LOST CREEK DAM HAER No. CA-367
Spanning Lost Creek 1.72 miles east of Strawberry Valley
Clipper Mills Vicinity
Butte County
California

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
333 Bush Street, Suite 500
San Francisco, CA 94104

HISTORIC AMERICAN ENGINEERING RECORD

LOST CREEK DAM

HAER No CA-367

Location:	Lost Creek, Clipper Mills vicinity, Butte County, California U.S. Geological Survey 7.5-minute Clipper Mills, California, Quadrangle, Latitude and Longitude coordinates: Lat 39° 34' 32" N Lon 121° 8' 14" W. The coordinates represent the meeting point of the structure's crest with the northern slope of Lost Creek Valley. The coordinates were obtained on July 30, 2013, using Google Earth Pro software. The coordinate datum is World Geodetic System 1984 (WGS84). The Lost Creek Dam location has no restriction on its release to the public.
Present Owner:	South Feather Water and Power Agency (SFWPA)
Present Use:	Lost Creek Dam was originally built as part of an irrigation system but is now a component of the South Feather Power Project (SFPP). It is a part of the Woodleaf development, which also includes Lost Creek Reservoir, Woodleaf Power Tunnel and Penstock, Woodleaf Powerhouse, and Woodleaf Switchyard. The SFPP is a water supply/power project constructed in the late 1950s and early 1960s.
Significance:	Lost Creek Dam is significant for its contribution to the development of irrigation and hydroelectricity to serve the growing population of the Butte County, California, region in the early twentieth century. The dam is also significant as an early example of a constant-angle arch structure.
Historian:	Madeline Bowen, MA Historian AECOM 2020 L Street, Suite 400 Sacramento, CA 95811
Date:	January 2014

Project Information: This documentation has been prepared at the request of the SFWPA, which proposes to modify Lost Creek Dam to meet current flood design and safety requirements for probable maximum flood and seismic considerations established by the Federal Energy Regulatory Commission (FERC) and the California Department of Water Resources (DWR) Division of Safety of Dams. After consultation with FERC and the State of California's Office of Historic Preservation, a memorandum of agreement was reached, stipulating the completion of this Historic American Engineering Record (HAER) document to address the effects of the undertaking.

Madeline Bowen of AECOM served as principal investigator. Alan Abramowitz of AECOM conducted all photography. The documentation is based on the *Cultural Resources Inventory and Finding of Effect Report for the Lost Creek Dam Improvements Project, Butte County.*[1]

[1] AECOM, *Cultural Resources Inventory and Finding of Effect Report for the Lost Creek Dam Improvements Project* (Sacramento, CA, 2013).

Part I. Historical Information

A. Physical History:

1. Date of Construction: 1923-24 (SFWPA 2007: A-13)

2. Engineer: Lars Jorgensen served as engineer for the dam.

Lars Jorgensen was born in Denmark in 1876. Educated in Germany with degrees in mechanical and electrical engineering, Jorgensen immigrated to the United States at the turn of the twentieth century. Upon his arrival, he worked for a short time as a draftsman with General Electric Company in Schenectady, New York. He moved to Los Angeles in 1903 and took a position with Edison Electric Company. Later, he joined California Pacific Gas and Electric Company in San Francisco, where he assisted with hydroelectric development. In 1907, Jorgensen joined the consulting firm of F. G. Baum & Company, where he worked with electric power transmission and new theories in dam design. In 1914, he formed the Constant Angle Arch Dam Company, based in San Francisco, and patented the concept of the constant angle arch dam, which was based on conical geometry rather than a cylindrical geometry. During this period, he designed the first constant angle arch dam in the world: Salmon Creek Dam in Juneau, Alaska. While at the firm, he also completed work on other dams, such as Lost Creek Dam and the Diablo Dam on the Skagit River in Washington (1929). Jorgensen died in 1937.[2]

3. Builder/Contractor: Lord & Bishop was the builder/contractor for the dam.

Lord & Bishop was an engineering firm based in Sacramento. The company was involved in construction projects throughout California and the west in the early part of the twentieth century, such as the Cape Royal Road in the Grand Canyon (1931), Hansen Bridge (Sierra County, 1938), Jibboom Street Bridge (Sacramento County, 1931), Sutter Slough Bridge (Sacramento County, 1939), and Walnut Grove Crossing Bridge (Sacramento County, 1950). In addition to these projects, the firm completed work on a pumping plant at Snodgrass Slough in San Joaquin County (1937) and on the approaches to the I Street Bridge and tunnels near the Southern Pacific Railroad (now Union Pacific Railroad) rail yards in Sacramento.[3]

4. Original Plans and Construction: Lost Creek Dam was designed as a constant-angle, variable-radius arch dam rising 122 feet high with a thickness varying from

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[2] National Register of Historic Places, *National Register Nomination for Skagit River and Newhalem Creek Hydroelectric Projects* (1996); South Feather Water and Power Agency, *Historic Properties Management Plan* (2007): 27.

[3] Bridgehunter.com, *Historic and Notable Bridges of the U.S.*; E. C. Eaton, *Lost Creek Dam Inspection Report* (1924a); *Pacific Constructor Journal* (1937): 33.

23.5 feet at the base to four feet at the crest of the dam structure. The dam was designed to provide 5,700 acre-feet of water for irrigation purposes. Upon completion, the Oroville-Wyandotte Irrigation District (OWID, later renamed SFWPA) assumed maintenance oversight of the dam structure. An underground tunnel associated with the dam was designed as a pressure tunnel with a length between 1,100 and 1,200 feet. It was planned to allow water flowing through the tunnel to achieve a velocity of approximately seven feet per second. At the time of its construction, Lost Creek Dam was one of the few variable-radius arch dams in the United States.[4]

5. Alterations and Additions: In 1930, the OWID authorized repairs for dam erosion. The face of the dam was resurfaced, and eroded holes were filled with concrete.

In 1960, the wood bridge on the crest of the dam was replaced. The new bridge burned and was rebuilt in 1963.

Between 1960-1962, a tunnel was constructed from Lost Creek Reservoir behind the dam to the Woodleaf Powerhouse, located downstream from the reservoir.

In 1993, the dam was sealed for seepage, and in 1997, a geomembrane was installed on the upstream face of the dam to arrest the through-dam seepage, which was the principal cause of the freeze-thaw damage to the concrete close to the downstream face.[5]

B. Historical Context:

1. Butte County:

Butte County is situated on the east side of the Sacramento Valley and is bounded by the Sacramento River on the west and the Sierra Nevada on the east. It initially included all of the lands of Plumas County and portions of Lassen and Tehama counties. In 1923, state officials drew the present county boundaries. The county was part of the original 27 counties created when California became a state in 1850.[6]

Spaniards explored parts of Butte County as early as 1808. Gabriel Moraga guided an expedition along the Calaveras, Mokelumne, Cosumnes, American, and Sacramento

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[4] South Feather Water and Power Agency (SFWPA), *Historic Properties Management Plan* (2007): 29; Eaton, *Lost Creek Dam Inspection Report* (1924a); "Structure to Cost $50,761: Completion Set for Dec. First" *Oroville Daily* Register (1923).

[5] H. R. Howells, "Memorandum to Mr. Hawley: Lost Creek Dam No. 63-2," Inspection Report (1930); SFWPA (2007): F-6.

[6] E. G. Gudde, *California Place Names: The Origin and Etymology of Current Geographical Names* (Berkeley: University of California Press, 1996): 370; O. C. Coy, *California County Boundaries* (Fresno, CA: Valley Publishers, 1973): 296.

rivers in northern California in search of potential interior mission sites. In 1820, Luis Arguello led a party through the region as far north as the Columbia River. Hunters and explorers such as Jedediah Strong Smith and Hudson's Bay Company trappers also explored the region in the early nineteenth century.[7]

The county remained mostly outside the mainstream of both Mexican and American settlement until the California Gold Rush of 1848. The six largest communities in the county are Chico, Biggs, Gridley, Oroville, Durham, and Paradise. Overall, the county lacked major mineral deposits, such as coal or iron, which contributed to the largely rural development in the region. Agriculture, lumber, and mining have proven the major means of subsistence among inhabitants of the county.[8]

2. California Water History:

Water and its availability have shaped much of California's history. Rain falls unevenly and seasonally over the length of the state, and sometimes California faces prolonged drought or flood cycles. The state has a generally Mediterranean climate, with little rain falling in summer. Although the amount of available water varies enormously from the northern redwood regions of heavy rainfall to the dry southern deserts, California as a whole is considered semiarid, and much of the state relies on winter snow in the mountains to provide spring and summer runoff water to the valleys below.

