HISTORIC AMERICAN ENGINEERING RECORD

SHEM DAM
(WINSOR DAM)
(42WS5931)

HAER No. UT-96

Location: Along Santa Clara River on west side of County Road 3184, 0.9 miles north of intersection with Old Highway 91. Ivins vicinity, Washington County, Utah. Latitude 37.192351035, longitude –113.769429447. This coordinate is the location of the center of the gear lift mounted on the upstream crest of the northeast abutment of the dam. The coordinate was determined on February 2, 2015, using a handheld GPS mapping grade unit (Trimble GeoXT) accurate to +/- 50 centimeters after differential correction. The datum of the coordinate is North American Datum 1983. The location of Shem Dam has no restriction on its release to the public.

Present Owner/ Occupant: Shivwits Band of Paiutes
6060 West 3650 North
Ivins, UT 84738

Present Use: The dam was built for flood control and to divert water for irrigation. Even in its current (2015) state of disrepair, the dam still serves a role in flood control, although less effectively than originally intended. It stopped serving as an irrigation diversion in 2003. The dam is being rehabilitated to restore its function as a flood-control structure.

Significance: Shem Dam was built in 1934–35 by the Civilian Conservation Corps (CCC) as a project sponsored by the U.S. Forest Service, Dixie National Forest. The dam was designed by two Utah engineers: Luther M. Winsor, an irrigation and flood-control specialist with the U.S. Department of Agriculture, Bureau of Agricultural Engineering, who was assigned to design and oversee Forest Service flood-control projects in Utah; and Leo A. Snow, an engineer and surveyor from nearby St. George, Utah. The dam is an embankment of rubble masonry with a rock and earth fill. It has two large abutments that stand perpendicular to the channel of the Santa Clara River and are linked by a central-arch spillway. The dam has a maximum height of 38' and an overall length of approximately 375', which made it one of the largest dams built by

the CCC in Utah. In addition to serving as a flood-control structure on the Santa Clara River, Shem Dam diverted irrigation water to fields downstream on the Santa Clara Bench, cultivated by residents of the communities of Ivins, Santa Clara, and St. George. A diversion below the dam also routed irrigation water to lands cultivated by the residents of the Shivwits Indian Reservation.

Historian(s): Scott O'Mack, William Self Associates, Inc., 2015

Project Information: Shem Dam was damaged by major floods in 1938 and 1955 but was repaired both times. A major flood in 2011 badly damaged the dam once again and prompted the Shem Dam Rehabilitation Project, sponsored by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), under the authority of the Emergency Watershed Protection program. In accordance with the National Environmental Protection Act and the National Historic Preservation Act, the NRCS developed a historic properties treatment plan to mitigate the adverse effects of the rehabilitation project on Shem Dam. The mitigative measures specified in the treatment plan included documentation of the dam for inclusion in the Historic American Engineering Record.

The Shem Dam Rehabilitation Project was undertaken by the NRCS in cooperation with Washington County (Utah) and the Shivwits Band of Paiutes, and in March 2014, the Utah State Historic Preservation Office reviewed and accepted the historic properties treatment plan prepared by the NRCS. In 2013, an archaeological inventory of the Shem Dam site was carried out by NRCS Cultural Resources Specialist Tara S. Hoffman, under the supervision of NRCS State Cultural Resources Specialist Andrew Williamson. Hoffman conducted historical research on the dam at the libraries of Utah State University, Weber State University, and Southern Utah University; she also consulted several online databases for relevant documents. In 2014, the NRCS hired William Self Associates, Inc. (WSA), to carry out additional historical research and additional field documentation of the dam, including preparation of Historic American Engineering Record (HAER) documentation. WSA's Scott O'Mack, based in Tucson, Arizona, carried out additional research at the Utah Division of State History in Salt Lake City, the office of the Washington County Recorder in St. George, and the Dixie State University Library, Special Collections, in St. George. O'Mack also completed additional field documentation of the dam, assisted by WSA archaeologist John Curry. O'Mack and Curry collected data for measured drawings using a Leica TCR407 total station and a Trimble GeoXT handheld GPS unit. Jimmy Mack, WSA GIS specialist, processed the data, and Lindsay Wygant, WSA graphics specialist, created the measured

drawings. Large-format black-and-white photographs of Shem Dam were taken by Roger Whitacre of Denver, Colorado, on January 29–30, 2015, a few days before the rehabilitation project began. Color digital photographs of the dam and associated features were taken by Hoffman during the 2013 fieldwork and by O'Mack and Curry during the 2015 fieldwork.

Historic photographs of Shem Dam are reproduced here with the permission of the libraries of Utah State University, Weber State University, and Southern Utah University. Photographic reproductions of the original construction drawings of Shem Dam are used here with the permission of the Dixie State University Library.

Part I. Historical Information

A. Physical History

1. Dates of construction

January 1934–February 1935

The first sheet of the original construction drawings for Shem Dam, a plan view of the overall site and structure, is dated January 16, 1934.[1] Construction was underway by February 1, 1934, using the labor of a CCC company based in nearby St. George, and preliminary work at the dam site had probably begun a month earlier.[2] In April 1934, the CCC company relocated to another camp for the summer, leaving the dam project unfinished. The same company returned to the St. George camp in October 1934 and continued to work on the dam over the winter.[3] In February 1935, the superintendent of the CCC camp told the St. George newspaper that the dam was complete: "Monday, February 4th, saw the last cement poured into its construction. A crew of a few men will be used for the next week or ten days in finishing the last construction details."[4]

2. Engineers

Luther M. Winsor (1884–1968) and Leo A. Snow (1881–1963)

The title block on the first sheet of the original construction drawings for Shem Dam includes the line, "Designed by L. M. Winsor and Leo A. Snow."[5] Luther Martin Winsor, born and raised in Washington County, was an irrigation and flood-control specialist with the U.S. Department of Agriculture, Bureau of Agricultural Engineering, based in Logan, Utah, from 1913 to 1934. In that post, he designed and oversaw the construction of numerous irrigation and flood-control projects throughout Utah and in other western states. In 1934, he designed 26 different flood-control projects for the Forest Service (22 in Utah, three in Nevada, and one in Colorado), including Shem Dam, all built with CCC labor. After 1934, Winsor held several other

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[1] "Flood Control Dam, Shivwits Indian Reservation, Washington County, Utah." January 16–March 6, 1934. Original construction drawings (3 sheets). Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

[2] "Forestry Dept. and CCC Boys Make Progress," *Washington County News,* February 1, 1934.

[3] "Santa Clara, Ivins Show Appreciation for C.C.C. Work," *Washington County News,* April 5, 1934; "CCC Company 961 Now in St. George," *Washington County News,* October 18, 1934; "St. George Camp News," *Washington County News,* January 10, 1935.

[4] "St. George Camp," *Washington County News,* February 7, 1935.

[5] See note 1 above.

professional positions with the federal government and also worked as a private consulting engineer.[6]

Leo Alva Snow, also born and raised in Washington County, had a private engineering practice in St. George and at different times held official positions as an engineer with Washington County, the City of St. George, and other municipal governments around the county. His early work was as a surveyor, but he later designed bridges, dams, water pipelines, irrigation systems, sewage and drainage systems, and other structures throughout Washington County. Snow began working for the CCC as an engineer in September 1933 and was assigned to the Shem Dam project in February 1934.[7]

Additional information about Winsor and Snow is provided in the Historical Context section below.

3. Builder

Civilian Conservation Corps, Company 961, St. George, Utah

Shem Dam was a project of the U.S. Forest Service, which oversaw its design and construction, but all of the labor to build the dam was provided by CCC Company 961, based at Camp SE-213 (later known as Camp PE-213) in St. George.[8] Additional information about the role of the Forest Service and the CCC in building the dam is provided in the Historical Context section below.

4. Original plans and construction

The original construction drawings for Shem Dam are among the collected professional drawings of Leo Snow, previously on file at the office of the Washington County Recorder in St. George and now kept at the Dixie State University Library, also in St. George.[9] The final drawings are ink on drafting film, made on three sheets, each measuring about 25" × 33". Sheet 1 is a plan view of the overall dam, with 5-foot-interval contour lines showing the river channel and adjacent hillsides. Sheet 2 has a section drawing of the overall dam including the center spillway, plus detail drawings of the tunnel that passed through the dam to divert water to an irrigation ditch. Sheet 3 has additional detail drawings of the tunnel, including the head gate and the gear lift that operated the gate. The Leo Snow collection also includes the original pencil-and-paper

[6] Luther M. Winsor, "Experience Summary of L. M. Winsor in Handling Water and Related Problems" (ca. 1958). L. M. Winsor Papers, 1912–1964 (COLL MSS 98), Utah State University, Special Collections and Archives Department, Logan, Utah.

[7] Leo A. Snow, "Incidents in the Life of Leo A. Snow" (as related to Marva S. Snow, 1963). Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

[8] "Forestry Dept. and CCC Boys Make Progress," *Washington County News*, February 1, 1934.

[9] Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

drawings, made at the same scale, from which the final ink-and-film drawings were traced. The Washington County Recorder made digital scans of all of the drawings in the Leo Snow collection before it was transferred to the Dixie State University Library in 2014. The digital scans of the original ink-and-film drawings for Shem Dam are reproduced, at a reduced scale, in Appendix A.

Neither Snow nor Winsor seems to have written a systematic description of the original design of the dam or its construction, or at least none has been found in research for the current HAER documentation. The L. M. Winsor collection at Utah State University includes numerous photographs of the dam taken during its construction and in the early years after it was completed, and some of the photographs are accompanied by Winsor's comments on the design and the construction process.[10] These brief comments, in conjunction with Snow's construction drawings and Winsor's general discussion of barrier dams of the same type as Shem Dam,[11] are the basis of the description provided below. Photographs of Shem Dam taken during its construction, as well as other photographs taken in later years, are reproduced in Appendix B.

Three early, informal descriptions of the dam project were found in research for the current HAER documentation and are quoted in full below—with the cautionary note that some details provided in the descriptions, such as measurements and the interpretation of design features, are erroneous.

The first description was written by the editor of the *Washington County News* (St. George), who toured the dam site at the start of construction in late January 1934, guided by J. C. Tolton of the Dixie National Forest, who served as superintendent of the St. George CCC camp. This description is most useful for its details on the building of roads to service the project, the drilling and blasting of the adjacent hillsides to obtain rock for the dam, and the building of the cableway to move building materials:

> The dam, which is located just below the old copper smelter, is to be 750 feet long at the top, will have a base of 85 feet in width, with an eight foot cut-off wall at the bottom with an eighteen inch [layer of] concrete poured between the rocks. The wing walls are to be ten feet on top and the dam is to be thirty-eight feet above the channel of the stream. The spillway will be constructed of rock and cement and will be fifty feet in width and located twenty-three feet above the channel at about the middle of the dam. Since it is being built as a flood control dam they are constructing it in such a way that the water can seep through and come up lower down the stream. It is possible that this may create new springs and raise the water level in the ground below the dam.

[10] L. M. Winsor Photograph Collection, 1915–1963, typed notes accompanying photographs of the dam project on Santa Clara Creek. Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah.

[11] Luther M. Winsor, *The Barrier System for Control of Floods in Mountain Streams.* Miscellaneous Publication No. 165. (Washington, D.C.: U.S. Department of Agriculture, 1933).

> There is to be a tunnel built on the north side of the dam which will take care of the normal flow of the stream. This will be constructed of rock and cement and will be five feet in width and seven feet in height.
>
> Over a mile of road had to be built part of which is for the replacing of the road that followed up the stream and part was road needed in the building of the dam. Considerable blasting had to be done, and much work was encountered in the building of these roads.
>
> Securing of rock for the dam was facilitated by the large quantity of rock on both hill sides of the stream. This rock is being drilled and then dynamited. Twelve ton of concrete was used in building one dead man for the overhead cable. This was tied into a big rock which will add much to its weight. The overhead cable is one and one half inches in diameter, 750 feet in length, will have a sag of twenty feet and will be able to carry up to four tons. This cable will be used to carry all materials used in the dam's construction after it becomes to[o] high to work on from below.[12]

The roads, the quarry area, and the cableway are all represented at the dam site today by extant features documented in a recent archaeological survey[13] and revisited during the fieldwork for the current HAER documentation (see Part II below). The towers of the cableway are visible in photographs of the dam project taken in 1934–35 (see Appendix B).

A second description of the Shem Dam project was provided by a reporter at the *Washington County News* about a month before the project was complete. This description is notable for the detail, confirmed in later comments on the dam by Winsor, that the interior fill of the dam consisted of "rock and gravel, the gravel being washed with pumps into the space between the rocks":

> The largest Erosion Control structure in this area is now nearing completion. According to J. C. Tolton, camp superintendent, it will be finished by February 1, 1935.
>
> This structure is a flood control dam on Santa Clara Creek. The dam is of the combined arch and gravity type. It is 100 feet long by eighty-five feet thick at the base and twenty feet thick on top. The spillway is sixty feet wide and twenty-three feet above the bed of the creek. The wall on either side of the spill is fifteen feet high making a total of thirty-eight feet in height. Below the spill is a stilling pool with a baffle wall four feet high; below the stilling pool is a protecting apron

[12] "Forestry Dept. and CCC Boys Make Progress," *Washington County News*, February 1, 1934.

[13] Tara S. Hoffman, *Cultural Resources Inventory of the Shem Dam Rehabilitation Emergency Watershed Protection Project, Washington County, Utah* (Salt Lake City: U.S. Department of Agriculture, Natural Resources Conservation Service, 2014).

> which extends twenty-five feet downstream and is three feet thick, built of rock masonry set in concrete mortar.
>
> Both faces of the dam are of rock masonry about four feet thick, with the space between filled with rock and gravel, the gravel being washed with pumps into the space between the rocks. The whole structure contains some 45,000 cubic yards of material. It is located one-half mile above the Shivwits Indian reservation farm. Just below the junction of [an unnamed] wash and Santa Clara creek and just below the point where the waters of Santa Clara creek are diverted into the canal that supplies Ivins and Santa Clara with irrigation water. It was partially completed by the camp last winter; and last summer it did yeoman service in protecting the Santa Clara–Ivins canal from a flood which would have washed out the diversion works and done great damage to irrigation works and crops below.
>
> The dam was designed by L. M. Winsor and Leo A. Snow with [Forest Service] Regional Engineer J. P. Martin as chief consulting engineer. It was designed primarily as a flood control dam and not as an irrigation project, although it does protect previously existing irrigation systems.[14]

A third description of the dam was written by an unidentified CCC enrollee of Company 961 and appeared in the second issue of the Camp PE-213 newsletter:

> The first Erosion project of Company 961 was recently completed by the crew of men working under Forestry Thomas [i.e., Forest Service superintendent Tolton]. The Winsor Dam, on the Shivwits Indian reservation, is one of the largest Public Erosion projects in the Fort Douglas District [of the CCC].
>
> Work on this project began in Oct. of 1933, and was discontinued in May of 1934, the work having shown rapid progress during the preceding months. The dam at this point was completed up to the spillway and facing of the front wall.
>
> The Company was then moved to Panguitch Lake for the summer months, and when it returned to St. George in October of 1934, work was again resumed on the structure and it was completed about the middle of February, 1935.
>
> The purpose of the dam, primarily, is not storage of water, but rather as a flood control measure.
>
> The dam is 350 feet long, 84 feet thick at the base, and 20 feet thick at the top. The spillway is 60 feet in width. The walls extend 15 feet above the creek bed, making a total height of 38 feet. The project contains 45,000 cubic yards of building material, for the best part sandstone and lava rock hauled down from the surrounding hills.

[14] "St. George Camp News," *Washington County News*, January 10, 1935.

> The damn dam, as it was often referred to, is completed, and we of 961 feel proud of our work. One of the most outstanding phases of the project was the fact that so few serious injuries were incurred by the laborers. Nothing more serious than the loss of a fingernail or the acquiring of a scar on an arm or leg.[15]

This brief description is useful for a few of the details it includes, such as the note that the dam was built of "sandstone and lava rock [i.e., basalt] hauled down from the surrounding hills," but it is probably most interesting for a simple but basically accurate and easily recognizable sketch of the dam that appears on the same front page of the newsletter (see Appendix C).

To describe the original appearance of the dam briefly but more systematically: Shem Dam was a linear barrier built across the Santa Clara River at a point where the natural channel was relatively constricted by the adjacent hillsides. The dam was a single, continuous, rock- and earth-filled embankment with masonry outer walls, standing perpendicular to the channel of the river. Its long axis was oriented northeast-southwest; the construction drawings give the perpendicular orientation as "N 40° W". The dam consisted of two straight, aligned abutments that met bedrock on either side of the river and were joined by an arched central wall that held the spillway (see Appendix B for early photographs of the dam). The overall length of the dam was about 375', and its maximum height, measured from the center of the streambed to the crest of the abutments, was 38'. The downstream face of the spillway had the shape of a partial hemisphere or bowl, with its lower portion extending downstream as a continuous rock apron flanked by small wing walls. A low secondary crest ran across the apron, forming a churning bowl at the foot of the spillway to help dissipate the energy of the water coming over the spillway. A tunnel was built through the northeast abutment to divert water to the irrigation canal that led from the dam to the Santa Clara Bench downstream. The tunnel had a steel gate at its upstream end that could be raised by hand with a gear lift mounted on the crest of the abutment.

Additional physical details of the dam, which in many respects has not changed since its original construction, are provided in Part II below.

5. Alterations and additions

Significant alterations were made to Shem Dam on two occasions to repair damage caused by flooding. In early March 1938, heavy rains caused the Santa Clara River to swell drastically, raising concerns that the dam would be swept away.[16] The dam proper was not damaged, but the lower parts of the spillway—the churning bowl, the secondary crest, the wing walls, and the apron—were damaged significantly. Photographs of the damage taken by Winsor later that year show that the flow over the spillway had undercut these features, causing them to subside, crack,

[15] "The Winsor Dam," *Cactus Chronicle* 1, no. 2 (March 14, 1935), 1. Civilian Conservation Corps Newsletters Collection, 1935–1941, Utah State Historical Society, Salt Lake City. Minor spelling errors have been corrected.

[16] "Flood Conditions Exist as Rain Continues," *Washington County News,* March 3, 1938.

and fall apart (see Appendix B, Figures 18–21). In notes on the photographs, Winsor attributed the damage to a shortcoming in the construction. The secondary crest

> had been built on top of loose gravel, due to the fact that the C.C.C. camp could not procure a pump with sufficient capacity to remove water during construction. Therefore, the structure was not carried down to sufficient depth to make it secure against erosive action of heavy flood.[17]

The CCC crew apparently had no such difficulty when raising the rest of the dam, but this part of the spillway was the very first part of the dam to be built (see Part II below), so perhaps the lack of a pump was resolved before construction of the dam proper began.

By December 1938, local business interests, including the irrigation company that relied on the diversion at the dam, were pressing the Forest Service, the Soil Conservation Service, and the CCC to make the needed repairs.[18] Winsor, who by 1938 was working for the U.S. Biological Survey and based in Salt Lake City,[19] was evidently still available to design and oversee a CCC project for the Forest Service, although the only record of his role in the repairs are photographs of the dam he took at the time.[20] The St. George CCC camp and Company 961 no longer existed, but Company 585, based at Camp SCS-7 in Leeds, Utah, about 15 miles north of St. George, was active in the area and loaned the Forest Service a crew of about 30 men for the repairs, which were made in May 1939.[21] The repairs consisted of rebuilding the churning bowl, the secondary crest, the wing walls, and the apron, providing all with a solid foundation, then adding a row of "breakers" along the downstream edge of the apron to slow the flow off the apron and prevent it from being undercut. The breakers were low, freestanding concrete piers, poured in place and aligned in a row, and spaced about 4' apart. Each breaker was diamond-shaped in plan, with the long axis of the diamond oriented parallel to the flow; the top of each breaker stood about 2' above the streambed and measured about 15" × 18" in plan. The completed repairs to the spillway were documented by Winsor in photographs in June 1939 (see Appendix B, Figures 22 and 23).[22] The CCC crew from the Leeds camp left informal inscriptions in wet concrete on the

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[17] L. M. Winsor Photograph Collection, 1915–1963, typed notes accompanying photographs of the dam project on Santa Clara Creek. Snow also reported that a lack of pumps was the reason for the inadequate construction of the spillway features (Leo A. Snow to John Hafen, 4 October 1938; Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah).

[18] "C. of C. Helps Save Dam Above Indian Reservation," *Washington County News*, December 29, 1938.

[19] Winsor, *Life History of Luther M. Winsor*, 41.

[20] L. M. Winsor 1912–1964 (COLL MSS 98), Utah State University, Special Collections and Archives Department, Logan, Utah.

[21] "Leeds CCC Camp," *Washington County News*, May 5, 1939. Baldridge, "Nine Years of Achievement: The Civilian Conservation Corps in Utah," 373, gives the camp and company numbers for the Leeds camp in the thirteenth enrollment period, April 1–September 30, 1939.

[22] L. M. Winsor Photograph Collection, 1915–1963. Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Another photograph of the dam was taken at the time by John Niezgoda, an

upper surface of the repaired southwest wing wall, including their company number and a few names and dates, as documented in the fieldwork for the current HAER documentation (see Part II below).

