regular intervals. The number of times AC oscillates is known as frequency. Alternating current allows electricity to be generated at one voltage, stepped up by transformers to a higher voltage for transmission, then stepped down in one or more stages through transformers and eventually distributed to consumers. French inventors Lucien Gaulard and Lucien Gibbs produced the first alternating current transformer, a necessary component for increasing and decreasing voltages in power transmission.[25]

Nikola Tesla, a Serbian mathematician and engineer living in Budapest, conceived the idea for an AC induction motor, but it would be several years before the concept became a reality (Figure 2.4). Tesla immigrated to New York City in 1884 and began work for Thomas Edison. The two inventors did not get along as Tesla advocated the use of alternating current and Edison did not think the idea was feasible. Tesla left Edison's company, secured funding for the AC induction motor and formed his own company, Tesla Electric Company. Between 1887 and 1891 he applied for and received a total of 40 patents, all related to the AC motor and the resulting AC system he devised. Edison's was not the only electric company of the time. George Westinghouse, another pioneer in the electric industry who manufactured railway air brakes, switches, and signals, formed his own company, Westinghouse Electric and Manufacturing Company, in 1884.

Westinghouse believed in alternating current. He bought patents from Tesla and began selling AC systems. Edison's agents had covered many of the major towns and cities, so Westinghouse concentrated on selling in less populated regions. Edison continued to promote direct current and for two years between 1888 and 1889 waged a public battle, known as "The War of the Currents" with Westinghouse over the merits of direct current versus alternating current.[26] The advantages of alternating current won out and soon new power sources paved the way for hydroelectric plants in the west.

New Power Sources

In 1889 the Willamette Falls Electric Company built an alternating current hydroelectric plant at Oregon City, Oregon and transmitted electricity for arc lighting 13 miles to Portland, the first time this combination of plant (hydroelectric) and current (alternating) were used.

Two years later Lucien L. Nunn and Westinghouse revolutionized the commercial electrical industry at the Gold King Mining Company near Telluride, Colorado. Cheaper power options were sought as fuel and transportation costs skyrocketed, bankrupting many mines. Nunn, who understood the principals of hydropower from his years managing a placer mine, recognized that water flowing out of the nearby mountains might be a source of power. Nunn convinced George Westinghouse to partner with him and invest in developing an alternating-current generator and matching electric motor. The generator and motor were delivered to Nunn in the winter of 1890. The generator was installed in a frame power house at Ames, 11 miles southwest of Telluride. A 4,000-foot steel penstock led up a canyon and provided 320 feet of head above a six-foot-diameter Pelton water wheel. The Tesla-Westinghouse motor was installed two and a half miles away. In June 1891, the Ames Hydroelectric Plant transmitted its first current, and continued to run smoothly for a week. The first long distance transmission of AC electric power for commercial purposes sparked the beginning of the industrial electric power. By 1894 the Ames Hydroelectric Plant was powering mines throughout the region and the town of Telluride.[27]

According to historians Mark Fiege and Janet Ore, these technological developments during the late 19th century allowed western mining companies, utility companies, and individual power developers to establish efficient hydroelectric stations on remote stretches of streams and rivers.[28]

Mining was big business in Idaho too. Initiated by the discovery of gold by Elias D. Pierce and the rush to the Clearwater region in 1861, mining was the catalyst behind the development of Idaho. Mines flourished throughout the state. The Coeur d'Alene region was the major mineral producing area. Mining remained an important industry into the 21st century. Major producers were located in the Boise Basin, Wood River, Stibnite, Blackbird, and Owyhee regions. Central Idaho boasted mines at Atlanta, Bear Valley, Bay Horse, Florence, Gilmore, Mackay, Patterson, and Yankee Fork. Elk City, Leesburg, Pierce, Rocky Bar, and Warren make up the rest of the major Idaho mining areas. Mining promoters from the East invested money in many Idaho mining ventures.

Mining districts throughout Idaho benefitted from the new technology. Hydropower offered new opportunities for expanding mining operations. In southeastern Idaho, the unique geography of the Bear River and its steep drops attracted the attention of 20th century promoters who saw the possibility of power generation. Idaho and the community of Grace would play an important role in the development of hydroelectric power. [29]

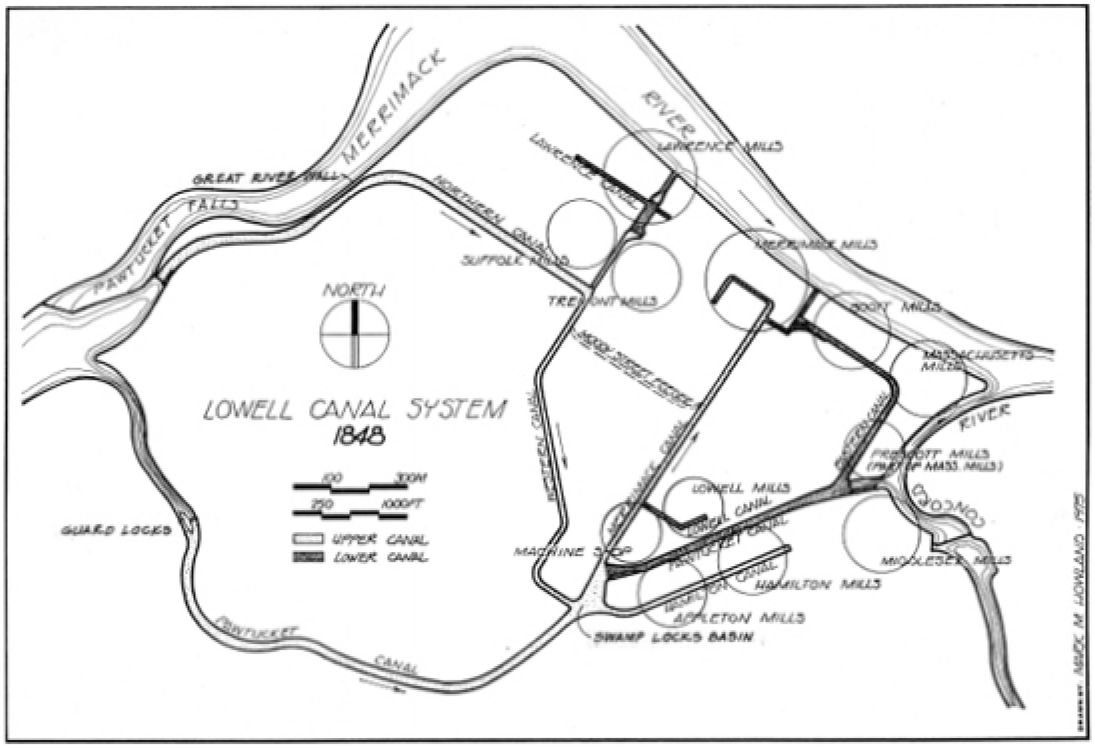

Figure 2.1 Lowell Canal System in 1848. Courtesy of the Historic American Engineering Survey.

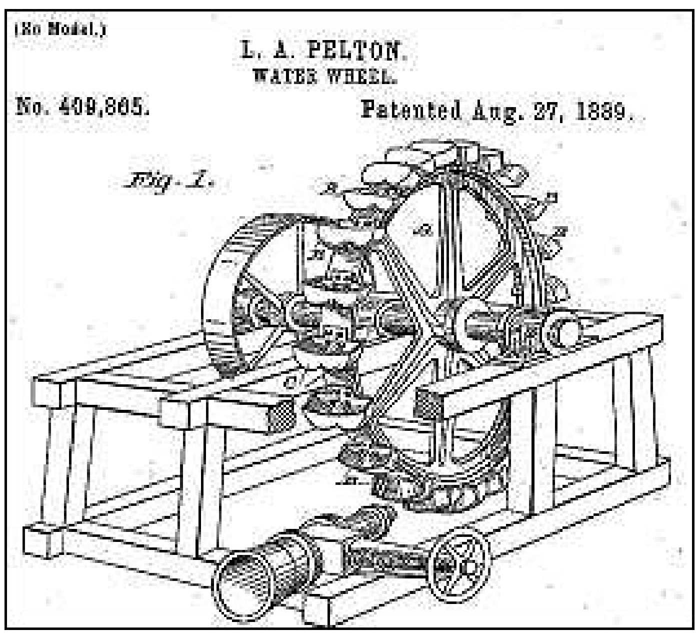

Figure 2.2 Diagram of original Lester A. Pelton water wheel. (Public Domain).

Chapter 2 Illustrations and Maps

Figure 2.3 In 1881 Salt Lake City electricity lit up the streets of the city. Display at Electric Show, Fairbanks Morse and Company, 1911. (Utah State Historical Society image). http://content.lib.utah.edu/cdm/ref/collection/USHS_Shipler/id/4431.