The effects of the erratic water distribution are magnified by the eccentric placement of population centers in the state. Traditionally, cities and towns are developed from agricultural beginnings located adjacent to water sources. California, however, developed abruptly during the Gold Rush. Instead of following a gradual growth pattern along waterways based on traditional practices of agriculture, California became suddenly urban, with cities preceding farms.

During the Gold Rush and the following years, many planning decisions were made without regard for a long-term supply of water. People set up businesses in locations that suited them in other ways. They built cities along the coast, where shipping and commercial advantages outweighed the shortages of municipal water supplies; extracted gold from dry diggings using water carried in miles of mining ditches; planted crops requiring irrigation in fertile, but arid valleys; and brought in the water to make desert housing developments possible.

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[7] M. D. Selverston et al., Archaeological and Historical Resources Inventory Report; Oroville Facilities Relicensing FERC Project No. 2100 (Chico, CA: Anthropological Studies Center, Sonoma State University, 2005): 51; Douglas E. Kyle, *Historic Spots in California* (Stanford, CA: Stanford University Press, 1990): 35.

[8] Kyle, *Historic Spots in California*, 35–37.

The development of water infrastructure systems has been part of California's history. The spread of agriculture in the state led to important changes in how the growing population used and gathered water. This process culminated in the development of the modern California landscape and infrastructure system.[9]

3. Butte County Irrigation:

During the early years of the twentieth century, developing transportation and irrigation were prominent endeavors in Butte County. Irrigation in particular, and later hydroelectric production, allowed for agriculture to develop and population to grow in the region. The Butte County Canal, built in 1905, successfully provided water to the Gridley district and eventually resulted in forming the Feather River Canal to provide irrigation for agricultural fields in 1915.[10]

In 1907, T. F. Hornung embarked on studies involving the Middle Fork Feather River as a source for power development. In an effort to develop and increase water delivery on the South Fork, Hornung and several investors formed the South Feather Land and Water Company. By 1918, the organization improved water distribution in the region by providing water to roughly 2,100 acres of agricultural land, much of it used to grow olives, citrus fruit, and deciduous fruits.[11]

The OWID formed one year later as an irrigation district under the California Water Code and in 1923 assumed control of the South Feather Land and Water Company's water distribution system (including Forbestown Ditch) in addition to holdings in the Palermo Land and Water Company (Palermo Ditch) also located in Butte County. When the OWID was formed, 800 people lived in the district and 2,000 others benefited from the irrigation and received their domestic water from the project. Shortly after the OWID was established, it initiated plans for $2 million in improvements to water distribution systems and structures throughout the region, including the construction of Lost Creek Dam. In 2003, the OWID changed its name to South Feather Water and Power Agency.[12]

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[9] David S. Byrd, *Historic Resource Evaluation Report—O'Donnell Lateral. Merced Irrigation District, Merced County, California* (Davis, CA: JRP Historical Consulting Services, 2000).

[10] SFWPA (2007): 26.

[11] SFWPA (2007): 26.

[12] Charles H. West and J. C. Youngberg, "Oroville-Wyandotte Irrigation District: A Survey of the District, Its Present Position, Future Outlook and an Analysis of its Bonds" (Sacramento, CA., ca. 1932); SFWPA (2007): 27.

4. Arch Dam Construction:

Lost Creek Dam was designed as a thin, unreinforced, concrete arch dam. The design of concrete dams can be divided into three main types: gravity, buttress, and arch. Gravity dams rely on their weight for stability, whereas buttress dams are supported at intervals by supports or buttresses. The design of an arch dam, such as Lost Creek Dam, makes use of abutment reaction forces to resist the force of water pressure. It was during the mid-nineteenth to late nineteenth century that significant progress in arch dam design took place, with larger structures designed through the use of concrete as a principal building material. With the availability of concrete, designers were able to consider complex curved shapes to minimize cost and construction material. Arch dams were typically used for sites where the ratio of the width between the abutments and the height was not significant.[13]

The historical development of arch dams took place in stages, spanning many countries and several centuries (Chanson and James 2000). The earliest arch dams, built by the Romans, were made from cut stone. By the thirteenth century, the Mongols, who had invaded and settled in modern-day Iran, had built several large dams, many of them arch structures. The 75-Miles Dam, built in Warwick (Australia) in 1880, is considered the world's oldest concrete arch dam.[14]

By 1887, eight curved dams 120–324 feet high had been built in the United States. Modern-era arch dam technology was introduced in North America at the beginning of the twentieth century, with designs such as the double-curvature arch and the constant-angle arch. The constant-angle arch, also known as a variable-radius arch, employs a subtended angle that is kept constant, and the variation in distance between the abutments at various levels is overcome by varying the radii. By using a constant angle at every elevation, it is possible to reduce the concrete required without increasing the stresses in the arch.[15] Character-defining features of this dam type include this constant subtended angle and wide-sweeping arch, the use of concrete as a construction material, and a smaller ratio of width between the abutments and the height. Since the turn of the twentieth century, no major design breakthroughs in arch dam construction have occurred, which has resulted in contemporary arch dams relying on these early twentieth-century arch design precedents.[16]

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[13] H. Chanson, H. and P. James, *Historical Development of Arch Dams: From Cut-Stone Arches to Modern Concrete Designs* (Australia: Department of Civil Engineering, University of Queensland, 2000): 1–3.

[14] Chanson and James (2000): np.

[15] D. Jackson, *Great American Bridges and Dams: A Natural Trust Guide* (Washington, DC, 1988).

[16] A. Prescott Folwell, *Water-Supply Engineering: The Designing and Constructing of Water-Supply Systems* (New York: John Wiley & Sons, 1917); Chanson and James (2000): 3.

5. Lost Creek Dam—Construction

Steps to build a dam in Lost Creek were being taken as early 1914 when South Feather Land and Water Company assessed the proposed site for construction of a dam. The site was deemed favorable for a dam as the rock in the area, which was mostly serpentine with slate and porphryrite, was observed to be strong enough to support a heavy load. Plans for the dam continued when the OWID was formed in 1919. The OWID estimated that the cost to build was approximately $217,116. Original plans designated that the dam would be 122 feet high and 500 feet long at the crest. The lower (outlet) end of the tunnel associated with the dam would feature a concrete circular lining, leaving an inside diameter of 5'6". A wood bridge would be constructed along the crest of the dam. It would have a floor consisting of double three-inch planking and side posts comprised of 6x6 timbers with a sizable hand railing. The purpose of the dam would be to create a reservoir to hold more than 5,000 acre-feet of water at the junction of Lost Creek and Pinkard Creek. The reservoir formed by the dam (Lost Creek Reservoir) would inundate an existing crib dam located upstream from the location of the proposed dam. The newly created reservoir along with a reservoir at North Honcut Creek would allow for the irrigation of thousands of additional acres.[17]

The Lost Creek dam project would be paid in part by bonds issued by the OWID to the public. In the early 1920s, the bond funds were made available for construction. In April 1923, the OWID issued a call for bids for the project and estimated a completion date of December 1923. Water would be made available in early 1924 to adequately irrigate acreage in the region.[18]

The OWID received ten bids in total for construction of Lost Creek Dam, ranging from $58,761 to $137,416. The winning bid was listed as $58,761.00 and was submitted by Lord & Bishop, a Sacramento contracting firm. Lord & Bishop estimated that nearly $50,000 of the construction costs would be spent on concrete alone. Lars Jorgensen, owner of the Constant Angle Arch Dam Company and a consultant to Butte County, was chosen to design the dam, and Samuel J. Norris, an engineer for the OWID, prepared the plans for its construction.[19]

Jorgensen's design of the dam offered significant savings in material over comparable gravity dams. Gravel and sand from Pinkard Creek provided all the aggregate needed for

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[17] T. F. Hornung, "Lost Creek Dam Diversion Dam" (South Feather Land & Water Company, 1914); Charles H. West and J. C. Youngberg, "Oroville-Wyandotte Irrigation District: A Survey of the District, Its Present Position, Future Outlook and an Analysis of its Bonds." (ca.1932): 6.8; Eaton, *Lost Creek Dam Inspection Report* (1924a, 1924b); SFWPA (2007): 27.

