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#153	January	2021

The C/DPHS is an association of individuals dedicated to the preservation of the history of our community. To the preservation of the region's oral history, literary history, social history, graphic and pictorial history, and our history as represented by the region's artifacts and structures. To the preservation of this history for future generations. To the art of making this common heritage accessible to the public. And to the act of collaborating with other individuals and organizations sharing similar goals.

THE CLAYTON ◊ DEER PARK HISTORICAL SOCIETY

Mortarboard

The Construction of the Long Lake Dam in Photographs.

by

Peter Coffin & Wally Lee Parker

Included within is an article copied from the February 28th, 1915 Edition of the Spokesman-Review that describes in detail the construction of Long Lake Dam.

Permission to Use Select Photos from the Washington State University Archive:

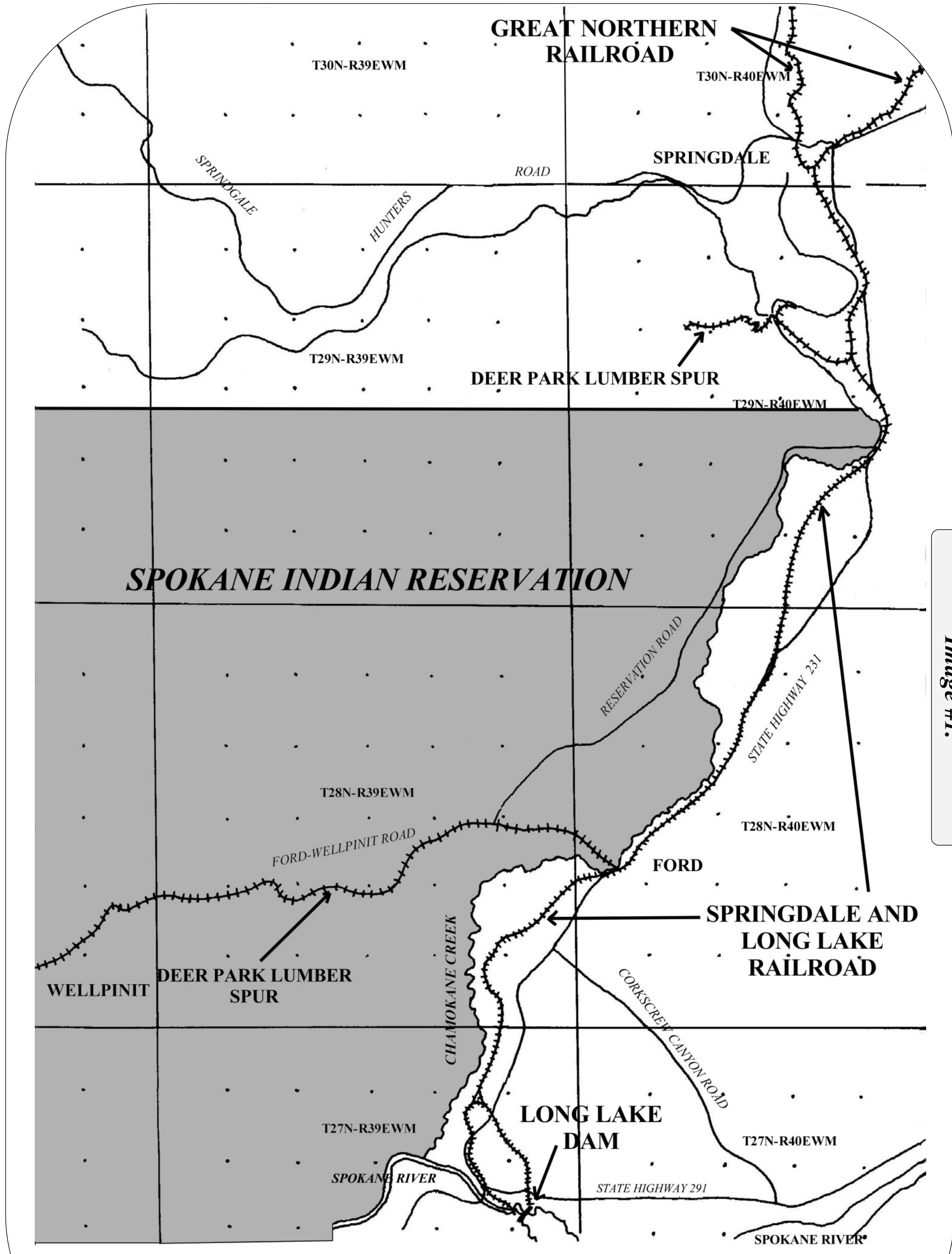
Regarding said permission, the Clayton ◊ Deer Park Historical Society wishes to extend its gratitude to Greg Matthews, Special Collections Librarian, WSU Libraries.
The University's preferred citation for the file from which the photos used here have been selected, "Joseph Beckman Photographs of Long Lake Dam Construction — 1910-1915 (PC 135). Manuscripts, Archives, and Special Collections, Washington State University Libraries, Pullman, Washington."

Introduction:

Long Lake Dam is located in a narrow canyon of the Spokane River approximately twenty-five miles northwest of the City of Spokane. It was built between 1910 and 1915 by the Washington Water Power Company to generate electricity. When completed, it was believed to have the highest spillway and the largest electric generating turbines in the world.

Joseph Beckman, a 20-year-old construction worker on the project, collected approximately 150 photographs of the Springdale & Long Lake Railroad being laid to supply the dam's construction site on the Spokane River, along with images of the building of the dam itself. These photographs are now held as part of the Washington State University Library's 'Special Collections' at Pullman. With permission, a selection from that collection has been reproduced here.

—— *Peter Coffin* ——



MAP OF THE SPRINGDALE AND LONG LAKE RAILROAD

Image #1.

Construction of the Long Lake Dam.

by

Consulting Engineer — E. W. Miller

As Printed in the February 28th, 1915 Issue Of the Spokesman-Review.

Originally published under the headline "Builders of Great Long Lake Power Plant Performed an Impressive Series of Engineering Feats," this detailed account of the Long Lake Dam's construction is reprinted here unabridged. Due to the date of publication, the article now falls within the public domain.

Power was generated Wednesday, February 10, at the Long Lake plant of the Washington Water Power Company, the successful consummation of an undertaking which has taken nearly four years to reach its culmination.

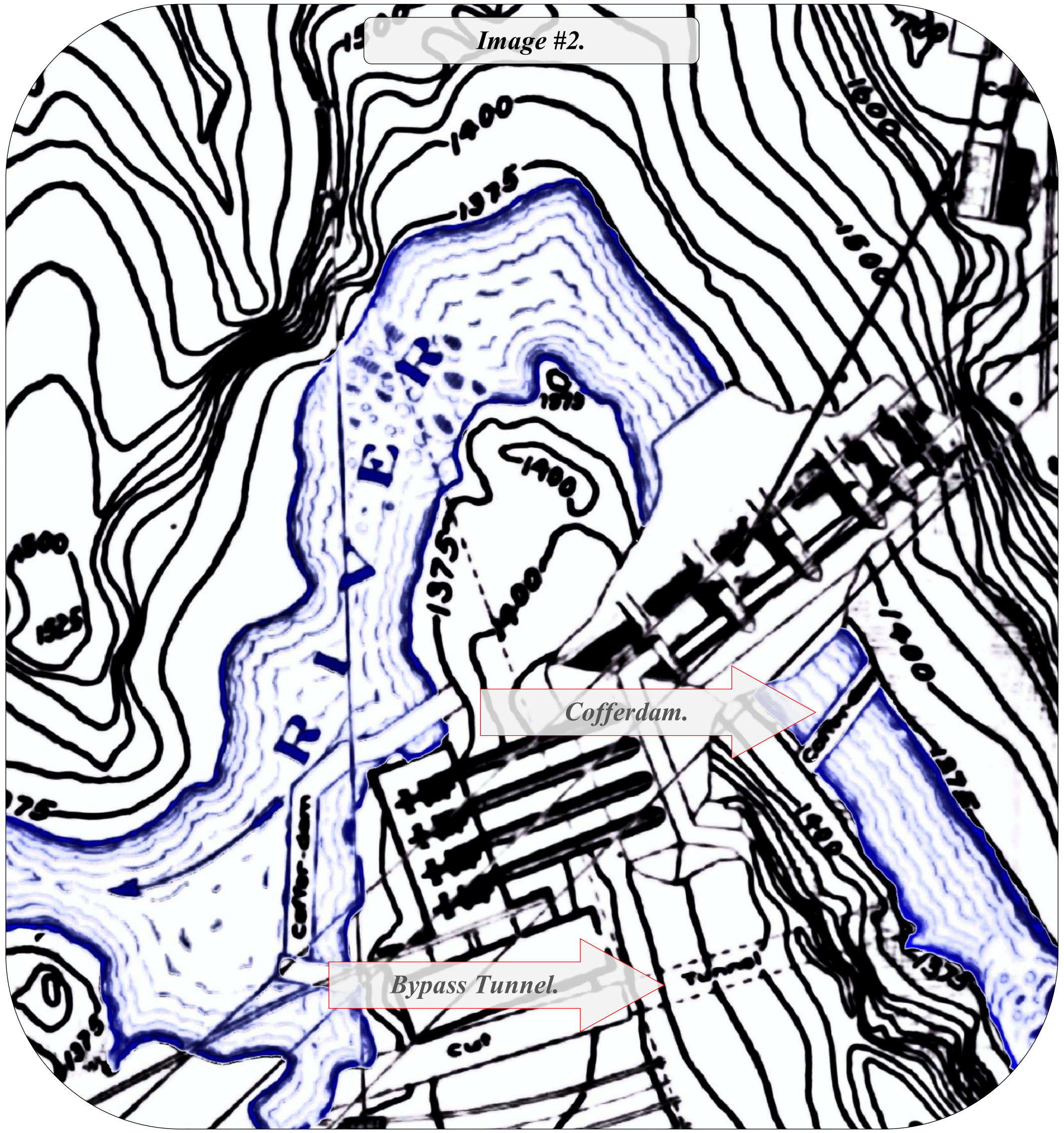
The plant is located on the Spokane River 28 miles below Spokane. At this point the river took a double turn, like the letter S ***(see Image #2, page 2220)***, passing between precipitous bluffs 400 and 500 feet high on the north side and 300 to 400 feet high on the south side, the sides being scarcely more than 200 feet apart. As the walls on both sides of the river were of solid granite and as the narrow ridge between the two lines of the S could readily be tunneled to bypass the river during construction work, this was an ideal site for the location of an immense dam and the accompanying powerhouse.

