National Park Service
Department of the Interior

Death Valley National Park
Death Valley, CA

Saline Valley Salt Tramway

Historic Structure Report





The historic structure report presented here exists in two formats. A traditional, printed version is available for study at Death Valley National Park, the Pacific West Regional Office of the NPS, Denver Service Center of the NPS, and at a variety of other repositories. For more widespread access, the historic structure report also exists in a web-based format through ParkNet, the website of the National Park Service. Please visit www.nps.gov for more information.

Death Valley National Park

Saline Valley Salt Tramway

Historic Structure Report

October 2021

for

Death Valley National Park
Death Valley, CA

PMIS # 236721A

DEVA 143 177283

by

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National Park Service
Department of the Interior

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Death Valley National Park

Saline Valley Salt Tramway

Historic Structure Report

Approved: MICHAEL REYNOLDS Digitally signed by MICHAEL REYNOLDS Date: 2021.11.29 10:34:38 -08'00'

Superintendent, Death Valley National Park Date

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Project Team

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Executive Summary

This Historic Structure Report (HSR) was produced for Death Valley National Park to determine the best treatment and use for the four extant support towers of the Saline Valley Salt Tramway managed by the National Park Service (much of the Tramway is managed by the Bureau of Land Management). This HSR will guide future treatment (preservation and maintenance) of the four structures.

The project was conducted under an agreement between the Historic Preservation Training Center (HPTC) and Death Valley National Park (DEVA) entitled "Saline Valley Salt Tram Historic Structure Report (HSR) & Cost Estimating" (PMIS 236721A). Funding was provided through the Abandoned Mines Lands Program and project management was provided through DEVA. HPTC and DEVA are units of the National Park Service (NPS), United States Department of the Interior. NPS policies and guidelines were adhered to in the production and distribution of this HSR.

A Historic Structure Report is the primary guide to treatment and use of a historic structure and is required by NPS-28: *Cultural Resource Management Guideline*. It is prepared to identify and minimize the loss of character-defining features and materials and provides a basis upon which to address anticipated management objectives. This HSR aims to provide a current understanding of the four historic Saline Valley Salt Tramway support towers managed by the NPS.

The historical background, context, chronology, and technical evaluations provide an understanding of the historical integrity of the four structures. This information is valuable for guiding sustainable development of the tramway support towers by offering research and insight to park management and directing planning and construction alternatives. The contents are used by the park when scoping new projects. These new projects contain parameters for reuse functions and physical modifications that complement resource protection and preservation goals.

The Historical Background and Context section provides information on general themes associated with the support towers described in this HSR. Included are a biography on tramway developer White Smith and his family; history and details of Trenton-Bleichert Aerial Tramways, of which this tramway was one, including specific tramway components; and discussion of the United States Geological Survey Saline Valley Salt Study.

The Chronology of Development and Use section includes a thorough history of the salt mining operations in Saline Valley, from the 1860s when salt was laboriously hauled out via horse-drawn wagon, development of the area by the Saline Valley Salt Company, including construction of the salt tramway 1911-1913, salt mining efforts in the area through 1930,

abandonment for the last ninety-one years, and modern efforts for preservation of the tramway by the NPS and BLM.

Research Conducted to Produce HSR

The following activities were conducted to gain a thorough understanding of the Saline Valley Salt Tramway at Death Valley National Park:

- Primary and secondary historic research into the sequence of changes and evolution of construction and associated individuals:
    - Death Valley National Park archive, Death Valley, CA
    - Newspapers.com digital archive
    - Ancestry.com digital archive
    - Archive.org digital archive
    - Google Books digital archive
    - California Digital Newspaper Collection digital archives
    - Colorado School of Mines digital archives
    - Owensvalleyhistory.com digital archives
    - Salttram.blogspot.com digital archives
    - Various other internet repositories as cited in the bibliography (Appendix A)
- Condition assessments by HPTC
- Recommended treatments by HPTC
- Documentation drawings by HPTC

Condition Assessment Summary

After HPTC's visit and assessment of the four tramway support towers, investigation revealed varying maintenance deficiencies and overall condition assessment ratings. The results of these investigations provide a more fully integrated narrative of developmental history of the extant structures, including changes made over the years by former owners and the NPS. The results will also educate users of the structures about the integrity of the historic fabric and the character-defining features so that they may be interpreted and preserved for future generations.

It should be noted that these are high-quality and historically significant structures that cannot be replicated in today's economic environment. The maintenance deficiencies described herein, while needing to be addressed, are superficial and in no way justify any treatment other than preservation of the structures and continued use.

Generally, the four support towers retain a moderate level of historic integrity dating to and/or sympathetic to the original date of construction and the Period of Significance (1911-1935). Since the end of the Period of Significance, the tramway was abandoned, and the support towers have not been maintained resulting in loss of historic fabric through deterioration and unauthorized salvage.

The four support towers differ in overall condition and maintenance deficiency ratings. Support Tower #1 is in poor condition with serious deficiencies, including deteriorated standards and

ties due to periodic flooding by the nearby salt lake. Support Tower #2 is in fair condition with minor deficiencies. Support Tower #3 is in poor condition with critical deficiencies, namely the standards have collapsed. This has already affected the ties and could further affect the remaining wood members structurally. Support Tower #4 is in fair condition with serious deficiencies, including shifting of the standards which could cause the tower to fall and affect the other wood members.

Treatment and Use Recommendations Summary

The recommended ultimate treatment for the four tramway support towers, as determined through research for this HSR, is *preservation* with the retention of character-defining features important to the historic design and construction of the four support towers by the Saline Valley Salt Company and Trenton Iron Company in 1911-1913 and any alterations to the structures which occurred by other companies through 1935, when the tramway was abandoned.

The recommended ultimate use for the four tramway support towers, as determined through research of this HSR, is scene-setting exhibits.

Treatment recommendations vary between each support tower as each structure was found to be in a different condition with differing maintenance deficiencies. A recommendations summary is provided for each of the four support towers managed by the NPS.