[18] "Structure to Cost $50,761" (1923).

[19] "Structure to Cost $50,761" (1923); Eaton, *Lost Creek Dam Inspection Report* (1924a).

the construction of the dam. The gravel at Pinkard Creek was considered favorable because gravel at the dam site was not first grade and contained small amounts of clay. Materials used to batch the concrete for the dam were locally obtained with the exception of the cement, which the OWID provided. Lord & Bishop likely acquired the lumber from a mill at Challenge, a community twelve miles from the dam site. All other construction supplies were obtained either from Marysville or Oroville. The construction plant for the project was located at the junction of Lost Creek and Pinkard Creek. After the bridge was under construction, the OWID requested additional bids for lining the tunnel associated with the dam. Lord & Bishop submitted the only bid, which came in at a cost of $23.00 per foot for the lining alone. The entire tunnel without the lining was constructed at $12.50 per foot.[20]

Construction of the dam began in spring 1923 with up to 60 laborers assigned to the project. Construction crews were housed in tents and a small cabin at the project site. By autumn 1923, trenching of the foundation and the pouring of concrete were completed. The height of the dam at that point was 55 feet. The dam was expected to be completed by November or December of that year; however, construction continued well beyond the anticipated end date, likely because of inclement weather that affected the setting of the concrete.[21]

In April 1924, the dam had been completed to an elevation of 107 feet and was expected to be finished by summer. Inspection reports dating to this time state that approximately forty feet of water had filled the reservoir in April and that in May the level had reached sixty-four feet. Work during this period was also progressing on the overflow spillway and piers for the wood bridge that would extend over the top of the dam. The road leading to the dam had also been completed, and the tunnel that would connect Lost Creek Reservoir to the ditch system was under construction. In August 1924, the dam was finished, and by October it was fully operational.[22]

6. Lost Creek Dam—Maintenance

In general, the dam remained in good condition over the decades and required mostly minor maintenance and repairs. The main area of concern was deterioration on the face of the dam. An inspection of the dam in autumn 1930 showed evidence of spalling on the downstream face and stains from lime deposited from seepage. The foundation of the dam had also been seriously eroded. Spillway flows had washed away portions of the

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[20] Hornung, "Lost Creek Dam Diversion Dam" (1914); Eaton (1924a, 1924b); "Bids Called for Construction of Lost Creek Dam" (*Oroville Daily Register*, 1923).

[21] Hornung, "Lost Creek Dam Diversion Dam" (1914); "Dam Building Proceeding Rapidly" (*Oroville Daily Register,* 1923); "Concow Dam Plans Here: Will House Big Water Supply" (*Oroville Daily Register,* 1923).

[22] Eaton (1924a); "Concow Dam is now Filling" (*Oroville Daily Register*, 1924).

serpentine rock, creating holes as large as 18 feet deep. Timber that had floated through the reservoir filled some of these holes. In October 1930, repairs were made to the deteriorated portions of the dam abutments, and they were filled with concrete.[23]

In 1960, the existing wood bridge on the crest of the dam was replaced. That bridge burned in a 1963 fire because of the uncontrolled burning of driftwood and logs that had been removed from the reservoir. Another bridge was built in its place in November 1963. During this period, a tunnel was built between the Lost Creek Reservoir and Woodleaf Powerhouse.[24]

In 1985, an assessment of the dam found that small pieces of concrete had fallen from the face of the dam. The inspection also revealed that the surface of the left side of the downstream face of the dam was in poor condition and that the dam showed evidence of seepage on the left side. Leaking flashboards hid any evidence of seepage on the right side; although reports showed that that side of the dam was usually wet and that the right abutment was discolored, indicating seepage. To address the ongoing deterioration attributed to freeze-thaw action, the dam was initially sealed in 1993. In 1997, a geomembrane system was installed. The installation of the system marked the first underwater installation of a waterproofing membrane system in the world.[25]

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[23] Howells, "Memorandum to Mr. Hawley" (1930).

[24] SFWPA (2007):29.

[25] SFWPA (2007):29; Carpi, *Underwater* (2013).

Part II. Structural/Design Information

A. General Statement:

1. Character: The concrete overflow arch dam is an early example of a constant-angle arch structure (a pioneering style that continues to influence contemporary arch dam construction). Unique features of the dam include its constant angle and wide-sweeping arch, its concrete construction, and the smaller ratio of width between its abutments and the overall height of the structure.

2. Condition of Fabric: Overall, the dam is in good to fair condition. The downstream face of the dam shows substantial evidence of deterioration attributable to freeze-thaw action on the concrete.

B. Description: Lost Creek Dam is a constant-angle, variable-radius concrete overflow arch structure. It measures approximately 122 feet high and 486 feet long, with a crest elevation of 3,279.05 feet without flashboards and 3,283.80 feet high with flashboards. The thickness of the dam varies from 23.5 feet at the base to four feet wide at the base of the spill crest. The dam measures 112 feet to the spill crest, and the arch radius measures 196 feet. The spillway is approximately 251 feet wide and is composed of 15 spill bays separated by concrete piers that support the timber bridge and the flashboard system. It is controlled between May 1 and October 31 by flashboards measuring four feet by eight feet. The dam tunnel is 1,140 feet long. The dam is accessed from Mooresville Ridge Road, which crosses the dam via a wood bridge located above the dam crest and spillway. The bridge deck is at an elevation of 3,287 feet, approximately 122 feet above the toe of the dam. The dam forms a 5,361-acre-foot reservoir that covers 137 acres. The reservoir is located immediately downstream from the Sly Creek Powerhouse, the Sly Creek Dam, and the Sly Creek Reservoir.[26]

C. Site Information: Lost Creek Dam is located in Butte County, approximately twenty-two miles east of the city of Oroville and near the town of Clipper Mills. The area surrounding the dam is a rural and rough mountainous region.

[26] SFWPA (2007): A-13; Eaton (1924a, 1924b).

Part III. Sources of Information

Research was undertaken at the California Room of the California State Library, Sacramento; the California Department of Water Resources, Division of Safety of Dams, Sacramento; and the AECOM cultural resources staff library. Additional materials were provided by SFWPA from its files.

A. Primary Sources

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B. Secondary Sources

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C. Likely Sources Not Yet Investigated. None.

D. Engineering Drawings:

Engineering drawings for Lost Creek Dam include a 1909 plan for the dam prepared for South Feather Land and Water Company, and copies of an as-built drawing, details of outlets for the dam, details of the water stop, and details of the outlet crest and dam bridge (1923). Drawings courtesy of the California Department of Water Resources, Division of Safety of Dams, Sacramento and the Water Resources Center Archives (WRCA), U.C. Riverside, WRCA drawings provided by SFWPA.

E. Early Views:

Photograph 1: Lost Creek Dam, during construction (September 1923). Photograph courtesy of Division of Safety of Dams, Sacramento.

Photograph 2: Lost Creek Dam, during construction (ca. 1923). Photograph courtesy of SFWPA.