The first essential of any large undertaking such as this is economical construction, and the Washington Water Power Company put in at Long Lake what at first sight might look like an enormous amount of equipment, but the end has justified the means many times over, with the result that the entire work has been completed at a cost below that usually found in work of this character.

One of the important factors in secur-

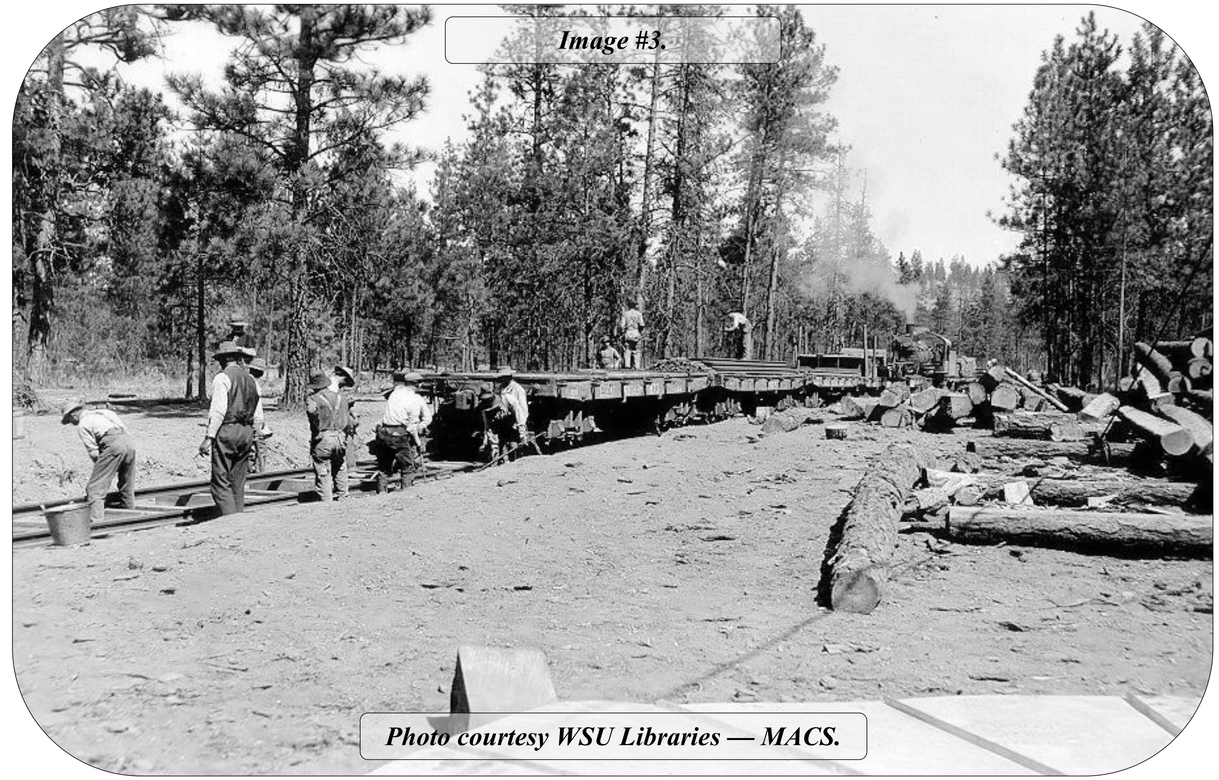
On the Facing Page: A Map by Peter Coffin.

Because the construction site was in a steep walled canyon remote from existing railroads, a railroad spur was built to haul in building materials and heavy generating equipment. This railroad, the Springdale & Long Lake, was built southward from Springdale to the dam site as a spur of the Great Northern's (the Spokane Falls and Northern's) Kettle Falls Railroad. This spur was incorporated from April 1911 to 1920. After the dam's construction, the Deer Park Lumber Company took over the spur to transfer timber harvested on the Spokane Indian Reservation to the company's mill at Deer Park.



The Curve in the River.

This is a portion of a map copied from an article by the Washington Water Power Company's chief engineer on the Long Lake Dam project, C. F. Uhden. Under the title "System of Washington Water Power Company," the article appeared in the September 5th, 1914 issue of the "Journal of Electricity, Power, and Gas." It clearly shows the "S" curve, the cofferdam, and the bypass tunnel mentioned in Mr. Miller's article.



Along Chamokane Creek.

Construction of the Springdale and Long Lake Railroad on August 22, 1911. This area is across the relatively flat Chamokane Creek valley.

ing good and at the same time cheap construction work is to have all the men on the job well housed and well fed, and the Washington Water Power Company outdid itself in this respect. The camp has been a model of its kind. Permanent quarters for the future operating staff were built at the start, and these houses, modern in every respect, formed the center around which was built the rest of the camp. A large commissary and mess hall were also built. The food served was on par with any of the hotels or restaurants in Spokane, while the store carried a stock as varied as can be found in Spokane, and at practically the same prices. By providing well for their men the company got through four years of strenuous work without experiencing a shortage of labor or having trouble with any of their men.

After the installation of the camp came the setting up of the machinery. Foremost in this list were the four cableways spanning the river, three of them each 1,550 feet long and of 12 tons capacity, running over the dam itself in a northeast and southwest direction, while the fourth, 700 feet long, ran over the powerhouse north and south. These cableways, as well as numerous derricks, were operated by compressed air engines. The compressors which furnished the air for these en-

Excavating.

Constructing railroad access to the dam site involved excavating much gravel glacial till on the north side of the Spokane River on September 20, 1911. Today the remains of this work are still visible downstream from the dam.

gines were located on both banks of the river, adjacent to the ends of the main cableways. These compressors were in turn driven by motors obtaining their motive power from the Little Falls (Dam) plant of the same company. The rest of the equipment consisted of innumerable drills, dinky engines, etc., all run either by electricity or by air compressed electrically, except the dinky engines, which were operated by steam.

Well-equipped machine shops, blacksmith shops, a carpenter shop, tin shop, storehouse, and sawmill were also established. At the latter, during the course of the work 3,356,000 feet of lumber were cut up, while there are still over 1,000,000 feet to be cut when the ice goes off the lake in the spring. This equipment was all installed before work on either the dam or the powerhouse started. The concrete building plant was not installed for some 18 months after excavation began.