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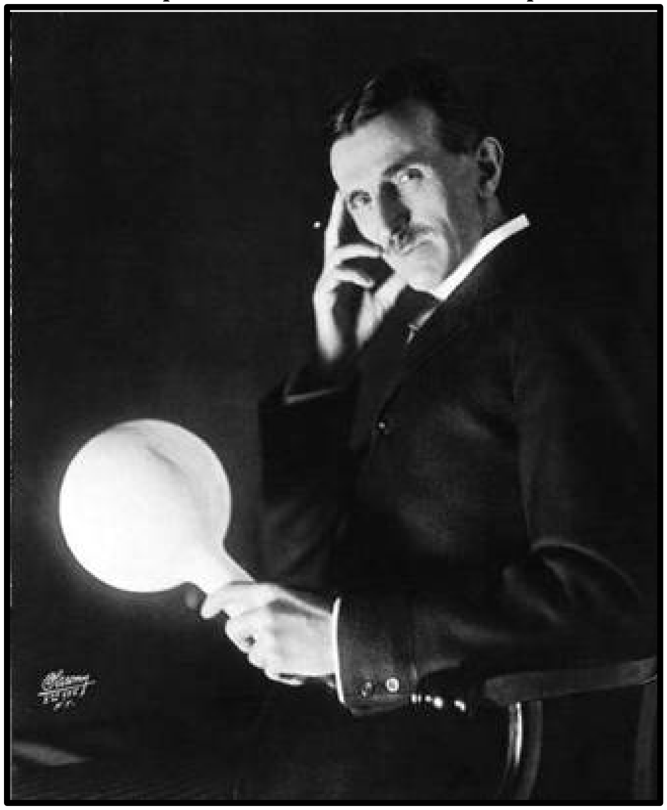


Figure 2.4 Nikola Tesla (1856-1943) (Public Domain).

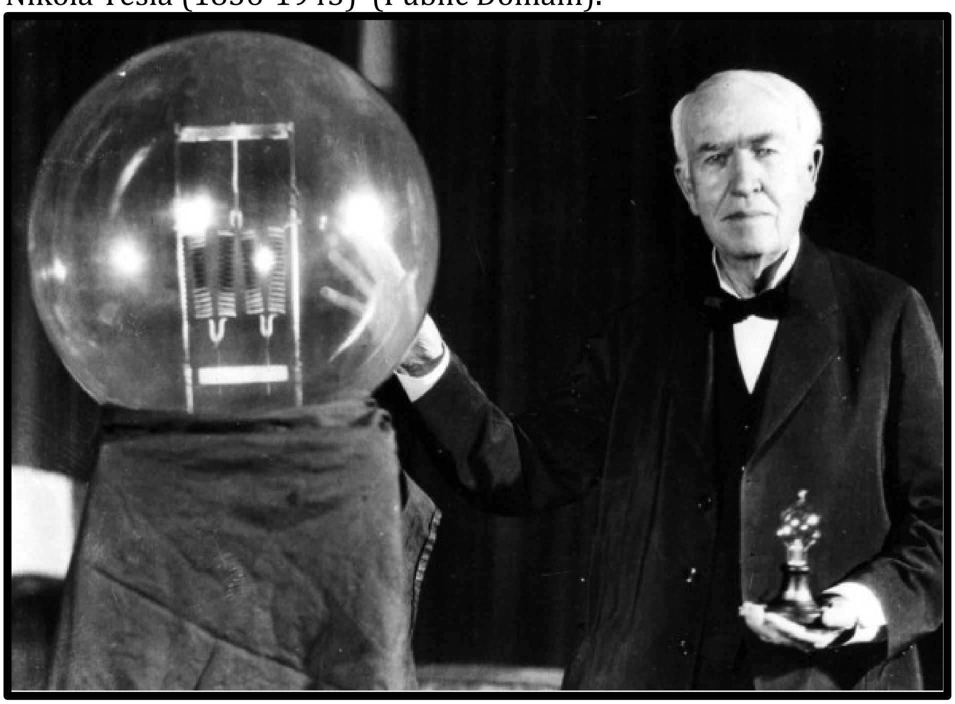


Figure 2.5 Thomas Edison advocated the use of direct current over alternating current. (Public Domain).

Chapter 3

Lucien L. Nunn – Hydropower King

The history of the Grace Development is directly linked to Lucien Lucius Nunn (1853-1925). Entrepreneur, lawyer, and businessman, Nunn built the Grace Power Plant as part of a growing empire of hydroelectric projects in Utah and Idaho. Between the early 1890s and the 1910s, Nunn operated twenty hydroelectric plants in Colorado, Utah, Idaho, and Montana (Figure 3.1).

A native of Ohio, Nunn studied at Oberlin College and one year at Harvard Law School before heading west in 1880 to the booming mining town of Leadville, Colorado, where he supported himself working as a carpenter. Surprisingly, this electrical power plant mogul started in business running restaurants. Nunn and Malachi Kinney, whom he met in Leadville, operated two restaurants in Leadville before moving on to Durango. In Durango, the partners bought several town lots, built and sold windows and doors for miner's cabins, and opened a new restaurant, the Pacific Grotto. From Durango the men went to Telluride to work in the carpentry and construction business. In Telluride, Nunn was stricken with typhoid fever, an attack that lasted for seven weeks. During his recovery time, he built a wooden-framed, zinc-lined bathtub and piped it to a wood stove for heat. It was reportedly the first bathtub in town. Nunn and Kinney rented out the tub to hundreds of miners, eventually expanding the business by building more bathtubs. Using the profits from the bathtub business, the partners bought town lots, built cabins, and rented or sold them to new residents. Their next endeavor was to open a law office. Nunn concentrated on law and Kinney managed real estate enterprises, developing commercial and residential properties. They began to build their business beyond Telluride, purchasing land in and around other towns, including San Miguel, Keystone, and Sawpit.[30]

Nunn and Kinney ended their partnership in 1887 when Kinney moved to San Diego to open a new business. Their business separation was amicable and the two men remained lifelong friends. After Kinney's move, Nunn focused his attention on his mining interests. He organized the Ilium Gold Mining Company, a placer operation, in 1881 and expanded his operations to develop other placer and shaft mines along the San Miguel River. As his business grew, Nunn brought in relatives and friends to help manage his sprawling operations. He purchased a controlling interest in the San Miguel Valley Bank and started a newspaper, the *Telluride Republican.* Even with his multiple business endeavors, Nunn seemed to have unstoppable energy. When James Campbell, the dominant stakeholder in the Gold King Mine, asked him to manage the property, Nunn accepted. In return, he demanded a large share of the mine.[31]

Using experimental generators provided by George Westinghouse, Nunn constructed the Ames power plant bear Ophir, Colorado to provide power to the Gold King Mine. The plant successfully powered machinery at the mine over two-and-a-halfmiles away. His power company provided Colorado mine operators with hydropower that was cheaper than steam-powered methods and pioneered the world's first long distance transmission of electric energy for industrial use. The successful production of power at the Ames Plant near Telluride was a stepping stone for Nunn's involvement in the commercial development of hydroelectricity.(Figures 3.2 and 3.3) On February 19, 1890, Nunn organized the Telluride Power Transmission Company. He brought his brother Paul, an electrical engineer, into his power schemes and made him chief engineer. Initially, Nunn built most of his hydroelectric plants to supply power to the mining industry. Over time his interest shifted from mining to hydroelectric power and long-distance transmission. He looked outside Colorado for more opportunity.[32]

Nunn next focused on Utah, where he saw more opportunity to expand his operation. He moved his corporate headquarters to Provo in 1894. Slowly but surely he began to build ahydropower empire, building Nunn Station at Provo**,** the first 44,000-volt hydroelectric plant in America. Built in 1897 at an estimated cost of just $50,000, the plant harnessed the Provo River to generate electricity and transmit power over a distance of 32 miles to mining operations in Mercur, Utah.[33] This was almost three times the voltage of any existing line in the nation at that time. Demand for power was more than Nunn Station could handle, so he built more power plants. Nunn oversaw the construction of the Olmsted Plant at the mouth of Provo Canyon in 1903-1904. Named for Fred W. Olmsted, a promising engineer who worked for Nunn and died of tuberculosis, the plant operated until 2016.

Nunn's later hydroelectric projects in Utah included Jordan Narrows (1906), Battle Creek (1909), and two facilities on the Beaver River (1908 and 1917) built by the Beaver River Power Company. The Beaver facilities were built to supply mining districts near the town of Milford. As his interest shifted to long-distance transmission, he eventually built electrical power plants at Niagara Falls in New York, and built hydropower plants and established electricity-marketing organizations in Casper, Wyoming; Norris, Montana; and other locations scattered from Texas to Washington State.[34]

Education Pioneer

Nunn was not only a hydropower pioneer; he was also a pioneer in innovative education. In 1891 he created the Telluride Association, a work-study program at Bear Creek Mill near Telluride. Electrical engineering as a career was in its infancy at that time and there was a lack of experienced staff to run the power plants. Nunn hand-picked promising Association students to work at his power plants. The students were known as "pinheads." According to Nunn's biographer, L. Jackson Newell, the name originated from Nunn's practice of keeping track of where students were working with colored pins on a map of his power station locations.

The three-year program required first-year students to work 8 to 12 hour shifts at one of Nunn's remote power plants, where they maintained waterways and penstocks, operated power stations, assisted in laboratories and did other tasks related to the operation of the power station. In their second year, the students were moved to a different plant, where their time was divided between work and study. After 1903, the year Nunn moved his residence to Utah, students spent their third at the Telluride Institute at the Olmstead Plant. Not only did Nunn build a substantial residence for himself at the Olmstead Plant, he also built a four-story "Institute Building" with classrooms, laboratories, and offices, and a dormitory, known as the "Quarters Building." Ernest A. Thornhill, a graduate of Harvard, and other staff were hired to teach the third year students. At the end of their third year, students were given scholarships to continue their education.