Shem Dam was repaired a second time following a heavy flood in 1955, a flood described by Snow as "the largest known in the history of man on the Santa Clara unless it be the flood that came soon after the first white settlers came there."[23] Photographs of the dam taken shortly after the flood show that the damage was more substantial than in 1938 (see Appendix B, Figures 31–35). Once again the abutments withstood the flood, but the lower, downstream portion of the spillway was badly undercut, and most of the bowl-shaped downstream face of the spillway was carried away, along with nearly all of the interior fill behind it. The upstream wall of the central arch somehow stayed intact, despite the disappearance of most of the structural mass on its downstream side. The secondary crest and apron at the foot of the spillway were also largely carried away.

In 1958, Winsor and Snow, probably at the request of the irrigation companies that still relied on the dam for water, collaborated on plans for the repair of the dam. Winsor drew plan and section drawings of the dam, showing the extent of the damage and the proposed repairs, and Snow described the damage and the proposed repairs in a brief report to the irrigation companies.[24] Both men were in their 70s.

Snow recommended that the downstream apron of the spillway again be rebuilt, this time using large boulders from the streambed below the dam, set in concrete. He also recommended that a deep "cutoff wall" be built at the toe of the apron, extending downward to large boulders in the streambed, presumably to prevent new undercutting. Finally, he recommended widening the spillway crest from its original 70' to 100', which would "distribute the force of the water flowing over the crest over a larger area of the new apron."[25] The drawings by Winsor show that the spillway crest would be widened on the northeast side of the existing spillway, corresponding with the extent of damage to that portion of it (see Appendix A, Figures 8 and 9). Although Snow did not mention it, this would compromise the originally symmetrical appearance of the central arch by rebuilding its damaged upper northeast end not to its original height, 15' above the spillway crest, but only to the original height of the crest.

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enrollee of the Leeds camp (Utah Civilian Conservation Corps Photographs and Records, ca. 1933–2000, MSS B 1456, Research Center, Utah Division of State History, Salt Lake City, Utah).

[23] Snow, "Suggested Repairs to the Winsor Dam," January 24, 1958, Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

[24] Snow, "Suggested Repairs to the Winsor Dam." Winsor, "Winsor Dam Repair," January 20, 1958, construction drawings (1 sheet). Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah. "Winsor Dam Repairs Make Progress with Supervisor," *Washington County News*, January 30, 1958.

[25] Snow, "Suggested Repairs to the Winsor Dam."

No photographs of the 1958 repair project as it was underway, or of the dam shortly after the repairs were made, were found in research for the current HAER documentation. More-recent photographs of the dam, taken not long before the spillway was again badly damaged in 2011, show that the portion of the spillway repaired in 1958 contrasted sharply in appearance with its intact original portion and with the intact original abutments.[26] The basalt boulders used in the 1958 repair, lifted from the bed of the river downstream of the dam, were much larger than any of the quarried rocks visible in the original construction and apparently were used with minimal if any modification. In the 2011 flood, the downstream face of the spillway and the apron were again undercut and partially carried away, exposing the interior of the portion of the spillway repaired in 1958. The large boulders used in the repair evidently took the place both of the original masonry face of the spillway and of the rocky fill behind it.

B. Historical Context

The construction of Shem Dam in 1934–35, during the depths of the Great Depression, was part of a national response to two circumstances viewed as central to the ongoing economic crisis: widespread unemployment and unchecked degradation of the natural environment. President Franklin D. Roosevelt, within days of his inauguration in March 1933, took a major step to address both problems by asking Congress to create the Civilian Conservation Corps (CCC). Over the nine years of its existence (1933–42), the CCC put millions of unemployed young men around the country to work on diverse federally sponsored projects—planting trees, preventing soil erosion, and otherwise protecting and developing natural resources.[27] Shem Dam, built by a CCC company under the direction of the U.S. Forest Service to address flood-control and irrigation problems, was unambiguously a part of this broad national context. But the history of how the dam was planned, built, and used was also determined by unique local circumstances, notably the location of the dam in a part of Utah where a Mormon tradition of irrigated farming, developed first in the temperate parts of the state, was adapted to the hotter, drier environment of Washington County. The historical significance of the dam is also evident in the roles played by the two engineers who designed it and supervised its construction, Luther M. Winsor and Leo A. Snow, both natives of Utah and descendants of Mormon farmers.

1. Mormon Settlement in Washington County

Washington County, which occupies the southwest corner of Utah, has long been known as "Utah's Dixie," so named by the Mormon pioneers because it was the one place in the state with

[26] A photograph of the downstream face of the dam, including the repaired spillway, taken in 2002, was published by Emma Hafen Fife, *History of the Santa Clara Bench: Ivins, Our Home Beneath the Red Mountain* (Ivins, Utah: privately printed, 2010), 46.

[27] John A. Salmond, *The Civilian Conservation Corps, 1933–1942: A New Deal Case Study* (Durham, North Carolina: Duke University Press, 1967).

elevations low enough to provide the long, frost-free growing season needed for cotton and other semitropical crops. Like most other counties in the state, Washington County has high, rugged mountains, including peaks higher than 10,000 feet, but it also has valleys as low as 2,100 feet—the rest of Utah is higher than 4,000 feet—along with the heat and aridity of the adjacent portions of Arizona and Nevada. The Virgin River, the county's principal stream, originates in the mountains just northeast of the county, then flows generally southwestward across the county, eventually crossing the northwest corner of Arizona and joining the Colorado River in southeastern Nevada. The Santa Clara River, a small, perennial stream and one of the larger tributaries of the Virgin, originates in the north-central part of the county and flows generally southeastward, meeting the Virgin just below St. George, the county seat.[28]

The Virgin River and its tributaries were a regional focus of Native American settlement in precontact times and the earliest focus of Anglo-American settlement in Washington County. In 1852, just five years after the arrival of the Mormon pioneers in northern Utah, Mormon leader Brigham Young sent a group of the faithful to southwestern Utah to establish a Mormon presence in the region, both to proselytize among the local bands of Paiutes and to find suitable places for new Mormon settlements. By 1854, a mission was established on the Santa Clara River just above the site of the modern town of Santa Clara, at a place where local Paiutes had long been settled and were already farming with irrigation from the river. By the following year, the small Mormon community, with the help of the Paiutes, had built a dam across the river to route water to newly turned fields, and the first crop of cotton was grown and harvested, an important step toward agricultural self-sufficiency for the Mormon Church, which hoped to rely as little as possible on goods from outside Utah.[29]

Apart from an initial outpost at Fort Harmony, Santa Clara was the first Mormon farming community in Washington County, but it was soon followed by other small settlements along the Virgin and Santa Clara rivers. In 1861, this initial, scattered effort at settlement was greatly augmented when Brigham Young called on two church apostles, Erastus Snow and Orson Pratt, to lead a "Cotton Mission" to Washington County, with the specific goal of establishing the town of St. George. Three hundred families living near Salt Lake City formed the Cotton Mission, and under Snow's leadership (Pratt left after a few years) the new town of St. George quickly became the social, economic, and religious center of southern Utah. This status was confirmed in 1877

[28] Douglas D. Alder and Karl R. Brooks, *A History of Washington County: From Isolation to Destination* (Salt Lake City: Utah State Historical Society, 1996), 1–4. Andrew Karl Larson, *"I Was Called to Dixie." The Virgin River Basin: Unique Experiences in Mormon Pioneering* (St. George, Utah: Dixie College Foundation, 1992), 1–14.

[29] Alder and Brooks, *A History of Washington County*, pp. 20–25. Larson, *"I Was Called to Dixie,"* pp. 38–39. On the practice of irrigation by the Paiutes along the Santa Clara, see Richard W. Stoffle and Maria Nieves Zedeño, "Historical Memory and Ethnographic Perspectives on the Southern Paiute Homeland," *Journal of California and Great Basin Anthropology* 23, no. 2 (2001): 229–48.

with the dedication of the St. George Temple, an imposing structure that still stands today and was the first Mormon temple completed in Utah Territory.[30]

The Mormon settlement of Utah was, in almost every part of the state, a deliberate process guided by the Church. The goal was the establishment of farming communities, with an eye to making the most of scarce water and farmland. An important part of every Mormon farming community was its irrigation system, designed and built by the community for the benefit of all members. The earliest settlements in Utah were established along the western foot of the Wasatch Mountains, north and south of Salt Lake City, where the streams that drained the mountain slopes opened onto the piedmont. Simple dams built of rocks and brush diverted water into ditches that fed the fields of individual community members.[31] The Mormon settlement of Washington County followed a similar pattern, with the added burden of using water sparingly in a hot, arid environment.

Despite the general scarcity of water, floods were a frequent hazard for farming communities throughout Utah. Heavy seasonal rains and snowmelt would quickly fill mountain canyons and send enormous volumes of water down to the piedmont communities below. Diversion dams and irrigation ditches were severely damaged or obliterated, and towns were sometimes buried in mud, boulders, and uprooted brush and trees.[32] Washington County, with expanses of rugged, sparsely vegetated topography, was especially prone to disastrous floods. The first major flood experienced by the Washington County pioneers came in 1861, the same year that the Cotton Mission first settled at St. George. Rain began to fall across the county in late December 1861 and did not stop until February 1862, forty-four days later. Heavy flooding affected the entire Virgin River basin, wiping out multiple communities only recently established and forcing others to relocate.[33] It is still considered the most severe flood in the county's 160-year history, but it was far from the last. The repeated experience of floods, with the attendant devastation of dams, ditches, and fields, eventually led farming communities along the lower Santa Clara River to look for ways to protect their livelihood, including the building of Shem Dam.

The early Mormon mission at Santa Clara, under the leadership of Jacob Hamblin, was successful in gaining the confidence of the southern Paiute people already living and farming along the river, a group that was probably part of the Tonaquint band, named for the location of one of their villages at the confluence of the Santa Clara and Virgin rivers. Hamblin was respected by the Tonaquint and was their strongest advocate in the face of early encroachments

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[30] Alder and Brooks, *A History of Washington County*, pp. 27–28, 36–40. Larson, *"I Was Called to Dixie,"* pp. 101–18. Albert E. Miller, *The Immortal Pioneers: Founders of City of St. George, Utah* (St. George, Utah, privately published, 1946), 40–46, 103–13.

[31] Leonard J. Arrington, *Great Basin Kingdom: An Economic History of the Latter-day Saints, 1830–1900* (Urbana: University of Illinois Press, 2005), 51–52. George Thomas, *The Development of Institutions Under Irrigation, with Special Reference to Early Utah Conditions* (New York: Macmillan, 1920).

[32] Winsor, *The Barrier System for Control of Floods in Mountain Streams*, pp. 1–3.

[33] Alder and Brooks, *A History of Washington County*, pp. 44–46.

on their land and water, but he soon moved on to a new mission among the Hopi in Arizona. By 1878, the Tonaquint living near Santa Clara numbered just two, nearly wiped out by disease and displacement. In the late 1880s, Anthony W. Ivins, a young rancher and later a prominent Mormon leader, convinced the federal government that the Shivwits band of southern Paiute, who were struggling to survive on arid lands just south of the Utah border, should be moved to an area along the river just west of Santa Clara. Ivins used federal funds to establish a Shivwits settlement, build a school, and supply the Shivwits with the teams, wagons, and tools they needed to live as farmers. In 1891, the Shivwits Indian Reservation was officially set aside and the Shivwits Band of Paiute became a federally recognized tribe. The reservation was later expanded in 1916, and again in 1937, reaching its current size of 28,480 acres, though only a small part of the reservation located along the Santa Clara River was suitable for farming.[34] In 1933, when a site for a flood-control dam along the Santa Clara was sought by Luther Winsor and local engineers and farmers, the location they chose for what became Shem Dam was in the northwest corner of the reservation, which required the cooperation of the Shivwits band and the Bureau of Indian Affairs (see below). The new dam would block an existing irrigation diversion used by the Shivwits band, but the project included a separate diversion below the dam for reservation lands.

Missionizing and farming were the earliest draws of Mormon settlement to Washington County, but within a few years mining opportunities were drawing other Anglo-Americans to the region. The largest mining boom ever in Washington County took shape at the Silver Reef mine, about 17 miles northeast of St. George, and lasted from 1875 until about 1890, followed by a string of less productive years.[35] As the workings at the Silver Reef were abandoned, other ore deposits were developed in the county, including a large copper deposit at the Apex mine (later known as the Dixie mine) in the Beaver Dam Mountains about 10 miles southwest of Santa Clara. The Apex was first worked with some success around 1890, then abandoned for a few years when the price of copper declined. In 1898, a new owner, the Utah Eastern Copper Company, reopened the mine and built a smelter along the Santa Clara River due north of the mine at a place called Shem, a name reportedly borrowed from a baptized Shivwits leader who lived nearby. For the next decade, the smelter at Shem, powered by water diverted from the river two miles upstream, was the center of a small settlement from which copper was shipped by

[34] Alder and Brooks, *A History of Washington County*, pp. 20–25. Isabel T. Kelly and Catherine S. Fowler, "Southern Paiute," in *Great Basin*, edited by Warren L. d'Azevedo, pp. 368–97, vol. 11 of *Handbook of North American Indians*, edited by William C. Sturtevant (Washington, D.C.: Smithsonian Institution, 1986), 389. Larson, *"I Was Called to Dixie,"* pp. 21–24. Edward Leo Lyman, "Southern Paiute Relations with Their Early Dixie Mormon Neighbors." Twenty-seventh annual lecture, Juanita Brooks Lecture Series, Val Browning Library, Dixie State College, 2010.

[35] W. Paul Reeve, "Silver Reef and Southwestern Utah's Shifting Frontier," in *From the Ground Up: The History of Mining in Utah*, ed. Colleen Whitley (Logan, Utah: Utah State University Press, 2006), 359–77.

wagon to Acoma, Nevada, the nearest railroad stop, some 50 miles to the west. Another drop in copper prices closed the Shem smelter permanently in 1907.[36]

In 1909, just two years after the Shem smelter closed, two engineers from St. George, Leo A. Snow and Clarence S. Jarvis, filed an application with the State of Utah to appropriate water from the Santa Clara River at "the outflow from the Utah and Eastern Copper Company's smelter power plant" at Shem.[37] Two years later, Snow and Jarvis assigned their water right to a group of citizens from Santa Clara and St. George in order to form the St. George and Santa Clara Bench Irrigation Company. The company's goal was to build a ditch that would carry water from the diversion point at Shem to the Santa Clara Bench, or the broad terrace on the north side of the Santa Clara River that extends for about eight miles upstream from the town of Santa Clara. The company hoped to claim for irrigation as many as 8,000 acres of federal land on the Santa Clara Bench under the Carey Act of 1894 (also known as the Federal Desert Land Act); the plans included a reservoir for irrigation water and a nearby townsite. After a few changes that modified the proposed diversion point, the site of the reservoir, and the acreage to be watered, and after negotiations to secure a right-of-way across the Shivwits Indian Reservation, the ditch was finally built along the north bank of the river, a substantial project headed by Leo Snow that took about four years to complete, 1911–14.[38]

The outflow of the old smelter at Shem was apparently never used as the diversion point. Instead, a dam was built just below the smelter, a dam that Luther Winsor later described as a "temporary structure" of "brush and straw covered with sand."[39] It was probably built with the understanding that it would be regularly damaged or destroyed by seasonal flooding and would need to be rebuilt frequently. A few years later, Snow and Jarvis built the proposed reservoir and laid out a townsite about three miles upstream of Santa Clara, and by 1922 lots were being sold in the townsite to people who would farm the bench with the newly delivered water. The new

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[36] "Conditions at 'Shem City,' the New Mining Camp," *Deseret News,* March 25, 1903. "The Copper Mines of Utah's Dixie," *Deseret News,* December 19, 1903. "The Dixie Copper Mine in Washington County, Utah," *Salt Lake Mining Review,* March 30, 1904. "Washington County Mines," *Salt Lake Mining Review,* January 15, 1906. Horace J. Stevens, "Utah & Eastern Copper Co.," *The Copper Handbook: A Manual of the Copper Industry of the World,* vol. 9 (Chicago: M. A. Donahue and Company, 1909), 1381–82. Alder and Brooks, *A History of Washington County,* p. 117. Larson, *"I Was Called to Dixie,"* pp. 327–28.

[37] State of Utah, Application to Appropriate Water, File No. 2368, April 29, 1909. Utah Division of Water Rights, Water Right 81-7, http://www.waterrights.utah.gov/.

[38] "To Reclaim Desert Land," *Washington County News,* March 9, 1911. "To Irrigate Clara Bench," *Washington County News,* March 30, 1911. "To Irrigate Clara Bench," *Washington County News,* April 6, 1911. "New Incorporations," *Salt Lake Tribune,* April 11, 1911. "Notice to Water Users," *Washington County News,* June 1, 1911. "Notice to Water Users," *Washington County News,* October 19, 1911. "Santa Clara Bench Canal Work Progressing," *Washington County News,* May 1, 1913. "Santa Clara Bench Canal to Be Finished," *Washington County News,* December 11, 1913. "S. C. B. Irrigation Project Completed," *Washington County News,* March 30, 1916.

[39] L. M. Winsor Photograph Collection, typed notes accompanying photographs of the dam project on Santa Clara Creek. Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah.

town was eventually named Ivins, after Anthony Ivins, the man who years before had helped settle the Shivwits band on their reservation and who in 1907 became an apostle of the Mormon Church.[40]

It is not clear when the water users of the St. George and Santa Clara Bench Irrigation Company first considered replacing the simple diversion dam at Shem with a more durable structure, but by early 1933 they were ready to listen to a proposal by Luther M. Winsor, an engineer with the U.S. Department of Agriculture, Bureau of Agricultural Engineering, to build flood-control features in the Santa Clara River, both to protect their canal and to stop the washing away of valuable farmland adjacent to the river. Winsor was well known in Utah as an expert in flood control issues and in 1930 had been appointed to a committee of specialists by Governor George H. Dern to study flooding problems statewide.[41] Winsor's proposal for the Santa Clara River included a series of revetments or partial levees built at intervals along the river and a large new dam, to be raised near the existing dam at Shem.[42]

2. Luther M. Winsor and Leo A. Snow

Luther Winsor was born in 1884 in Hebron, Utah, a small Mormon farming community (now abandoned) in northwestern Washington County, about 30 miles north of the eventual site of Shem Dam. He was raised a Mormon in Hebron and in nearby Enterprise and had friends and family ties in St. George, the county sea and a town his family frequented while he was growing up. In 1904, he began studies at the Utah Agricultural College (now Utah State University) in Logan, where he earned a bachelor's degree in 1911. It was the first degree in irrigation engineering awarded by any school in Utah and was the beginning of Winsor's long and distinguished career as an irrigation and flood-control engineer. He went on to hold a succession of positions in the federal government as well as academic appointments, and he also played diverse roles as a private consultant. In addition to the design of irrigation and flood-control projects in Utah and other western states, his accomplishments included establishing the Department of Irrigation at the Utah Agricultural College; designing and overseeing the construction of an irrigation system for the American Smelting and Refining Company near Santiago, Chile; graduate studies at the University of California at Berkeley, leading to a master's degree in 1926; more than twenty years with the Bureau of Agricultural Engineering; an important role in the establishment of the federal Soil Conservation Service; and almost five years in Iran, 1941–45, as Director General of the Department of Irrigation, Iran Ministry of

[40] Emma Hafen Fife, *History of the Santa Clara Bench: Ivins, Our Home Beneath the Red Mountain* (Ivins, Utah: privately published, 2010).

[41] "Group to Study Flood Control in Utah Named," *Salt Lake Telegram,* September 9, 1930.

[42] "Creek Water Conservation Plan Offered," *Washington County News,* February 9, 1933.

Agriculture, an appointment made by President Franklin D. Roosevelt. Winsor was also the first county extension agent in Utah, assigned to Uintah County in 1913.[43]

Leo Alva Snow was of the same generation as Winsor and also a native of Washington County, but his own long career in engineering had a local focus. He was born in St. George in 1881, a grandson of Erastus Snow, the leader of the first Mormon colony in St. George and a prominent figure in Utah pioneer history. Leo Snow graduated with a degree in engineering from the University of Utah in 1908 and was hired the same year by the federal government as a surveyor on a project in upper Zion Canyon in eastern Washington County. After completing the survey, Snow recommended that the canyon be set aside as a national park, a recommendation heeded in 1909 when President William Howard Taft designated the canyon Mukuntuweap National Monument. The name was changed to Zion National Monument in 1918 and became Zion National Park, its current identity, in 1919.[44] In 1961, Snow was officially recognized by the National Park Service for his role in the original designation of the monument, and he is probably best known today, outside of Washington County, for this accomplishment. [45]

After his work at Zion, Snow began a private engineering practice in St. George and also worked at different times as county engineer for Washington County, as city engineer for the City of St. George, and as supervising engineer for other municipal governments around the county. He continued to work as a surveyor but also designed bridges, dams, water pipelines, irrigation systems, sewage and drainage systems, and other structures throughout Washington County. Snow's work for the CCC began in September 1933 with the design of a flood-control dam on the Escalante River in Garfield County, Utah, just east of Washington County. In February 1934, the CCC assigned him to the Shem Dam project as the supervising engineer.[46]

Both Winsor and Snow deserve credit for designing Shem Dam, but their contributions to the project differed. The design was based on a general concept for inexpensive flood-control dams developed by Winsor during the 1920s at various locations in Utah and presented in an official

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[43] Luther M. Winsor, *Life History of Luther M. Winsor* (Murray, Utah: R. Fenton Murray, 1962). "More Positions for A. C. Men," *Iron County Record*, August 1, 1913. "L. M. Winsor Leaves for South America," *Logan Republican*, February 4, 1919. Luther M. Winsor, "Irrigation in Iran," *Civil Engineering* 14, no. 2 (1944): 62–64. "From Sagebrush to Sand Dunes. Compiled from Letters by Luther M. Winsor," *Improvement Era* 48 (June 1945): 340–41, 373–74. Jessie L. Embry, "The Church Follows the Flag: U.S. Foreign Aid, Utah Universities, the LDS Church, and Iran, 1950–64," *Journal of Mormon History* 32, no. 3 (2006): 145–46. Charles S. Peterson, "Cholera, Blight, and Sparrows: A Look at Utah's First Agricultural Agents," *Utah Historical Quarterly* 57, no. 2 (1989), 140.