Support Tower #1 (poor/serious):

- Replace concrete footings deteriorated beyond repair.
- Replace all four wood standards.
- Reattach iron brackets to concrete footings.
- Replace all four wood bracing boards.
- Replace all four wood ties.
- Replace cap timber.

Support Tower #2 (fair/minor):

- Replace concrete footings deteriorated beyond repair.
- Replace missing wood bracing boards.

Support Tower #3 (poor/critical):

- Replace concrete footings deteriorated beyond repair.
- Replace all four wood standards.
- Install new bracket, where missing.
- Reattach iron brackets to concrete footings.
- Replace all wood bracing boards.
- Replace all four wood ties.

Support Tower #4 (fair/serious):

- Replace concrete footings deteriorated beyond repair.
- Replace all four wood standards.
- Install new bracket, where missing.
- Reattach iron brackets to concrete footings.
- Replace all wood bracing boards.
- Replace three of four wood ties.

Administrative Data

Project Identification

PMIS Number:	252879A
Project Title:	Saline Valley Salt Tram Historic Structure Report (HSR) & Cost Estimating
Project Location:	Death Valley National Park

Name and Location Data

Region:	Pacific West
Park:	Death Valley National Park (DEVA)
Resource Name:	Salt Works and Tram
Resource Type:	Archeological
Resource ID:	DEVA02140.000
Park ID:	SV 173
State ID:	CA-INY-01973
State:	California
County:	Inyo

The four tramway support towers managed by the NPS are not listed in the NPS Cultural Resource Inventory System (CRIS). For the purposes of this report, the four structures will be defined from north to south, as follows (see fig. 1 for locations):

Support Tower #1: -117.815805, 36.694156
Support Tower #2: -117.815847, 36.693006
Support Tower #3: -117.815851, 36.692403
Support Tower #4: -117.816016, 36.688016

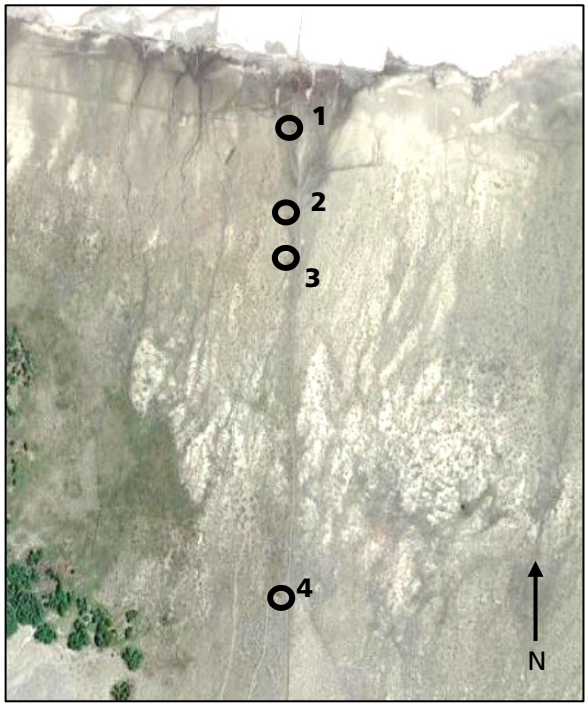


Figure 1. Locations and numbering of the four tramway support towers managed by the NPS. Source, Google Maps, 2020.

Related Studies (chronological)

Gale, Hoyt S. "Salt, Borax, and Potash in Saline Valley, Inyo County, California." *Department of the Interior, United States Geological Survey. Bulletin 540: Contributions to Economic Geology (Short Papers and Preliminary Reports), 1912, Part I—Metals and NonMetals Except Fuels.* Washington, DC: Government Printing Office, 1914.

Carstarphen, F.C. (Associate, ASCE). "An Aerial Tramway for the Saline Valley Salt Company, Inyo County, California." *Proceedings of the American Society of Civil Engineers,* vol. XLIII, no. 4. (April 1917): 525-558.

Carstarphen, F.C. (Associate, ASCE). "An Aerial Tramway for the Saline Valley Salt Company, Inyo County, California." *Transactions of the American Society of Civil Engineers,* vol. LXXXI, paper no. 1394. (2 May 1917): 709-42.

Conrad, Richard D. (Natural Resources Tech, BLM). "Saline Valley Salt Tram Historic Structure" *National Register of Historic Places Inventory – Nomination Form,* NR no. 74000514. (31 October 1974).

Norwood, Richard H., Charles S. Bull, and Ronald Quinn. "A Cultural Resource Overview of the Eureka, Saline, Panamint, and Darwin Region; East Central California." Prepared for the United States Department of the Interior, Bureau of Land Management, California Desert Planning Staff. (1980).

DeDecker, Mary (Death Valley '49ers, Inc.). "White Smith's Fabulous Salt Tram." *Keepsake No. 33.* Morongo Valley, CA: Sagebrush Press, 1993.

Unrau, Harlan D. "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994." *Special History Study.* (United States Department of the Interior, National Park Service, September 1997).

Leuders, Laurel E. "For the Sake of Salt: A Landscape-Level Management Approach for the Saline Valley Salt Tram." *Thesis (Master of Arts in Cultural Resources Management).* Rohnert Park, CA: Sonoma State University, 2019.

Cultural Resource Data

National Register of Historic Places

National Register Status:	Listed
National Register Date:	December 31, 1974
NR Information System No.:	74000514
Significance:	The Saline Valley Salt Tramway is significant at the National Level. "Besides being the steepest tramway in the United States,

the Saline Valley Salt Tram is one of the most scenic, historic, best preserved, oldest, and largest of its kind remaining [in 1974]."