Many students went on to study at Cornell University, where they resided at Telluride House, managed by the Telluride Association. Eventually, branches of the Telluride Association were formed at various locations including Grace and Boise.[35]

Nunn's extensive interest in education led to the establishment of Deep Springs College on a cattle ranch in California. The independent college was founded to prepare students (male only) for a "life of service to humanity" through a three-part program of liberal arts, student self-governance, and labor. The college admitted its first class of 20 in 1917 and remains in existence today.[36]

Chapter 3 Illustrations and Maps

Figure 3.1 Lucien Lucius Nunn, circa 1890 (photo courtesy of the Northwest Lineman College historic photo collection)

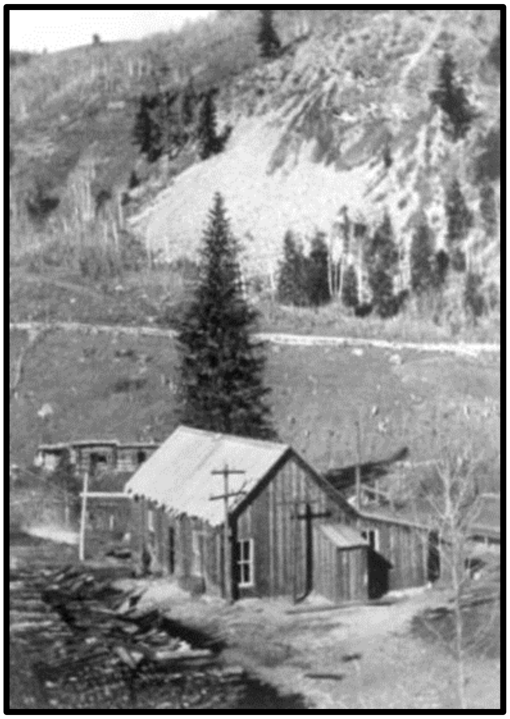


Figure 3.2 Original power station at Ames, Colorado (http://digital.denverlibrary.org/cdm/ref/collection/p15330coll22/id/6863)

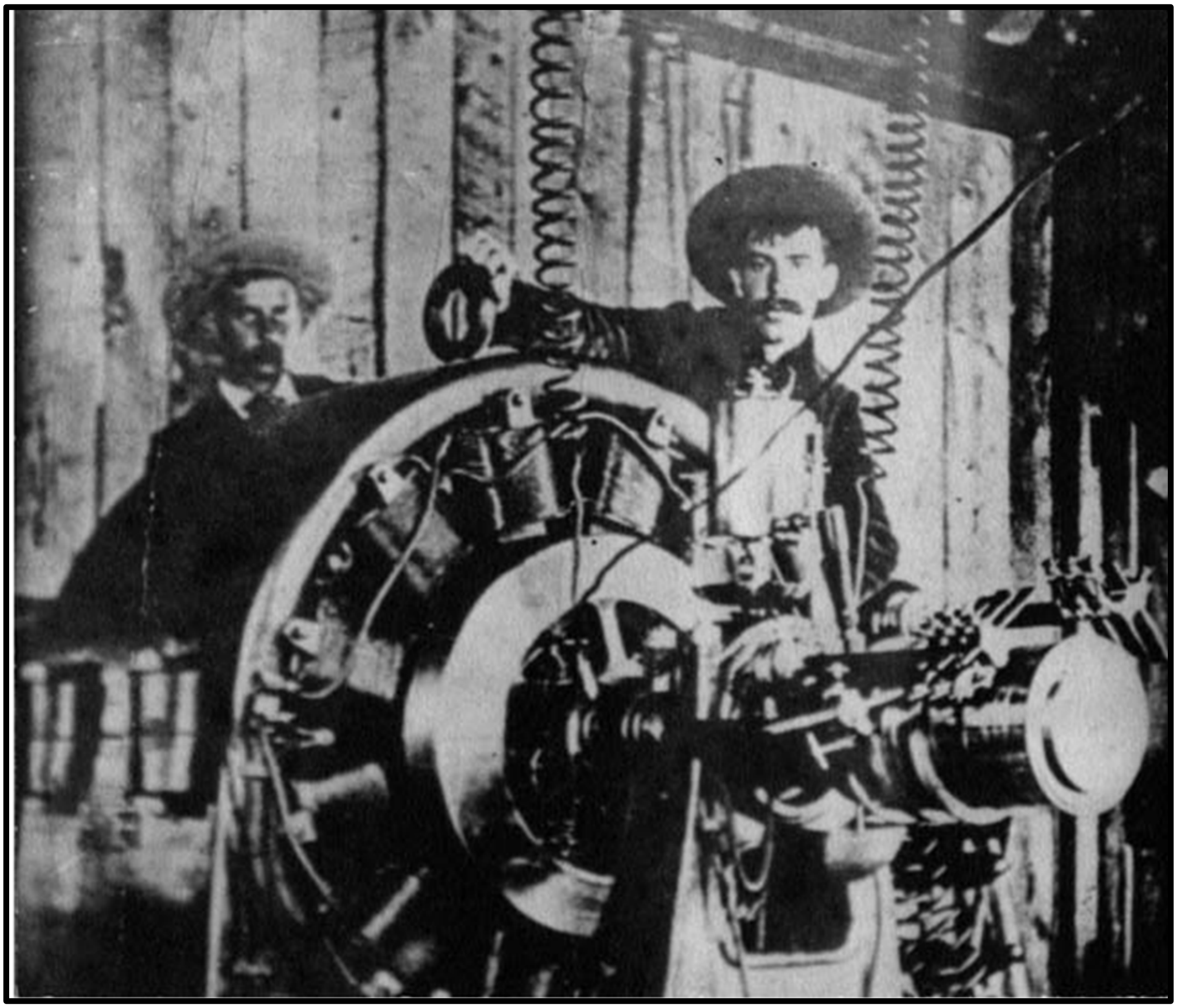


Figure 3.3 Interior of Ames power plant. Unidentified men with 100 H.P. generator. (Photo courtesy Center of Southwest Studies, Fort Lewis College)

Chapter 4

The Idaho Connection

The increased demand for power to supply emerging street car lines, homes, and machinery, combined with the need to power mining operations pushed the development of power systems in Idaho. Along the Snake River Valley in western Idaho and eastern Oregon, companies were formed to answer the need for power. Swan Falls Dam was the site of the first hydroelectric power generator in western Idaho. In 1901 it sent power to Silver City in the Owyhee Mountains, stimulating an interest in developing more power systems. A number of operating companies and investors attempted to form local power companies. Changing technology made it necessary to invest more money in equipment and dams. As interest in electrical systems increased, the companies competed with one another for clients in communities across the state. In September, the *Soda Springs Chieftain* informed its readers that Emmett had recently installed one of the most modern light systems in the west.[37] Communities statewide were eager to have an electrical system. In 1905 residents of Soda Springs voted on several bond issues for the purpose of building the Soda Springs Power Plant. Hydroelectric power would develop in the area through the efforts of L. L. Nunn.

As L.L. Nunn expanded his business he sent agents throughout the Intermountain West looking for potential dam sites for power plants. In 1900, Nunn organized the Telluride Power Company, a new entity, combining his interests in Colorado and Utah.[38] After building plants in Logan and Provo Canyon, Utah, he looked north to Idaho, where the Bear River area interested him. Nunn conceived the idea of using Bear Lake as a reservoir for hydroelectric power plants and irrigation systems downstream. Bear Lake, straddling the Utah/Idaho border, empties into the Bear River. Nunn conceived a plan to divert the spring runoff. The river would be dammed and during summer when the river was low, the water would be pumped out of the lake and back into the river, feeding the plants downstream. In 1902 Nunn filed appropriations for Bear River water. A few years later, in 1907, the Department of the Interior granted him permission to develop Bear Lake.[39] Nunn never realized his dreams for the Bear River as UP&L took over Telluride Power in 1912 (Figure 4.1).

In April 1906 the *Soda Springs Chieftain* reported to readers that the Telluride Power Company had sent a party of surveyors to Grace. The development plans included a dam to take advantage of a narrow canyon and a natural falls location a short distance north of Grace (Figure 4.2). The power plant, with its turbines and generators, was constructed in Black Canyon, approximately five miles downstream from the dam. The water from the dam was carried overland four miles by a flowline (Figure 4.3) in a straight line and with a fall of more than 500 feet to the plant.[40] Penstocks connect pipelines with turbine cases, have steep slopes and are built to withstand high pressures. A wooden crib, rock-filled dam 44 feet high and 185 feet wide was built on the river a mile and a half north of the village of Grace (Figure 4.4). Water was diverted from the river at this point and carried four and a half miles by flowline to connect again with the Bear River at the plant buildings. This major project included not only the construction of the dam and plant, but associated road building from the construction site to Grace and housing for the laborers.[41]

The flowline was wood-stave construction, a little over eight feet in diameter, and the penstock, connecting to the turbines, was made of riveted steel plate. Approximately seven million pounds of steel pipe were used for the penstock (Figures 4.6 to 4.10).

Not long after the surveyors completed their work, representatives of the company were in the area recruiting construction laborers to build the plant.[42] Construction was fast-tracked. In late November the company reported that more workers were needed to meet the deadline to start operations June 1, 1906.[43] The work did not go as quickly as anticipated. Much of the excavation for the flowlines and the power plant was in solid lava rock, which required dynamite. One set-back, as reported in the *Soda Springs Chieftain*, occurred when the powder house at the construction site blew up.

Power plant construction news was of interest to people throughout Idaho. C.J. Bassett, a Boise resident, visited the construction site in the summer of 1907 and reported:

> "Four hundred cars of pipe are arriving. This is hauled to the scene of operations, five miles from the railway, by great traction engines. The pipe is eight feet in diameter, a tall man wearing a tall hat being able to walk through it with plenty of room overhead".[44]

The Grace hydroelectric plant was completed in 1908. That August the plant began transmitting power to Salt Lake City.[45] The finished plant included the dam, the pipeline (known as Flowline No. 1), the penstock, a surge tank to relieve pressure in the pipeline and penstock, and a power house. (Figures 4.11 to 4.14).