[44] Thomas G. Alexander, "Red Rock and Gray Stone: Senator Reed Smoot, the Establishment of Zion and Bryce Canyon National Parks, and the Rebuilding of Downtown Washington, D.C.," *Pacific Historical Review* 72, no. 1 (February 2003): 8. Angus M. Woodbury, "A History of Southern Utah and Its National Parks," *Utah Historical Quarterly* 12, nos. 3–4 (July–October 1944): 187–88, 202.

[45] Leo A. Snow, "Incidents in the Life of Leo A. Snow" (as related to Marva S. Snow, 1963). Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

[46] Leo A. Snow to Carl W. Hughes, 22 July 1939. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

publication of the U.S. Department of Agriculture in 1933.[47] In his position with the Bureau of Agricultural Engineering, Winsor was advocating for the construction of a flood-control dam on the Santa Clara River near Shem as early as January 1933, making investigative trips to the area in the company of local farmers, the directors of local irrigation companies, and local engineers, including Leo Snow, who was working as the Washington County engineer at the time. Winsor and his local contacts had a plan for a dam in place by March 1933, apparently before it was known that the project would be able to draw on CCC labor.[48] Shortly afterward, the Bureau of Agricultural Engineering temporarily assigned Winsor to the U.S. Forest Service to design and oversee a total of 22 flood-control projects in Utah, including Shem Dam, plus three projects in Nevada and one in Colorado, all built using labor provided by the newly formed CCC.[49]

Snow's early role in the Shem Dam project is less clear, but by February 1934, when construction began, the local newspaper described him as "the engineer in charge of the dam," in the same article that it described Winsor as "the man who suggested the design of the dam."[50] Snow, whose large collection of drawings from several decades of work include the original construction drawings for Shem Dam, probably adapted Winsor's general concept to the specifics of the Shem Dam site and made the original drawings. (Two of the three sheets of the original construction drawings for the dam list only Snow as the designer.[51]) Winsor later attributed the innovative use of "hydraulic fill" in the dam to Snow but did not indicate who was responsible for the overall design.[52]

Early on, Snow seemed eager to give Winsor credit for the dam. At a banquet in April 1934, held by the citizens of Santa Clara and Ivins to show their appreciation for the CCC and their first season of work at the dam, Snow gave the last speech of the evening and

> made the suggestion that since Mr. Winsor has had so much to do with the building of the dam that it be named after him in honor of the part he had played

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[47] Luther M. Winsor, *The Barrier System for Control of Floods in Mountain Streams.* Miscellaneous Publication No. 165. (Washington, D.C.: U.S. Department of Agriculture, 1933).

[48] "Make Survey for Water Storage," *Washington County News,* February 2, 1933. "Creek Water Conservation Plan Offered," *Washington County News,* February 9, 1933. "Reclamation Plan Studied by Farmers," *Washington County News,* March 2, 1933. "Santa Clara Farmers Study Water Storage," *Washington County News,* March 9, 1933. "Reclamation Proposal Told at Field Trip," *Washington County News,* March 16, 1933. "Cement Here for Making Shem Dam," *Washington County News,* March 23, 1933. "St. George Residents Launch River Control Project," *Washington County News,* March 24, 1933. "Much Activity in Flood Control in Southern Utah," *Iron County Record,* March 30, 1933.

[49] Luther M. Winsor, *Irrigation and Flood Control* (Murray, Utah: R. Fenton Murray, 1963), ii, 13–14.

[50] "Forestry Dept. and CCC Boys Make Progress," *Washington County News,* February 1, 1934.

[51] "Flood Control Dam, Shivwits Indian Reservation, Washington County, Utah." January 16–March 6, 1934. Original construction drawings (3 sheets). Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

[52] Winsor, *Irrigation and Flood Control,* 32–33, 75.

> in its construction. This met with the approval of those present so it will be so called in the future.[53]

The dam was indeed called Winsor Dam thereafter by most people, but Shem Dam, a name based on the proximity of the dam site to the abandoned town and copper smelter known as Shem, is used in the current HAER documentation because it was the name used when plans for the dam were first being discussed.[54]

Winsor and Snow, both born and raised in Washington County and members of Mormon families long resident there, were related by marriage—not a surprising fact considering the limited population of the county in the early twentieth century and the many social and economic ties among its small towns. This connection between the two men did not have any obvious influence on the design or construction of Shem Dam, but it is an interesting detail that reflects the nature of the larger community to which both men belonged. In 1914, a year after Winsor was appointed to his post as irrigation engineer with the U.S. Department of Agriculture in Logan, he married Beatrice Snow, whom he had met in 1912 during a trip to Millard County in his capacity as an extension agent with the Utah Agricultural College. Miss Snow was working in Millard County as a home economics teacher, but she was born in St. George (in 1891) and was a great-granddaughter of Erastus Snow, the Mormon leader who helped found the town in 1861. Leo Snow, a grandson of Erastus Snow, was a first cousin to Beatrice's father, William Spencer Snow, and so Leo and Beatrice were first cousins, once removed. When she was a little girl, Miss Snow moved with her family to Colonia Juárez in Chihuahua, Mexico, where the Mormon Church had established a settlement in 1886. She returned to St. George as a young woman, planning to return to Colonia Juárez eventually, but the Mormon settlement was abandoned in 1912 because of unrest associated with the Mexican Revolution. On December 16, 1914, two years after they met in Millard County, Luther Winsor and Beatrice Snow were married at the Salt Lake Temple, in a ceremony officiated by the apostle Anthony W. Ivins, namesake of the town of Ivins (see above) and an uncle of the bride.[55]

3. The CCC at St. George

The CCC was created by President Franklin D. Roosevelt in 1933 in response to the Great Depression, both to provide work for the unemployed and to address deforestation, soil erosion,

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[53] "Santa Clara, Ivins Show Appreciation for C.C.C. Work," *Washington County News*, April 5, 1934. Winsor later stated that the idea of naming the structure Winsor Dam was suggested by Edward Frei of Santa Clara (Winsor, *Life History of Luther M. Winsor*, caption to undated photograph of Winsor Dam, unnumbered page following the text).

[54] For example, "Cement Here for Making Shem Dam," *Washington County News*, March 23, 1933.

[55] Luther M. Winsor, *Life History of Luther M. Winsor*, 22, 25; Beatrice Snow Winsor, *Life History of Beatrice Snow Winsor*. "Prof. Windsor [*sic*] Gets Married," *Logan Republican*, December 19, 1914. Church of Jesus Christ of Latter-day Saints, Family Search website, https://familysearch.org/, August 2014.

and other conservation issues around the country. CCC enrollees were young men from 18 to 23 years of age (enrollment was later opened to men 17 to 28 years of age) who were put to work as laborers on a wide range of conservation projects throughout the United States, sponsored by various federal agencies including the Forest Service, the National Park Service, and the Division of Grazing. The enrollees lived in camps established near the projects they worked on, with as many as 225 enrollees to a camp. Each camp was run by three or four U.S. Army officers and one or more staff from the sponsoring federal agency. The enrollees had little or no relevant work experience and were supervised in the field by technical experts hired by the sponsoring agency. The technical experts were assisted in the field by a group of "local experienced men" from nearby communities. The local experienced men were chosen for their practical experience in construction, the supervision of laborers, the handling of horses and machinery, or other skills. The young enrollees in a CCC company were often from places distant from their duty location—many companies in Utah consisted of young men from eastern, southern, or other states—and the enrollment in a company would change periodically, usually at the end of each six-month enrollment period.[56]

When the St. George camp opened, Company 961 was "composed completely of Utah enrollees" from different parts of the state, probably including at least a few young men from Washington County.[57] The number of enrollees living in the camp and working at the dam undoubtedly varied over the course of the project, but in October 1933 the St. George camp was reported as holding "over two hundred men."[58] When dam construction began in February 1934, the number of enrollees working at the dam site was reported as "about one hundred," which probably meant that the rest of Company 961 was instead working on the related project of constructing levees in the river channel at multiple locations.[59]

Leo Snow, the engineer placed in charge of the construction project, was assisted by at least four local experienced men. The editor of the St. George newspaper toured the dam site in February 1934 and published an article about his visit, naming the four men: Hyrum Kunz, general foreman; George Maise, "who has charge of the rock work [i.e., the masonry]"; Oscar Lyman, foreman; and Claude Tulley, "who has charge of getting the rock that will be used in the dam's construction."[60] The lives and careers of these four men have not been researched for the current HAER documentation.

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[56] Baldridge, "Nine Years of Achievement: The Civilian Conservation Corps in Utah." Beth R. Olsen, "Utah's CCCs: The Conservators' Medium for Young Men, Nature, Economy, and Freedom." *Utah Historical Quarterly* 62, no. 3 (1994): 261–74. John A. Salmond, *The Civilian Conservation Corps, 1933–1942: A New Deal Case Study* (Duke University Press, 1967).

[57] "C.C.C. Camp Is Now Finished for Men," *Washington County News*, October 19, 1933.

[58] "C.C.C. Camp Was Dedicated Saturday," *Washington County News*, November 2, 1933.

[59] "Forestry Dept. and CCC Boys Make Progress," *Washington County News*, February 1, 1934.

[60] "Forestry Dept. and CCC Boys Make Progress," *Washington County News*, February 1, 1934.

The CCC camp at St. George opened in October 1933, at the start of the second federally designated CCC enrollment period (October 1933–March 1934). The official designation of the camp in this period was SE-213 (sometimes shortened to S-213). The SE- prefix stood for "State Erosion" and was used by the CCC for camps under the supervision of the U.S. Forest Service and working on soil-erosion projects selected by a state committee. The work assigned to Company 961 in this period was to carry out Winsor's plan, most notably to build the dam at Shem but also to build the series of partial levees in the channel of the Santa Clara River, to control the flow of the river and prevent the erosion of adjacent farmland. Company 961 spent the third CCC enrollment period (April–September 1934) at a higher elevation camp at Panguitch Lake working on unrelated tasks but returned to St. George in October 1934 to continue its work on the Santa Clara River.[61] In this period, or possibly at some moment in the second enrollment period, the official designation of the St. George camp changed from SE-213 to PE-213. The PE- prefix apparently stood for "Private Erosion" and was used for camps working on soil-erosion projects supervised by the Forest Service but on private land.[62]

The switch in prefix may have been prompted by the location of Shem Dam on the tribally owned Shivwits Indian Reservation, or perhaps the revetment work elsewhere along the river included locations on private land. Whatever prompted the change, it is the PE-213 designation that appears on the original construction drawings of the dam (see Appendix A, Figures 1–3). It was also the designation used by the Company 961 enrollees themselves in the newsletter they published for a brief period in 1935, and in informal inscriptions they made in wet concrete at the dam when it was completed the same year.[63]

4. Construction Techniques

The site for Shem Dam was chosen in part because it was near the site of an existing, less-substantial dam, used since 1916 to divert water into the canal of the St. George and Santa Clara Bench Irrigation Company.[64] The existing dam, which Winsor described as a "temporary structure" of "brush and straw covered with sand," was regularly damaged by flooding and

[61] "CCC Company 961 Now in St. George," *Washington County News*, October 18, 1934.

[62] Baldridge, "Nine Years of Achievement: The Civilian Conservation Corps in Utah," 55.

[63] For use of the SE-213 and S-213 designations, see "C.C.C. Camp 961 Was Dedicated Saturday," *Washington County News*, November 2, 1933, and Kenneth W. Baldridge, "Nine Years of Achievement: The Civilian Conservation Corps in Utah." PhD diss., Brigham Young University, 1971, 89. The use of the SE-213 designation in the second enrollment period and the PE-213 designation in the fourth enrollment period is indicated in a list of camps by enrollment period sent by Regional Forester R. H. Rutledge to Utah Governor Henry H. Blood in 1934 (R. H. Rutledge to Henry H. Blood, 20 October 1934; Utah State Archives and Records Service, Governor Blood Relief Programs, Series 191, Salt Lake City). The Camp 961 newsletter was *The Cactus Chronicle*, published in five issues, March 2–April 11, 1935 (vol. 1, nos. 1–5); Utah State Historical Society, Civilian Conservation Corps Newsletters Collection, 1935–1941, Salt Lake City. For a discussion of the informal inscriptions at the dam, see Part II of the current HAER documentation.

[64] "S. C. B. Irrigation Project Completed," *Washington County News*, March 30, 1916.

frequently in need of replacement or major repairs.[65] The new dam, which would stand 600' downstream of the old dam, would be the new diversion point for irrigation water, but its primary purpose, in Winsor's view, was flood control. Specifically, it was a way to slow down the river during a high-water event to allow the debris it carried—boulders, gravel, mud, brush, trees—to settle out above the dam, thus protecting the irrigation diversion point, the irrigation ditches that the diversion point fed, and other improvements downstream.

Winsor's reasons for selecting the exact site of Shem Dam are not completely clear, but the selection probably conformed to his general concept of a barrier dam, which required a site that was not necessarily the narrowest point along a stream (where a dam could often be built at the lowest cost) but the point where floodwaters above the dam could spread out enough to allow the material they carried to settle out:

> The primary consideration in fixing the site of a barrier system is a comparatively broad and even area over which the flood can be spread and upon which the debris can be deposited. The location of control works within narrow canyon walls is seldom effective because of the limited amount of spreading and the smallness of capacity for the storage of detritus.[66]

The eventual site of Shem Dam provided both a limited but suitable narrowing of the channel and a relatively broad floodplain immediately above. In contrast with dams built to create a large reservoir to impound water, the primary purpose of the reservoir created by Shem Dam was not the storage of water but the storage of flood debris. Included in Winsor's general concept of flood-control dams was the assumption that the steady accumulation of debris behind the dam would require the periodic raising of the dam or spillway crest, but at Shem Dam this never happened.

Section drawings of Shem Dam included by Leo Snow in the original construction drawings indicate that the dam would rest on a "firm foundation," a maximum of about 12' below the streambed at the center of the river channel, but this did not mean the dam would rest on bedrock. Photographs taken in 1934 during the early days of the project show a roughly excavated trench running across the river and up the adjacent hillside, a trench that would anchor the base of the dam but did not obviously reach bedrock (see Appendix B, Figures 4–6). In his general discussions of barrier dams like the dam at Shem, Winsor emphasized that effective, durable dams could be built on the stable alluvial soils, rocky detritus, and boulders found at the mouths of canyons.[67] The site of Shem Dam was not the mouth of a canyon, but there was a

[65] L. M. Winsor Photograph Collection, typed notes accompanying photographs of the dam project on Santa Clara Creek.

[66] Winsor, *The Barrier System for Control of Floods in Mountain Streams,* 5–7.

[67] Winsor, *The Barrier System for Control of Floods in Mountain Streams,* 11.

similar reliance on the alluvial deposits of the streambed for a foundation. In a discussion of repairs that Shem Dam would require following a major flood in 1955, Leo Snow recalled:

> At the time of construction by the Forest Reserve C.C.[C.] camp there were few needed methods of preparing the stream channel but it was found that there were many large rocks imbedded in the stream bed and upon these the dam was largely rested. There is also a rock shelf that extends from the south end [i.e., from the hillside adjacent on the south] and runs out into the channel but which dips rather abruptly when it reaches the center of the channel.[68]

In Winsor's view, the key to the strength of Shem Dam and other flood-control dams of similar design was not so much what a dam rested on as the rubble masonry used to build it, a technique that was less expensive and easier than either conventional masonry or solid concrete construction but was nevertheless strong and lasting when properly done. Rubble masonry is a centuries-old technique, but Winsor developed a modified version of it beginning in the 1920s as he designed and supervised the construction of dozens of dams, spillways, retaining walls, culverts, and other flood-control structures around Utah and later in other states.[69] The method was especially valuable in a period when materials and skilled labor were scarce and the builders of dams and other projects often had to make do with what was available locally, notably the rock naturally available at the site of a project. In an article Winsor wrote in 1941 (aboard a ship bound for Iran), he described the method in some detail, emphasizing its minimal use of concrete and his preference for using unskilled labor. His discussion of the "chief variations" of his version of rubble masonry—the ways it differed from conventional masonry—is a useful description of the method used at Shem Dam:

> (1) There is no mortar or concrete in the joints between rocks in the outer surface of the wall. The stones are fitted together as closely as possible, making sure that there are at least two good bearing surfaces on the exterior and one on the interior. Then the voids that remain under and around each rock are completely filled with good concrete of standard mix with plenty of coarse aggregates…
>
> (2) There is no coursing as in stone masonry and no selection of stones for face rocks. In ordinary practice strength and stability are sacrificed for looks, and

[68] Snow, "Suggested Repairs to the Winsor Dam," January 24, 1958, Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

[69] Winsor, "Check Dams Control Debris Movements on Mountain Streams," *Engineering News-Record* 107, no. 8 (August 20, 1931): 290–91; *The Barrier System for Control of Floods in Mountain Streams* (1933); "The Barrier System of Flood Control," *Civil Engineering* 8, no. 10 (October 1938): 675–78; "Rubble Masonry for Road Culverts and Retaining Walls," *Civil Engineering* 12, no. 1 (January 1942): 36–37; "Rubble Masonry to Save Critical Materials," *Engineering News-Record* 128, no. 13 (March 26, 1942): 482–84.

> each stone in the outer wall is placed with its best face on line and exposed to the outside regardless of stability. In the new [i.e., Winsor's] type of masonry each stone is a header and is placed with the thick end to the outside. It is wedged down between two rocks already in position, with the long axis pointing inward and slightly downward…Then the voids around and under the inner end are completely filled with concrete…
>
> (3) There is no place on the new type of rubble masonry job for the stone mason of the old school or for his tools. He has too much to unlearn to be of service and he always slows down production because he wants to place every rock that is laid. No mortar of sand and cement, or sand, lime and cement is used, hence no need for a trowel; and since there is no attention to a smooth, even outer surface, there is no need for a stone hammer. The work is laid to a line, but the uneven surfaces of each boulder project beyond the line; in other words the main bearings in the outer surface rather than the face, are kept on line.[70]

In a note to a photograph of Shem Dam taken as it neared completion in January 1935, Winsor commented that the dam was essentially complete in its originally planned form by the end of the first winter, or early April 1934, just three months or so after construction began.[71] The photograph shows the completed dam in the early stages of receiving a smooth masonry veneer, a veneer that is still intact on much of the dam today. Winsor described, rather wistfully, the appearance of the structural masonry of the dam that was being covered by the cosmetic veneer:

> In its original form it was left like a diamond in the rough with huge blocks of basalt rock left exposed just as placed by the C.C.C. boys. These were not pointed or faced as a stone mason would have them, but gave the appearance of stability and showed the massiveness of the undertaking. During the following winter, officials in charge of the C.C.C. work decided to add a veneer of masonry.[72]

In the photograph, and in several similar views taken around the same time, the uneven face of the original rubble masonry is clearly visible above the beginnings of the smooth-faced masonry veneer (see Appendix B, Figures 8–12 and 15). The original masonry largely reflects Winsor's general method as he later described it, although the sloping downstream faces of the abutments have what appear to be successive, basically level courses, if roughly cut and laid, despite what Winsor wrote about his method not requiring courses. Perhaps the need to maintain a regular

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[70] Winsor, "Rubble Masonry to Save Critical Materials," *Engineering News-Record* 128, no. 13 (March 26, 1942): 482–83.

[71] L. M. Winsor Photograph Collection, typed notes accompanying photographs of the dam project on Santa Clara Creek. In his comment, Winsor mistakenly gave the date as a month earlier.

[72] L. M. Winsor Photograph Collection, typed notes accompanying photographs of the dam project on Santa Clara Creek.

slope on the faces of the Shem Dam abutments as they were incrementally raised made some reliance on courses unavoidable.