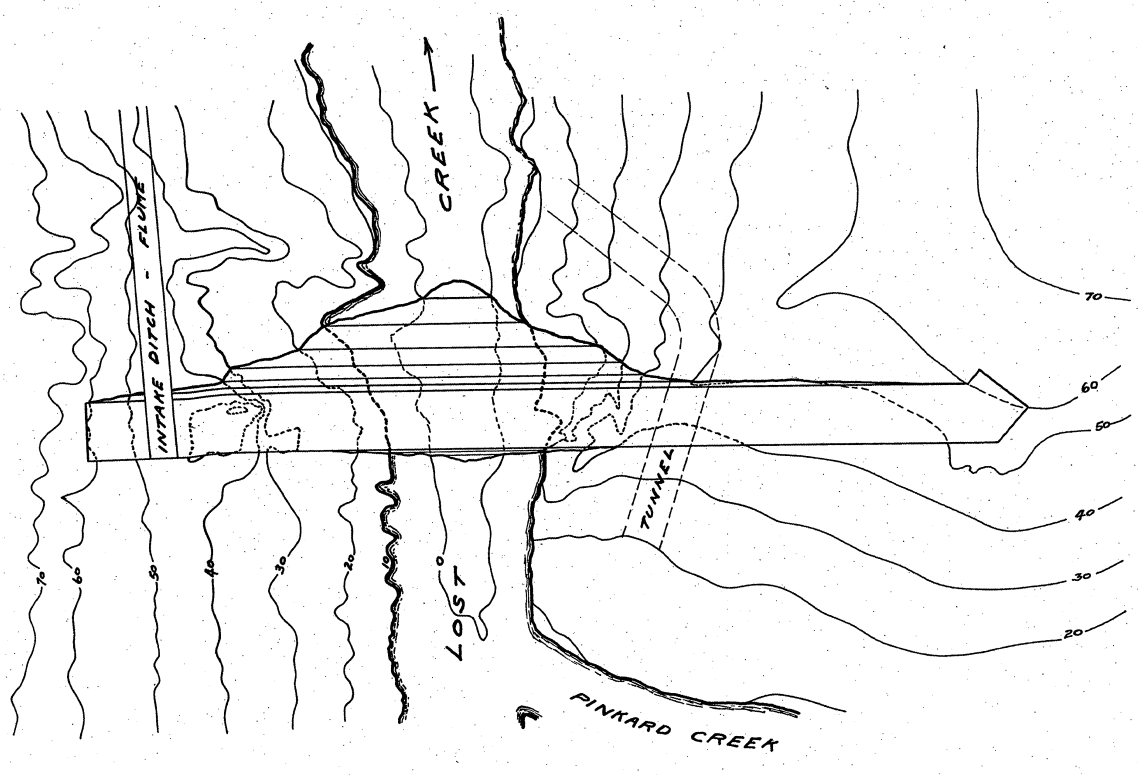
Photograph 3: Lost Creek Dam, dam abutment (ca. 1923). Photograph courtesy of SFWPA.

Photograph 4: Lost Creek Dam, view from right-hand abutment (May 1924). Photograph courtesy of Division of Safety of Dams, Sacramento.

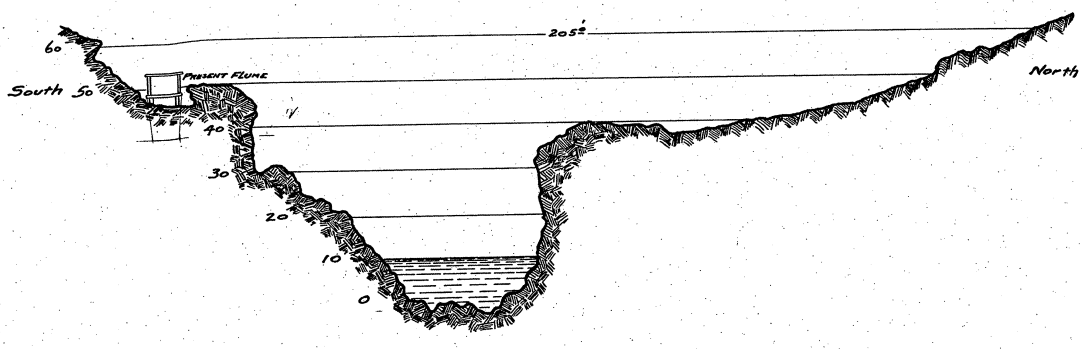
Photograph 5: Lost Creek Dam, upstream face of the dam (September 1930). Photograph courtesy of Division of Safety of Dams, Sacramento.

Photograph 6: Lost Creek Dam, timber deck on crest of dam (April 1961). Photograph courtesy of Division of Safety of Dams, Sacramento.

Photograph 7: Lost Creek Dam, upstream face of the dam showing completed timber deck (December 1961). Photograph courtesy of Division of Safety of Dams, Sacramento.