Having installed the machinery, the first thing to be done was to divert the river from its regular course. As stated above, this was accomplished by driving a tunnel through one of the narrow ridges separating two of the turns of the river. This tunnel was 300 feet long and 30x30 in section and was capable of

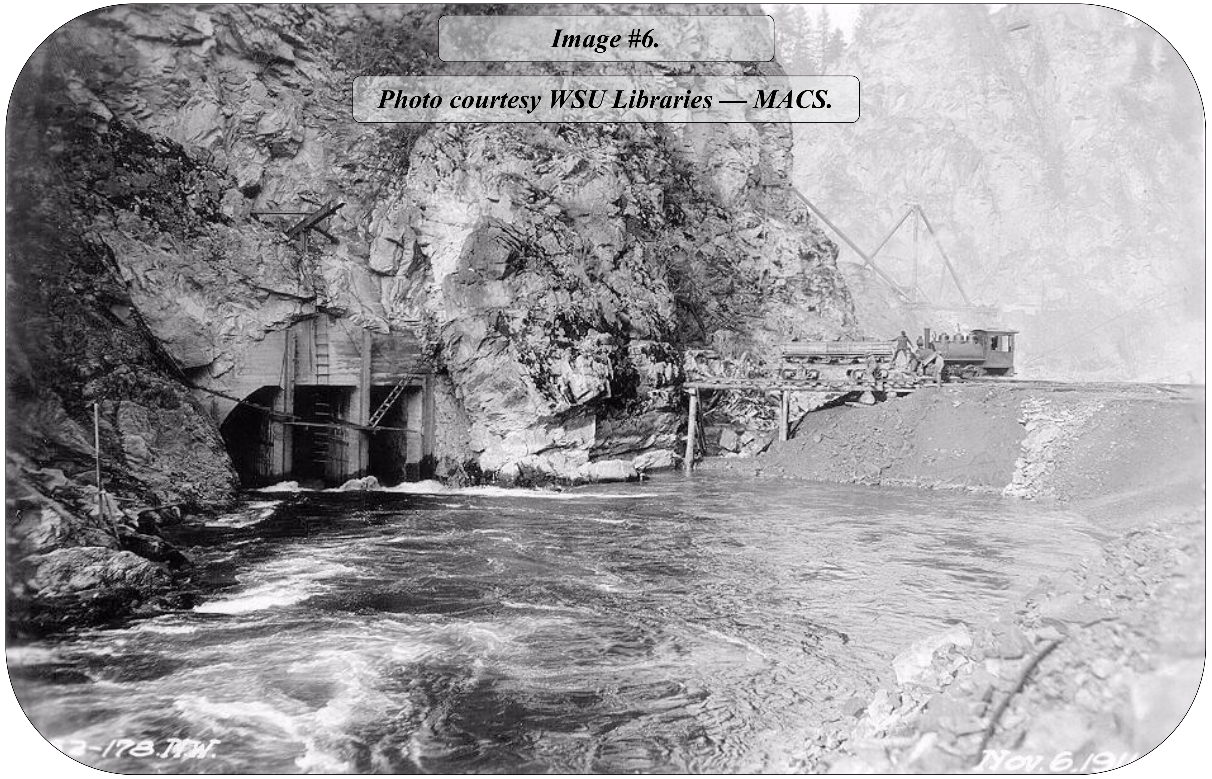
Crossing the Spokane River.

Constructing a bridge to the powerhouse site on the south side of the river is underway on November 20, 1911.

carrying all the water in the river except at a time of exceptionally high water.

After the tunnel was completed, a cofferdam about 25 feet high above low water level was built across the main river channel and the river thus permanently diverted from its course and through the tunnel.

The work of excavation for the dam itself, and also for the powerhouse below the dam, was next begun, and the immense cableways overhead were soon working to their full capacity. In excavating for the main dam, the riverbed was found to consist of gravel filled with boulders of all sizes to a depth of about 40 feet. The former channel of the river was distinct and was in the shape of the letter V, the width at the bottom of the V being only a few feet, while the top widened out to the full width of the river. This gravel fill of the old riverbed was found to be remarkably compact, as little water leaked though into the workings below even when the water in the river was comparatively high. This was rather remarkable, as a gravel fill is usually porous and water flows through it almost as readily as it does over the surface. The only explanation for this unusual condition was that the water, as it deposited the gravel and boulders on the rocky bottom, deposited with the gravel minute particles of silt which closed all the openings in the



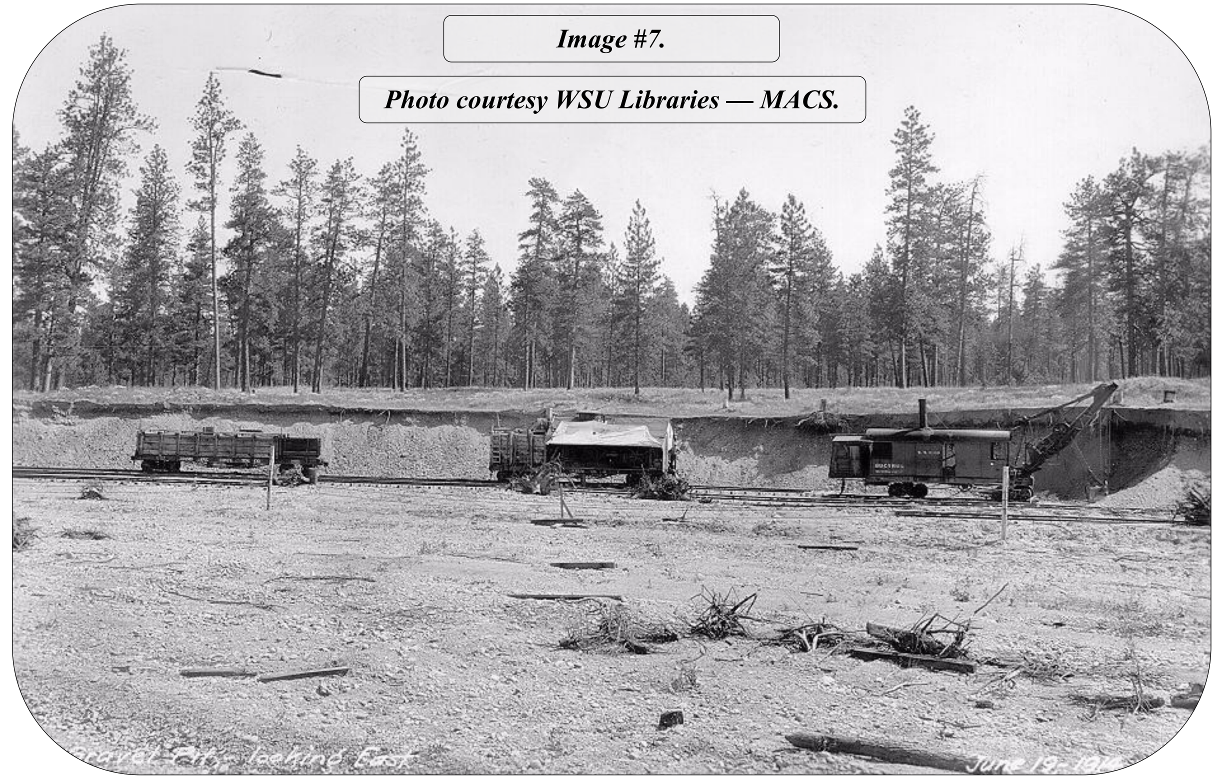
Cofferdam & Diversion Tunnel.

After a diversion tunnel was drilled though the canyon walls, a cofferdam was built so that the bottom of the river could be prepared for pouring the concrete foundation for the dam. The above photo was taken on November 6, 1911.

gravel, at the same time cementing the particles of gravel into what became in time a practically impervious mass. This proved a fortunate circumstance, as it made the work of pumping in the excavation below the cofferdam almost negligible.

As soon as the rock bottom of the river was reached, quarrying operations were started and the rock was broken out in as large blocks as possible up to the capacity of the cableways. This rock was all sorted on the south bank of the river directly under the cableways, so that it could afterward be reclaimed and put back into the concrete of the dam itself. The excavation was carried down into the rock until every appearance of soft or disintegrated rock had disappeared. By this time the excavation had reached a depth of 60 feet below the old river and extended 250 feet up and down the river. A total of 500,000 yards of rock was taken out of this huge hole before the engineers of the Washington Water Power Company considered it safe to stop the work of excavation and begin that of concreting.

One of the forces acting on a dam which is sometimes not provided against in an adequate manner is the buoyant effect of any



Gravel for Concrete.