The new 11,000 kilowatt plant was the largest facility in the region and multipurpose plants in the areaand provided electricity to mines in Utah..[46] Nunn had no interest in selling power to the residents of Grace. A group of local businessman formed a company to pay for a transmission line from the power plant to Grace. They recouped their investment by charging residential and commercial customers to connect to the line. [47]

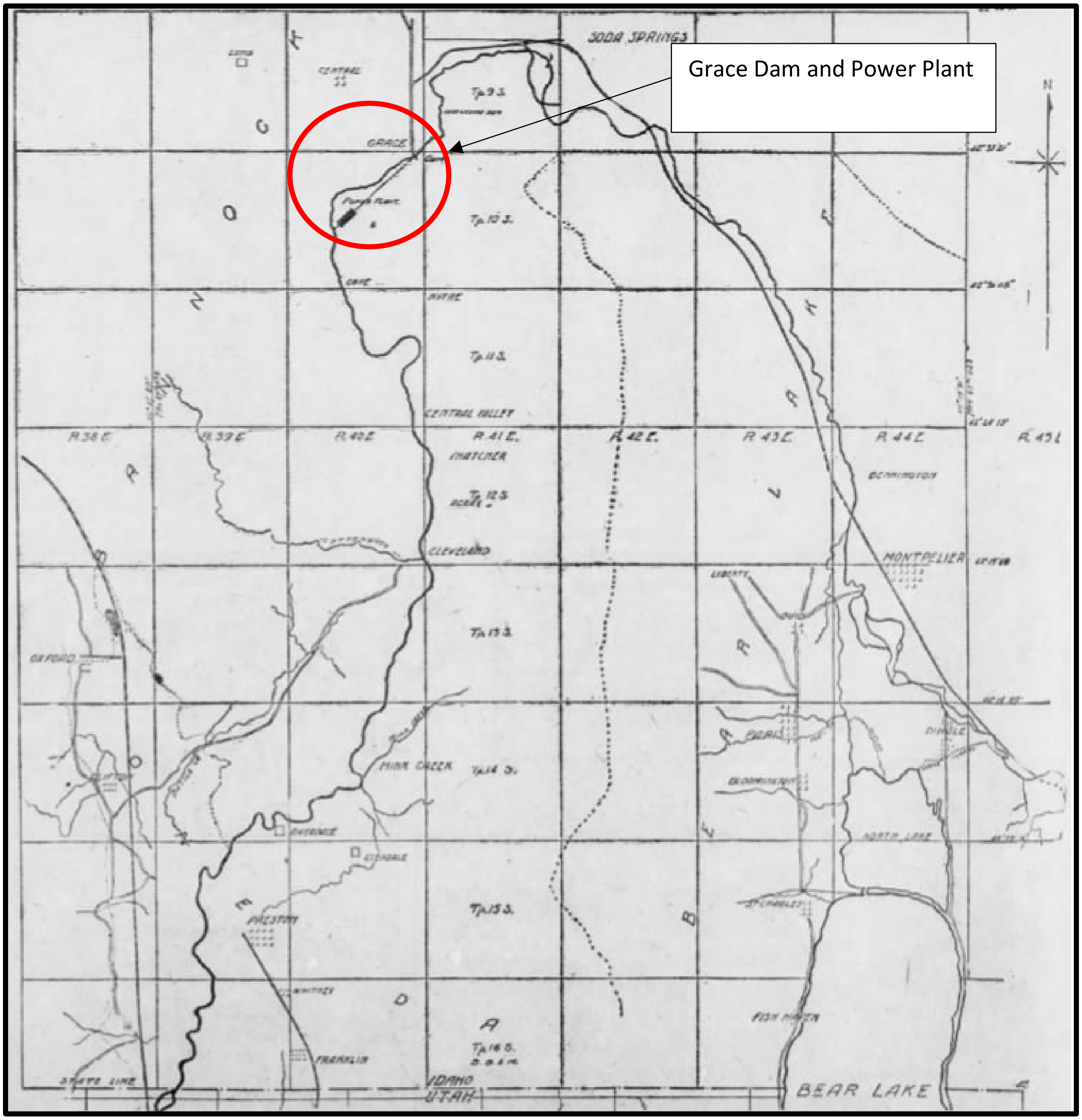


Figure 4.1 1908 map showing Grace Dam and Bear River Valley. (The Salt Lake Herald, June 15, 1908).

Figure 4.2 View of Bear River Canyon from construction photos of Grace Dam, 1907. (Courtesy PacifiCorp).

Figure 4.3 Excavation for flowline October 12, 1907. (Courtesy PacifiCorp).

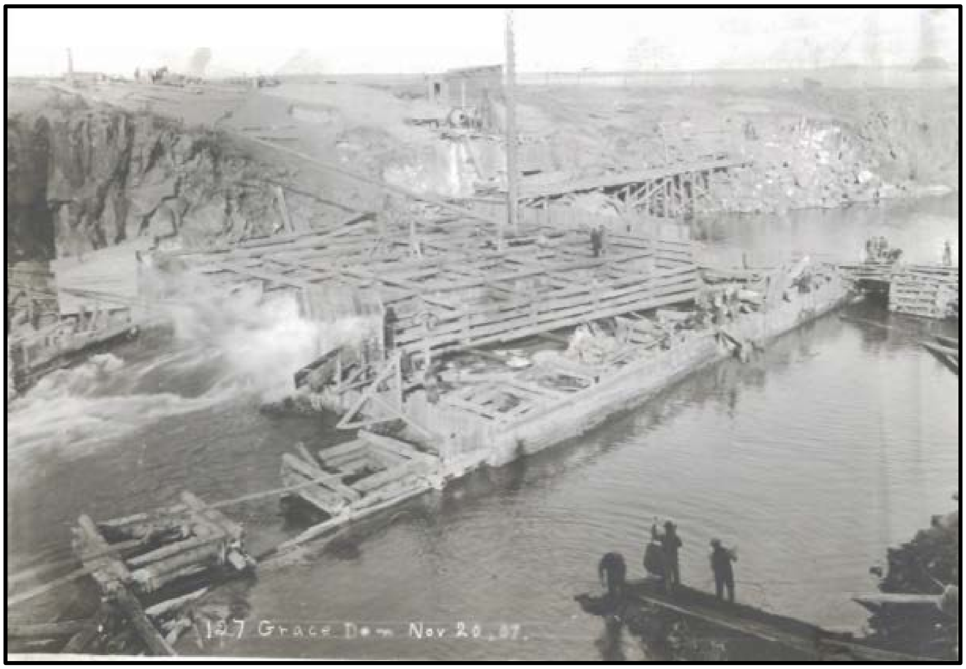


Figure 4.4 Construction of Grace Dam, November 20, 1907. Note men at foreground pouring concrete. (Courtesy PacifiCorp).

Figure 4.5 A cofferdam or coffer is a temporary structure constructed to facilitate projects in areas that are normally submerged. This 1907 photo shows construction crews standing in the riverbed near the east coffer. (Courtesy PacifiCorp).Chapter 4 Illustrations and Maps

Figure 4.6 Construction crew building four-mile long wood flowline and steel penstock, . November 2, 1907. (Courtesy PacifiCorp).

Figure 4.7 The immense size of the pipeline is shown in this photo taken during the 1907 construction. (Courtesy PacifiCorp).

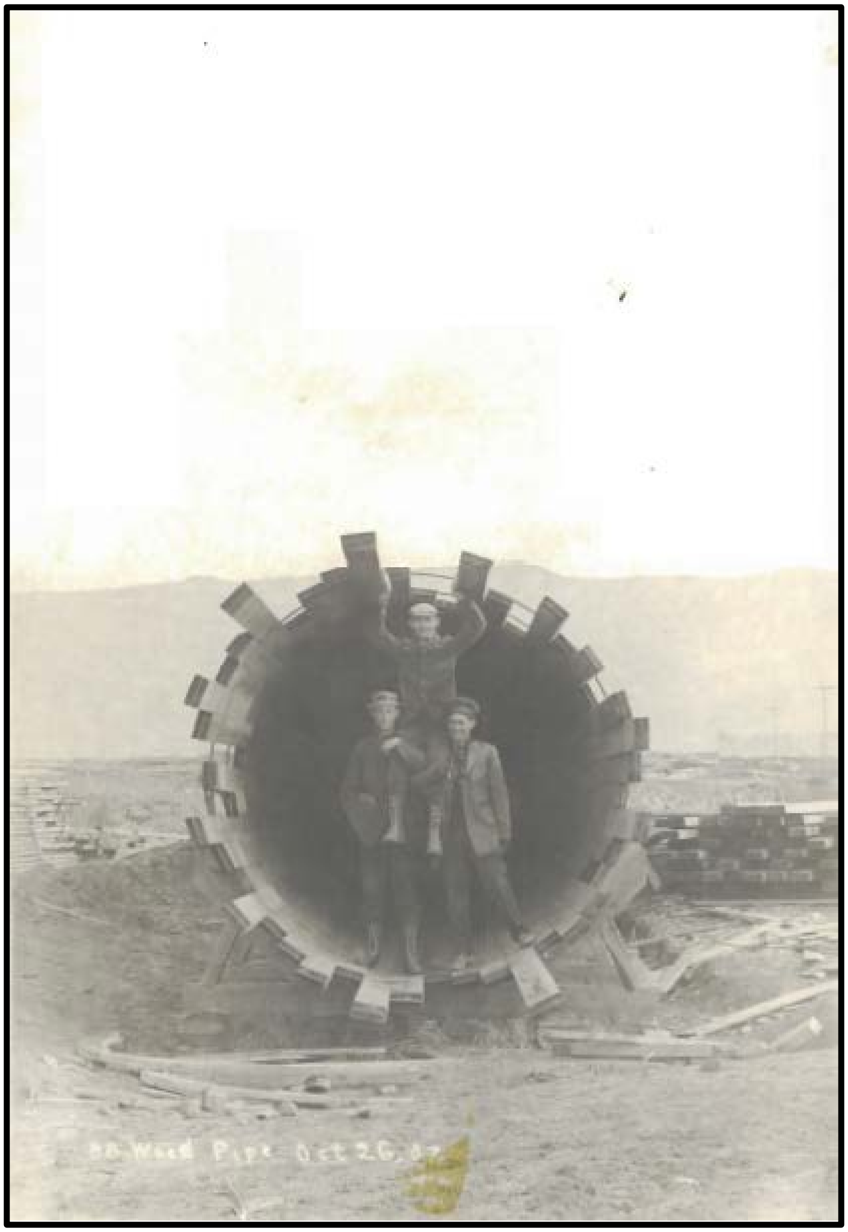


Figure 4.8 Men standing inside wood stave, October 26, 1907 (Courtesy PacifiCorp).