PLAN



PROFILE

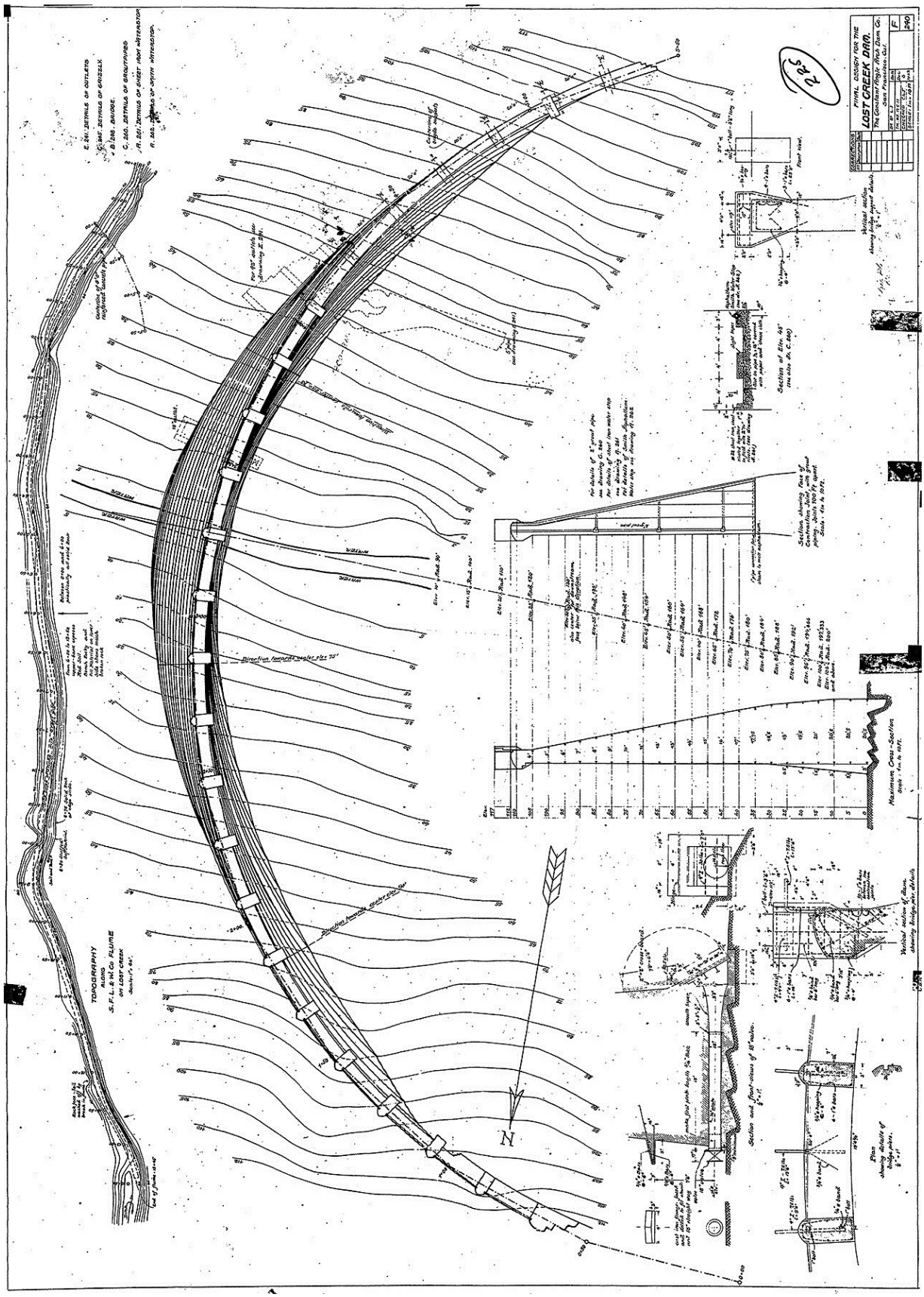
Looking down stream

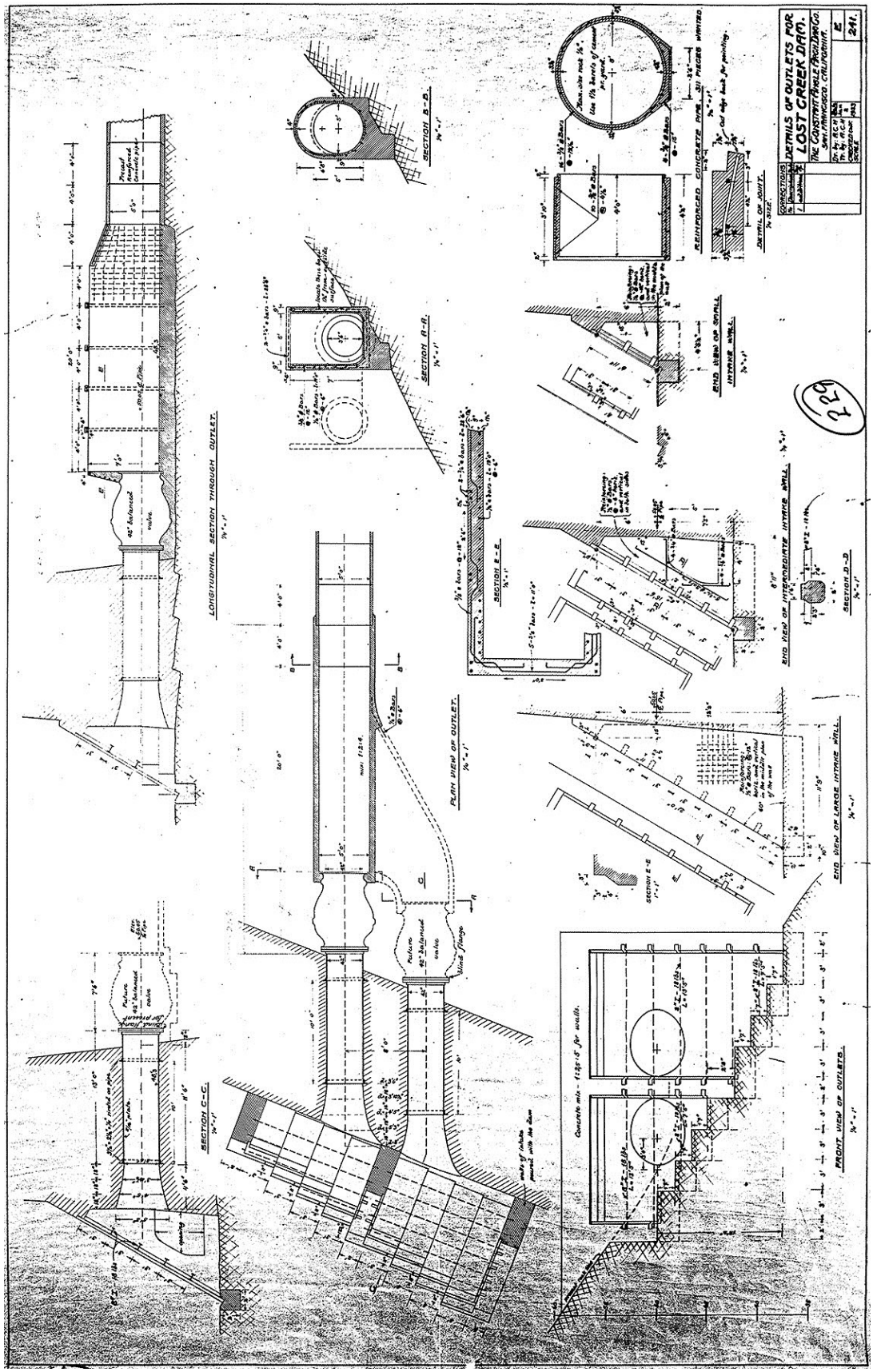
SOUTH FEATHER LAND AND WATER CO.
PLAN OF PROPOSED DAM
AND
PROFILE OF DAM SITE
ON
LOST CREEK

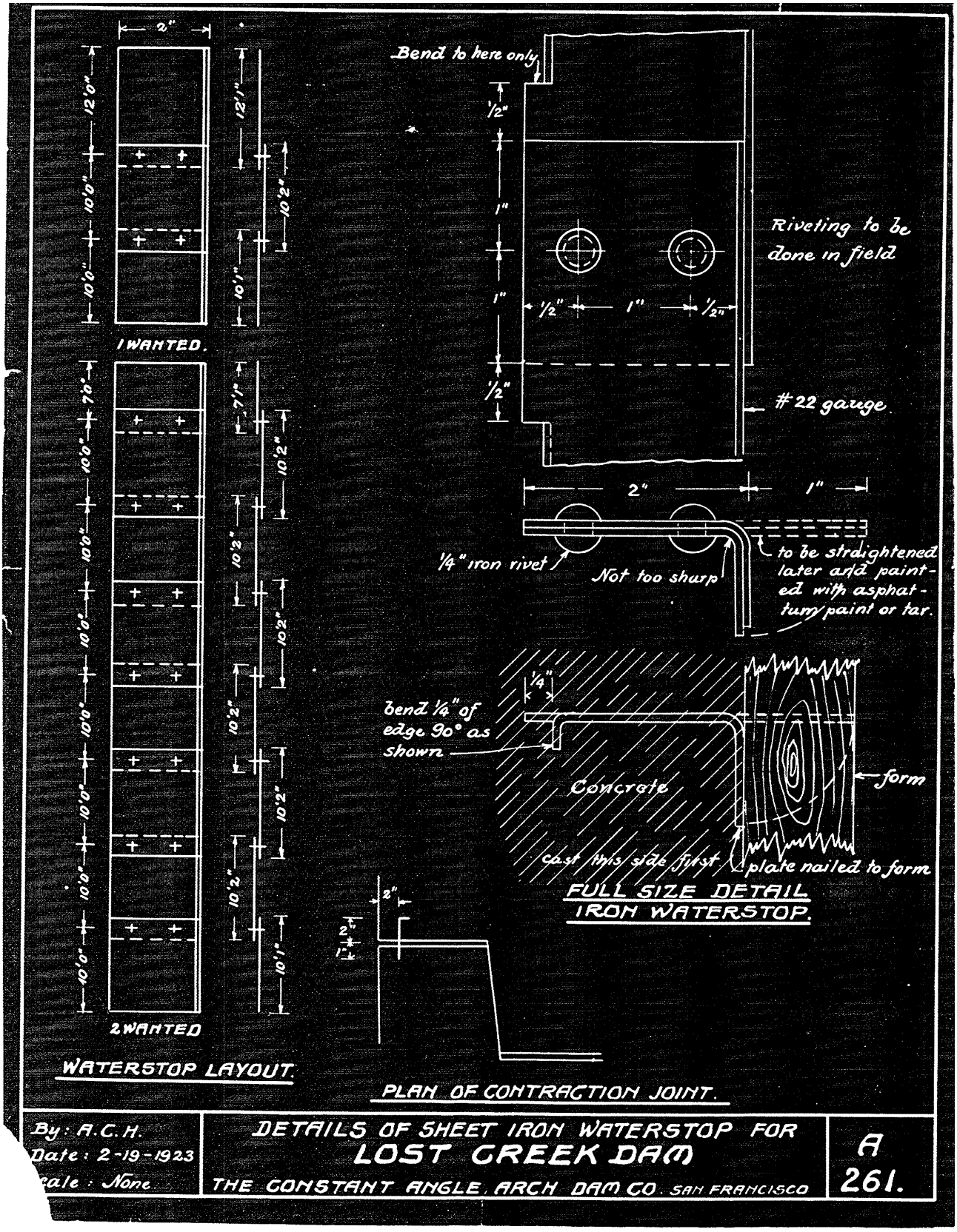
APRIL 1909 L.T. Hickey
SCALE 1"=20'
Traced Dec 1920