It is not clear who made the decision to add a veneer to the dam once it was structurally complete, but it was evidently not Winsor. It is also not entirely clear, either in Winsor's photographs of the dam taken as the veneer was applied or in the informal accounts of the dam's construction cited above, which parts of the dam received a masonry veneer. However, photographs of the dam project by a local photographer, John Moffitt Stewart, taken in 1934 well before any veneer was applied, indicate that the upstream (and nearly vertical) faces of the abutments and the downstream face of the spillway bowl were built with the relatively smooth surfaces that their exposed intact portions have today and were never given a veneer.[73]

Photographs taken during the construction of Shem Dam show other details that reflect the use of Winsor's rubble masonry method. In a discussion of how to select and place individual boulders, Winsor had earlier written, "When available, pear-shaped boulders, 2 feet or more in length, should be used. For the floor and crest [e.g., of a spillway] they should be laid with the smaller ends tilted downward and pointing upstream."[74] Leo Snow's section drawing of the proposed Shem Dam spillway follows this instruction, with roughly pear-shaped boulders, smaller ends down and oriented upstream, in the face of the spillway and the floor of the churning bowl. Construction of the dam began with the churning bowl, and a photograph taken at the start of construction in January 1934 shows the recently placed floor of the churning bowl as a pavement of tightly packed, roughly pear-shaped boulders, their tapered ends oriented downward and upstream, exactly as in Snow's section drawing (compare Appendix A, Figure 5, and Appendix B, Figure 7).

Winsor's rubble masonry technique was an essential feature of Shem Dam, but Snow also made an important technical contribution. In a local newspaper article about the dam (one of the articles quoted at length above), the author reported that "Both faces of the dam are of rock masonry about four feet thick, with the space between filled with rock and gravel, the gravel being washed with pumps into the space between the rocks."[75] Winsor credited Snow with the decision to use this "hydraulic fill" technique at Shem Dam, though Winsor described it as the pumping of a slurry of fine sand into a rocky fill. Winsor later used the technique on other projects and noted that Snow had used the technique on a dam in the Pine Valley Mountains north of St. George, built to create a water reservoir for the town: "Between these rows of rocks [creating the faces of the dam] built higher and higher, layer after layer, he flushed in sand with the mountain water supply until the dam was completed."[76]

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[73] The photographs by John Moffitt Stewart, which are not reproduced here, are in the Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

[74] Winsor, *The Barrier System for Control of Floods in Mountain Streams*, p. 11.

[75] "St. George Camp News," *Washington County News*, January 10, 1935.

[76] Winsor, *Irrigation and Flood Control*, pp. 32–33.

5. Summary: Frugality and Control at Shem Dam

As dam projects go, Shem Dam was built on a shoestring budget. Research for the current HAER documentation did not find any specific information about either the total cost of the project or the cost of any of its components (e.g., labor, materials, equipment, administration), but the use of CCC labor, locally quarried rock, and, in at least one instance, salvaged cement, surely kept expenses low. The economizing was not simply a response to the state of the national economy in the 1930s but a part of the general frugality of rural Utahns in the period. The members of the local communities who helped plan the dam project, and even the young CCC enrollees brought to St. George to build the dam, were the descendants of pioneer Utah farmers who had struggled for decades to make do with limited resources. It was also part of the personal style of the two men who designed the dam, Luther Winsor and Leo Snow. Late in life, Winsor, referring to the "hydraulic fill" technique used at Shem Dam, wrote that "Leo Snow, the engineer, did many things of this nature. He was ultra conservative and found ways of doing things that would save expense."[77] This was high praise from a man whose notable contribution to engineering was a method for raising a large dam using unskilled labor and whatever materials were at hand.

Winsor developed his "barrier system" of flood control during his years at the Utah Agricultural College in Logan, where he worked for the Bureau of Agricultural Engineering and traveled around the region as an extension agent. He served many times as a consultant to farming communities that hoped to develop or improve an irrigation system or to protect one from flooding. For example, in 1926 he was asked by the Woodruff Irrigating Company of Rich County, in northern Utah, for advice on how best to build a dam in Lone Pine Canyon, where floods had repeatedly wiped out the company's irrigation works. Just as he had at other locations around the state, and as he soon would at multiple locations for the CCC, Winsor showed the company how to build a functional, durable, and inexpensive dam using the rocks, gravel, and sand present at the dam site. The historian Robert Parson, in a discussion of Winsor's role in the Lone Pine Dam project, linked his economizing method to his early experiences growing up in Washington County:

> Winsor had watched his own mother darn socks and patch overcoats, and he had listened to the quiet drawl of rural, southern Utah women as they talked, working busily around their quilting blocks, which included the remnants of someone's discarded clothing. Winsor understood the importance of economy and the necessity of frugality, and his engineering always reflected his familiarity with rural Utah.[78]

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[77] Winsor, *Irrigation and Flood Control*, p. 75.

[78] Robert Parson, "Lone Pine Dam and Reservoir: A Minimalist's Approach in Woodruff, Utah," *Agricultural History* 76, no. 2 (Spring 2002), 426.

As admirable as Winsor was for his loyalty to the principle of frugality, and for his efforts on particular projects like Shem Dam, his approach to flood control has been criticized for its focus on increasing the frequency and scale of existing solutions rather than addressing underlying causes. The historian Andrew Honker has discussed the devastating effects of floods in the settled parts of Utah in the first four decades of the twentieth century, a problem that most engineers initially addressed by building more and larger flood-control structures.[79] They were slow to recognize that flooding was often a product of overgrazing and deforestation, processes that began soon after the Mormon pioneers arrived in Utah in 1847 and continued unabated in the twentieth century. Watersheds stripped of trees and other vegetation through logging, mining, and grazing delivered increasing volumes of water to mountain streams, which would then overwhelm flood-control and irrigation structures in both rural and urban areas. An early recognition of the problem led the federal government to establish large forest reserves in Utah beginning in the late nineteenth century (which led to the national forests of today, including Dixie National Forest in Washington County), but Winsor remained, in Honker's view, a "firm believer in flood control works."[80] The same was true of many other people in Utah, "and the first four decades of the twentieth century marked a flurry of construction of such works," including the 26 projects designed by Winsor for the CCC.[81] "At the foundation of this expansion of flood control works," Honker writes, "lay notions of human domination of the environment."[82]

When Winsor studied engineering and worked at the Utah Agricultural College in Logan, he was closely associated with John A. Widtsoe, director of the school's Agricultural Experiment Station (and later college president, 1907–16). Soon after arriving in Logan in 1904, Winsor began working for Widtsoe both as a research assistant and as a handyman at the Widtsoe home, and Widtsoe undoubtedly had a strong personal and intellectual influence on Winsor.[83] Widtsoe was a prominent researcher in dry farming, or the cultivation of unirrigated lands where 20" or less of rain fell annually, and he was well known for his advocacy of dry-farming methods as a way of extending agriculture into marginal areas.[84] He was also a prominent Mormon leader who published widely read works on Mormon theology, and he eventually became a member of the Quorum of the Twelve Apostles.[85] Widtsoe's approach to agriculture was informed by his belief

[79] Andrew M. Honker, "'Been Grazed Almost to Extinction': The Environment, Human Action, and Utah Flooding, 1900–1940," *Utah Historical Quarterly* 67, no. 1 (1999), 23–47.

[80] Honker, "'Been Grazed Almost to Extinction'," 27.

[81] Honker, "'Been Grazed Almost to Extinction'," 47.

[82] Honker, "'Been Grazed Almost to Extinction'," 46.

[83] Winsor, *Life History of Luther M. Winsor*, p. 18. Anson Perry Winsor III, interview by Fielding H. Harris, June 18, 1969, Oral History Collection, Dixie State College of Utah, St. George (typescript on file, Dixie State University Special Collections and Archives, St. George, Utah).

[84] John A. Widtsoe, *Dry-Farming: A System of Agriculture for Countries Under a Low Rainfall* (New York: Macmillan, 1911).

[85] Alan K. Parrish, *John A. Widtsoe: A Biography* (Salt Lake City: Deseret Book Company, 2003).

that farming was a fundamental part of life and centered on the struggle to wrest a living from the land. The historian Donald Dyal has written that, in his many books on agriculture,

> Widtsoe articulated an agrarian philosophy in which the farmer was an activist in redeeming and subduing the land. Through energetic and knowledgeable farming, man could control and use nature. Widtsoe viewed the people who reclaimed land as heroic; they were the leaven in the dough of humanity.[86]

Winsor, in the course of his long career as an engineer, embodied the energetic, knowledgeable ideal that Widtsoe envisioned for the practice of agriculture more generally. Like Widtsoe, Winsor was guided by a philosophy that tended to see the mission of agriculture, and of the engineering that supported it, as a matter of control over the forces of nature. It is perhaps not surprising that dry farming, the agricultural practice still linked closely with Widtsoe today, met with the same basic problem confronted by Winsor's flood-control projects: the inadequacy of the method in the face of increasingly challenging natural circumstances. After some initial success in the relatively favorable conditions of the early twentieth century, dry farming in Utah and other western states was largely a failure, sometimes a catastrophic one, when drought and other difficulties struck. Large areas newly settled by homesteaders hoping to dry-farm on marginal land—homesteaders encouraged, directly or indirectly, by the theorizing of Widtsoe and others—were quickly abandoned. Ironically, one of the first areas in Utah to be settled by would-be dry farmers was the Escalante Desert of western Utah, the southernmost tip of which includes Hebron and Enterprise, the towns in Washington County where Winsor grew up. Despite grand plans for the establishment of farming communities in an area where agriculture was never previously considered, homesteaders trying to dry-farm the Escalante Desert met a resounding defeat.[87]

Part II. Structural/Design Information

A. General Statement

1. Character

Shem Dam is a simple embankment built of rubble masonry with a rock and earth fill, which makes it similar to many other flood-control and irrigation dams in Utah and other western states, some of which were also designed wholly or in part by Luther Winsor. The dam differs from many other simple embankment dams in having a central-arch spillway, a feature that is

[86] Donald H. Dyal, "Mormon Pursuit of the Agrarian Ideal," *Agricultural History* 63, no. 1 (1989), 24.

[87] Marshall E. Bowen, "Crops, Critters, and Calamity: The Failure of Dry Farming in Utah's Escalante Desert, 1913–1918," *Agricultural History* 73, no. 1 (1999), 1–26. Carlton F. Culmsee, "Flimflam Frontier: Submarginal Land Development in Utah," *Utah Historical Quarterly* 32, no. 2 (1964), 91–98; "Last Free Land Rush," *Utah Historical Quarterly* 49, no. 1 (1981), 26–41.

both visually distinctive and—judging by the significant damage it sustained in flood events in 1938, 1955, and 2011—the weakest structural component of the dam. Winsor did not invent the central-arch spillway, which was commonly used in the designs of larger, more complex dams in the same period, but he considered it an important part of Shem Dam and advocated its use in similar projects.

Shem Dam is also of engineering interest for its use of a rubble masonry technique developed by Winsor in the 1920s and 1930s, and promoted by him in articles in engineering publications as late as the early 1940s.[88] The technique called for locally available, minimally dressed rock and a limited amount of concrete mortar, relying for strength on the appropriate placement of the rock, without concern for the outward appearance of a structure. Shortly after it was structurally complete, Shem Dam was given a smooth masonry veneer on its downstream face, but this step was a cosmetic one and not part of Winsor's original design.

Along with Winsor's rubble masonry technique, Shem Dam was built using a hydraulic fill technique developed locally by the dam's other designer, Leo Alva Snow. Like the rubble masonry technique of Winsor, Snow's hydraulic fill technique made use of inexpensive materials (sand, gravel, and rock) readily available at the site of the dam.

2. Condition of fabric

The condition of Shem Dam at the time of the current HAER documentation is best interpreted with reference to the earlier repair episodes. The damage sustained by the dam in the 1938 flood was completely repaired the following year, returning the structure to its original 1935 appearance except for the addition of a line of "breakers" (low, freestanding concrete piers) along the downstream edge of the spillway apron. The damage sustained by the dam in the 1955 flood was also completely repaired, but the original appearance of the affected portions of the dam, including most of the downstream face of the spillway and the adjacent portion of the northeast abutment, was significantly changed. Rather than rebuild the spillway and the damaged portion of the abutment to their original appearance, the repairs were made in 1958 using large basalt boulders taken from the bed of the river and stacked in place with little or no modification. For the next 53 years, the repaired area looked markedly different from the intact portions of the dam. It was the same repaired area that sustained most of the damage caused by yet another flood in 2011.

At the time of the current HAER documentation, Shem Dam and the adjacent portions of the Santa Clara River streambed had been recently cleared of dense vegetation in anticipation of construction for the Shem Dam Rehabilitation Project. The area immediately upstream of the dam was long ago filled with silt and is level with the intact crest of the spillway, which means the upstream faces of the spillway and abutments are mostly obscured below the level of the spillway crest. To route the minimal seasonal flow of the river away from the spillway, which is

[88] See note 70 above.

the focus of the current repairs, the construction crew excavated ditches in the accumulated silt leading to the dam's diversion tunnel, including a deep ditch along the north bank of the river. The diversion tunnel gate was then raised, using the existing gear lift, to allow the flow to pass through the dam. The gear lift, which is either the original mechanism or an early replacement, is in generally good condition, but its large horizontal gear is broken and missing about half of its original diameter; the gate itself is apparently operable but mostly obscured by silt and debris, so it is difficult to judge its condition.

Overall, the southwest abutment is in good condition and essentially unchanged from its 1935 appearance, which is especially evident on the fully exposed downstream side. The portion of the northeast abutment not damaged in the 1955 flood also looks like it did in 1935, but the portion adjacent to the spillway, along with the entire downstream face of the spillway, has the markedly different appearance of the 1958 repair. The spillway itself was badly undercut in the 2011 flood, which carried away nearly all of the apron that once extended downstream from its face, including the lower portion of the spillway wall and the ridge that crossed the apron along the downstream side of the churning bowl. The only part of the spillway apron that survived is a portion of the line of "breakers" built along the downstream edge during the 1938 repair. The low masonry wing walls built along the sides of the apron in 1935 and rebuilt in 1938 were unharmed in the 2011 flood. The masonry-walled canal that extends downstream from the diversion tunnel, including the masonry gate structure that diverts water from the canal to the streambed, is also in good condition, though the presence of water in the canal and in the adjacent streambed made it difficult to view it closely. The canal, which is either original to the dam or an early addition, feeds into a concrete gate box of uncertain but probably quite recent date, also in good condition.

B. Description

Except for the portions of the spillway and the northeast abutment rebuilt in 1958 (see Part I above), Shem Dam today has basically the same appearance and dimensions that it had when it was completed in 1935. The dam consists of two straight, aligned abutments that meet bedrock on either side of the river and are joined by an arched central wall that includes a spillway. The overall length of the dam is about 375'. The southwest abutment has a maximum length (measured along the upper edge of the downstream face of the abutment) of about 175'; the northeast abutment has a maximum length of about 85'; the central arch occupies the intervening space of about 115'. The upper edge of the exterior (upstream) face of the central arch—still intact despite the damage and repairs to the downstream face of the arch—has a radius of about 80'. The spillway, originally centered on the central arch and 70' wide, is about 100' wide, a result of the 1958 repairs which did not restore the spillway to its original width and instead made it as wide as the extent of the flood damage. The two abutments both have a crest about 38' above the center of the streambed, and this height continues as a portion of both ends of the central arch. The crest of the intact spillway portion of the central arch is about 23' above the center of the streambed and 15' below the crest of the abutments (see Appendix B for early photographs of the dam).

The upper surface of both abutments is basically flat and level, and about 18' thick; the upper surface of the higher portions of the central arch is also flat and level, tapering from 18' thick where the arch meets the abutment proper to 12' thick where the intact portion of the spillway begins. These highest surfaces of the dam, which include the tops of the outer masonry walls of the dam and the top of the interior fill, were apparently never capped with a continuous layer of concrete or rock. Today, the tops of the masonry outer walls are exposed in limited areas and show a thin concrete layer that was applied when the walls were finished, but elsewhere the tops of the outer walls are obscured by at least a few inches of sediment. Even more sediment, perhaps a foot thick, obscures the top of the interior fill of the abutments and the higher portions of the central arch. The upper surface of the spillway, once basically flat but now somewhat uneven as a result of the 1958 repairs, is about 20' thick. The entire upstream face of the dam, including both the abutments and the central arch, has a 1:10 slope, which means it slopes inward slightly as it rises from the base of the dam. The downstream face of the abutments has a 1:1 slope, which gives the base of the abutments a maximum thickness of about 56', substantially thicker than the top of the dam.

The downstream face of the central arch originally had the profile of a partial hemisphere, a shape that Winsor, in a general discussion of spillway design, once likened to "a huge butter bowl with one side cut out."[89] The bowl-shaped spillway, perhaps the most distinctive feature of Shem Dam, was not a Winsor innovation, but it was an important characteristic of the spillways of similar flood-control dams he designed and built elsewhere in Utah, and he was convinced of its effectiveness:

> The best design for a spillway is bowl-shaped, with the crest in a semicircle and with the downstream wing walls blended into the arch of the crest so that there is no marked line where crest or floor ends and wall begins. Construction of this type is stable, and may be built safely upon foundations generally considered insecure for masonry. The semicircular crest deflects the flow toward the center of the stream where the converging currents counteract each other to decrease the velocity of outflow. The water cushion formed by the bowl-shaped apron aids in this result and spreads the stream over the downstream apron level with the stream bed, which minimizes any tendency toward erosion at the lower toe.[90]

One of the newspaper articles about Shem Dam quoted above, written when the dam was nearing completion, stated that the dam was "of the combined arch and gravity type," probably based on the evident combination of straight abutments and a central arch.[91] But in an actual arch-and-gravity dam, the entire dam forms an arch and its load is borne both by the ends of the arch,

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[89] Winsor, "The Barrier System of Flood Control," 677.
[90] Winsor, *The Barrier System for Control of Floods in Mountain Streams,* 9.
[91] "St. George Camp News," *Washington County News,* January 10, 1935.

which meet bedrock on either side of the stream, and by the mass of the dam, which, for the structure to be considered a gravity dam, must be sufficient to augment the load-bearing capacity of the arch. In Winsor's design, the arch bears part of the load, but only incidentally and no more effectively than would a continuous straight barrier. The primary function of the arch is instead to form part of the bowl-shaped spillway. Because of the damage to the spillway in the 1955 flood and the character of the 1958 repairs, the original downstream face of the central arch and spillway of Shem Dam was never fully restored.

As originally built, Shem Dam had a rock apron at the foot of the spillway that extended downstream, ending in a line parallel with the downstream toe of the abutments. Together the spillway and apron, which were a continuous surface of rock, had an ogee (or S) shape in profile, consistent with the bowl-shaped spillways of other dams designed by Winsor, and a feature of dam spillways more generally in the period.[92] The ogee profile began at the upstream edge of the spillway crest, continued with the slightly rounded downstream edge of the crest, then down the bowl-shaped face of the spillway, joining the horizontal surface of the apron in a curve. A low ridge built into the apron ran in a slight arc across the middle of the apron, basically parallel to the abutments. From there, the apron dropped again on the rounded downstream face of the ridge (see Appendix A, Figure 5). The ridge in the apron, the upstream face of which was vertical and 8' higher than the apron surface, formed a "churning bowl" along the toe of the spillway. The churning bowl created a "water cushion," weakening the force of the water coming over the spillway. The ridge or "secondary crest" of the apron then served "to distribute the flow after it enter[ed] the channel below the structure," thereby reducing the risk of erosion at the foot of the dam.[93] At the time of the current HAER documentation, nearly all of the apron, including the churning bowl and secondary crest, were no longer present. These features were badly damaged by the 1955 flood, and it is not clear what portion of these features were rebuilt in the 1958 repairs. But whatever portion was repaired, the features were severely damaged once again by the 2011 flood.

The original construction drawings for the dam do not show any additional spillway features downstream of the spillway apron, but photographs of the dam taken during construction show that small masonry wing walls were built perpendicular to the abutments, extending downstream from the lower corners of the apron (see Appendix B, Figures 9–15). These were not the primary wing walls of the bowl-shaped spillway proper, which Winsor described as "blended into the

[92] Creager, William P., Joel D. Justin, and Julian Hinds. *Engineering for Dams.* Vol. 3, *Earth, Rock-Fill, Steel and Timber Dams* (New York: John Wiley and Sons, 1945).

[93] Winsor, *The Barrier System for Control of Floods in Mountain Streams*; "The Barrier System of Flood Control." All of the terms in quotation marks are Winsor's. Winsor sometimes used "stilling pool" instead of "churning bowl" to describe the area at the foot of a spillway where the flow over the spillway was slowed before entering the river channel below the dam, but he also sometimes used "stilling pool" to describe the area immediately *above* a dam, where the natural flow of the stream was slowed by the dam and most of the debris and silt carried by the stream would settle out.

arch of the crest" (see above); instead, they were simply minor extensions of the spillway. The absence of the wing walls on the original construction drawings suggests that these features were something of an afterthought, a revision made during construction to further control the flow of water across the spillway apron. Both wing walls were about the same height as the secondary crest that crossed the apron (or about 5' higher than the downstream edge of the apron) and about 1½' wide. Both wing walls were perpendicular to the line of the abutments and about 14' long. For the 1958 repairs, Winsor drew a simple plan of the dam that included the wing walls (see Appendix A, Figure 9). He showed the southwest wing wall as having an additional segment, 10' long, that extended south at a 45-degree angle from the end of the first segment. His depiction of the northeast wing wall lacks the additional segment. Both wing walls are still present today, even though the apron that they once flanked is largely gone, and both wing walls have the additional angled segment, making the two wing walls mirror images of each other.