Gravel Junction near Ford, Washington, as seen on June 19, 1914. This was the source for the gravel used in the dam's concrete.

water which might percolate though the rock under the dam and exert a lifting action over the whole undersurface of the dam. As the pressure of water is exerted in every direction with equal intensity, the lifting action of the water under the dam would be equal to the direct pushing action of the water against the face of the dam under a head equal to the full height of the water in the lake above the lowest part of the dam. As this may reach a maximum of 231 feet and the water exerts a pressure equal to its weight, 62.4 pounds per cubic foot, multiplied by the head under which it acts, or 231 feet in this case, the upward pressure or buoyant effect can easily be calculated to be 14,414 pounds per square foot on the undersurface of the dam. The failure to allow for this upward pressure has caused the failure of more than one dam, notably the Austin Dam in Texas, which failed from this very cause in 1912. There are two methods of overcoming this upward pressure, the first and most obvious being to prevent any water from percolating under the dam. As this is not always possible, in fact, is almost always impossible, the second method must be resorted to, and that is to add enough weight to the dam over and above that necessary to give it stability from direct overturning or from sliding on its foundation to counteract this lifting or

Image #8.

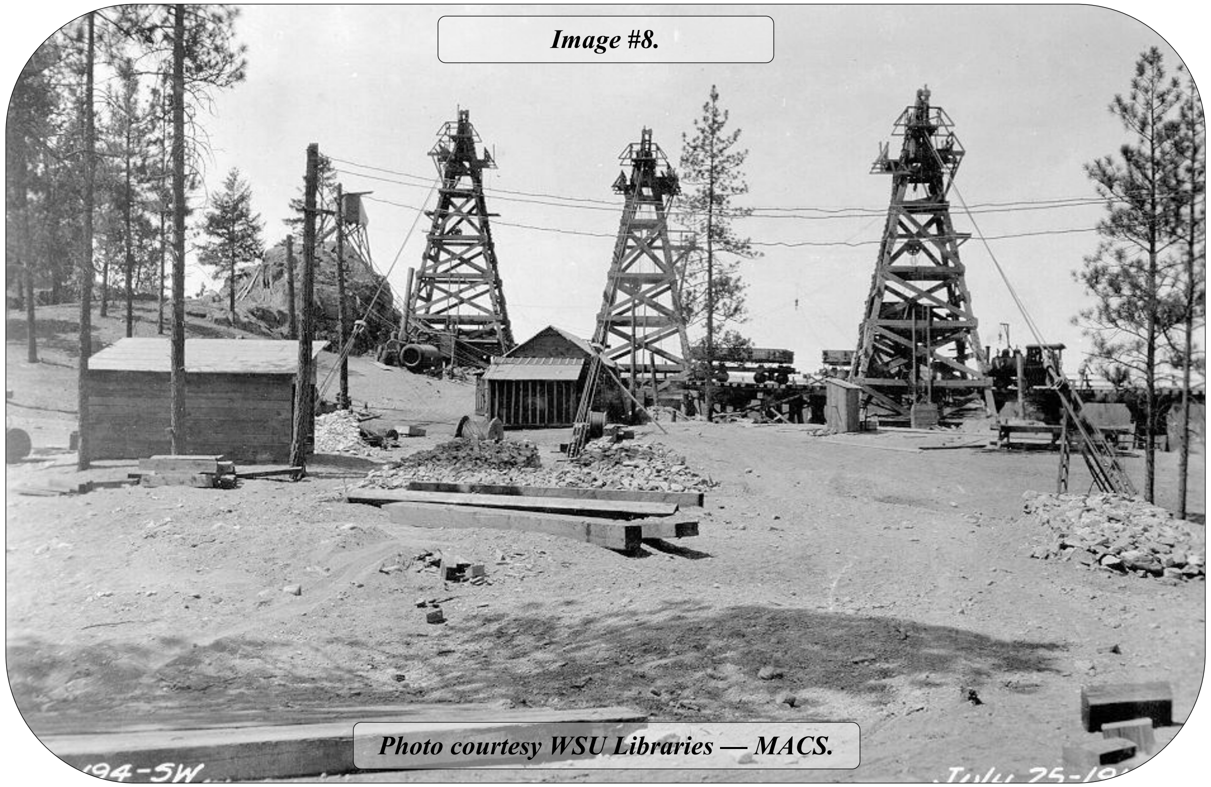


Photo courtesy WSU Libraries — MACS.

Concrete Delivered by Cable.

The aerial cable towers on the north river cliff top on July 25, 1911. Concrete from the batch plant would be poured into the train cars and then transferred into buckets to be delivered by cable to the dam site.

buoyant effect. As concrete weighs more than twice as much as water, addition of concrete in large quantities is the solution of this problem.

At Long Lake the failure of the dam would have unusual results, as it would mean the sweeping away of the Little Falls Dam and power plant four miles below Long Lake, which represents an investment of about $2,000,000. In order to make assurance doubly sure at Long Lake, the Washington Water Power Company's engineers adopted both of the methods specified above. They not only added enough concrete to the mass of the dam to counteract the buoyant action of the water, but they adopted every measure known to modern engineering science to prevent the water from getting under the dam. With this end in view, they drilled a row of holes in the rock on the upstream side of the dam. These holes were two inches in diameter and 30 feet deep, 10 feet from the face of the dam and 10 feet apart. Into these holes a thin mixture of cement and water called "*cement grout*" was forced under 135 pounds pressure until no more of the grout would go in. The theory of this treatment is that the thin grout under such high pressure would seek out and find any minute cracks or fissures in the rock and ce-

Image #9.

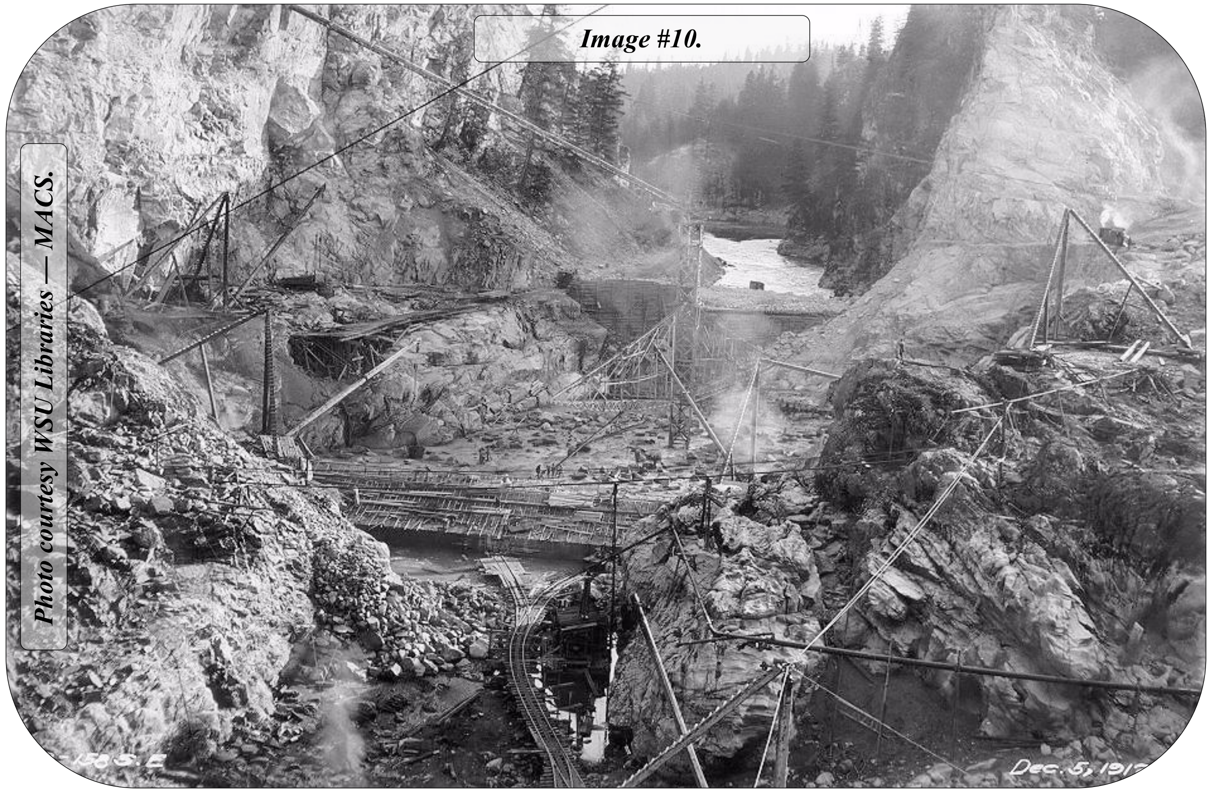
Photo courtesy WSU Libraries — MACS.

Concrete by the Bucket.