Figure 4.9 View of penstock tram from inside the eight-foot diameter steel pipe, November 1907. (Courtesy PacifiCorp).

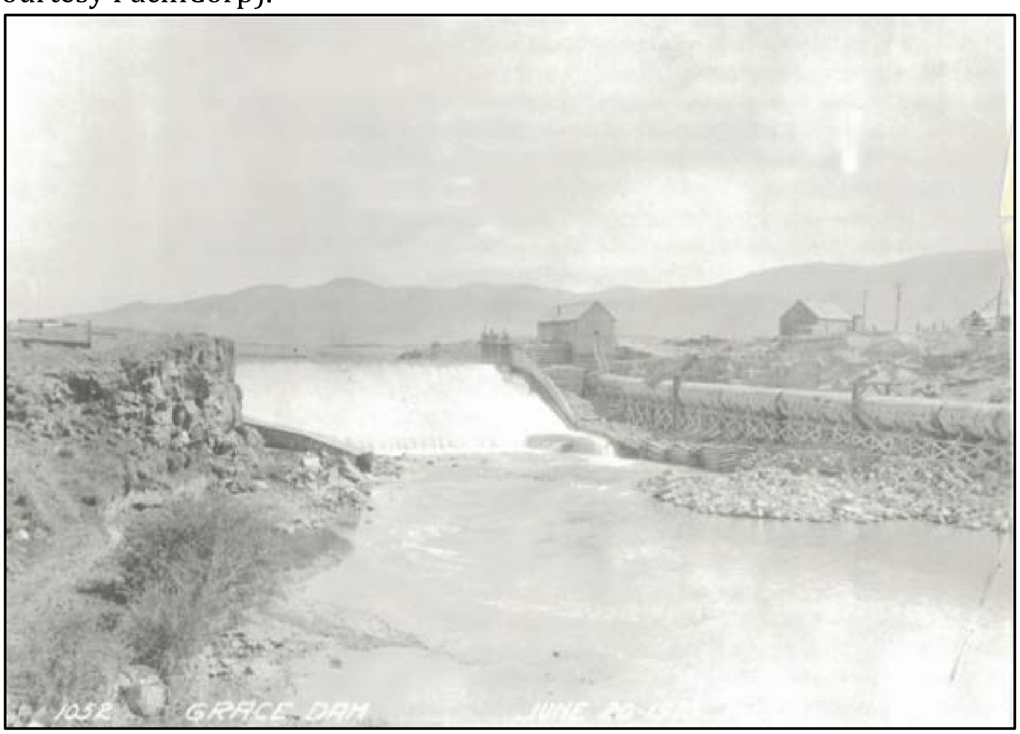


Figure 4.10 Grace Dam spillway of Grace Dam and flowline. June 1910. (Courtesy PacifiCorp).

Figure 4.11 Construction workers completing detail work on the powerhouse. 1907. (Courtesy PacifiCorp).

Figure 4.12 Men spreading concrete for powerhouse floor. November 1907. (Courtesy PacifiCorp).

Figure 4.13 Interior of powerhouse. September 1908. (Courtesy PacifiCorp).

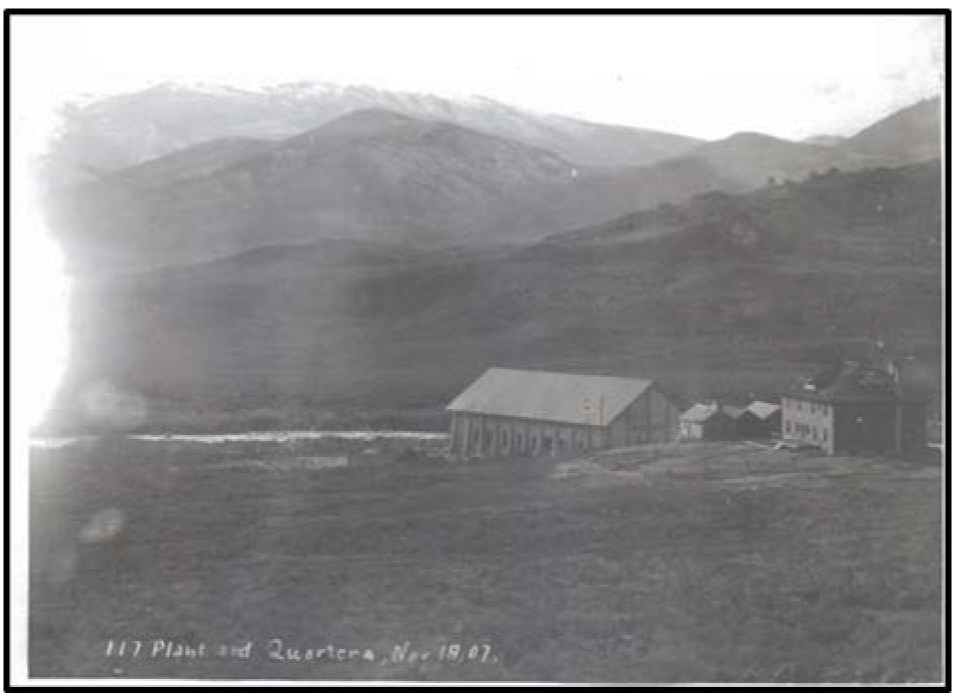


Figure 4.14 The finished Power Plant included the dam, flowline, and surge tank. Staff quarters are shown at right in the photo. This building burned down in 1914. (Courtesy PacifiCorp).

Chapter 5

Utah Power and Light Company: New Owner and New Developments

Although Nunn's company continued to run the Grace Power Plant, Nunn moved onto other endeavors in Idaho. In 1890 he formed a new company, the Beaver River Power Company, to exploit resources in the Beaver Creek drainage in the Tushar Mountains in Beaver County, Utah. In an effort to expand his Beaver Company into western Idaho, he built a power house in Boise, competing with existing companies at a time when small local companies were struggling to survive. According to historian Susan Stacy, more than 50 companies competed for clients before entering a period of financial crisis and collapse around 1913 and 1914.[48]

Nunn's companies also came under a General Electric subsidiary known as the Electric Bond and Share Company (EBASCO) that was formed in 1905. The specialized holding company was organized to "merge small, financially unstable electric companies into larger, financially secure ones, and to provide financial, management, and engineering advice to them and other companies."[49] Nunn would eventually divest himself of most of his companies as his interest turned to developing Deep Springs College in California.

Originally formed in 1913 as a subsidiary of EBASCO, Utah Power & Light Company (UP&L) undertook to consolidate a number of Utah power companies, increasing the power available to customers in Salt Lake City and other urban areas in northern Utah and southern Idaho. Immediately after its organization, UP&L began purchasing companies, including the Telluride Company, which brought Nunn's Olmstead and Grace plants into the UP&L's integrated power system.[50]. By 1937, UP&L had acquired more than 130 power companies.[51]

In 1913, after acquiring the Grace plant from Nunn, UP&L undertook an expansion of the plant, contracting with the Phoenix Construction Company to do the work. The company's work force of approximately 100 men was divided between several construction camps. The crew included Russian, Greek, and Japanese workers who were housed in separate camp buildings (Figures 5.1 to 5.3). The men worked year round in harsh and unsanitary conditions. In the winter, the workers had to drill into the frozen ground (Figure 5.4). In the summer, improper dishwashing led to an epidemic of diphtheria in the camp. In November, Ernest P. Vlahos, a Greek laborer, was found unconscious on the road between Grace and Construction Camp No. 3. He had been shot in the head, a wound which proved fatal. No one was ever arrested for the murder.[52]

Despite the many problems, a new powerhouse was constructed adjacent to the old one to house more generators, increasing the voltage the plant could produce (Figure 5.5). The power was transmitted directly to the company's new substation three miles west of Salt Lake City by means of a 135-mile steel power line. From the substation, the power was distributed to the UP&L and to copper mines at Bingham and Garfield. [53] Other improvements included a new intake and gate house dam and a flowline, Flowline No. 2, built on concrete supports, which supplied two additional power units. The new line paralleled the original Flowline No. 1 a few feet to the west. Two miles of the upper 11,000 feet of Flowline No. 2 were built of wood staves, measuring 11 feet in diameter on concrete supports. The lower 15,000 feet of the flowline was built from riveted steel pipe.[54] The flowlines rested on hundreds of large concrete "saddles" built into trenches across the plain above the Bear River. The trenches controlled the amount of the incline which in turn controlled the flow rate of the water in the flowlines.[55] According to historian John McCormick, the improvements were undertaken to meet the power company's goal of creating a "super power system" to improve service and cut operation costs. [56]

In 1917 materials were delivered to the power plant for the construction of a fifth generator unit. However, World War I intervened and construction of the fifth generator was delayed until 1923. Once completed, the fifth generator increased power capacity to 44,000 kilowatts.