National Historic Landmark: Unevaluated
National Historic Landmark Date: N/A
World Heritage Site: Unevaluated

Period of Significance

The Period of Significance, as identified by the National Register of Historic Properties nomination form, for the Saline Valley Salt Tramway is 1911—the year planning was completed and construction started on the tramway by the Salt Valley Salt Company—through 1935—the year the last owner, Sierra Salt Company, went into receivership and the endeavor was abandoned indefinitely.

Recommended Treatment & Use

The recommended treatment for the four tramway support towers managed by the NPS is preservation. The recommended use is as scene-setting, interpretive resources.

Recommendations for Cataloguing & Storage of Materials Generated by HSR

All project materials will be turned over from HPTC to the Death Valley National Park's archive. Electronic files and media will be transferred via NPS file-sharing applications available at the time of publication.

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List of Abbreviations (alphabetical)

ACHP Advisory Council for Historic Preservation

AMP Asset Management Process (NPS PFMD)

ASCE American Society of Civil Engineers

BFML Building Feature Master List

BLM Bureau of Land Management (DOI)

CDF character-defining feature

CIP cast in place

CRIS Cultural Resource Inventory System (NPS)

DEVA Death Valley National Park (NPS)

DOI Department of the Interior

DSC Denver Service Center (NPS)

FCAS Facility Condition Assessment Survey (NPS PFMD)

FMSS Facility Management Software System (NPS PFMD)

FY Fiscal Year

GMP General Management Plan

HABS/HAER Historic American Building Survey/Historic American Engineering Record (NPS)

HPTC Historic Preservation Training Center (NPS)

HSR Historic Structure Report

NPS National Park Service

NRHP National Register of Historic Places (NPS)

OVSC Owens Valley Salt Company

PFMD Park Facility Management Division (NPS)

PMIS Project Management Information System (NPS)

SHPO State Historic Preservation Office

SSC Sierra Salt Company

ST Support Tower

SVSC Saline Valley Salt Company

SVST Saline Valley Salt Tramway

TIC Technical Information Center (DSC)

USGS United States Geologic Survey

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Part 1 | Developmental History

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Historical Background and Context

White Smith & Family[1]

James White Smith was born February 10, 1853 in Tipton County, Tennessee to Mary Margaret (nee Bell) (1825-1881) and James Frederic Smith (1818-1893), a farmer. From early on, the younger James was referred to as "White," likely to differentiate from his father, the senior James. White was the fourth of nine children born to the couple, which included (oldest to youngest): Henrietta P. (1846-1916), Eudocia Carolina (1848-1891), Ambrose Henry (1850-1909), James White (1853-1927), Lucy Annabelle (1856-1939), Edward Bell (1859-1935), Frederic Robert (1862-1942), Eugene Ewart (1865-1934), and Jessie J. (1868-1950).

During the 1870 United States Federal Census, the Smith family resided in Gibson County, TN. In 1875, White moved to California and resided with a relative, A.N. Bell, near Independence. White's older brother, Ambrose, had preceded him there. For several years, White hauled freight between Darwin and Mojave and other roads.

The 1880 Federal Census places White in Independence, CA (Inyo County) living with his older brother, Ambrose, and working on a farm. This may have been a horse ranch at Black Rock slough (they sold it in 1896). The remainder of the family—James and Mary with children Henrietta, Eudocia, Frederic, Eugene, and Jessie—remained in Humboldt, TN. (It is unclear where siblings Lucy and Edward resided in 1880).

White's mother, Mary, passed away in November 1881 in Tennessee. After her death, it appears that father James and the remainder of his children relocated and joined White and Ambrose is California.

Eudocia died in California in February 1891. Father James died in Independence, CA in 1893. Around 1894, sister Jessie married a John Hayes.

In November 1899, White married Margaret E. Watterson, an immigrant from the Isle of Man. She was likely the stepsister of White's later business partner at the Saline Valley Salt Company. The 1900 Federal Census the next year places the couple in Inyo County, CA. White, 47, is an attorney. Margaret is 39.

The same 1900 Census places brother Edward Smith in Inyo County, CA, where he managed a farm he owned. Several farm laborers boarded in his home. Brothers Fred and Eugene and sisters Henrietta (Nettie) and Lucy resided together on a farm in Inyo County, owned by Fred;

[11] The information in this section was gleaned from the following sources:
1860, 1870, 1880, 1900, 1910, 1920, and 1930 Unites States Federal Censuses accessible through ancestry.com.
White family grave locations and other information accessible through Findagrave.com
Ancestral information provided through salttram.blogspt.com.

both Fred and Eugene worked on the farm. Jessie and husband John Hayes resided in Big Pine, CA with children William, Annie, and Merle. John farmed his own farm. Ambrose lived in nearby Fish Springs, CA; his occupation is listed as apiarist (beekeeper). He would die in Bishop in July 1909.

In 1905, after the death of Saline Valley Salt Company's president, J.L. Bourland, brothers White, Fred, and Eugene became interested in developing the salt works in Saline Valley, over the Inyo Mountains east of their family's residences (fig. 2). For the next five years, the brothers were involved in feasibility studies to transport the salt over the mountains, surveyed the area in preparation for construction of a tramway, and sought to gain investors in the project (see Chronology of Development & Use section for more information).

The 1910 Federal Census states White and Margaret resided on North Main Street, Bishop, CA. A daughter, M. Margaret, 8, lived with her parents. White remained a lawyer and owned his own home. Next door, Frederic, also a lawyer, lived with his sisters Henrietta and Lucy and brother Eugene, a gold miner. Brother Edward was a farmer on the Inyo National Forest Reserve.

White and Margaret moved to Los Angeles in 1913 where she died four years later.[2] White's sister Henrietta died in Bishop, CA in August 1916.

For the 1920 Federal Census, Fred and Lucy (brother and sister) lived together on Home Street in Bishop, CA. Fred was a real estate agent and owned their home. Brother Eugene also lived on Home Street with his wife Dora. He was a mining operator.

In 1923, White married Elizabeth Penn, a native of his hometown of Humboldt, TN. White died in Los Angeles, CA in April 1927 from a form of influenza.