Concrete buckets used to transfer concrete from the railroad at the top of the cliff to the construction site — December 13, 1913.

ment them shut. Assuming that even these precautions would not be entirely effective, a minute search of all the rock floor under the dam was made for cracks, and over all such cracks found a brick drain was built before the concreting commenced. These various brick drains were carried to a number of central points, where they were connected with vertical risers which were carried up inside the dam to a point above the low water level of the downstream side of the dam.

Three rows of holes two inches in diameter and 30 feet deep were then drilled underneath the dam itself. The first row was 40 feet from the row of grouted holes mentioned above, the second row 40 feet from this one and the third row was 65 feet from the second one. The holes in each row were 20 feet apart. These holes were all left open and the tops connected by means of brick drains to the tunnel which opens on the downstream side of the dam. Thus, if any water does find its way under the dam it will meet either the open holes or the crevices and flow from these to the brick drains, and instead of exerting an upward pressure on the dam it will quietly flow through these drains to the risers, through them to the upper tunnel and thence out into the river. The Long Lake Dam, therefore, is thrice protected against the lifting action of the



Looking Upstream.

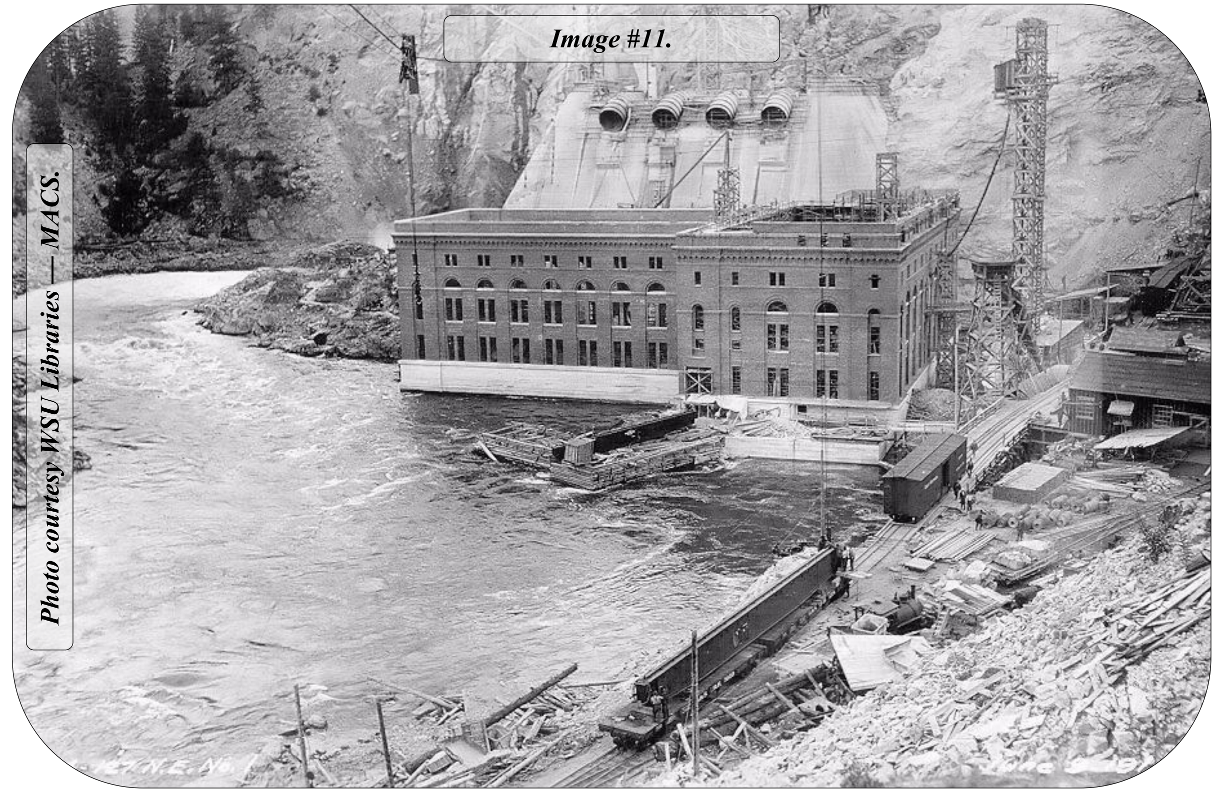
December 5, 1912. Looking upstream and across the excavation site, its wooden forms in place to receive concrete for the dam foundation.

water and nothing less than the absolute dissolving of the rock should ever alter its stability.

As the total amount of the concrete to be placed ran well above 300,000 yards, the design of the concrete mixing and handling plant was of the utmost importance. Advantage was taken of the fact that the bluff on the north side of the river was about 300 feet higher than the top of the dam. The concrete mixing plant was located there to utilize the force of gravity in mixing and placing the concrete.

Gravel was obtained from a pit about two miles from Long Lake on the railroad between there and Springdale. In order to handle the gravel most economically a 45-ton steam shovel was installed, and the railroad was electrified as far as the gravel pit. A large electric locomotive was built and did all the miscellaneous work on the north side, besides hauling the gravel train to and from the gravel pit.

The gravel was loaded into 20-yard side-dump cars, which were pushed over the storage bins at the mixing plant, where it was dumped onto "*grizzly bars*" directly over the bins. These grizzly bars were built of rails placed about three inches apart and set on a slight incline. Everything smaller passed through the grizzly, while the large boulders



Nearing Completion.

With the dam about two thirds finished up to the penstock tubes, the powerhouse building's shell is finished. The two flat cars in the lower right center of this June 9, 1914, photograph appear to be carrying the gantry crane that will be fitted in the powerhouse to install and repair the electric generating turbines.

were retained and passed to a number 4 Gates Gyratory Crusher. After passing through the grizzly the gravel was put through rotating washing machines to eliminate all the clayey material, of which there was a large percentage. It was soon found, however, that some of the clay was in large lumps, which resisted the effects of the water, so picking belts were put in below the washers. These are wide rubber belts moving at very slow speed. A man sits beside the belt and picks out all the clay lumps from the material as it passes him. With these precautions it was found that practically all the clay and clayey material was eliminated. From the picking belts the washed gravel dropped into storage bins, which fed it into measuring chutes below.

The sand was obtained from a sandpit within 500 feet of the mixing plant. It was reclaimed by means of ta dragline scraper of two cubic yards capacity. At the time of maximum output, two of these scrapers were employed, each requiring only two men to operate. The scrapers dumped the sand directly into side-dump cars, which were pushed over the storage bins of the mixing plant in a simi-


Image #12.

A Recent Photo of the Dam.

Pete Coffin's May 11, 2010, photograph of the Long Lake Dam and powerhouse. At the extreme left is lighter colored fill from the 1911 railroad construction spilling down the canyon wall. After the dam was finished, the Springdale & Long Lake Railroad was renamed the Deer Park Railroad, with spurs added to harvest timber on the Spokane Indian Reservation.

lar manner to the gravel. The sand storage bins discharged into measuring chutes below.

The cement was furnished by two Inland Empire cement companies. The Inland Portland Cement Company of Metaline Falls furnished the first 150,000 barrels, while the International Portland Cement Company of Trent furnished the rest — about 100,000 barrels. The Washington Water Power Company exercised unusual care in their testing of the cement. They maintained a chemist and an assistant at the plants of both cement companies during all of the time, not only when the companies were shipping, but when they were

Further Reading — Springdale & Long Lake Railroad.

"Springdale & Long Lake RR & the Deer Park Ry Company," by Michael Denuty. Mortarboard #33, January, 2011 — page 409 — Collected Newsletters, Volume 9.
http://cdphs.org/uploads/3/4/2/0/34204235/newsletter_33_downsizesingepageweb.pdf

manufacturing the cement as well. The chemist watched the making of all the cement used by the company from the time the rock was taken from the quarry until it was turned into the stock houses as finished cement. He took samples constantly, and if at any time any one of the samples did not come up to the specifications under which the cement was to be tested he immediately rejected it. The cement was held in bins at the cement plants until the expiration of 30 days, when additional tests were made. If these tests did not prove satisfactory, the cement was rejected.

The cement was delivered to the Washington Water Power Company at Springdale on the Great Northern Railroad, the balance of the trip being over the private railroad built by the Washington Water Power Company from there to the dam site. This private line had two branches, one of which ended at the north side of the river, while the other, by a long detour, ran down into the valley and across a bridge to the powerhouse site on the south bank of the river. Most of the cement was delivered on the north side, where a storage house was built capable of holding about 10,000 barrels. This large storage capacity was necessitated by the fact that the railroad was irregular in its service. Although the cement was shipped in regular allotments, sometimes a week would pass without any of it being delivered at Springdale, and then 15 to 20 cars would come together. At other times, especially during the crop and apple shipping season, it would be hard and sometimes impossible to get cars for days at a time. Notwithstanding the large storage capacity, there were occasions when the supply fell below 1,000 barrels, hardly a day's run during the busy season.