The Grace Development encompasses the dam and its support structures as well as the power plant and its support structures, all located several miles from the dam. Over the years more structures were built to support operations at both the dam and power plant. Power plant workers lived on site in a residential community east of the two powerhouses which was developed between 1908 and 1920. A two-story building constructed in 1908 to provide housing for power plant employees burned down in 1914, and was replaced with a similar structure which was finished in 1915. The 100-year old building still stands. It is currently in use as a training center and offices for PacifiCorp staff (Figures 5.6 and 5.7).

Before the automation of many power plant operations, a large work force was needed to operate and maintain the power plant. Additional housing constructed around1920 housed power plant workers and their families. The small community included 13 bungalows built west of the power house.[57] Most of those buildings were demolished by the time of the 1998 cultural resource survey. Other power plant buildings besides the residential buildings and power houses included the office switch house, warehouses, switch yard and shops. (Figures 5.8 and 5.9).

During the 1920s, UP&L also constructed a Craftsman bungalow-style house for the dam tender at Grace Dam. This building is still in use today by the foreman for the dam.[58] (Figures 5.10 and 5.11).

A third flowline, constructed of wood staves on steel supports, was added to the system in about 1923. Flowline No. 3 was built next to Flowline No. 2 on the southeast side, in the same trench. AY-shaped structure was built near the east side of Grace Dam to supply water to both Flowline No. 1 and Flowline No. 3. Flowline No. 3 was later abandoned.[59]

After the Grace power plant was completed in 1908, engineers realized that the Bear River's elevation drop of 100 feet in a mile allowed for the placement of a second power plant. In 1917, UP&L began construction a 7500 kilowatt power plant to take advantage of the elevation drop. The Cove Power Plant was supplied by a large wooden flume measuring 20 feet wide and 14 feet high.[60]

During the early 1920s, a bridge was constructed over the two original Grace Development flowlines on Turner Road, a farm-to-market road. Turner, originally called China Flat, was an agricultural community located west of Grace which was settled between 1897 and 1898. In 1900, through the efforts of Theodore Turner, a land commissioner in Pocatello, a school and post office were built. The community was then named in his honor.[61] The Turner Road Penstock Bridge provided a crossing point over a portion of the wood stave segment of the flowlines. When first constructed the bridge consisted of horizontal board formed concrete wall with two corrugated multi plate "arch" pipes or culverts that spanned each of the flowlines.[62] The bridge was a unique engineering feature, since the arches were specifically designed to cross the flowlines. In 2014 the bridge was determined to be structurally deficient and closed to traffic due to failing concrete and stability issues. The failing bridge was replaced in 2016 with a geo-synthetic reinforced soil integrated bridge system (GRS-IBS) technology.

After the construction in the 1920s, UP&L continued its efforts to provide more power to consumers, expanding the Grace Power Plant and building three new hydroelectric facilities in southeast Idaho. The company integrated the Grace and Cove power plants with two other facilities, Soda and Oneida, to become one of the first power grids established in the Intermountain West.[63]

Regular maintenance over the years extended the lives of many of the structures. Between 1937 and 1952 the system underwent extensive alterations and upgrading. In about 1950 Flowline No. 2 was completely reconstructed of wood staves on steel supports. Other improvements consisted of enlarging and updating the switchyard. A new Grace Dam was built below the original dam in 1951. The original rock-filled timber crib dam is now submerged in the fore bay just upstream of the 1951 dam. Flowline No. 1 was removed in 1985.

In 1989 ownership of the Grace Dam Complex, including the dam, penstocks, and power plant, transferred from UP & L to PacifiCorp following the merger of the two companies. The original 15,000 feet of riveted steel pipe of Flowline No. 2 was replaced with welded steel pipe in the 1990s. The 89-year old Cove Dam was decommissioned in 2006 after Flowline No. 2 broke. The cost of repairing it was considered too high to justify in relation to the electricity the dam produced.[64] Grace Dam and Power Plant continues to provide power as part of PacifiCorp's Bear River Basin hydroelectric system.

Conclusion

> "[Grace Dam] is the greatest development of hydraulic power between the Mississippi and California rivers. It is said to be the greatest, with the exception of Niagara Falls, in the world"-- *Salt Lake Herald*, June 15, 1908, p. 6

Between 1883 and 1927 western states led the nation in the development of hydroelectric power plants. Grace Dam was built during that age of development. Although this context is not a complete study of all hydroelectric plants in Idaho, the Grace Dam Complex is important on the local, state, and national levels. Nationally, the complex was important as a plant developed by Lucien Lucius Nunn, who is regarded by many historians as the "father of the electric power industry in the Intermountain West."[65] Nunn's pioneering effort with long-distance transmission in Ames, Colorado, opened the door to large-scale development of power companies in Colorado, Utah, and Idaho. His methods were adapted for use at plants in other locations in the United States including New York and California.

He created the Telluride Association, an innovative work study program for the new field of electrical engineering. Many graduates of Nunn's program, known as "pinheads" went on to study at Cornell and other universities. The Telluride Association established branches at many of the Nunn power plant locations, including Grace. During their enrollment, students gained hands-on experience running and servicing power plants, providing a much-needed skilled workforce for a new industry.

As Don Southworth and others concluded in a cultural resources survey of the complex, the Grace Dam Hydroelectric Complex is significant for its association with the early development of hydroelectricity in Idaho and Utah. When UP&L recognized the economic benefit of providing power to consumers in southeast Idaho and northern Utah they began an aggressive expansion campaign to purchase and expand existing power companies and build new power plants. John S. McCormick noted that UP&L's goals were to produce a power grid, which would improve service and cut operating expenses.[66] This goal required a large number of plants scattered in northern Utah and to southeastern Idaho including the Bear River region. The Grace Power Plant was instrumental to this plan and was integrated into one of the first power grids established in the Intermountain West.

Figure 5.1 Construction camps were built near the dam and power plant. (Courtesy PacifiCorp).

Figure 5.2 The Phoenix Construction Company hired Russians, Greeks and Japanese. They were housed at separate camps. (Courtesy PacifiCorp).

Figure 5.3 Approximately 100 men were divided among the construction camps. (Courtesy PacifiCorp).

Figure 5.4 Men worked in all conditions during the construction of the expanded Grace Dam and Power Plant. (Courtesy PacifiCorp).

Figure 5.5 The site of the new power house shown adjacent to the 1908 one. (Courtesy PacifiCorp).