Shem Dam was built with a tunnel through its northeast abutment, designed to carry water through the dam to a canal that began at the dam's downstream face. The tunnel passed through the northeast abutment on a perpendicular line, about 2' from the bedrock of the adjacent hillside and about 32' below the top of the abutment. The upstream opening of the tunnel was equipped with a steel gate connected by a long steel rod to a gear lift at the top of the abutment. The tunnel gate could be raised and lowered by turning a hand crank on the gear lift. The tunnel, gate, and hand-operated gear lift are still in place today; the gate and gear lift are either the originals or replacements of similar appearance. The initial plan for the tunnel was apparently to build it entirely of masonry, including an arched masonry roof, a design represented by a section detail in the original construction drawings (see Appendix A, Figure 2). But in March 1934, two months or so after construction began, an alternative design was added to the plans, with the roof of the tunnel formed instead by a steel-reinforced concrete slab, 10' wide and 14" thick; the walls and floor of the tunnel would still be of masonry (see Appendix A, Figure 6). In the revised design, the upstream opening of the tunnel measured 6' wide × 7' high; the steel-panel gate, 5' × 5', was mounted on the exterior of the opening in a steel frame. The connecting rod, 2½" in diameter and 32' long, with a threaded upper end, was mounted to the upstream face of the abutment with steel brackets and anchor bolts. All of this is still true today.

The original construction drawings show a masonry-walled canal originating at the outlet of the tunnel and extending downstream in a line perpendicular to the abutments, but the drawings provide few details about the canal or how it articulated with the dam. Neither the tunnel outlet nor the canal are visible in photographs of the dam taken during construction. Today, where the head of the canal meets the tunnel outlet, the first 12' or so of the canal walls appear to be simple extensions of the masonry walls of the tunnel. The canal continues in the same alignment (southeastward), immediately adjacent to the bedrock of the hillside. At 20' from the tunnel outlet, it enters a concrete gate box of undetermined but probably quite recent date. The concrete gate box empties into a buried culvert that continues southeastward, eventually passing under County Road 3184, and leading to the (currently inactive) Santa Clara Bench Canal.

Just before the point where the masonry-walled canal meets the concrete gate box, a masonry-walled diversion structure angles southward from the canal at 45 degrees, at the head of

a drop of several feet to the streambed below the dam. The diversion structure once had a gate where it met the canal, probably a simple panel that slid into vertical grooves in the masonry sides of the gate opening. The original gate is missing, but boards were in place at the time of the current documentation, recently placed by the construction crew to keep water coming through the tunnel flowing through the concrete gate box and away from the foot of the dam. Masonry wing walls, built continuously with the gate and perpendicular to it, extend southward for 12'; the walls are about 8' high at the gate, sloping down to about 6' high at their south ends. The western of the two walls has an additional segment that runs at 90 degrees westward for 6'. The age of this diversion structure is uncertain, but the masonry is similar in appearance to the rest of the dam and clearly older than the recent concrete gate box. One of the original construction drawings includes a simple detail of the canal leading away from the dam (see Appendix A, Figure 2), but this gate structure is not shown. The drawing does show an opening in the side of the canal labeled "sand gate," but that particular feature may never have been built. Its intended function as a way of diverting sediment coming through the tunnel away from the canal and back into the stream was probably served by this diversion structure.

1. Materials

Shem Dam was constructed of rock quarried from an adjacent hillside or gathered from the streambed at the dam site. The quarried rock is a yellowish- or reddish-brown sandstone and comprises the bulk of the rock used for the exterior surfaces of the dam. The gathered rock, which is most prominent in the 1958 repair of the spillway, is a dark brown basalt, originating from a discontinuous, volcanically deposited layer that rests on the sandstone substrate of the area. The location where most or all of the sandstone was quarried is immediately south and upslope of the dam, as first documented in the archaeological survey of Hoffman.[94] The rock used in the core of the dam apparently included as much basalt as sandstone, which was evident when the core was exposed at the ends of the abutments at the start of the 2015 rehabilitation project.[95]

The sand and gravel used in the concrete mortar for the dam was probably gathered at the dam site, and the same was probably true of the sand and gravel used for the hydraulic fill of the core of the dam. In research for the current HAER documentation, no full record was found of the sources of the cement used to make the mortar, but the first batch was salvaged from a cement plant that had burned down in Box Elder County in northern Utah. A railroad car of the

[94] Hoffman, *Cultural Resources Inventory of the Shem Dam Rehabilitation Emergency Watershed Protection Project.*

[95] Scott O'Mack, *Supplemental Site Documentation and Construction Monitoring for the Shem Dam Rehabilitation Project, Washington County, Utah.* Technical Report 2015-15 (Tucson: William Self Associates, 2015).

salvaged cement was sent to Cedar City in early 1933, and most of the load was eventually used at Shem Dam.[96]

2. Dimensions

Except for the portions of the spillway and the northeast abutment rebuilt in 1958, Shem Dam still has the same dimensions that it had when it was completed in 1935. The basic dimensions of the dam today, calculated from total station data collected during the current HAER documentation are given below. Certain dimensions, such as the maximum height of the dam or of its major components, could not be determined with precision because portions of the dam are obscured by sand and silt. Also, the collection of total station data for some dimensions was complicated by unsafe conditions, including the presence of water and mud around the dam and the unstable surfaces of the damaged portions of the spillway.

Overall length:	375'
Southwest abutment length:	175'
Northeast abutment length:	85'
Central arch length:	115' (distance between abutments)
Spillway length:	100' (approximate, damaged)
Abutment thickness (upper surface):	18'
Abutment thickness (maximum at base):	56' (approximate, obscured)
Central arch thickness (upper surface):	18' (at abutments); 12' (at spillway)
Spillway thickness (upper surface):	22' (approximate, damaged)
Maximum abutment and central arch height:	38' (approximate, lower portion obscured)
Maximum spillway height:	23' (approximate, lower portion obscured)

3. Inscriptions

Shem Dam is notable for the large number of informal inscriptions (or graffiti) that it preserves, all of them made in wet concrete by the men who worked on the dam, either during its original construction in 1934–35 or during later repairs. The inscriptions were probably not a planned part of the dam, but they are interesting as a tangible link to its period of construction and to individuals working there, some of whom are known from other sources consulted for the current HAER documentation.

A few of the inscriptions were first recorded by the NRCS in an archaeological survey of the dam and its vicinity in 2013,[97] but the clearing of vegetation from the dam in 2015 in

[96] "Cement Here for Making Shem Dam," *Washington County News*, March 23, 1933; Winsor, *Life History of Luther M. Winsor*, 33.

[97] Hoffman, *Cultural Resources Inventory of the Shem Dam Rehabilitation Emergency Watershed Protection Project.*

anticipation of the rehabilitation project exposed many additional inscriptions, most notably along the crest of the two abutments, in a thin layer of concrete applied along the upper surface of the outer abutment walls when their maximum height was reached. An effort was made during the current HAER documentation to expose more of this area (mostly obscured by sediment) in order to document as many of the inscriptions as possible, but it was quickly apparent that doing a thorough job was beyond the scope of the documentation project. Complete exposure and recording of all of the inscriptions would be a valuable future project. The NRCS has asked the construction contractor not to damage or obscure the areas where inscriptions are already exposed or may be present.

Individual inscriptions or groups of inscriptions were found in eight places on or near the dam. Each group of inscriptions (sometimes a single inscription) is referred to here as a panel. Table 1 is a list of the eight panels; their locations are included on the site plan. Table 2 describes the individual inscriptions in each panel (see Appendix D for Tables 1 and 2). Other inscriptions, mostly or entirely illegible, occur in some of the panels but are not listed in Table 2. (Digital color photographs of the panels and inscriptions are included in the Field Records of the current documentation.)

The legible inscriptions include personal names or initials, dates (often just a year), CCC company or camp numbers, and miscellaneous symbols or marks. Most inscriptions were made with simple block letters, but there are a few examples of cursive script and several examples of a cartoonish balloon lettering. The same style of balloon lettering, probably drawn by one of the same young men, appears many times in issues of *The Cactus Chronicle*, the newsletter of CCC Camp PE-213 (see Appendix C).[98] In a few of the panels, inscriptions overlap or impinge on other inscriptions, which is probably evidence of the informal and haphazard process by which they were made, the final, perhaps hurried touches on a year-long project.

Panels 1–5, all found on intact portions of the original dam of 1934–35, were probably all made by the CCC enrollees of Company 961, based at Camp PE-213 in St. George. These company and camp designations, and the years 1934 and 1935, appear in multiple places in Panels 1 and 2 (see Table 2). Panels 3–5 have only limited inscriptions and do not include company and camp designations or dates, but their locations on the original dam indicate their probable age. Panels 6–8, all found on portions of the dam either built or rebuilt as part of the 1939 repairs, were probably all made by the CCC enrollees of Company 585, based at Camp SCS-7 in Leeds, Utah. The inscription in Panel 6 includes the company number, and the inscriptions in Panels 6–8 include the year 1939.

A few of the names that appear in Panels 1 and 2 also appear in issues of *The Cactus Chronicle*. The name H. J. Colman, which appears in two neatly executed inscriptions in Panel 1, is listed in the masthead of every issue of *The Cactus Chronicle*. Colman filled two positions on

[98] *The Cactus Chronicle*, Civilian Conservation Corps Newsletters Collection, 1935–1941, Utah State Historical Society, Salt Lake City.

the newsletter staff, Associate Editor and Artist (later Cartoons). It was presumably Colman who drew the sketch of Shem Dam reproduced here in Appendix C. Panel 1 includes an inscription in balloon letters: KEACHIE / 34. This is probably the work of John Stuart Keachie, an enrollee who died from a heart condition at age 19 on March 29, 1935, shortly after the dam was completed.[99] With more research, other connections between personal names in the dam inscriptions and particular enrollees undoubtedly could be made.

4. Archaeological Features

As recorded by the NRCS in 2013, the archaeological site of Shem Dam (42WS5931) consisted of the dam, its irrigation diversion and canal, a hillside quarry, two faintly visible road segments, the concrete base of a cableway tower, and two small concrete inscription panels.[100] For the current HAER documentation, all of these features were revisited. As discussed above, many more concrete inscriptions have now been recorded on the dam, but the other minor features of the site that are not directly parts of the dam—the quarry, the road segments, and the tower base—were adequately recorded by the NRCS in 2013.

Two of the features originally recorded by the NRCS are especially interesting as remnants of the original Shem Dam construction project. The first is the quarry, where much of the rock for building the dam was removed by blasting. The quarry covers a roughly oval area of about 5,622 m² (about 1.4 acres) on the hillside just south of the dam and is distinguished from the surrounding rocky hillside by scattered concentrations of sandstone fragments and relatively sparse vegetation. Instead of creating an obvious excavation into the hillside, the quarrying focused on exposed outcrops of rock. The quarry still has locations along its perimeter where 2-inch-diameter blasting holes were drilled in bedrock outcrops but never used.

The second notable feature is the concrete tower base, which held one of the two cableway towers built at the start of the construction project to move building materials to work areas on the dam as it was raised. The cableway towers, visible in photographs of the original construction project, seem to have been constructed of wood beams (see Appendix B, Figures 4, 5, 7, 8, and 15). Presumably, both towers were dismantled and removed when the dam was complete. The towers stood in line with the long axis of the dam, one near each end of the overall structure. Nothing remains of the tower that stood at the northeast end of the dam, and it is possible that the spot where it stood is now part of the adjacent road. The tower base that survives is located about 55 feet southwest of the southwest end of the dam. It consists of a flat, rectangular, concrete slab poured over a low, stacked-rock base, with a rectangular pattern of anchor bolts embedded in the surface. The slab measures about 14' × 18' and is a maximum of

[99] "John Stuart Keachie Dies Here Friday," *Washington County News,* April 4, 1935. "Member Seriously Ill," *The Cactus Chronicle* 1, no. 4 (March 28, 1935), 1.

[100] Hoffman, *Cultural Resources Inventory of the Shem Dam Rehabilitation Emergency Watershed Protection Project.*

about 6" thick, with a visible aggregate of large gravel. At one edge of the slab, a heavy steel wheel or hub, possibly from a vehicle, is partly embedded in the concrete, for no obvious functional reason. A roughly circular arrangement of loose rocks and a scrap piece of steel plate rest on the slab but are probably recent additions.

C. Mechanicals/Operation

Shem Dam was built to serve its functions of flood control and irrigation diversion in a mostly passive way, with minimal human intervention. The dam's only moving parts are the steel-panel gate mounted to the upstream opening of the diversion tunnel that passes through the dam, and the hand-cranked gear lift connected to the gate by a long steel rod. The gate and gear lift were used to regulate the flow of water into the irrigation canal that began at the downstream side of the dam. The gate and gear lift appear to be the same as, or very similar to, the ones shown in the original construction drawings for the dam (see Appendix A, Figure 7). The gate could not be examined closely, but the gear lift, which is mounted along the upstream crest of the northeast abutment, was easily examined. The steel or cast-iron body of the mechanism is embossed "2054XA / R HARDESTY / MFG CO / DENVER COLO." The R. Hardesty Manufacturing Company of Denver, Colorado, which was in business at least as early as 1909, made a wide range of iron and steel items used in water-storage and irrigation works.[101]

As discussed above, Luther Winsor intended Shem Dam to serve primarily for flood control, slowing the flow in the Santa Clara River long enough for its flood-induced burden of sediment, rocks, and debris to settle out above the dam, thus protecting fields and irrigation works downstream. Consistent with his experience on similar projects around Utah, Winsor expected the area above the dam to become filled with sediment and debris over time, which would require that the crest of the spillway be raised periodically so that the dam would continue to be effective in slowing the flow of high water. There is no evidence that this strategy was ever pursued successfully at Shem Dam. By 1941, three years after the first major repairs were made to the dam, the accumulated sediment above the dam was as high as the crest of the spillway, but there was no attempt to raise the crest. Instead, the gate to the diversion tunnel was opened, with the hope that the flow in the river was sufficient to carry away a portion of the sediment. Photographs of the effort, probably taken by Luther Winsor, show Leo Snow and the directors of the St. George and Santa Clara Bench Irrigation Company on the dam, raising the gate (see Appendix B, Figures 24–30). At least some sediment passed through the tunnel, but it is unknown whether the effort made a difference, or how the accumulated sediment affected the use of the dam as an irrigation diversion.

[101] "R. Hardesty Manufacturing Company," *City of Denver*, vol. 1, no. 1 (October 12, 1912): 9. Published by the City and County of Denver, Colorado.

D. Site Information

Shem Dam was built across the Santa Clara River at a point where the natural channel of the river was relatively constricted by the adjacent hillsides, and where the floodplain just above the dam was broad enough to allow the floodwaters slowed by the dam to spread out and deposit their burden of sediment and debris. The site was also chosen because an earlier, less-substantial dam, frequently washed away by the river, stood about 600 feet upstream, where it served as the original diversion point for the Santa Clara Bench Canal. The precise location and alignment of the earlier dam are uncertain, but it is faintly visible in at least one photograph of the CCC dam project taken in 1934 by a local photographer, John Moffitt Stewart.[102] The photograph shows that it crossed the river in a straight line with about the same orientation as Shem Dam, immediately downstream of a circular stone structure located on the north bank of the river. The stone structure, probably the base of a furnace associated with the long-abandoned smelting operation at Shem, still stands today and is part of archaeological site 42WS4717.[103] The location of the stone structure is included on the site plan for Shem Dam.

The landscape around Shem Dam has not changed much since the dam was completed in 1935: rugged, sparsely vegetated, with much exposed rock on the surrounding hillsides. County Road 3184, the two-lane highway that runs along the hillside at the northeast end of the dam, crossing the river by bridge about 800' downstream, is the only nearby development. The dam is located about 2 miles upstream of the community of Shivwits, and about 5 miles upstream of the nearest fields it waters at Ivins. The nearest community upstream of the dam is Gunlock, about 8 miles away.

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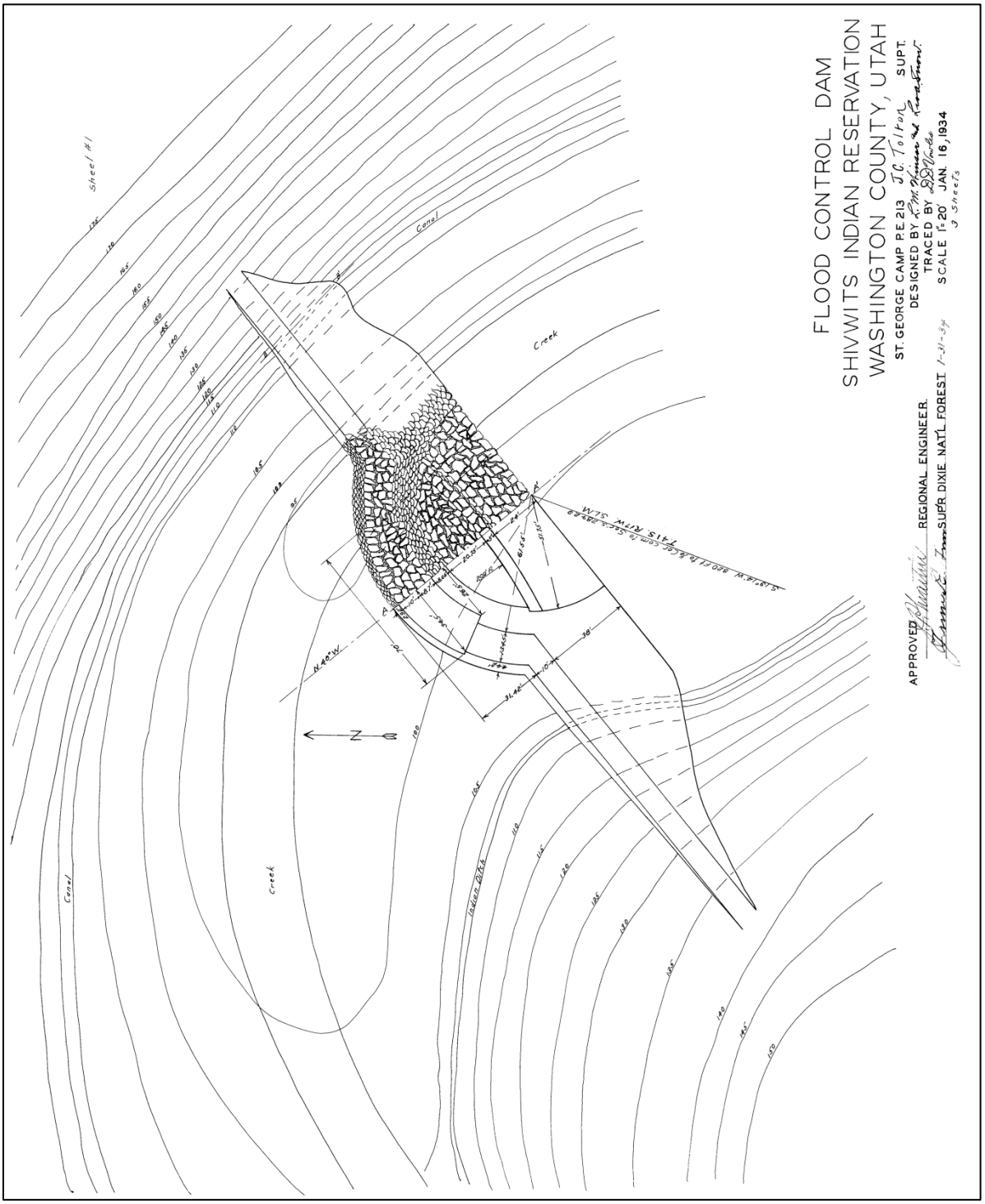
The National Archives and Records Administration (NARA), Washington, D.C. (or one of its branch locations), may have records related to Shem Dam among its holdings from the U.S. Forest Service, the Civilian Conservation Corps, or another agency. Because of the limited time and budget available for the current HAER documentation, and the discovery of useful records of the dam in Utah, no effort was made to access NARA records.

Photographs of Shem Dam taken in 1934 by a St. George photographer, John Moffitt Stewart, were consulted at Dixie State University Library, Special Collections, but it was not possible to reproduce these photographs here because of difficulties obtaining copyright permission. Some of the Stewart photographs exist only as negatives, which are hard to interpret without having prints made. If copyright permission were obtained and prints made, a closer look at these photographs, which show perspectives on the dam project not provided in the early photographs reproduced here, would be worthwhile.