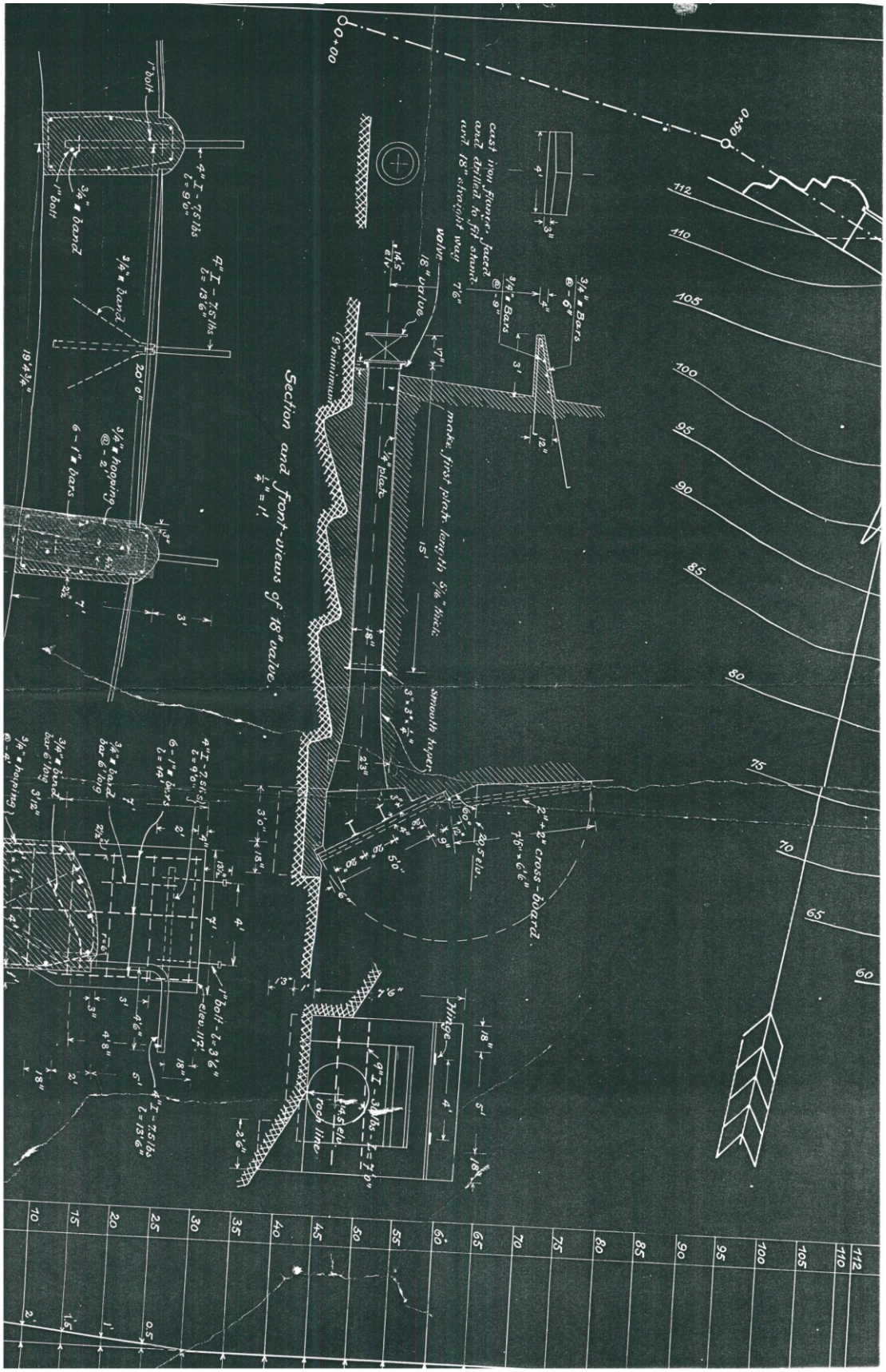
R13

137-H


FINAL DESIGN FOR THE
LOST CREEK DAM.
The Constant High Arch Dam Co.
San Francisco, Cal.
TOPOGRAPHY
ALONG
S.F.L. & W.R.R. Co. FLUME
ON LOST CREEK
N


DETAILS OF OUTLETS FOR
LOST CREEK DAM.
THE CONSTITUTIONALIST RECLAMATION CO.
SAN FRANCISCO, CALIFORNIA.
241.
LONGITUDINAL SECTION THROUGH OUTLET.
SECTION B-B.
SECTION A-A.
SECTION E-E.
PLAN VIEW OF OUTLET.
REINFORCED CONCRETE PIPE.
DETAIL OF JOINT.
END VIEW OF INTAKE WALL.
END VIEW OF INTAKE WALL.
SECTION D-D.
END VIEW OF LARGE INTAKE WALL.
SECTION C-C.
FRONT VIEW OF OUTLETS.


2"
12'0"
10'0"
10'0"
12'1"
10'2"
10'1"
1 WANTED.
7'0"
10'0"
10'0"
10'0"
10'0"
10'0"
10'0"
7'1"
10'2"
10'2"
10'2"
10'2"
10'2"
10'2"
10'1"
2 WANTED
WATERSTOP LAYOUT.
Bend to here only
1/2"
1"
1"
1/2"
1"
1/2"
1/2"
Riveting to be done in field
#22 gauge
2"
1"
1/4" iron rivet
Not too sharp
to be straightened later and painted with asphaltum paint or tar.
1/4"
bend 1/4" of edge 90° as shown
Concrete
form
cast this side first
plate nailed to form
FULL SIZE DETAIL
IRON WATERSTOP.
2"
2"
1"
PLAN OF CONTRACTION JOINT.
By: A.C.H.
Date: 2-19-1923
Scale: None
DETAILS OF SHEET IRON WATERSTOP FOR
LOST CREEK DAM
THE CONSTANT ANGLE ARCH DAM CO. SAN FRANCISCO
A
261.