As the powerhouse site was too far away from the north side to be reached by the gravity system of distribution, a small concrete mixing plant was installed on the south bank of the river, and part of the cement had to be taken to that point, where a storage house

Cement — Juggling Barrels and Sacks:

When it comes to cement, Mr. Miller's article seems to use the word barrels interchangeably with sacks. In search of an explanation, we dredged up the following quote from 1908's edition of a book by Halbert Gillette and Charles Hill titled "Concrete Construction: Methods and Costs." These gentlemen state, "The commercial unit of measurement of cement is the barrel; the unit of shipment is the bag." This seems to be the assumption under which Mr. Miller writes — essentially that for each barrel of cement ordered, four cloth bags of cement arrive — unless exposure to atmospheric moisture at high levels or for an extended period of time is an issue, in which case barrels with moisture resistant liners are the preferred means of shipment. It all comes down to cost. Refillable sacks are cheaper to manufacture than barrels — and much cheaper to ship back to the cement manufacturer for a refund.

Regarding the volume and weight of cement delivered in barrels or bags, Jerome Cochran, in his 1913 book "A Treatise on the Inspection of Concrete Construction," noted that "Portland cement barrels (from) different manufactures vary in weight and capacity due to differences in (the) weight of cement, to differences in compacting the cement into the barrels, and to slight differences in sizes of barrels." This lack of standardization suggested it was good practice in any contract to specify the weight/volume ratio expected of shipped cement — such weight/volume ratio eventually being set at the 94 pounds per cubic foot of Portland cement common today.

holding about 1,000 barrels was built.

On the north side the cars could be unloaded either into the storage house or sent directly to the mixing plant. A belt conveyor connected the storage house and the mixing plant. The belt extended under the entire length of the storage house and over to the small bins at the mixing plant. There were numerous holes in the floor of the storage house through which the bags of cement would slide onto the belt. At the mixing plant a man would lift the bags off, open them and dump their contents into the small bins there. These fed the cement directly into a measuring chute, from which it was discharged into the mixer.

In selecting the type of concrete mixers to be used, the Washington Water Power Company was influenced in its decision by the splendid showing made by the Haines gravity mixer ***(see illustration facing page)*** in the pouring of the concrete for the Monroe Street Bridge in Spokane. This type of mixer requires a great deal of headroom and so is not adaptable to a great many jobs, but as there was plenty of height available at Long Lake there was no objection on that score. Two of these mixers were accordingly installed, each taking sufficient material at each charging to make two yards of concrete. The Haines mixer consists simply of a number of hoppers, usually four, placed one above the other. Each hopper is six feet wide at the top and one foot at the bottom and is provided with a gate operated by hand. The cement, sand, and gravel are drawn, each from its own measuring chute, into the top hopper. Water is added according to the judgement of the operator. The amount of water varies greatly at different times, depending on the amount of water in both the sand and the gravel. After all the ingredients are in the top hopper, its gate is opened and the mixture drops into the next hopper, which has its gate closed. When all the material is in the lower hopper the gate to the upper one is closed and it is ready for another charge, while the gate of the lower hopper opened and the charge drops down into the next lower hopper. This is repeated as many times as there are hoppers. The charge in falling from one hopper to the next does not slide out, but tumbles over and over itself, with that portion directly over the hole going out first so that a thorough mixing is affected.

At Long Lake the G-Y or gravity system was used for the distribution of the concrete, so the mixers all discharged into a trough leading to another hopper from which the distribution to the dam itself was controlled. A steel tower was built near the center of the dam and connected to the last hopper by a bridge suspended from two steel cables by one-half inch manila rope tackle hung every 10 or 12 feet. This bridge supported a steel trough 14 inches high and 10 inches wide, with a semi-circular bottom. The bridge was built on a uniform slope of 15 degrees, as that was found to be the angle at which the concrete flowed best.

On two sides of the tower, latticed wood beams 90 feet long were hung with a hinge joint at the tower, permitting the booms to move through a horizontal angle of nearly 180 degrees. The booms, with their connections at the tower end, could also be raised as the progress of the work demanded. On top of the booms a light wooden framework was built, which supported a trough similar to the one on the bridge. In the center of the tower was another hopper which could also be raised as the booms were raised. The trough on the bridge discharged through a pipe into the hopper, which was connected by a universal joint to the troughs supported on each boom. At the end of each boom was suspended, on a counterbalanced truss, another trough through which the final placing of the concrete was affected. These troughs varied in length according to the height of the main boom above the surface of the concrete and were connected to the trough on the boom by a universal joint so that they too could be swung through a wide angle. By this means the bottom of the dam, although 250 feet wide, was covered by either one or the other of these booms with their suspended arms without any extra han-

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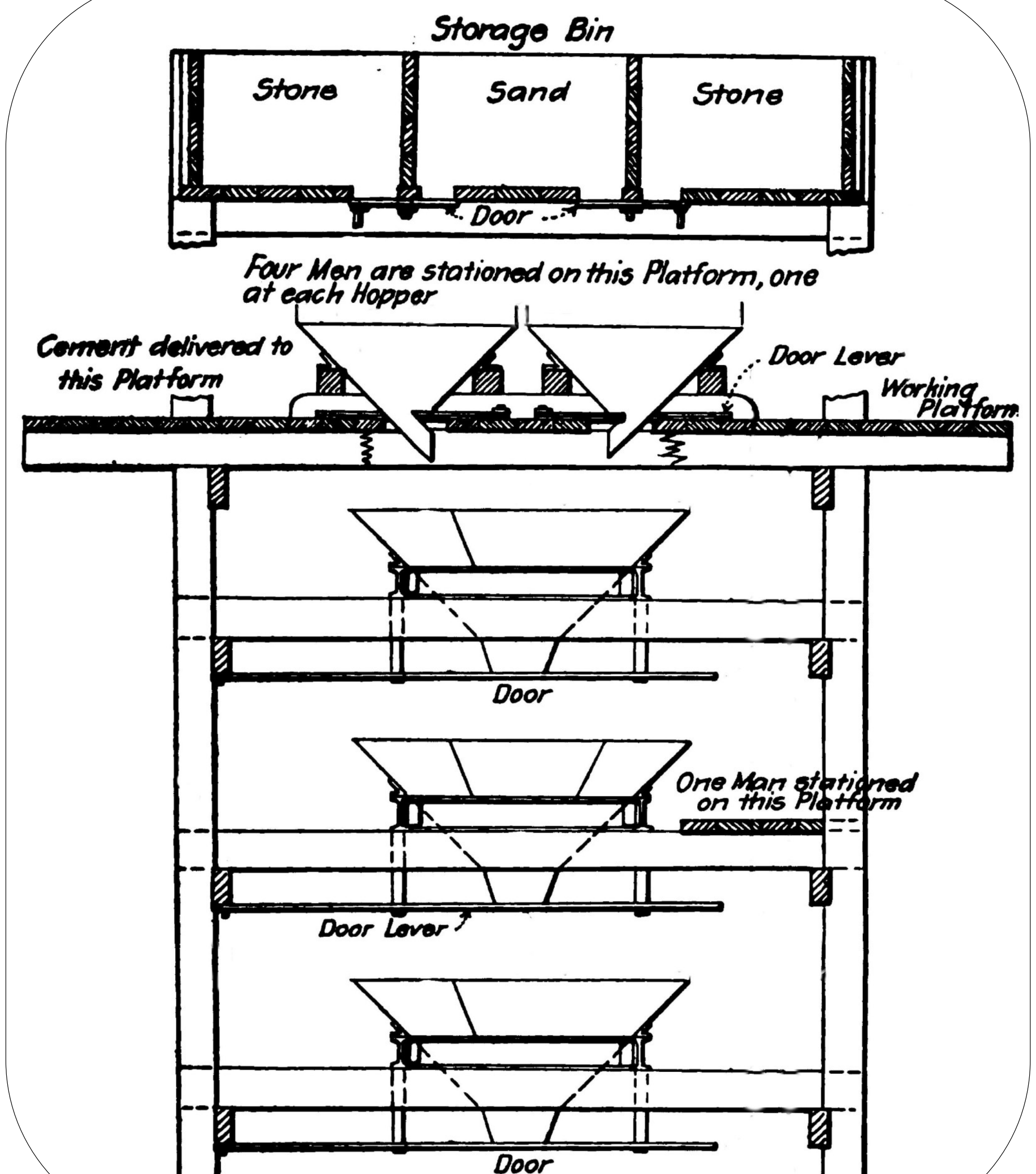

Typical Haines (properly spelled "Hains") Gravity Mixer, Fixed Hopper Form.