Figure 2. White Smith is located second from right in this 1913 photograph. The two men at left are thought to be two of White's brothers, perhaps Fred and Eugene.

[2] *Inyo Register* February 13, 1913.

In 1930 brother and sister Fred and Lucy continued to reside on Home Street in Bishop. Fred was a notary in a law office and owned their home. Brother Edward owned and operated a farm on the State Highway south of Bishop. Two farm laborers boarded on his farm. Brother Eugene had moved away from Inyo County and resided with his wife Dora and sister-in-law Carrie King in their home on Sixth Street in Temascal Township, Riverside County, CA. Eugene may have been an operator at an oil field for illuminating gas.

Eugene died in October 1934 in Riverside County. He is buried next to his wife in Corona Sunnyside Cemetery. Edward died in January 1935 and is buried at Elsinore Valley Cemetery in Riverside County. Lucy appears to have died in November 1939 and is buried next to her brother Edward. Fred died in November 1942 and is buried next to Edward and Lucy. Jessie died in February 1950 and is buried next to Edward, Lucy, and Fred.

Trenton-Bleichert Aerial Tramways

The Saline Valley Salt Company contracted with the Trenton Iron Works, a subsidiary of the American Steel & Wire Company, which was a United States Steel Products Company. This conglomerate were manufacturers and the sole licensees in the United States to use the Adolf Bleichert & Co. patents for aerial tramways.[3]

The Adolf Bleichert & Co. was a German engineering company responsible for an innovative double-rope aerial tramway system thought to be superior to the mono-rope systems prevalent in the United States in the late 1800s. Bleichert began expansion to other continents at the end of the nineteenth century, but, for various reasons, expansion into North America was found to be infeasible. Instead, in 1888, Bleichert entered into a license agreement with the Trenton Iron Company, then owned by Cooper Hewitt & Co., to manufacture and sell Bleichert tramways in the United States and Canada. Soon after, Trenton-Bleichert tramways began to be constructed on the east coast for coal mining and quarry operations. In 1890, a tramway was constructed at the silver mines in Aspen,



Figure 3. An 1892 advertisement for the Bleichert two-rope tramways by Cooper, Hewitt & Co. owner of Trenton Iron Company and only licensed manufacturer of the tramways in the United States.

[3] American Steel & Wire Company. "American Steel & Wire Company's Trenton-Bleichert System of Aerial Tramways, Reversible Aerial Tramways and Aerial Tramways of Special Design."

CO; at that time, the western states were considered a desirable, untapped market. During the early 1890s, Trenton Iron Company completed construction of approximately twenty aerial tramways in the mining west.[4]

The Trenton Iron Company displayed their system at the 1893 Columbian Exposition in Chicago (World's Fair). Besides an indoor display of various types of wire rope and carriers, the company had an extensive outdoor display: "The 1,000-foot Bleichert system ran from an ore storage yard, up and over the Intermural Railway, to a discharge terminal attached to the southwestern corner of the [Mines and] Mining Pavilion." The active system added interest to fair-goers by transporting "diamondiferous ground from the store yard at the distant terminal to the Mining building, whence it was transferred to the crushers which operate[d] daily in the South African diamond exhibit. . . ."[5]

For various reasons, including reliability and diverse application, by the end of the nineteenth century, the double-rope Trenton-Bleichert tramway systems overtook the mono-rope systems of earlier years (fig. 3).[6] Popularity of the system continued into the twentieth century, and was used for the tramway of the Saline Valley Salt Company. Between 1900 and 1920, "literally hundreds of double-rope tramways went up in the mining West. . . ."[7]

Trenton Iron Works completed construction of the Saline Valley Salt Tramway between September 1911 and June 1913. A year later, in 1914, an advertising pamphlet entitled *American Steel & Wire Company's Trenton-Bleichert System of Aerial Tramways, Reversible Aerial Tramways and Aerial Tramways of Special Design* was published by the company with detailed description and renderings of the intricacies and design of this conveying system. This pamphlet is the primary source for the following section and is supplemented with photographs of the aerial tramway constructed in Saline Valley, which was curiously not included in the advertisement.

Trenton-Bleichert aerial tramways were described as follows:

> This system of aerial tramways is one whereby the material is carried in receptables suspended from carriages on stationary track cables of special construction, supported at varying elevations above the ground. The carriers move in a continuous circuit, at definite intervals, determined by the individual loads and the amount of material to be transported in a given time, and at distances apart varying in accordance with the speed; the loaded carriers traveling along a line of cable graduated in size to the weight it has to support, and the empties returning along a lighter line of cable parallel with the loaded line. Motion is imparted to the carriers by means of a comparatively light endless wire rope. . .commonly known as the traction rope, to which the carriers are gripped. These Tramways belong to that class of aerial tramways known to many as the "Double-rope," in contradistinction to the "Single-rope" class, wherein one rope performs both the functions of support and propulsion.[8]

[4] Trennert, "Riding the Hight Wire…," 30, 37.
[5] Ibid, 38.
[6] Bleichert & Co. "Trenton Iron/American Wire & Steel/U.S. Steel."
[7] Trennert, "Riding the High Wire…," 45.
[8] Bleichert & Co. "Trenton Iron/American Wire & Steel/U.S. Steel," 5.

The company believed that stationary track cables were advantageous for several reasons: the cables were graduated in size related to the loads and pressures the cables were required to sustain; the traction (moving) rope was relieved of the weight of the load; at slopes, weight was shared as needed between the stationary track cable and the traction rope, depending on the incline; because the traction ropes were stretched to a high tension and were only required to move the loads (not also support them), the ropes were subject to less fluctuations (wave motion) and thus less wear and tear; and the double-track system was capable of carrying much heavier loads. The system was touted to be "especially adapted to the transportation of. . .all kinds of raw materials," "especially adapted to mountainous localities," and were "recommended for heavy service. *The ruggedness of contour, steepness of grades, and width of valleys or rivers, are no bar to the successful operation of such a line*" (emphasis original).[9]

Accurate grade survey was important so that "the curves of the track cables [could be] carefully plotted to the contour of the ground for safe working tension, and the heights of the supports determined accordingly." When laid, the cables were "actually stretched to a somewhat lower tension, so that there may be no possibility of their lifting out of the saddles upon which they rest."[10] This certainly occurred at Saline Valley; numerous surveys there occurred over several months in 1911 to ensure the most advantageous route was found over the Inyo Mountains.