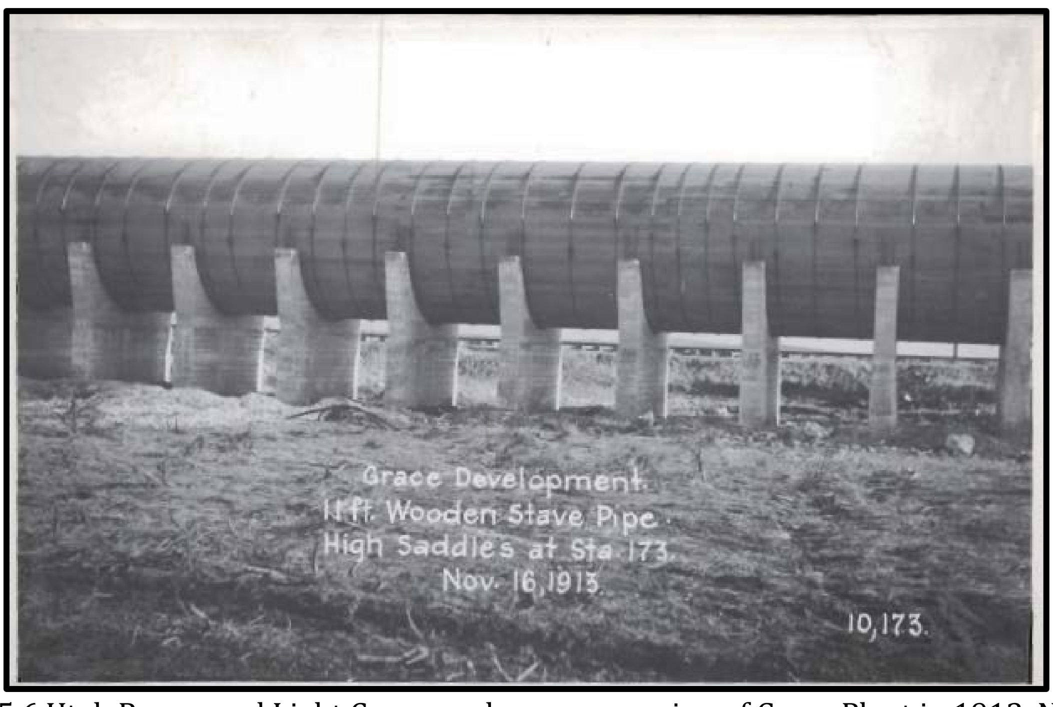


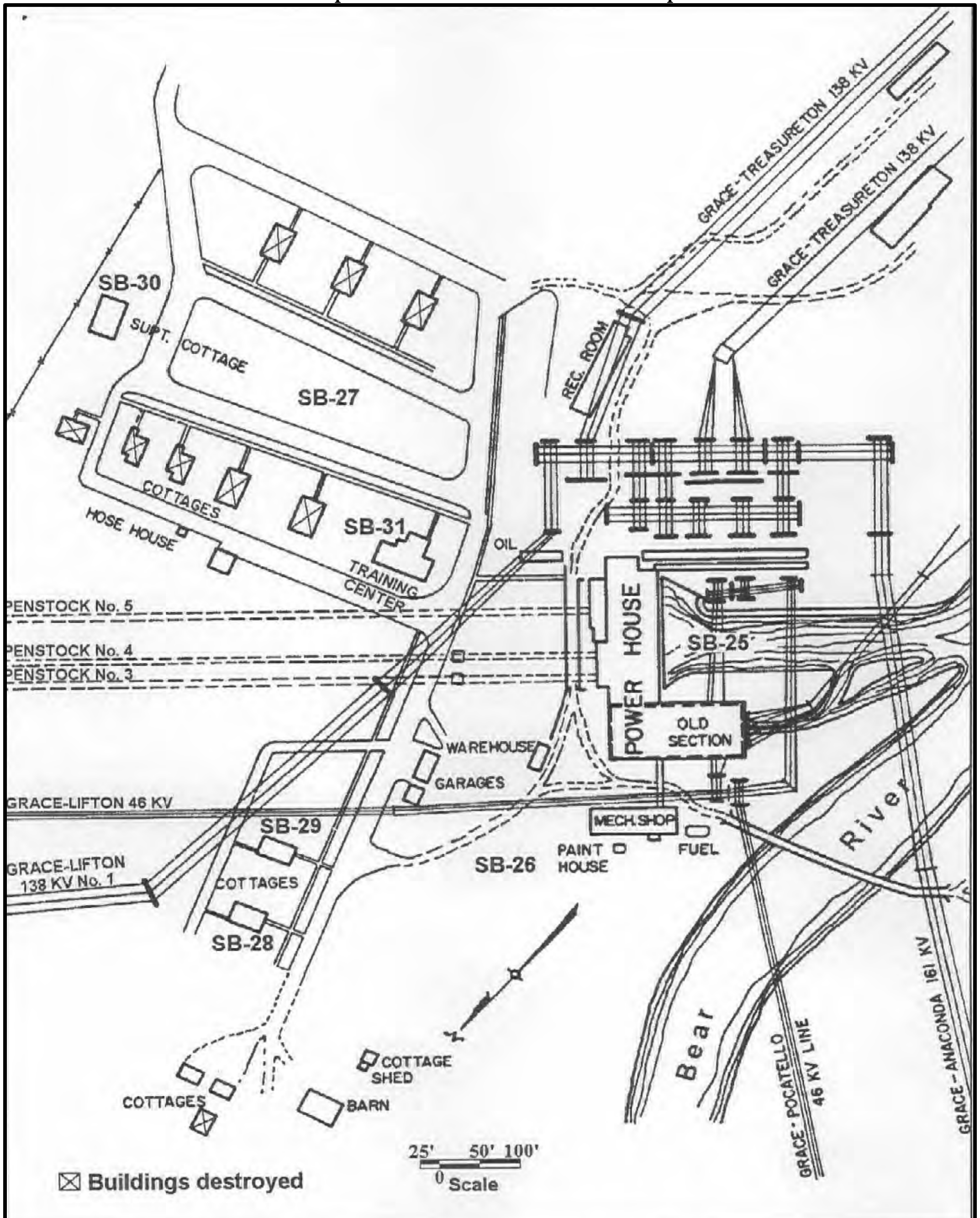
Figure 5.6 Utah Power and Light Company began expansion of Grace Plant in 1913. Note the concrete saddles supporting Flowline No. 2. (Courtesy PacifiCorp).

Figure 5.7 L.L. Nunn built quarters for the construction crew in 1908. The building burned down in 1914. (Courtesy PacifiCorp).

Figure 5.8 Shown above is the new Quarters Building constructed by UP&L in 1915. (Courtesy PacifiCorp).

Figure 5.9 Rear view of the newly constructed Quarters Building. (Courtesy PacifiCorp).

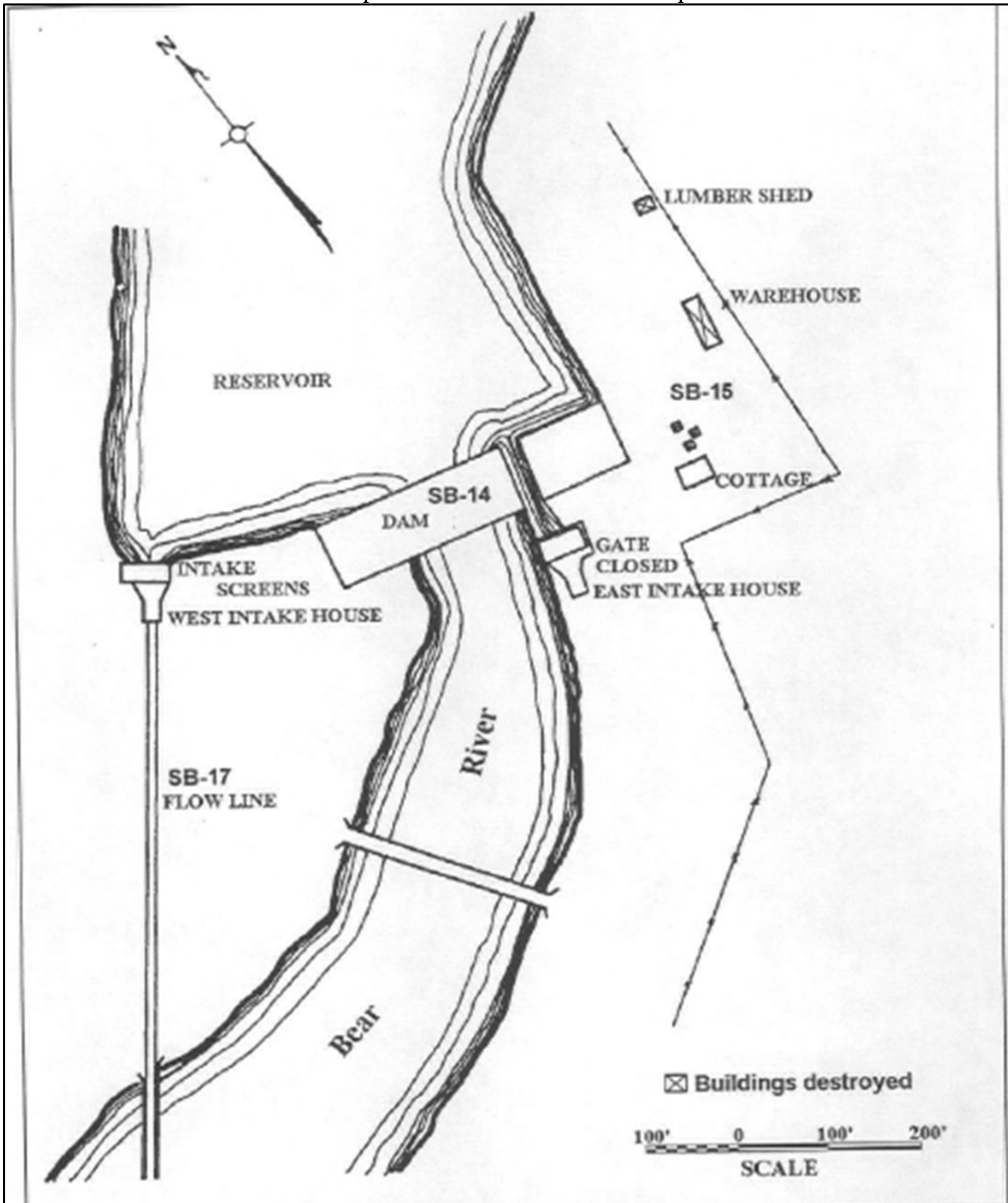
Figure 5.10 Interior view of UP &L Quarters Building. (Courtesy PacifiCorp).



Sites SB-27 through SB-31. Grace Hydroelectric Complex Landscape and Community Site Map. Adapted from "Grace Development General Map." Utah Power and Light Collection, Salt Lake City, 1975.

Figure 5.11 Sketch map of Grace Power Plant Complex from Idaho Historic Sites Inventory Form 29-15952.

Figure 5.12 2016 Google image showing layout of Grace Dam Power Plant complex. The 1915 Quarters building now used for PacifiCorp staff and training is circled in red.



Sites SB-14 and SB-15. Grace Division Dam (SB-14) and Dam Tender's Residence (SB-15) with wood stave flow line (SB-17). Adapted from "Grace Development General Map." Utah Power and Light Collection, Salt Lake City, 1975.

Figure 5.13 Sketch map of Grace Dam Complex from Idaho Historic Sites Inventory Form 29-15945.

Figure 5.14 2016 Google image showing layout of Grace Diversion Dam and Dam Tender's Residence. Residence shown in red circle.