The above illustration was extracted from Halbert P. Gillette and Charles S. Hill's 1908 book, "Concrete Construction: Methods and Cost."

dling. Although it was not possible to pour the entire dam from this one tower, between 65 and 75 percent of it was so poured, and it was during this period that the best records for amount of concrete placed was made. The best day's run was 1,000 yards, while the best whole month's run was 27,000 yards.

When the concrete in the dam became too high to be reached by the above system the movable hopper in the steel tower was replaced by a self-dumping bucket and additional towers were built, each one connected to the preceding one by a steel trough suspended on a 15-degee angle and each in turn provided with one or more booms. In this way the entire spillway dam and the headgate dam, in all containing 367,000 yards of concrete and covering 550 feet in length, were concreted by the spouting system.

One of the interesting sidelights of the concreting was the method of handling the empty cement sacks. After the sacks were emptied at the mixing plant, they were taken to the sack-cleaning house, where a cleaning wheel was installed. This is a cylindrical wheel of large dimensions, whose outer surface is made of slats. A bunch of empty sacks is thrown into the wheel, which is then revolved slowly until all the dust has been taken out of the sacks. The recovered cement drops through the slats of the wheel into a hopper below. By this simple device 2,057 barrels of cement were saved, or about four-sevenths of 1 percent of all the cement used. The cleaned sacks were counted, put in a baling machine and returned to the cement manufacturers. Besides saving all the cement, this method of handling also reduced the losses from torn and otherwise unfit sacks. On most contract work the loss of sacks is not much under 10 percent, while here the loss was reduced to about three-fourths of 1 percent.

The spillway dam consists of three spillway sections, each 65 feet wide, with a 15-foot pier 40 feet high between. The height of water over these sections will be controlled by immense roller gates. They are large steel cylinders, 13 feet in diameter and 65 feet long, to which is rigidly fastened a circular steel shield, 19 feet high and 15 feet in radius. When the gate is lowered, the center of the shield is about two feet below the center of the cylinder, so that the pressure of the water will tend to keep the gate tight. The ends of the cylinders are encircled by huge gear teeth, which mesh into the teeth of equally huge racks set in recesses in the concrete piers. When it is desired to raise the gates, the cylinders are caused to rotate, the teeth on the ends of the cylinders engage those of the racks and the gates open. For this purpose, each gate is provided with a seven and a half horsepower motor, and, although the gates each weigh 95 tons, the gear reduction is so tremendous that it only requires that amount of power to raise or lower the gate. Of course, the rate of movement is slow, requiring an hour to open or close each gate. These roller gates are not to be put in at the present time, the control to be affected by the waste gates at the north end of the dam, together with flashboards on the main spillway dam.

North of the spillway sections are two waste sections 35 feet wide and a debris or refuse section six feet wide. These are closed by the ordinary sliding gates, which are not supposed to operate under much pressure.

The headgate dam is 23 feet higher than the spillway level, and from it four penstocks lead down to the powerhouse. The headgate dam is built nearly at right angles to the spillway dam, on a point of rocks which formerly separated the two lines of the river. Its total height is therefore only 100 feet. The penstocks, of which only one is completed at present, are 16 feet in diameter and 240 feet long. They are built of steel one-half an inch thick at the top and increasing to fifteen-sixteenths of an inch at the bottom. In order to resist the pressure of the water, which would have a strong tendency to move them bodily, each is anchored in 1,500 yards of concrete. The headgates which close the mouths of the penstocks are of heavy structural steel, 31 feet square, and are opened and closed by 25-horse motors, which will open them in two minutes

and close them in three minutes. In order to fill the penstocks with water prior to opening the headgates, small auxiliary gates are provided in the headgates themselves. These filling gates are four feet by two feet six inches and are operated by a seven and one-half horse motor located on the stem of the main gate. When these small filling gates are opened and the water enters the penstock, the air in the latter escapes through a vent pipe extending through the concrete of the dam itself to a point above high water, and thence out to the face of the dam. As the headgates can only be opened by an operator in the headgates house, he can readily tell by the sound of the escaping air when the penstock is full of water and can thus be governed as to the opening of the main headgate. The headgates are thoroughly protected from floating debris by heavy iron screens arranged so that they can be readily cleaned.

As is stated above, the powerhouse was too far away from the north bank to be reached by the gravity system of concrete distribution, so a separate mixing plant was installed on the south bank. This consisted of a one-yard Rawsome mixer which delivered the concrete directly into a self-dumping bucket elevated in a tower close by. This bucket elevated the concrete, and it was distributed partly in cars and partly by chuting directly into place, the same as in the dam.

This mixing plant was also used to pour the concrete in the auxiliary arch dam 900 feet upstream from the main dam. At this point there was a deep draw, which extended to a considerable depth below the future surface of the lake. A dam 100 feet high and 240 feet long on top was accordingly built to close this draw. A gully led down from the draw to the working level south of the powerhouse and an inclined railway was built up the gully. Concrete for this dam was hauled in cars and poured directly into the forms. The arch dam contains 5,400 yards of concrete.

The powerhouse is shaped like the letter T, the stem being 75 feet wide and 160 feet long and containing only the four water wheels and the four generators. The cross of the T is 86 feet wide by 207 feet long and contains, besides the transformer and switchboard gallery, all the switches and other controlling apparatus. Only the foundations up to the highwater level are of concrete. The balance of the structure consists of structural steel framework with brick curtain walls and concrete floors. As the number of bricks required for this large structure and for the headgate house was close to 3,000,000, the Washington Water Power Company leased a brickyard at Chewelah and made all the bricks themselves. They were thus assured that they would get the kind of bricks they wanted. They wanted a certain percentage of hard burned black bricks, so as to relieve the monotony of color, and that they have succeeded admirably is shown by the appearance of the building which is one of the most sightly brick buildings that I have seen in the west. They were also successful financially, as they delivered all their bricks at a lower figure than was named by any of the brick companies who figured on the contract.

The building is fitted with metal window frames and sash, which were put in not so much because of their possible protection against fire, of which there is practically no danger, but because they found they could be purchased and installed at a considerably reduction from the price of wooden frames and sash.

Inside the powerhouse the most interesting objects are the huge water wheels, which are among the largest ever built. They were built by the I. P. Morris Company of Philadelphia Pa., and they are known as the double runner Francis inflow type, each runner ***(turbine wheel)*** being 83 inches in diameter. At full load rating — this is with the gates 8-10$^{\text{ths}}$ open — they will develop 22,500 horsepower, while with the gates open full they will develop 25,000 horsepower. They are governed or controlled by an auxiliary engine which is worked with oil under 200 pounds pressure. The oil is brought up to this pressure by a separate triplex pump run by a direct current motor, which runs continuously. When the oil pressure reaches 200 pounds a bypass valve opens and the oil flows back into the suction line. When the oil pressure drops five pounds, the bypass valve closes, and the pump works against the received pressure until that has again been raised to 200 pounds. With this type of governor control the gates move under a variation of one-half of 1 percent in the load, and for a sudden variation of 10 percent in the load the variation in speed will not exceed 3 percent.

The water wheel is directly connected through a 22-inch shaft to a General Electric Company three phase 60-cycle alternating current generator of 14,000 K. V. A. capacity. The generator generates the current at 4,000 volts pressure, which is much above what was thought possible only a very few years ago. This high voltage means that the current necessary for such large power production is relatively small, so the generator is not nearly so large as one would expect to see.

The water wheel, with its casing and shaft, weighs 875,000 pounds, while the generator, with its shaft, weighs only 500,000 pounds. To think that such huge pieces of machinery could revolve at the comparatively high speed of 200 revolutions per minute without making any sound is almost unbelievable, and yet I stood right beside the first unit the other day, and with my back to it I could not tell whether it was moving.

On the end of each shaft, away from the water wheel, is the exciter. This is a direct current generator of 220 K. W. capacity, which furnishes the current to excite the field of the alternating current generator. Each generator will have its own exciter, but each exciter is large enough to supply current for two generators, so that one can be cut off at any time without making it necessary to shut down its own generator.