Track Cables

American Steel & Wire Company tramways utilized *locked-coil track cables*, an important feature of these systems. These cables used outer wires which, when drawn into shape, interlocked with each other and created a smooth surface (fig. 4). This resulted in uniform distribution of wear adding to the life of the cable and the carriage wheels that ran along it.[11]

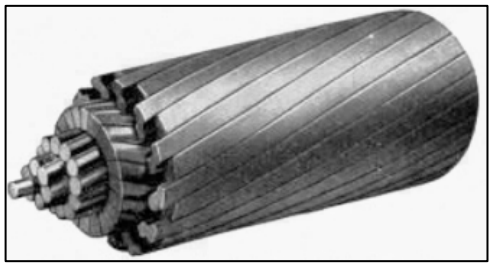


Figure 4. Trenton Locked-Coil Track Cable.

Track cables which required transport "over mountain trails [were] generally cut in lengths of 500 to 800 feet, which [were] most conveniently carried on the shoulders of men. . . ."[12]

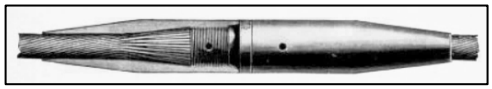


Figure 5. Coupling used to join ends of cables together.

The locked-coil track cable lengths were joined with patented steel *couplings* (fig. 5). Each coupling was composed of "two taper sockets of nickel steel. . .attached, by means of a press [fig. 6], . . .to the respective ends of the cables to be joined, and a central plug, [with] right and left hand thread corresponding to the threads in the coupling sockets." The sockets were "drawn together against

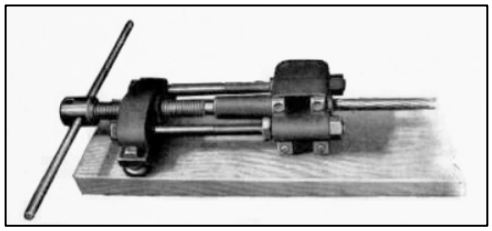


Figure 6. Press used to attach couplings to track cables.

[9] Ibid, 10.
[10] Ibid, 10, 12.
[11] Ibid, 7.
[12] Ibid, 12.

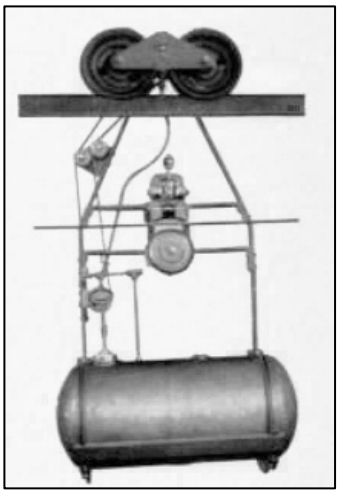


Figure 7. Track cable oiler.

the central collar of the plug" by inserting the plug and turning it, whereby "forming a perfectly secure and serviceable joint possessing the same tensile strength as the cables, and offering no obstruction to the free passage over them of the carriages from which the buckets are suspended. This not only facilitates the handling of the cables, but if at any time any one section or portion of a section becomes worn in service, or is in any way injured, the worn place—whether it be a few feet or more—can be cut out, and a new piece of cable of the required length inserted by means of the couplings."

The company built *track cable oilers* which were "special carriers…for coating the track cables with oil…" (fig. 7) The oil "is carried in a cylindrical tank, to which is attached a small rotary pump, driven from the carriage wheels by a belt and gears, that forces the material up through a small pipe to the cable at a point just under the middle of the carriage."[13]



Figure 8. This ¾" traction rope was used constantly for nearly five years and transported 661,125 tons of ore over the Highland Boy tramway.

Traction Ropes

Traction ropes were composed "of six strands coiled about a hemp core in the usual way, each strand being composed of selected steel wires, varying in number and grade according to the size of the rope and the duty is has to perform [fig. 8]." These ropes were commonly known as Lang-Lay Traction ropes. "The peculiarity of this rope is that the strands and the wires of which they are composed [were] both twisted in the same relative direction, whereas in the ordinary rope they [were] twisted reversely one to the other." The individual strands of wires of Lang-lay ropes were "approximately parallel with the wires in the adjoining strands, which render[ed] it somewhat more flexible than ordinary wire rope of the same diameter and the same size of wires."[14]

When transporting traction rope "over mountain trails on the backs of mules," the rope was coiled in bundles of 150 pounds, and arranged in pairs for each mule, "leaving a space between each pair of coils of about 25 feet [fig. 9]. In this manner a very long rope can be carried unbroken over a narrow trail by a train of mules…."[15]

The traction rope was periodically coated to protect from rust, using a *traction rope coating device* (fig. 10)—a "U-shaped receptacle containing the oil or coating, which [was] suspended near one of terminal guide sheaves. The rope passe[d] over a small roller in this receptacle, which in revolving slushe[d] it with the coating material, and then between some brushes that wipe[d] off the drip."[16]

[13] Ibid, 9.
[14] Ibid, 13
[15] Ibid, 14.
[16] Ibid, 14.