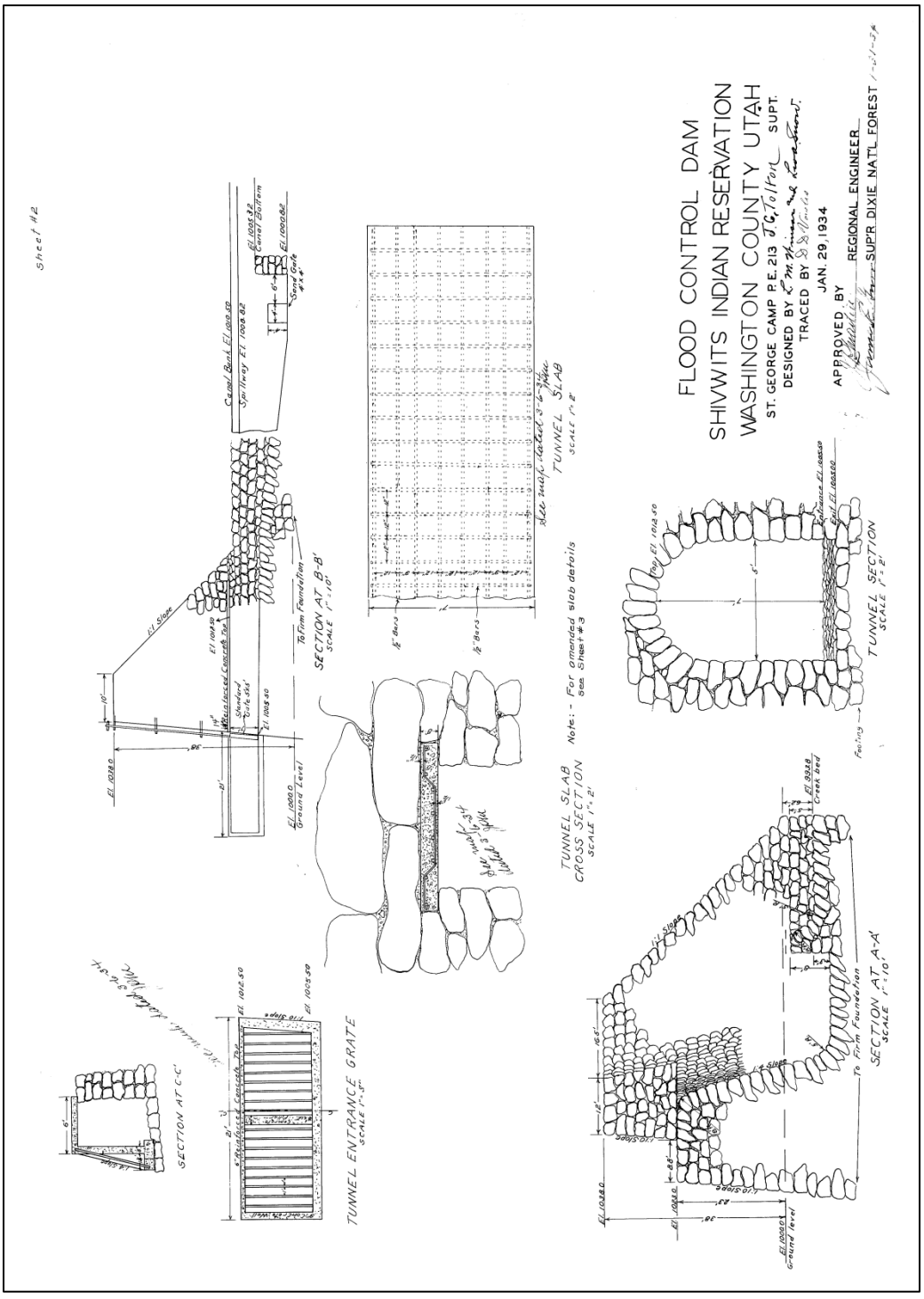
Other early photographs of Shem Dam may exist in the Lynne Clark Photography Collection, a private collection in St. George, Utah. No effort was made to access this collection, which is mentioned in some secondary sources and includes at least a few photographs of CCC enrollees and the CCC camp in St. George.

Finally, no effort has been made to consult the records of the St. George and Santa Clara Bench Irrigation Company or its successor organizations in Washington County. The archives of these organizations may hold useful documents relating to Shem Dam.

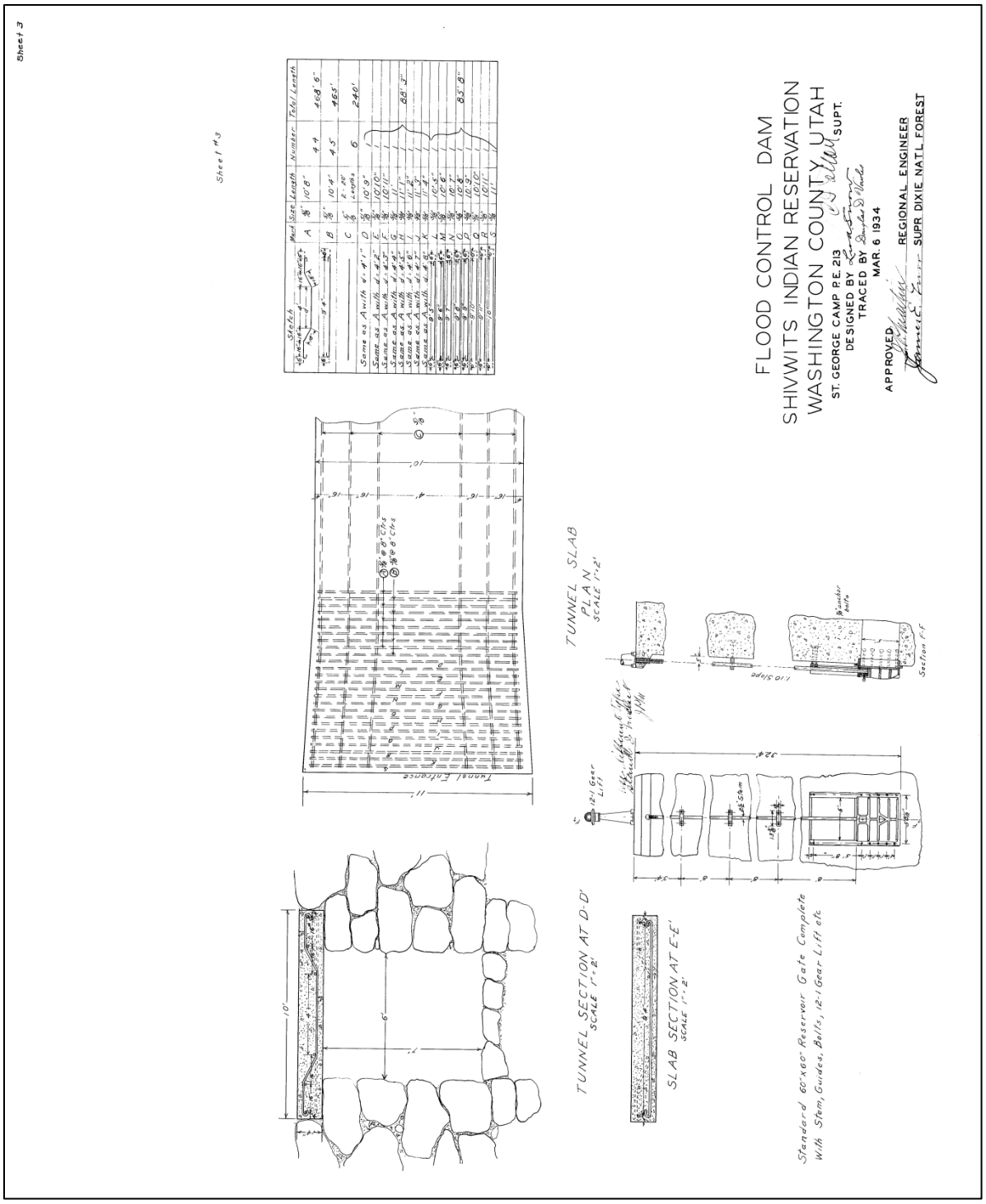
Appendix A. Construction Drawings (Reduced)



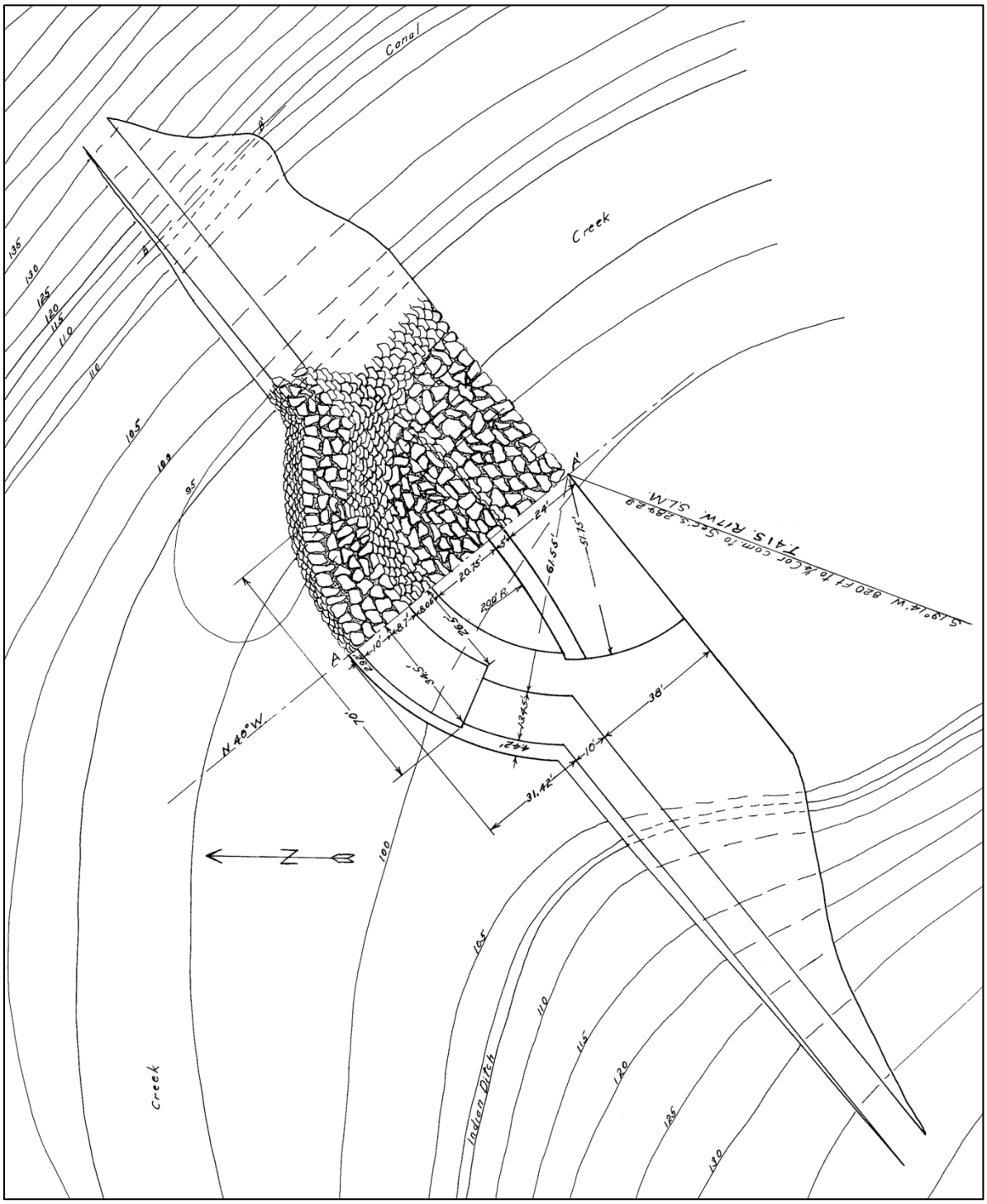
Appendix A, Figure 1. Original construction drawing, Sheet 1. Reduced; not field-checked for accuracy. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah. Used with permission.



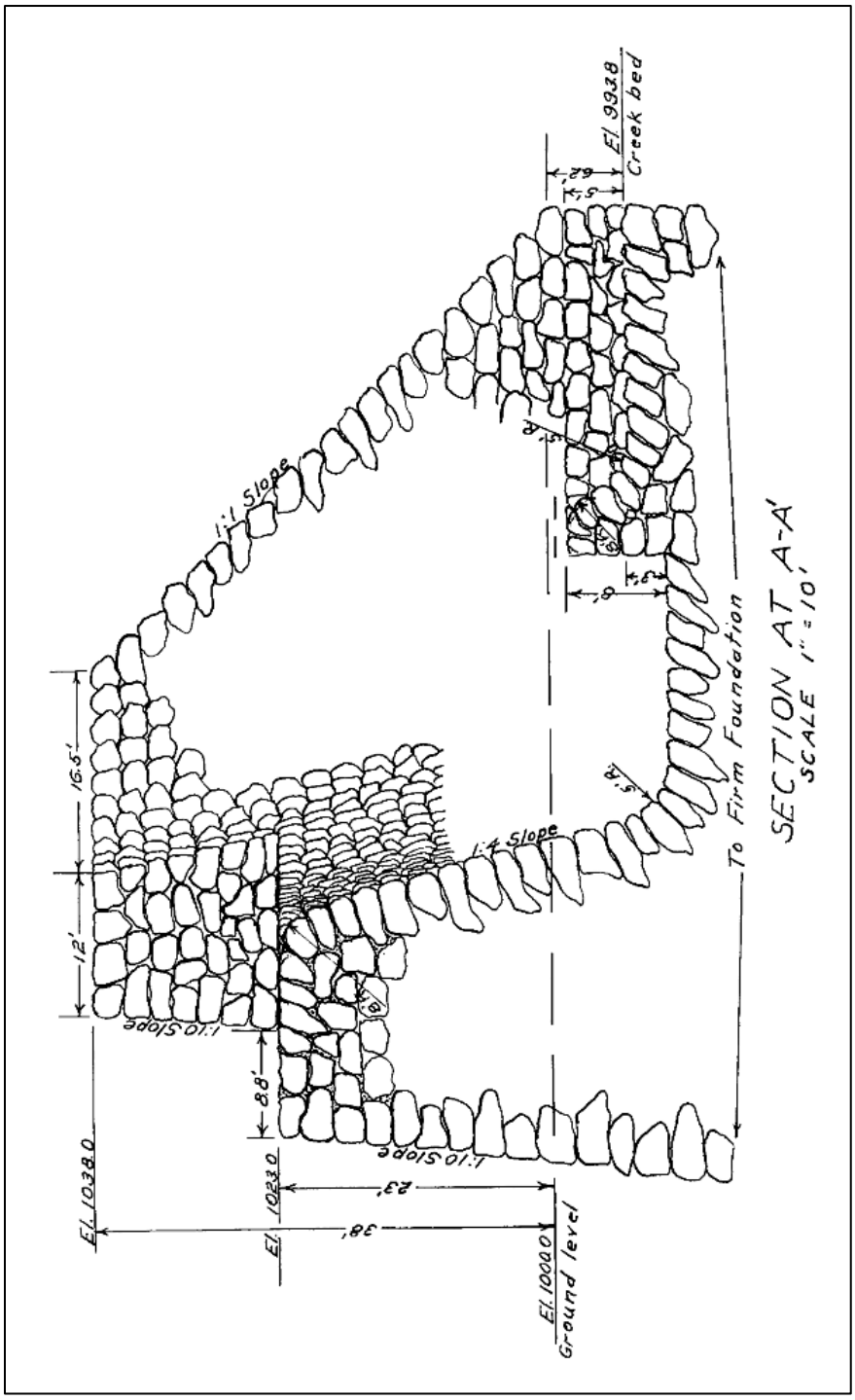
Appendix A, Figure 2. Original construction drawing, Sheet 2. Reduced; not field-checked for accuracy. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah. Used with permission.



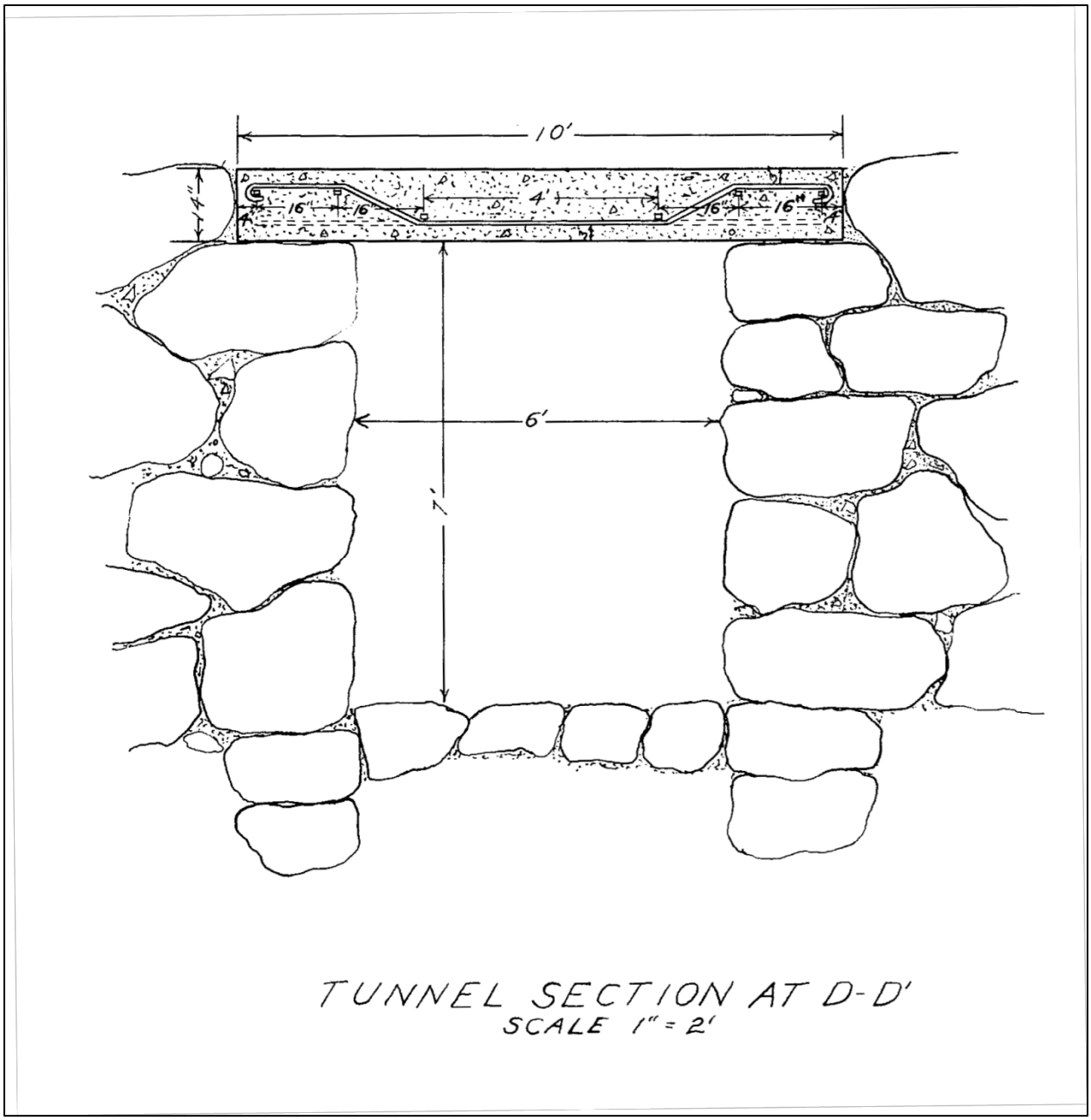
Appendix A, Figure 3. Original construction drawing, Sheet 3. Reduced; not field-checked for accuracy. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah. Used with permission.



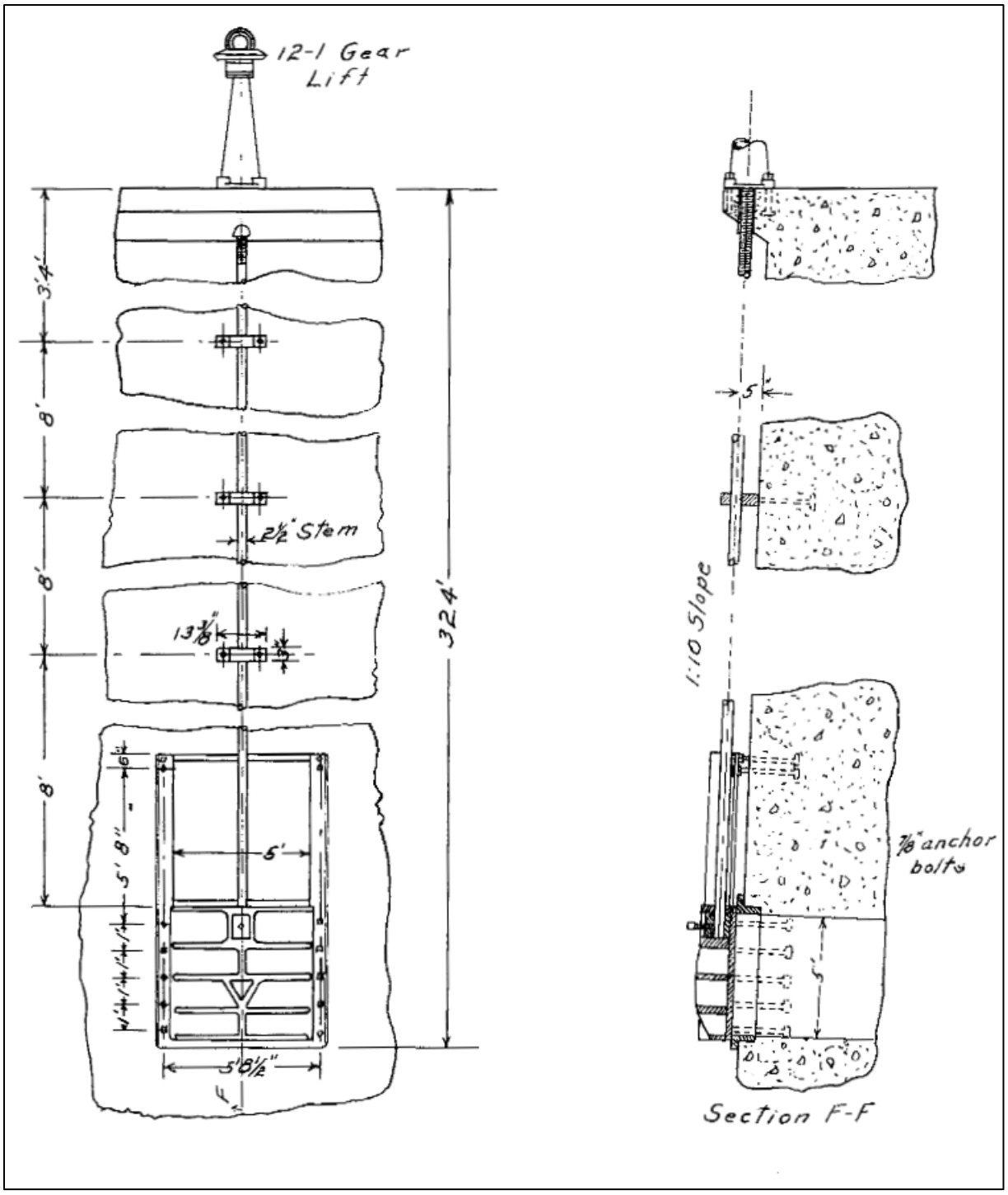
Appendix A, Figure 4. Detail from original construction drawing, Sheet 1. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.