The switchboard gallery, as is usual in Washington Water Power Company practice, is located at the end of the powerhouse and is elevated so that the switchboard operator can see the entire powerhouse without leaving his station. Nearly all the switches for every purpose are within easy reach, the only exceptions being the main line disconnecting switches, the switches for charging the lightning arresters, the switches for opening the headgates and the switches for raising and lowering the roller gates. The switches for closing the headgates are located on the switchboard gallery because it might be necessary at some time to close them in a hurry, but once closed it is necessary to go up to the headgate house before they can be again opened. The switchboard operator has under his immediate observation a miniature or dummy switchboard on which all the various connections are recorded by means of varicolored lights, so that anyone coming to the switchboard gallery can tell at once by a glance what machines are running and how the load is connected to the various circuits.

The transformers, which are single phase and of 6,500 K. V. A. capacity, are located under the switchboard gallery in reenforced concrete chambers facing the powerhouse. At present they are so connected as to deliver 66,000 volts to the transmission line, but by a slight change to their connections they can be made to deliver 110,000 volts. The outgoing lines are well protected from the effects of lightning and other surges on the line, being equipped with lightning arresters of the aluminum disk type and also with choke coils of large capacity. All the wiring is the best that can be provided and is installed in the most modern and scientific manner, with the thought ever uppermost to protect the system from any possible damage due to unexpected breakdowns or accidents.

The operating force for this large plant will be men, divided into three shifts of nine hours each. There will be one foreman in charge who will be on duty during the day, while the night force will consist of only two men. The other seven will be divided up so that there will always be four men on duty during the daytime and in the early evening, when the peak load is to be expected.

At present the main dam is completed and two units, consisting of water wheel and

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generator, are installed. The second unit cannot be operated for about 60 days, however, as it will require that time to erect the second penstock. The balance of the units in the powerhouse will not be installed until there is an additional demand for power.

——— **end** ———

Minutes of the

Clayton ◊ Deer Park Historical Society

—— December 12, 2020 ——

With the rise in COVID-19 cases, we discussed canceling all monthly Society meetings until the spring of 2021; however, we will re-evaluate our decision before each scheduled meeting. The following were reports sent by email.

Society President Bill Sebright reported that: 1) It has really been a slow month. Several Society members attended the grand opening of the Chamber of Commerce's "*Hot Spot*." Mike Reiter reports on that below. 2) Look for our name on the Rotary Christmas sign. It's on the west side of the NAPA Store. 3) Also look for an article about the Society in this month's *DP Gazette*, because our business card was drawn at the grand opening.

Society Treasurer Mark Wagner reported: The main checking account ended the month at $8,942.80. There was a $25 check written to the Rotary for the Christmas sign. The web hosting account ended the month at $881.26 with a withdrawal of $11.84 for web hosting. The Brickyard Day account is at $1,945.33. Mark took *Mortarboards* to Gardenspot Health Foods and Odynski's Accounting.

Society Vice President: No one has stepped forward to become Vice President.

Print editor Wally Parker reported: 1) One hundred and twenty copies of the December *Mortarboard* (#152) have been printed for free distribution, and the online version submitted for uploading to the website. The Loon Lake Library has received a file enabling reprinting of this issue, and The Heritage Network has been sent PDFs of both the online and print versions for distribution to its membership. 2) The December issue features an article by Peter Coffin titled "*Jefferson M. Moore: Early Deer Park Businessman*," and a revised reprint of one of your editor's stories this titled "*The Iron Wheel Tractor & The Williams Valley Farm*." The Letters/Brickbats segment includes a piece about several of Leno Prestini's paintings being stolen in the early 1960s, and also something regarding a late February, 1919 shootout in Williams Valley. 3) On January 30, 2021, the historical society will enter its 18th year of existence as a non-profit corporation within the State of Washington. Birthdays are usually a good time to take stock of past accomplishments and future goals. Regarding the latter, your editor has a suggestion. In the past, our area of interest has primarily been within the historical boundaries of the Clayton and Deer Park School Districts. That makes sense — with shared personal histories being the bond that often draw individuals into a group such as this. Beyond that, our area of interest extends north along Highway 395's corridor a bit, touching the history of Loon Lake, and even on occasion Springdale. Part of that is related to our shared history with the Washington Brick & Lime Company. The Deer Park Lumber Company's history pulls us down the rail bed of the old Springdale & Long Lake Railroad to the Spokane River's Long Lake Dam, as well as north with the company's timber holdings in Stevens and Pend Oreille Counties. All this considered, it

Image #1.

Image #2.

seems one logical area we should be paying more attention is to the east – toward Milan, Elk, and the foothills beyond. This is just another of my orphaned thoughts in need of adoptive guardians not already overwhelmed by other projects.

Webmaster Damon Smathers reported: The *Mortarboard's* December issue has been uploaded to the website. No new changes have been made other than a note on the front

Hanging the Historic Olsen Opera House Curtain at the Hot Spot, 104 North Main Street, Deer Park.

(See page 2240 for Mike Reiter's report on the curtain.)

Image #1: Moving into the Hot Spot, November 8th, 2020; from the left, Danielle Holstein — executive director Deer Park Chamber of Commerce, and society members Mike Reiter, Gordon Grove, Bill Sebright, and Rick Brodrick.
Photo courtesy of Pete Coffin.

Image #2: The historical society's curtain moving crew at the Hot Spot, November 8th, 2020; from the left, Bill Sebright, Gordon Grove, Mike Reiter, Pete Coffin, and Rick Brodrick.
Photo courtesy of Bill Sebright.

Image #3: At the "Hot Spot's" grand opening, November 17th, 2020; from the left, society members Chuck Lyons, Rick Brodrick, Bill Sebright, and Mike Reiter.
Photo courtesy of Tom Costigan.

Image #3.

page, letting viewers/members know the December meeting has been cancelled. Currently work is being done on the Wild Rose/Hazard section, there are enough photos and captions to dedicate a new page.

Mike Reiter reported: The Deer Park Chamber of Commerce held a grand opening for their new "Hot Spot" in the old *Tribune* building at 1st and Main. The room has been totally refurbished with two restrooms, a small kitchenette, a conference table, and several individual tables with high-speed internet access. The highlight of the decor of course is the 100-year-old Olson Opera House curtain that was donated to the Society by Gordon Grove before the Groves sold the building which housed the auditorium. After several months' storage at Pete and Judy Coffin's house, the curtain was hung on the wall in the new "Hot Spot" facility. At the grand opening Bill Sebright, Society president, and members Rick Brodrick, Chuck Lyons, Barbara Lyons, Tom Costigan, Mike Reiter, and Deron Schroeder were recognized. Mike spoke about the history of the curtain. The Chamber was excited to get the artifact to display, and although none of the businesses advertised on the curtain still exist, it is an important part of Deer Park's business history.

Our next meeting is scheduled for Saturday, January 9, 2021, at 10:00 AM at our new building. This is certainly subject to change due to Washington State's COVID-19 reopening guidelines.

——— *end* ———

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Comments Policy

We encourage anyone with observations, concerns, corrections, divergent opinions or additional materials relating to the contents of these newsletters to write the society or contact one or more of the individuals listed in the "Society Contacts" box found in each issue. Resultant conversations can remain confidential if so desired.

Editorial, Copyright, and Reprint Concerns

Volunteer proofreaders for this issue: Rick Hodges, Bill Sebright, Chuck Stewart, and Lina Swain.

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From "The Coast" magazine, April, 1907

See Yourself in Print.

The Clayton/Deer Park Historical Society's department of Print Publications is always looking for original writings, classic photos, properly aged documents and the like that may be of interest to our readers. These materials should be rooted within, though not limited to, northern Spokane County, southeastern Stevens County, and southern Pend Oreille County. As for types of materials, family or personal remembrances are always considered. Articles of general historical interest — including pieces on natural history, archeology, geology and such — are likely to prove useful. In other words, we are always searching for things that will increase our readers' understanding and appreciation of this region's past. As for historical perspective; to us history begins whenever the past is dusty enough to have become noteworthy — which is always open to interpretation. From there it extends back as deep as we can see, can research, or even speculate upon.

Copyright considerations for any materials submitted are stated in the "Editorial, Copyright, and Reprint Concerns" dialog box found in this issue. For any clarifications regarding said policy, or any discussions of possible story ideas or the appropriateness of certain types of material and so on, please contact the editor via the email address supplied on the same page.

——— ***the editor*** ———

About our Group:

The Clayton/Deer Park Historical Society was incorporated as a nonprofit association in the winter of 2002 under the title Clayton Historical Society. Our mission statement is found on the first page (upper left corner) of each issue of our newsletter, the Mortarboard. Our yearly dues are $20 dollars per family/household.
We are open to any and all that share an interest in the history of our region — said region, in both a geographic and historic sense, not limited to the communities in our group's name.