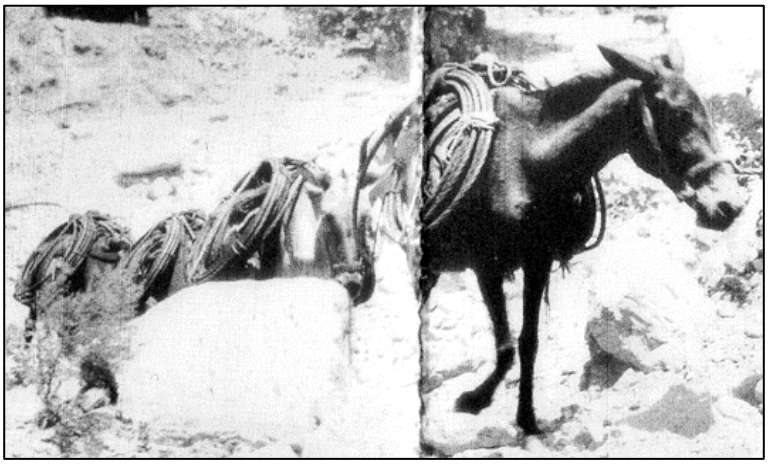


Figure 9. Mules transporting bundles of traction rope during construction of the Saline Valley Salt Tramway, n.d. The rope was continuous between the animals to maintain a long, uncut line.

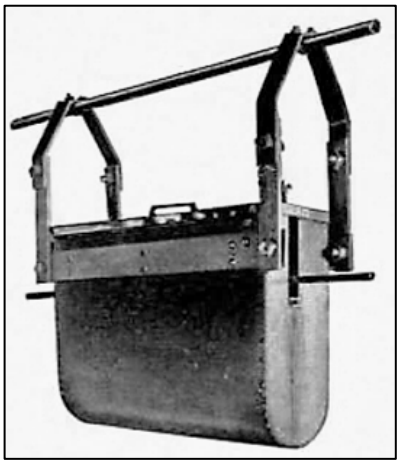


Figure 10. Traction rope coating device.

Carriers

Carriers supplied for the system transported ore and similar material and included a carriage which traversed the track cables. A hanger, pivoting in suspension from the carriage, supported a carrier bucket, or other receptable. Above the carriage was a grip which attached to the traction rope.[17]

> The carriers move in a continuous circuit at definite intervals, the loaded carriers traveling along one line of track cable, and the empties returning by the companion cable, which in the ordinary constructions is parallel with the loaded line, as already stated. When the carriers arrive at either terminal, or other loading or discharge stations, the grips detach automatically and the carriages are shunted to overhead rails, supported by the structure of the station, and by means of which they are conveyed to the various points of loading or discharge as the case may be.[18]

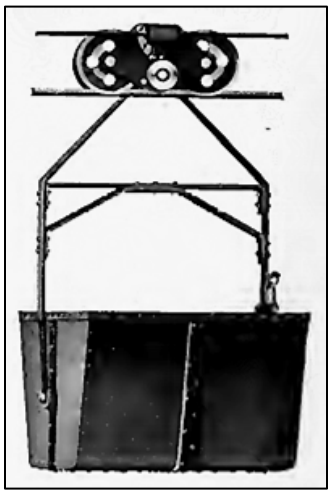


Figure 11. A carrier suspended from a wheeled carriage running along the track cable and attached to the traction rope above via an automatic overhead grip.

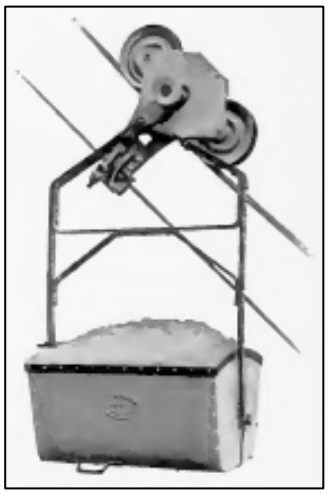


Figure 12. A carrier suspended from a wheeled carriage running along the track cable and attached to the traction rope below via an automatic underhung grip.

A *carriage* consisted of "two steel side plates, between which were mounted two cast steel wheels, fitted

[17] Ibid, 16.
[18] Ibid, 16.

with phosphor-bronze pins, so designed that as the upper surfaces become worn, they can be turned around underside up. The hanger pins are made of the best machinery steel."[19]

At angle and terminal stations "where buckets are not discharged, but merely have to pass around the sheaves," the traction rope ran "just above the track cables. . .making the grip an integral part of the carriage mechanism."[20] At Saline Valley, the buckets were discharged from the line at stations.

Two types of *grips* were typically used in the Trenton-Bleichert System: overhead and underhung. The patented automatic overhead grip (fig. 11) was constructed so "that the weight of the carrier act[ed] as the gripping force, which varies with the inclination of the cable, but this construction possess[ed] the advantage of being independent of any nice adjustment of the grip jaws, so that the grip automatically accommodate[d] itself to irregularities in the wear of the traction rope." It was impractical to use overhead grips (where the traction rope ran above the track cables) in locations where the tramway crossed mountain ridges, or where there were sharp vertical angles or sudden grade changes, as the downward pressure of the traction rope above could throw empty carriers out of plumb. In these locations, as at Saline Valley, underhung grips were used (fig. 12). Underhung grips utilized "the gripping force being exerted by the weight of the carrier" and did not require "any adjustment of the jaws to the wear of the traction rope. Since the grip form[ed] an integral part of the carriage, it also possess[ed] the advantage of accommodating itself to varying inclinations of the cable, without pulling the bucket out of plumb, as it [did] with an underhung grip attached to the hanger."[21]