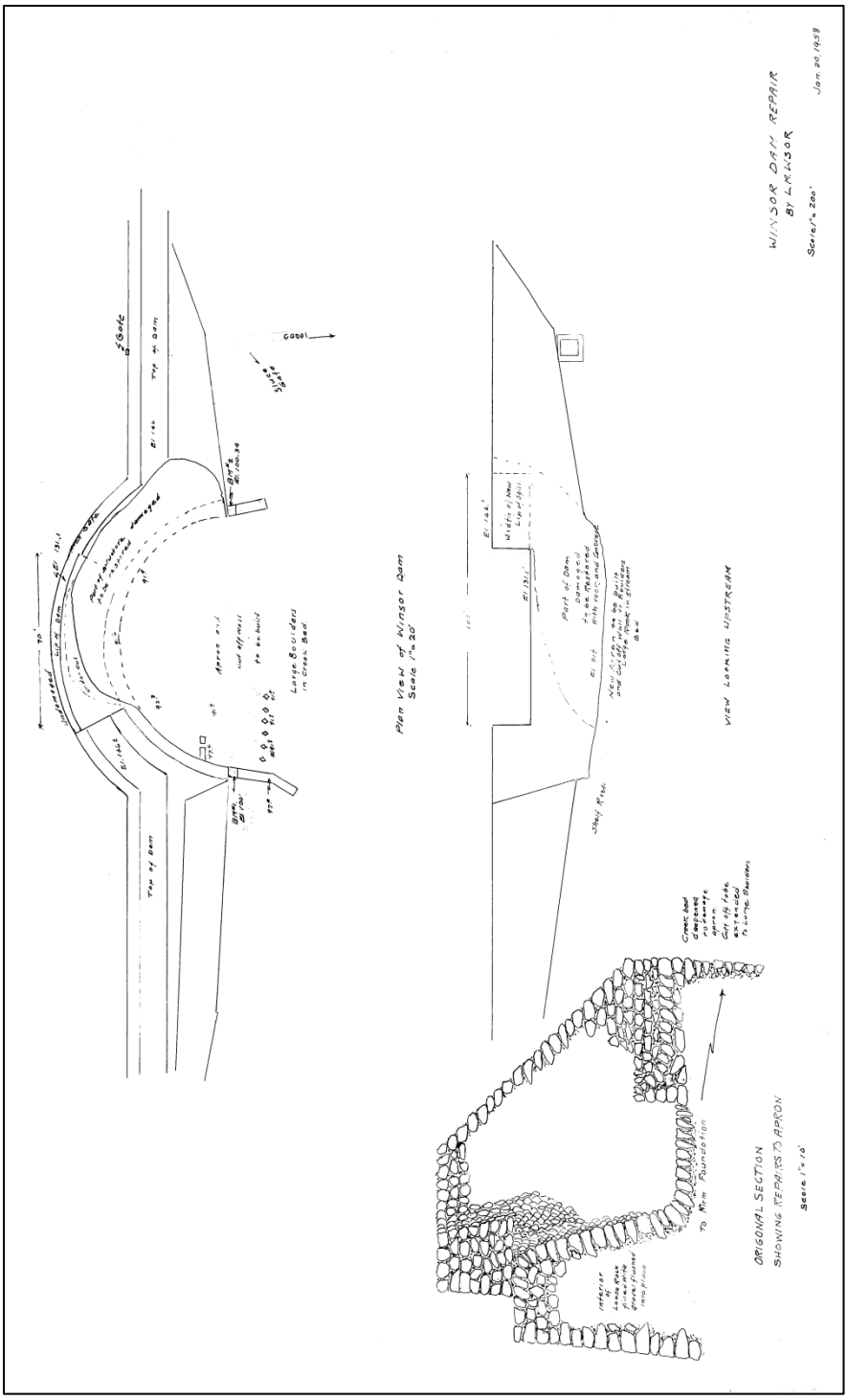
Appendix A, Figure 5. Detail from original construction drawing, Sheet 2. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.



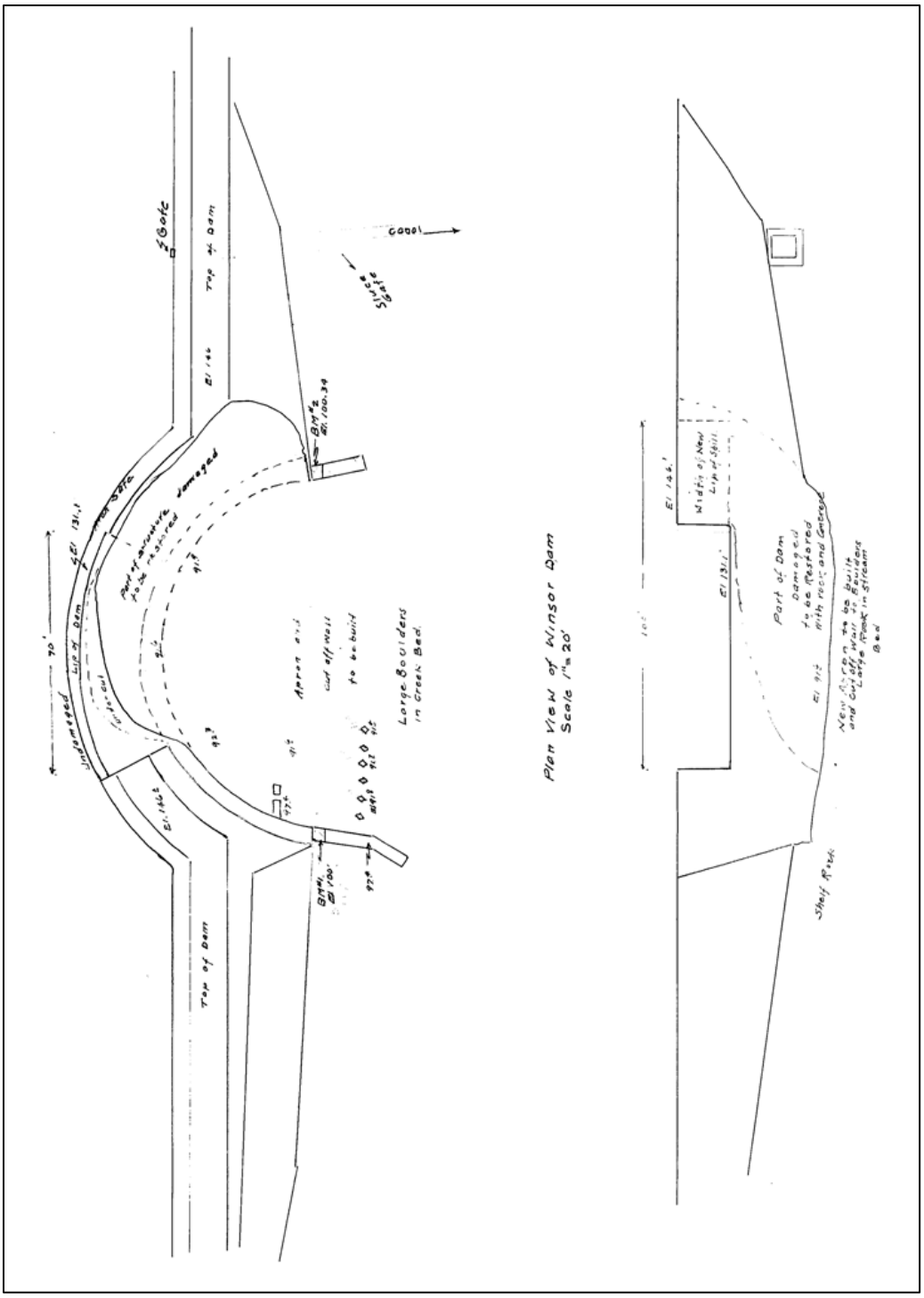
Appendix A, Figure 6. Detail from original construction drawing, Sheet 3. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.



Appendix A, Figure 7. Detail from original construction drawing, Sheet 3. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.



Appendix A, Figure 8. Construction drawing for 1958 repair. Reduced; not field-checked for accuracy. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah. Used with permission.



Appendix A, Figure 9. Detail from construction drawing for 1958 repair. Leo Alva Snow Papers, MC 03, Special Collections and Archives, Dixie State University Library, St. George, Utah.

Appendix B. Historic Photographs



Appendix B, Figure 1. Meeting at the site selected for Shem Dam, March 1933; camera facing southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 33-189, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 2. Meeting at the site selected for Shem Dam, March 1933; camera facing northeast. Luther M. Winsor Papers, COLL MSS 98, Photograph 33-190, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 3. The remains of the original dam at Shem, built in 1916 of “brush and straw covered with sand,” March 1933; camera facing south. The site selected for the new Shem Dam is in the background. Luther M. Winsor Papers, COLL MSS 98, Photograph 33-194, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 4. The Shem Dam site at the start of construction, following excavation for the foundation, 1934; camera facing west-southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 33-292, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 5. Beginning of construction on the Shem Dam spillway, 1934; camera facing southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 33-197, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



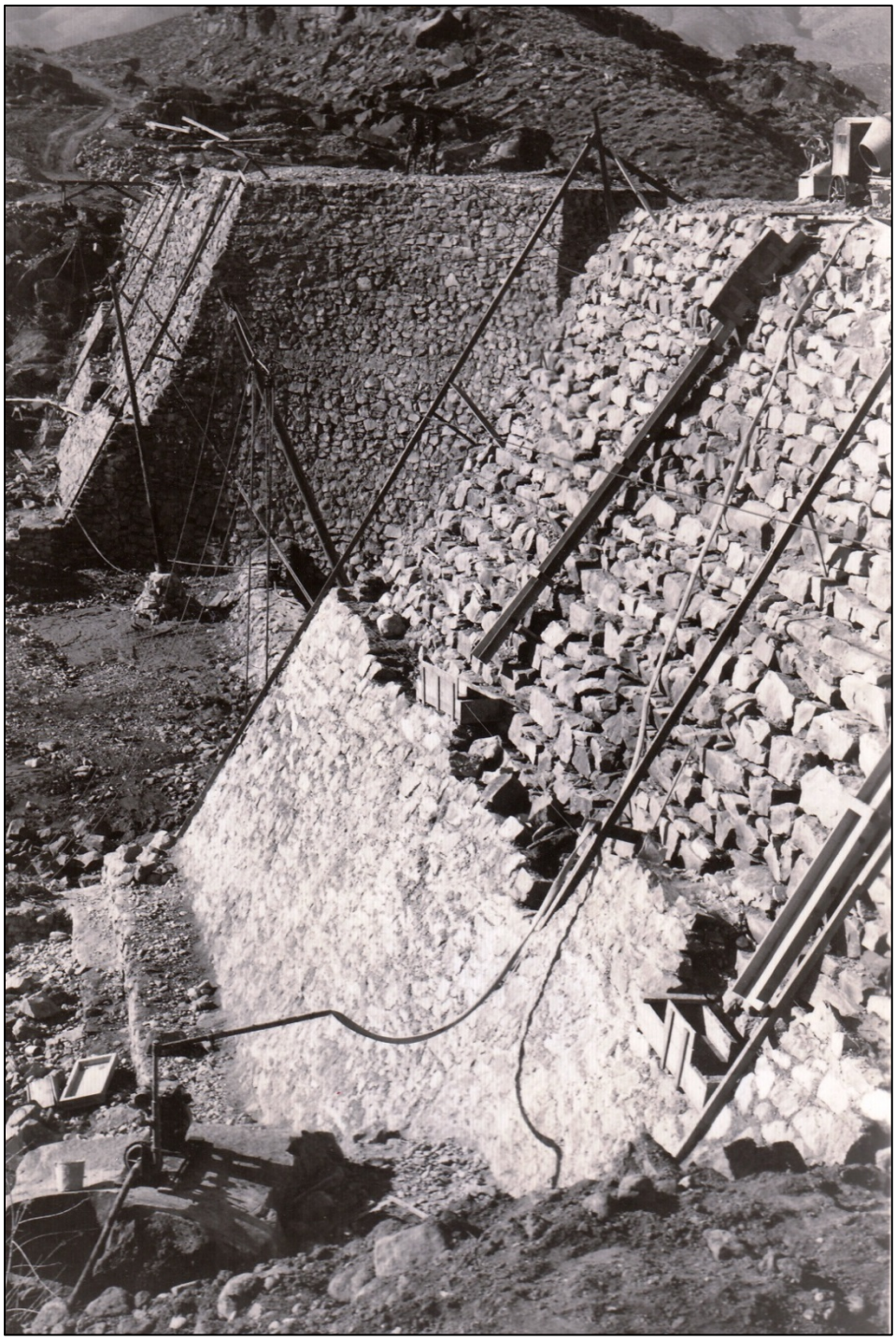
Appendix B, Figure 6. Beginning of construction on the Shem Dam spillway, 1934; camera facing northeast. Luther M. Winsor Papers, COLL MSS 98, Photograph 33-197a, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



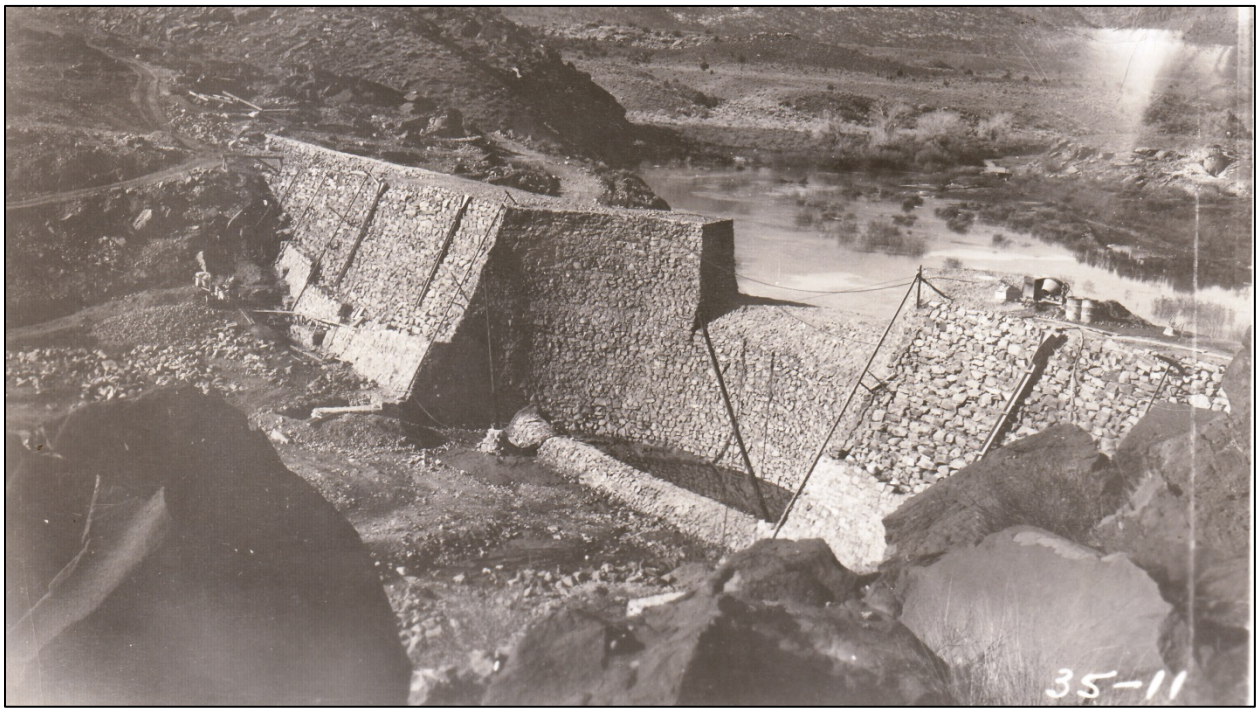
Appendix B, Figure 7. Beginning of construction on the Shem Dam spillway, 1934; camera facing south. Luther M. Winsor Papers, COLL MSS 98, Photograph 33-199, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 8. Shem Dam (Winsor Dam) at the start of a masonry veneer application to the downstream face of the abutments, 1935; camera facing north. Jerome Bernstein Photograph Collection of Civilian Conservation Corps Camps in the Intermountain West. Special Collections, Stewart Library, Weber State University, Ogden, Utah. Used with permission.