Section and front views of 18" valve.
1/4" = 1'
cast iron flumes, faced and drilled to fit chute and 18" straight way
18" valve
make first plank length 5 1/8" thick
smooth upper
cross-board
rock line
1" bolt
3/4" band
3/4" hoping
6 - 1" bars
3/4" Bars
3/4" plate
1" bolt - l = 3'6"
4" I - 7.5 lbs
l = 6'0"
4" I - 7.5 lbs
l = 13'6"
9" I - 21 lbs
l = 6'0"
6 - 1" bars
l = 14' bars
3/4" band
bar 8 long
3/4" band
bar 8 long
3/4" hoping
3/4" hoping
1" bolt - l = 3'6"
clev. 112'
9" I - 21 lbs
l = 7'0"
4.5 pin
hinge
0+00
0+50
112
110
105
100
95
90
85
80
75
70
65
60
10
15
20
25
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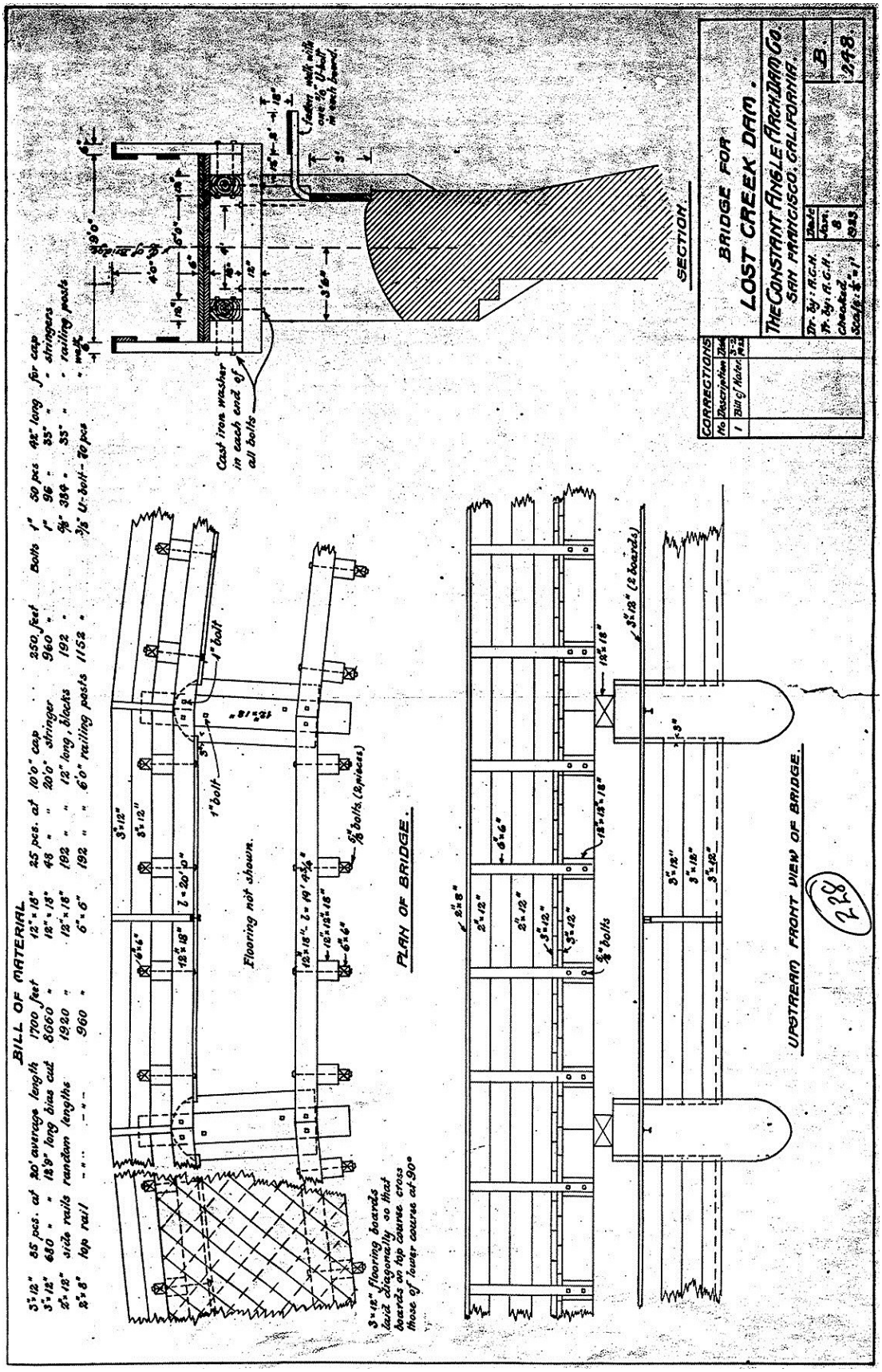
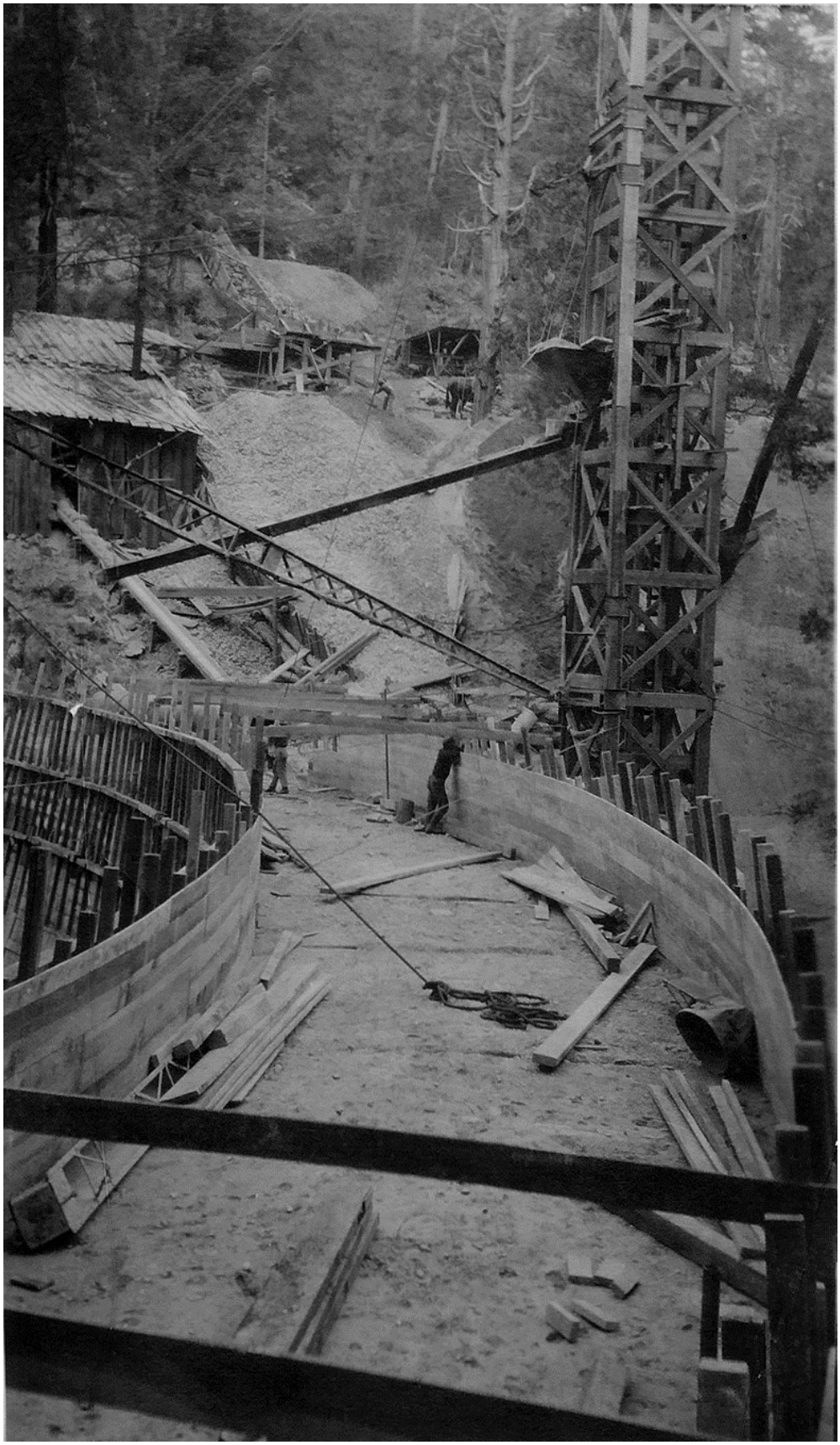
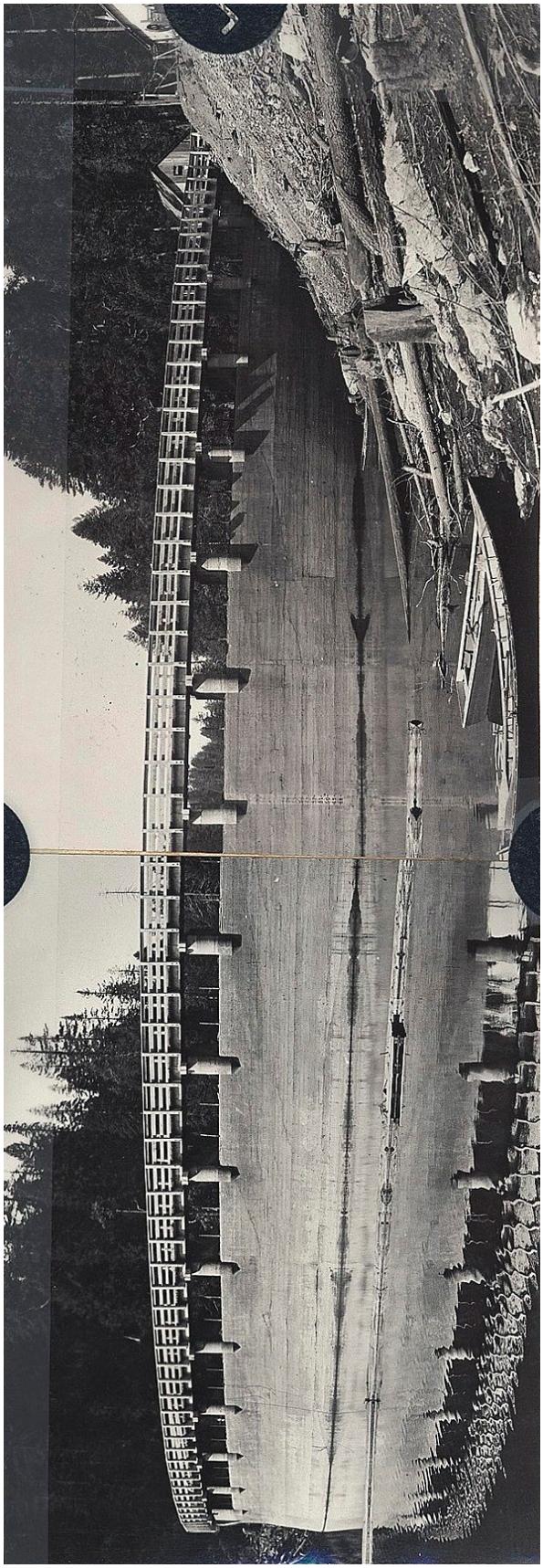
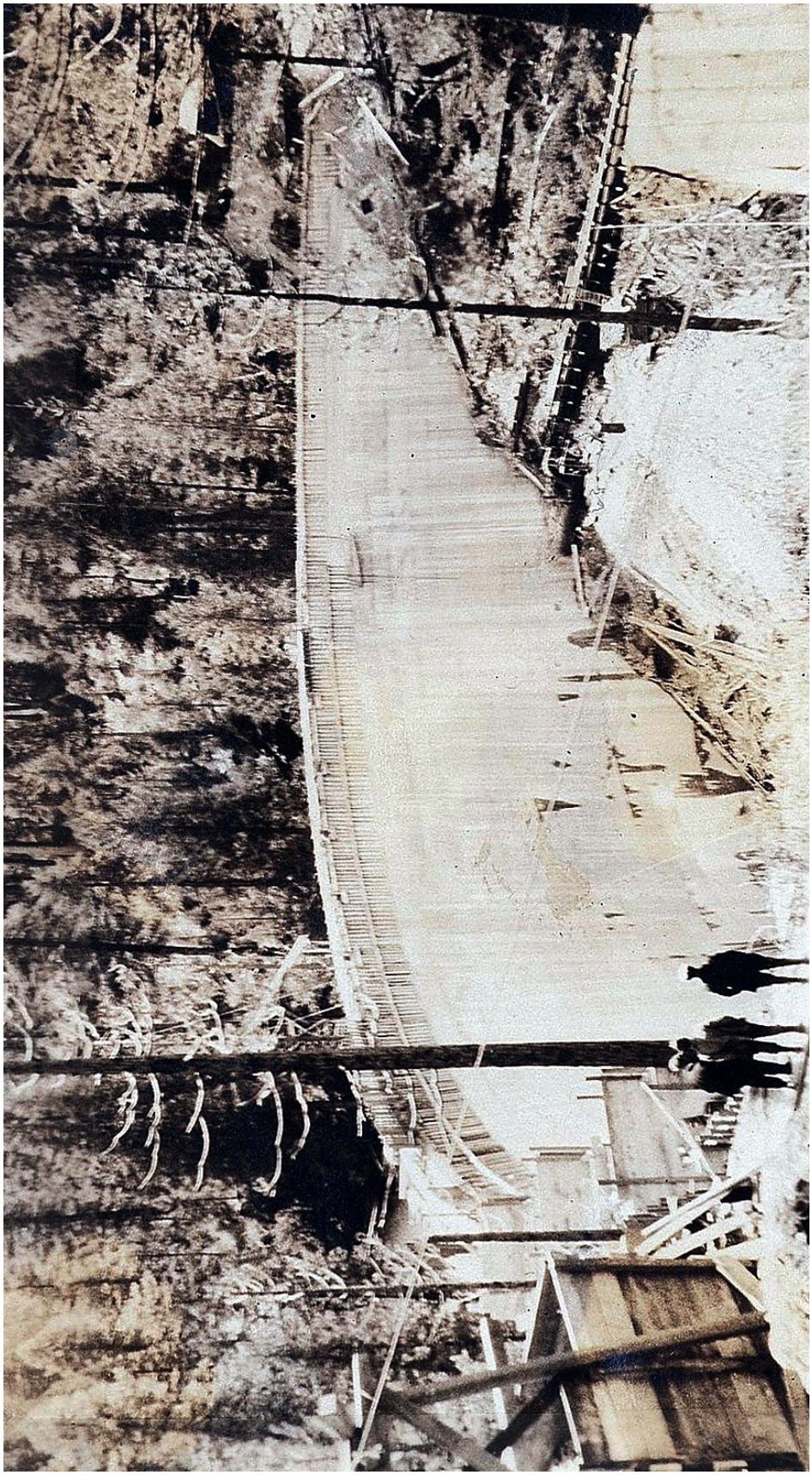
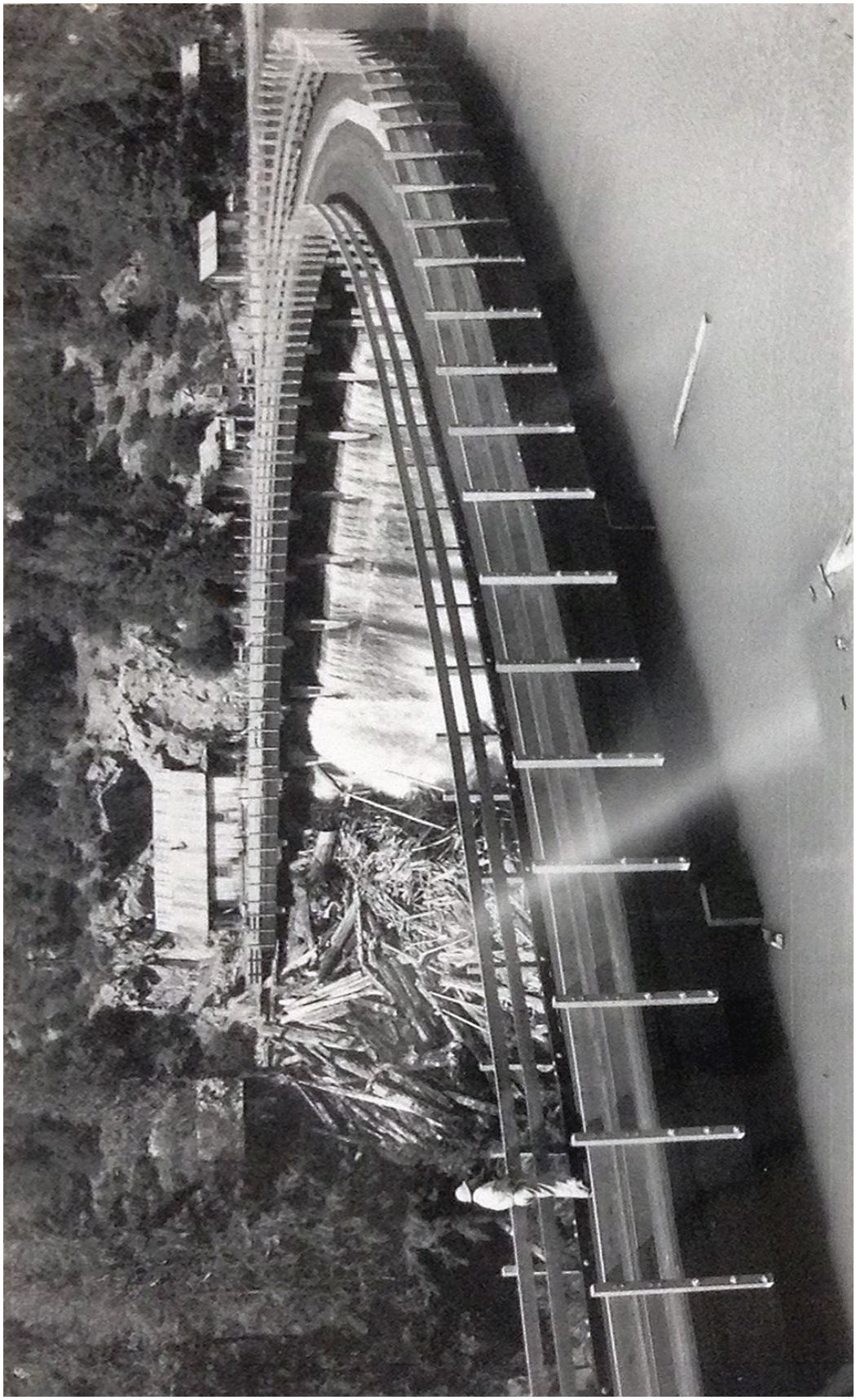
100
105
110
112