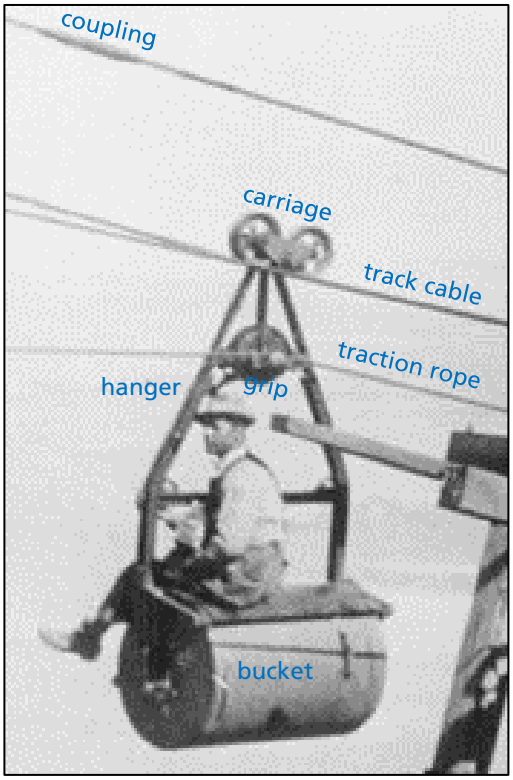


Figure 13. A special salt carrier used at the Saline Valley Salt Tramway, n.d. The wheeled carriage rides along the track cable. The underhung grip is attached to the traction rope below. Note the coupling—used to connect two sections of cable—in the upper left. Cropped by author.

At Saline Valley, underhung grips were used (fig. 13), likely due to the extreme slopes of the mountain passes over which the tramway was required to traverse. The original grips installed proved to be insufficient for the system and were wholly replaced at least twice until a fully operational solution was found.

[19] Ibid, 16.
[20] Ibid, 16.
[21] Ibid, 17.

Various types of carriers were manufactured by the company for hauling difference types of loads (figs. 14-19). Self-dumping buckets were lighter and easier to maneuver by the operators. Self-righting buckets were used where it was inconvenient for the operator to both right and load the buckets. Special receptacles were constructed to suit the material to be carried, like at Saline Valley for moisture-laden salt (see fig. 13).

The carriers' latches were "disengaged at the desired point of dumping by a specially designed tripping bar attached to the track cable or station rail, . . .the bucket being so hung that it instantly turns over and discharges its contents." When dumping from high above the ground, "the tripping bar is generally attached to a frame, guyed to the ground by wire ropes, in order to prevent the rebounding of the cable in dumping and consequent possibility of the carrier being thrown off."[22]

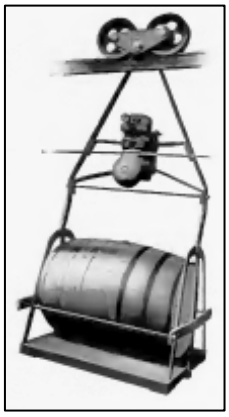


Figure 14. Platform carrier for barrels, boxes, etc.

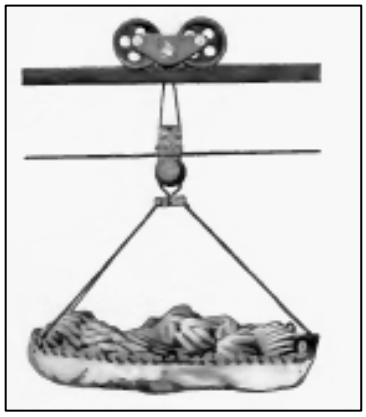


Figure 15. Banana carrier.

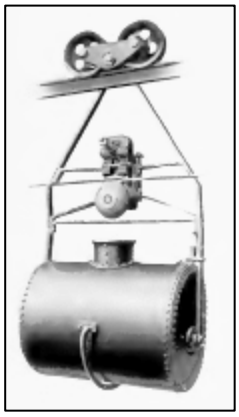


Figure 16. Liquid carrier.



Figure 17. Self-dumping and self-righting bucket carrier.

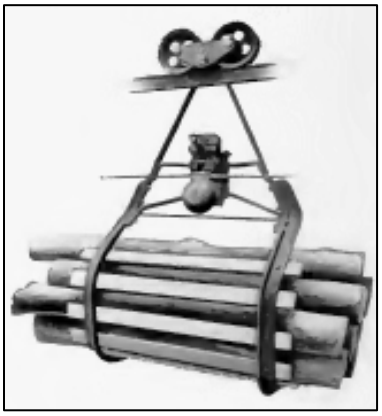


Figure 18. Cordwood carrier.

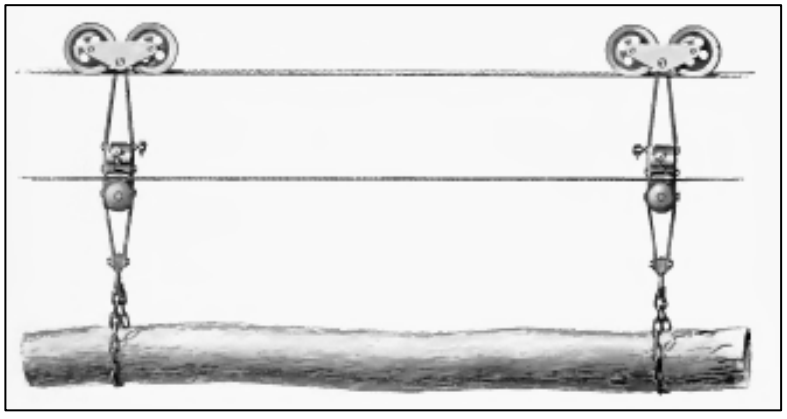


Figure 19. Log carrier.

[22] Ibid, 22.

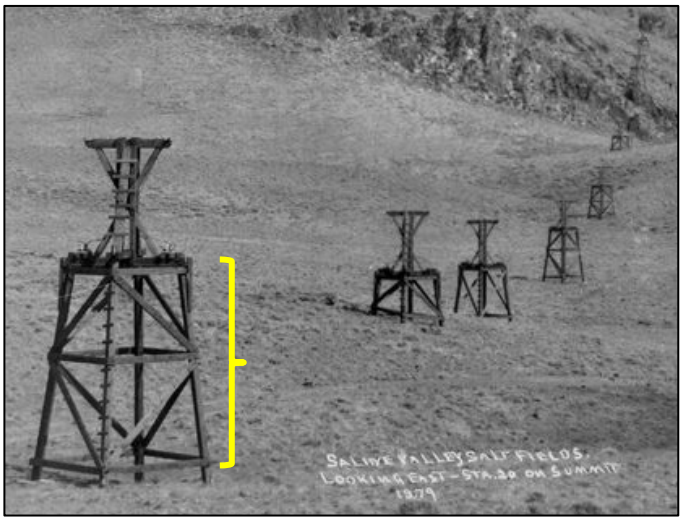


Figure 20. Support towers marching east from Owens Valley toward the summit, with varying base heights, n.d. Cropped by author.