Appendix B, Figure 9. Application of a masonry veneer to the downstream face of the Shem Dam abutments, 1935; camera facing southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 35-10, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



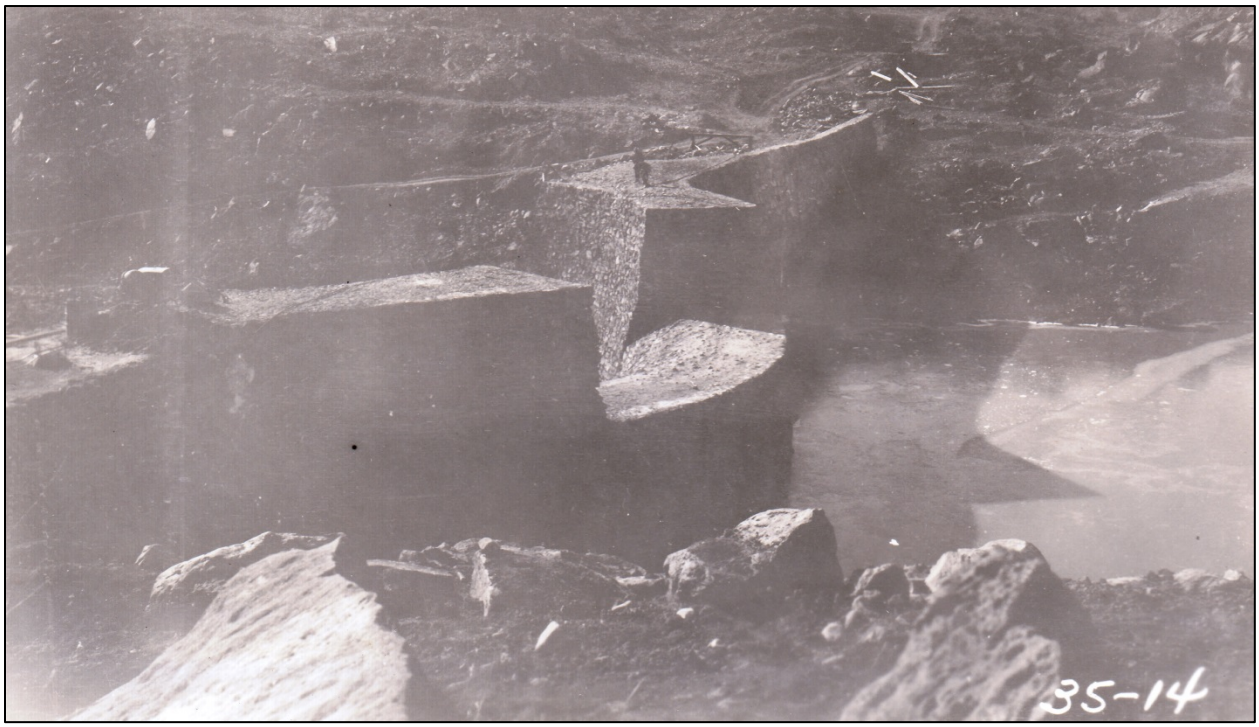
Appendix B, Figure 10. Application of a masonry veneer to the downstream face of the Shem Dam abutments, 1935; camera facing west. Luther M. Winsor Papers, COLL MSS 98, Photograph 35-11, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 11. Application of a masonry veneer to the downstream face of the Shem Dam abutments, 1935; camera facing north. Luther M. Winsor Papers, COLL MSS 98, Photograph 35-12, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



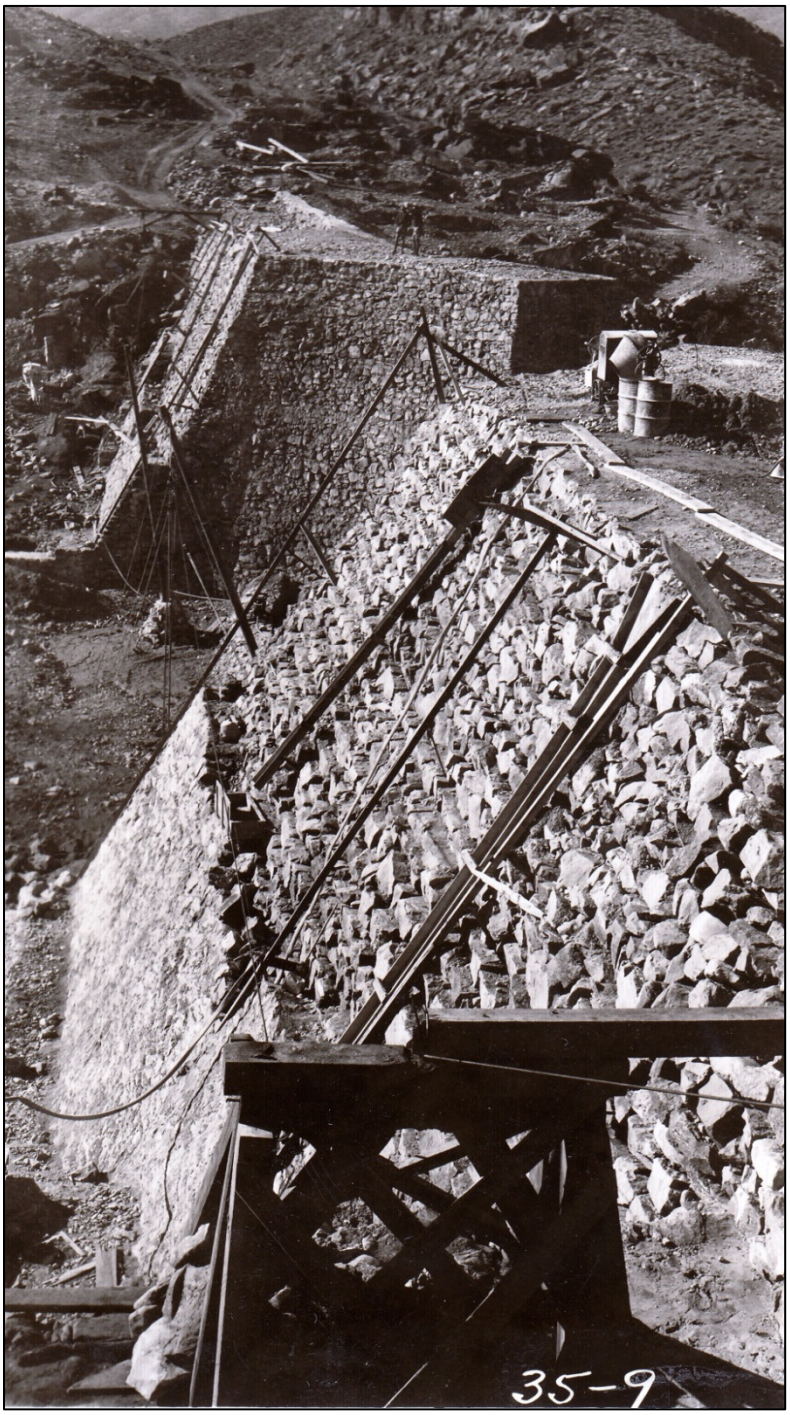
Appendix B, Figure 12. Application of a masonry veneer to the downstream face of the Shem Dam abutments, 1935; camera facing west-southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 35-13, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 13. Upstream face of Shem Dam, during application of a masonry veneer to the downstream face of the abutments, 1935; camera facing south. Luther M. Winsor Papers, COLL MSS 98, Photograph 35-14, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 14. Downstream face of the Shem Dam spillway, during application of a masonry veneer to the adjacent abutments, 1935; camera facing northwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 35-8, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



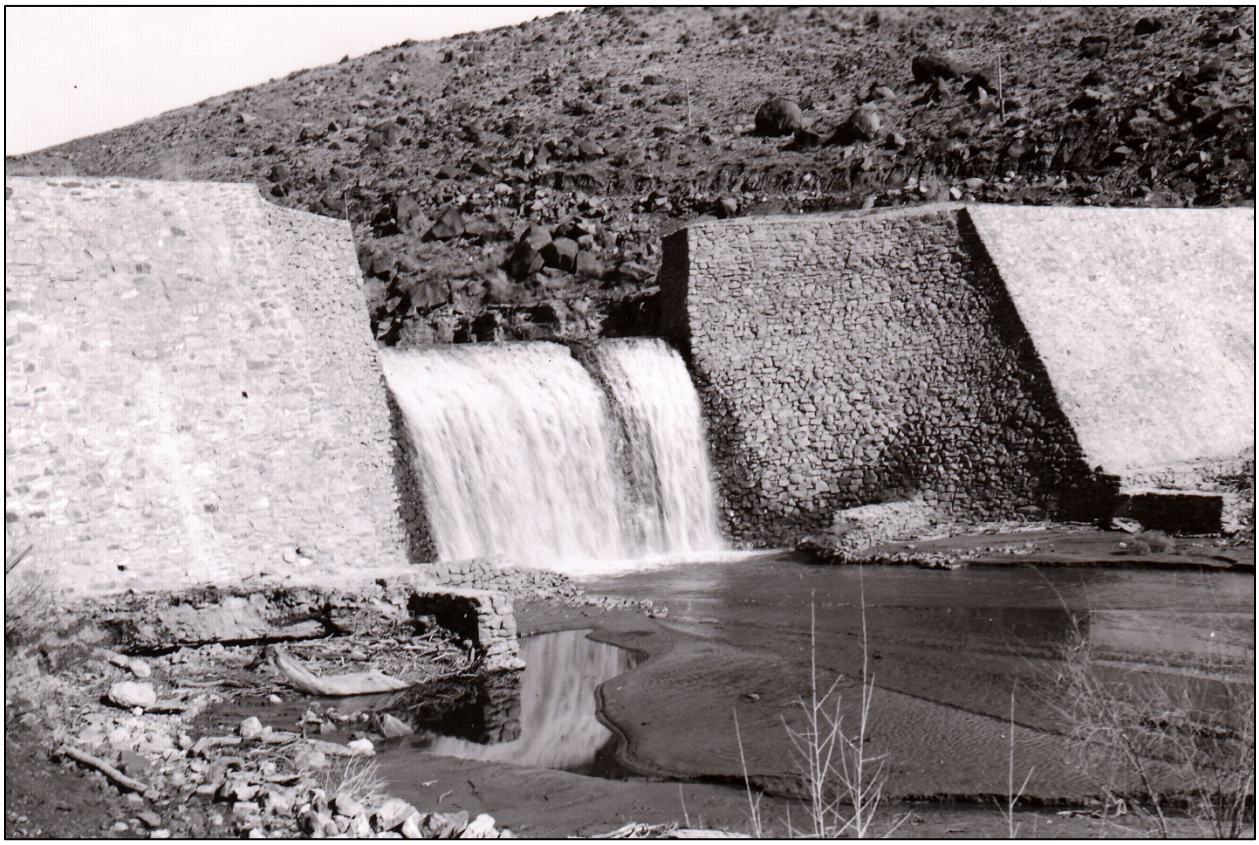
Appendix B, Figure 15. Application of a masonry veneer to the downstream face of the Shem Dam abutments, 1935; camera facing west-southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 35-9, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 16. The Shem Dam spillway, carrying spring runoff, 1937; camera facing north-northwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 37-1, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 17. Portion of the Shem Dam spillway, carrying spring runoff, 1937; camera facing north-northeast. Luther M. Winsor Papers, COLL MSS 98, Photograph 37-2, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 18. Shem Dam following the spring flood that damaged the lower portion of the spillway, 1938; camera facing north. Luther M. Winsor Papers, COLL MSS 98, Photograph 38-359, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 19. The damaged lower portion of the Shem Dam spillway at the start of repairs, 1939; camera facing north. Luther M. Winsor Papers, COLL MSS 98, Photograph 39-82, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 20. The damaged lower portion of the Shem Dam spillway and southwest wing wall, at the start of repairs, 1939; camera facing south. Luther M. Winsor Papers, COLL MSS 98, Photograph 39-84, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 21. The damaged southwest wing wall at Shem Dam, 1938; camera facing southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 38-546, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 22. The Shem Dam spillway after the completion of repairs, 1939; camera facing north. Luther M. Winsor Papers, COLL MSS 98, Photograph 39-267, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 23. The Shem Dam spillway after the completion of repairs, 1939; camera facing west-southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 39-268, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 24. Shem Dam with silt accumulated above dam as high as the spillway, 1941; camera facing west. Luther M. Winsor Papers, COLL MSS 98, Photograph 41-1, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 25. Shem Dam with silt accumulated above dam as high as the spillway, 1941; camera facing west. Luther M. Winsor Papers, COLL MSS 98, Photograph 41-2, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 26. Leo Snow and officers of the St. George and Santa Clara Irrigation Company at Shem Dam to attempt to flush silt from the reservoir, 1941 (Snow nearest the gate hoist); camera facing south. Luther M. Winsor Papers, COLL MSS 98, Photograph 41-3, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 27. Leo Snow and officers of the St. George and Santa Clara Irrigation Company attempt to flush silt from the Shem Dam reservoir, 1941; camera facing southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 41-5, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 28. Leo Snow and officers of the St. George and Santa Clara Irrigation Company attempt to flush silt from the Shem Dam reservoir, 1941; camera facing west. Luther M. Winsor Papers, COLL MSS 98, Photograph 41-6, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 29. Leo Snow and officers of the St. George and Santa Clara Irrigation Company attempt to flush silt from the Shem Dam reservoir, 1941; camera facing southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 41-7, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 30. Leo Snow and officers of the St. George and Santa Clara Irrigation Company attempt to flush silt from the Shem Dam reservoir, 1941; camera facing southwest. Luther M. Winsor Papers, COLL MSS 98, Photograph 41-8, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 31. Portion of the downstream face of the Shem Dam spillway, probably showing the 1955 flood damage; camera facing west. Luther M. Winsor Papers, COLL MSS 98, undated and unnumbered photograph, Special Collections and Archives, Merrill-Cazier Library, Utah State University, Logan, Utah. Used with permission.



Appendix B, Figure 32. Downstream face of the Shem Dam spillway, showing the 1955 flood damage, 1956; camera facing northwest. Dixie National Forest Photograph Collection, Photograph ph08b18i07190e, Special Collections and Archives, Gerald R. Sherratt Library, Southern Utah University, Cedar City, Utah. Used with permission.



Appendix B, Figure 33. Portion of the downstream face of the Shem Dam spillway, showing the 1955 flood damage, 1956; camera facing northwest. Dixie National Forest Photograph Collection, Photograph ph08b18i07190d, Special Collections and Archives, Gerald R. Sherratt Library, Southern Utah University, Cedar City, Utah. Used with permission.

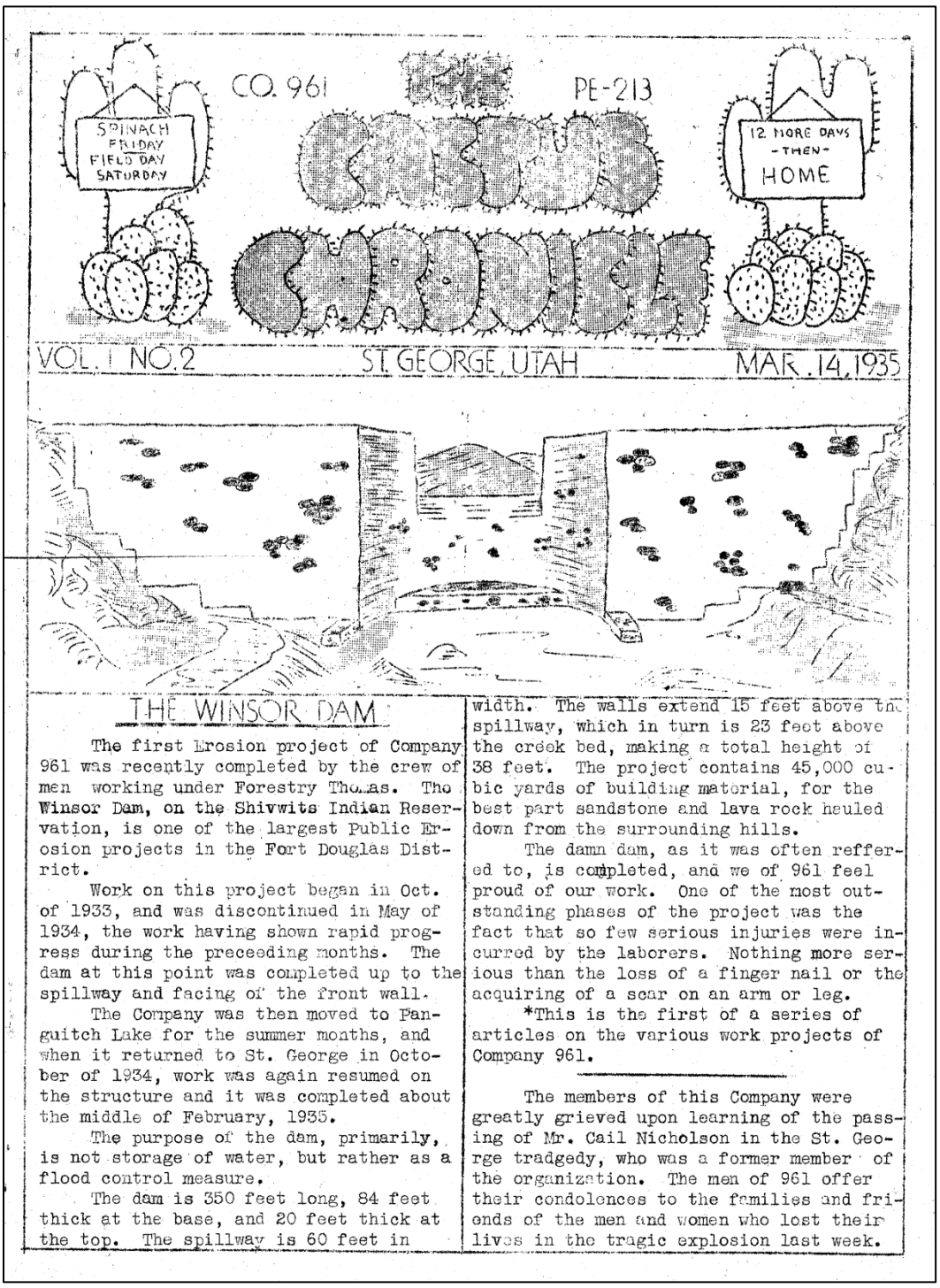


Appendix B, Figure 34. Portion of the downstream face of the Shem Dam spillway, showing the 1955 flood damage, 1956; camera facing southwest. Dixie National Forest Photograph Collection, Photograph ph08b18i07190c, Special Collections and Archives, Gerald R. Sherratt Library, Southern Utah University, Cedar City, Utah. Used with permission.



Appendix B, Figure 35. Portion of the upstream face of Shem Dam, showing the 1955 flood damage, 1956; camera facing east. Dixie National Forest Photograph Collection, Photograph ph08b18i07190a, Special Collections and Archives, Gerald R. Sherratt Library, Southern Utah University, Cedar City, Utah. Used with permission.

Appendix C. Miscellaneous Figures



CO. 961 PE-213

SPINACH FRIDAY FIELD DAY SATURDAY

12 MORE DAYS -THEN- HOME

CACTUS CHRONICLE

VOL. I NO. 2 ST. GEORGE, UTAH MAR. 14, 1935

THE WINSOR DAM

The first Erosion project of Company 961 was recently completed by the crew of men working under Forestry Thomas. The Winsor Dam, on the Shivwits Indian Reservation, is one of the largest Public Erosion projects in the Fort Douglas District.

Work on this project began in Oct. of 1933, and was discontinued in May of 1934, the work having shown rapid progress during the preceeding months. The dam at this point was completed up to the spillway and facing of the front wall.

The Company was then moved to Panguitch Lake for the summer months, and when it returned to St. George in October of 1934, work was again resumed on the structure and it was completed about the middle of February, 1935.

The purpose of the dam, primarily, is not storage of water, but rather as a flood control measure.

The dam is 350 feet long, 84 feet thick at the base, and 20 feet thick at the top. The spillway is 60 feet in width. The walls extend 15 feet above the spillway, which in turn is 23 feet above the creek bed, making a total height of 38 feet. The project contains 45,000 cubic yards of building material, for the best part sandstone and lava rock hauled down from the surrounding hills.

The damn dam, as it was often reffered to, is completed, and we of 961 feel proud of our work. One of the most outstanding phases of the project was the fact that so few serious injuries were incurred by the laborers. Nothing more serious than the loss of a finger nail or the acquiring of a scar on an arm or leg.

*This is the first of a series of articles on the various work projects of Company 961.

The members of this Company were greatly grieved upon learning of the passing of Mr. Cail Nicholson in the St. George tradgedy, who was a former member of the organization. The men of 961 offer their condolences to the families and friends of the men and women who lost their lives in the tragic explosion last week.

Appendix C, Figure 1. Front page of the *The Cactus Chronicle*, March 14, 1935, with a sketch of recently completed Winsor (Shem) Dam. Utah State Historical Society, Civilian Conservation Corps Newsletters Collection, 1935–1941, Salt Lake City. Used with permission.

Appendix D. Tables

Appendix D, Table 1. Panels of Concrete Inscriptions at Shem Dam

Panel No.	Location	Notes
1	Southwest abutment, upstream side, immediately southwest of spillway	Inscriptions made in thin layer of concrete on horizontal top of masonry abutment wall.
2	Southwest abutment, downstream side, immediately southwest of spillway	Inscriptions made in thin layer of concrete on horizontal top of masonry abutment wall.
3	Northeast abutment, downstream side, immediately southwest of adjacent bedrock	Inscriptions made in thin layer of concrete on horizontal top of masonry abutment wall; many faintly visible names and dates, most illegible.
4	Concrete base of gate hoist	Brief inscription on horizontal surface of base.
5	Southwest abutment, downstream side	Inscriptions made in small concrete patch in vertical masonry wall face, about 3 feet above ground.
6	Southwest wing wall	Inscriptions made in small concrete patch applied to horizontal top of masonry wing wall; patch was probably applied specifically to allow inscriptions.
7	Southwest wing wall, upper surface	Inscriptions made in small concrete patch applied to horizontal top of masonry wing wall; patch was probably applied specifically to allow inscriptions; previously recorded by Hoffman (2014).
8	Concrete pier at downstream edge of spillway apron, adjacent to southwest wing wall	Brief inscriptions on horizontal upper surface of pier.

Appendix D, Table 2. Concrete Inscriptions at Shem Dam

Panel No.	Inscription	Notes
1	V. L. N.	—
1	KRANWINKLE	—
1	Victor Schow	In rectangular outline.
1	HILL	—
1	E. A.	—
1	SCHOW / 34	All balloon letters.
1	KEACHIE / 34	All balloon letters.
1	(P H P)	Parentheses in original.
1	K W	—
1	WRIGHT / V S	"WRIGHT" in balloon letters.
1	WHITELOCK / C. C. C.	All balloon letters.
1	Vic	—
1	J W / Dunstone / C C C	—
1	Glenn Gold / 1934 / P E 213	—
1	V. N. SCHOW / C. C. C. 1934	—
1	H. J. COLMAN / C. C. C. '34	—
1	VERN NELSON	—
1	F. H. W.	—
1	H. J. COLMAN / C. C. C. 1934 / CO. 961 / P. E. 213	—
1	WHITELOCK	All balloon letters.
2	[illegible]	—
2	Gus / Mitchell / CO. 961 / 1934–1935	—
2	RED / John Brennan / Co 961 / 1934–35	—
2	1934–35 / […]TOR SCHOW	—
2	LEE EVANS	—
2	Gus Mitchell / Co 961 / 1934–1935	"Gus Mitchell" in cursive letters.
3	Vern L[…]	All cursive letters.
3	BILL JOSEPH / BEAVER	—
4	BUSH	—
5	I. A. / J T / J S / V S	—
6	EUGENE / PARSONS / AKRON O[…]	—
6	585 / C. C. C.	—
6	E. S.	In heart outline.
6	5/26[?]/39[?]	—
6	[…REVANMA[…]	—
7	DANNY / BEEZIE / & / MAXINE / MIKE / MAY 24 / 1939	Flanked by spade, diamond, heart, and club symbols.
8	DICK / [illegible] / 39[?]	—
8	GEORG[…] / SC[…] / [illegible]	—