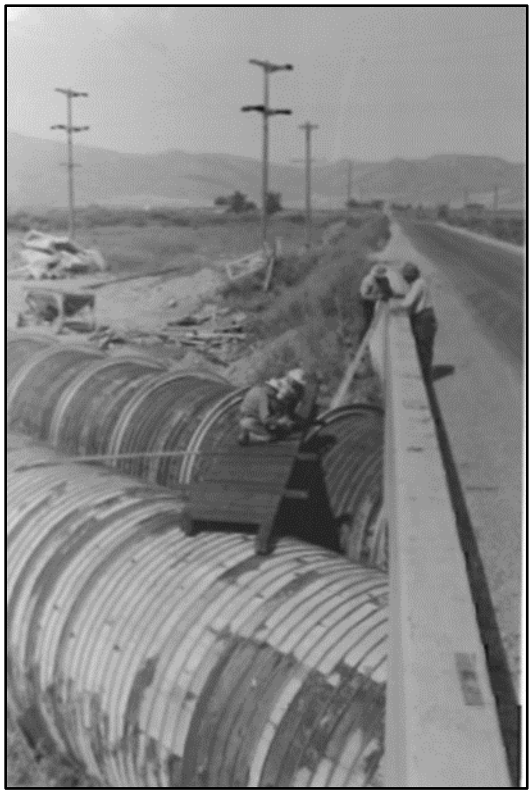


Figure 5.15 Few historic images of the Turner Road Penstock Bridge exist. This 1952 construction photo shows men standing on the bridge over the flowlines. (Courtesy PacifiCorp).

Figure 5.16 View of Grace Development and construction of new dam. (Courtesy PacifiCorp).

Notes

[1] "Bear River: Project Overview," http://www.pacificorp.com/es/hydro/hl/br.html.
[2] Bear River Watershed Information System, http://bearriverinfo.org/htm/bear-river-watershed-description.
[3] Ibid, "Middle Bear.
[4] Sheri Ellis, *A Cultural Resource Assessment in Compliance with PacifiCorp's Bear River Project Historic Properties Management Plan in Caribou County, Idaho*. (Salt Lake City, Utah: SWCA Environmental Consultants, 2008) p. 12.
[5] Merle Wells, *A Brief History of the Cache Valley Area, Northeastern Utah and Southeastern Idaho* (Utah Geology Association Publication 14, 1985), p.1-4.
[6] Brigham and Betty Madsen*, North to Montana: Jehus, Bullwhackers, and Mule skinners on the Montana Trail*. Salt Lake City, Utah: University of Utah Press, 1980), p.4.
[7] Wells, p. 1.
[8] Madsen and Madsen, *North to Montana*, p.4.
[9] Peter Skene Ogden was a chief trader with the Hudson's Bay Company. In the period 1824-1829, he led five trapping expeditions to the upper reaches of the Columbia Basin, "Snake Country." Information about Peter Skene Ogden, from *Peter Skene Ogden's Journal of His Expedition to Utah, 1825* edited by David Miller, https://user.xmission.com/~drudy/mtman/html/ogdenjrl.html.
[10] Leonard Arrington, *History of Idaho* (Moscow: University of Idaho, 1994), pp.272-273.
[11] Max R. McCarthy, *Last Chance Canal Company, Its Place in History as an Influence on Western Water Policy* (Provo, Utah: Brigham Young University Scholarly Publications, 1987) p. 23.
[12] Paul K. Link and E. Chilton Phoenix, *Rocks, Rails & Trails* (Pocatello: Idaho Museum of Natural History, 1996), pp 86-87.
[13] Vivian Simmons and Ruth Varley, *Gems of our Valley: A Written and Pictorial History of Gem Valley Located in Southern Idaho along Bear River 1811-1877 and the People Who Have Lived There* (Grace, Idaho: Grace literary Club, 1977), p. 40.
[14] McCarthy, pp. 23-25.
[15] Ibid.
[16] Max R. McCarthy provides a detailed analysis of this issue in the *Last Chance Canal Company.*
[17] Toni Rae Linenberger and Leah S. Glaser, *Dams, Dynamos, and Development: The Bureau of Reclamation's Power Program and Electrification of the West* (Washington, D.C.: United States Department of the Interior, Bureau of Reclamation, 2002), p.2.
[18] Patrick M. Malone, *Waterpower in Lowell: Engineering and Industry in Nineteenth-Century America* (Baltimore: Johns Hopkins University Press, 2009), pp 17-18.
[19] Ibid.
[20] Duncan Hay, *Hydroelectric Development in the United States, 1880-1940* (Washington, D.C.: Edison Electric Institute, 1991), pp. 2-4.
[21] Susan Stacy, *Legacy of Light: A History of the Idaho Power Company* (Boise: Idaho Power Company, 1991) p. 19, and Hay, pp.3-4
[22] An arc lamp is a device for producing light by maintaining an electric arc across a gap between two conductors; the lamp is a spark or electric arc through the air between two carbon rods. The rods must have a gap in between of the right size. If the gap is too big than the arc will flicker more or may go out, if the gap is too narrow than it will produce less light. The first carbon was made of charcoal (made from wood), http://www.edisontechcenter.org/ArcLamps.html.
[23] Hay, pp. 5 -9.
[24] Stacy, p.14.
[25] Linenberger and Glaser, pp 6 – 8.
[26] Ibid., pp 16-17 and http://www.smithsonianmag.com/history/edison-vs-westinghouse-a-shocking-rivalry-102146036/?no-ist
[27] L. Jackson Newell, *The Electric Age of Academe: The Sage of Lucien L. Nunn and Deep Springs College* (Salt Lake City: University of Utah Press, 2015) pp. 19-22. For a detailed description of the Ames project see Allen

Drew "Telluride Power Company: Pioneering AC in the Rocky Mountains," *IEEE Power and Energy Magazine*, January/February 2014. Also see P.N. Nunn, "Pioneer Work in High-Tension Electric Power Transmission," *Cassier's Magazine*, vol. 27, no. 3 (January 1905) 171-200, (https://archive.org/details/cassiersmagazi2719041newy).
[28] Mark Fiege and Janet Ore, *Electric Power Plants of Utah Multiple Property Study,* 1988, p.10.
[29] Hay, *Hydroelectric Development in the United States, 1880-1940*, pp. 2-4.
[30] Newell, pp 10-17.
[31] Ibid pp 18-19.
[32] Hugh Lovin, "Lucien Nunn, Provo Entrepreneur, and His Hydropower Realm in Utah and Idaho," *Utah Historical Quarterly* 76/2 (Spring 2008) pp.132-147.
[33] The Mercur Mine was owned by Joseph L. Delamar, a Belgian businessman, who had interests in several regional mines, including mines in the Owyhee Mountains in southwest Idaho.
[34] Fiege and Ore, p.12.
[35] Newell, pp.32-33
[36] http://www.deepsprings.edu/about/history/
[37] "Idaho State News", *Soda Springs Chieftain*, September 8, 1904. P. 8.
[38] McCarty, p. 54 - 58
[39] Fiege and Ore, p. 25.
[40] A flowline is a pipeline. In terms of hydroelectric generation, a flowline is open to the atmosphere by means of a stand pipe or surge tank. After the last location where the flowline is open to the atmosphere, and before it goes into the hydroelectric plant, the pipeline is termed a penstock. According to the 2015 report drafted by Taylor Planning Chartered, PacifiCorp personnel prefer the term "flowline" for the pipeline that lies beneath the Turner Road Penstock Bridge. Nancy Taylor, *Draft: Turner Penstock Bridge, Key 13563* p. 4.
[41] Simmons and Varley, p. 89.
[42] *Soda Springs Chieftain*, July 12, 1906 p. 4 and July 19, 1906 p. 7.
[43] *Soda Springs Chieftain,* November 29, 1906.
[44] "Great Bear Lake Power Plant", *Idaho Daily Statesman*, July 24, 1907 p. 5.
[45] *Idaho Statesman*, September 7, 1908. P. 4.
[46] Simmons and Varley, p. 89; Fiege and Ore p.25.
[47] Simmons and Varley p. 95.
[48] Stacy pp. 28-29. Also see Lovin for an in-depth description of the Beaver River Power Company and the Malad Power Company.
[49] Don Southworth, et al, A *Cultural Resources Survey and Inventory of the Soda, Grace/Cove and Oneida Hydroelectric Power Plants in Caribou and Franklin Counties, Idaho* (Ogden, Utah: Sagebrush Consultants, 1999), p. 32; Stacy, p. 31.
[50] "Utah Power & Light Company's System," *Journal of Electricity: Power and Gas,* no. 19, 1914 p.371 -373.
[51] Fiege and Ore, p. 16.
[52] "Grace is a Busy Burg,"*Soda Springs Chieftain*. March 27, 1913 p. 1; "Utah Power Company Has a Model Camp," *Soda Springs Chieftain*, July 10 p. 3; "Was Greek Laborer Murdered?" *Soda Springs Chieftain,* November 20, 1913 p. 1.
[53] *Journal of Electricity, Power and Gas*, Volume 31, p.552.
[54] Taylor, p. 24.
[55] PacifiCorp "The Grace Dam and Flowline," interpretive sign.
[56] John McCormick, *The Power to Make Good Things Happen: Past Present and Future; The History of Utah Power and Light Company* (Salt Lake City: Utah Power & Light Company, 1990), p. 12.
[57] Simmons and Varley, 91-92.
[58] For a complete description of the Grace Diversion Dam and associated features see Idaho Historic Sites Inventory Form 29-015944.
[59] Ibid.
[60] Southworth, p. 33
[61] Simmons and Varley, p. 42.
[62] Idaho Historic Sites Inventory Form #29-15950.
[63] Southworth, et al p. 33

[64] "Bear River dam removed," *Deseret News*, September 10, 2006.
[65] John McCormick, quoted in Fiege and Orr p. 11
[66] Ibid, p.12.

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