BILL OF MATERIAL
3"×12" 85 pcs. at 20' average length 1700 feet
3"×12" 680 " " 12'9" long bias cut 8660 "
2"×12" side rails random lengths 1920 "
2"×8" top rail " " " 960 "
12"×18" 25 pcs. at 10'0" cap 250 feet
12"×18" 48 " " 20'0" stringer 960 "
12"×18" 192 " " 12" long, blocks 192 "
6"×6" 192 " " 6'0" railing posts 1152 "
Bolts
1" 50 pcs 42" long for cap
1" 96 " 33" " stringers
3/4" 384 " 33" " railing posts
3/8" U-bolt - 20 pcs " walk
Flooring not shown.
1" bolt
3"×12" flooring boards laid diagonally so that boards on top course cross those of lower course at 90°
PLAN OF BRIDGE.
Cast iron washer in each end of all bolts
Timber walk with one 3/8" U-bolt in each board
SECTION.
UPSTREAM FRONT VIEW OF BRIDGE.
CORRECTIONS
No. Description Date
1 Bill of Matern 3-2-22
BRIDGE FOR
LOST CREEK DAM.
THE CONSTANT ANGLE ARCH DAM CO.
SAN FRANCISCO, CALIFORNIA.
Dr. by: A.G.H.
Tr. by: A.G.H.
checked
Scale: 1/8"=1'
Date
Jan. 8 1923
B.
248.
228