Supports

Intermediate towers, or *supports*, were constructed of wood or steel, as needed. Spacing between supports was determined "by the contour of the ground and the capacity of the line. Over level ground the distance apart [varied] from 200 to 300 feet. In mountainous localities, where the contour [was] rugged…, the distances between the supports [varied] greatly, being closer on the ridges and wider apart in the valleys."[23] For the Saline Valley Salt Tramway, the supports were nearly identical with only the base structure differing in height from support to support (fig. 20), and nearly identical to other supports advertised in the Trenton-Bleichert pamphlet. Distances between the supports varied. Based on the four extant support structures managed by Death Valley National Park, the supports were located roughly two hundred feet apart. This has not been confirmed in the more mountainous areas (fig. 21).

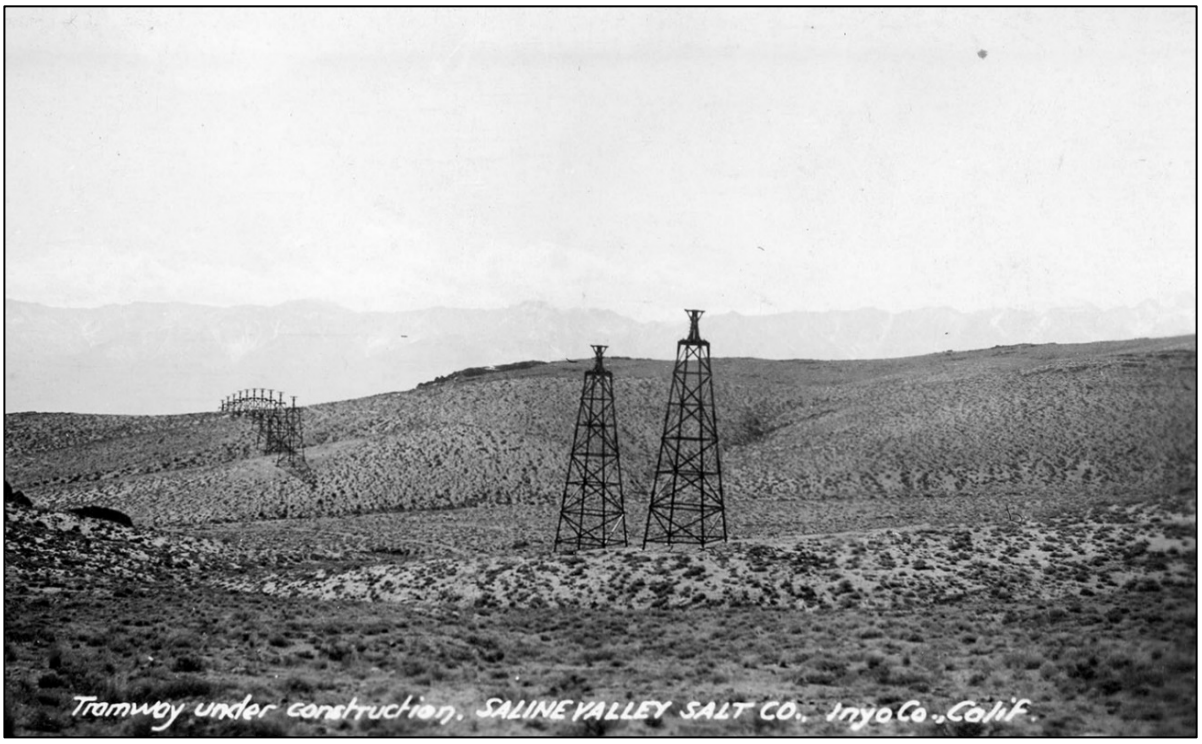


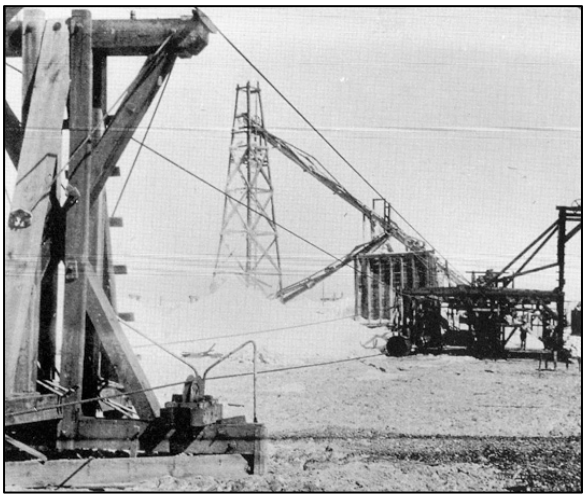
Figure 21. Supports of varying heights and distances apart for the Saline Valley Salt Tramway, n.d. This section is believed to be located between Station 28 and 29 on the east side of the mountains (according to salttram.blogspot.com).

[23] Ibid, 23.

Stations

For simpler tramways, the *loading terminal* and *discharge terminal* were the only required stations. The Saline Valley Tramway had one of each: the loading terminal was located in Saline Valley (fig. 22) and the discharge terminal was located in Owens Valley at Tramway (fig. 23).

For more intricate tramway systems, intermediate stations were required to load or discharge at intermediate points along the tramway. This did not occur at Saline Valley; all loading occurred at Saline Valley and all discharge occurred at Owens Valley.



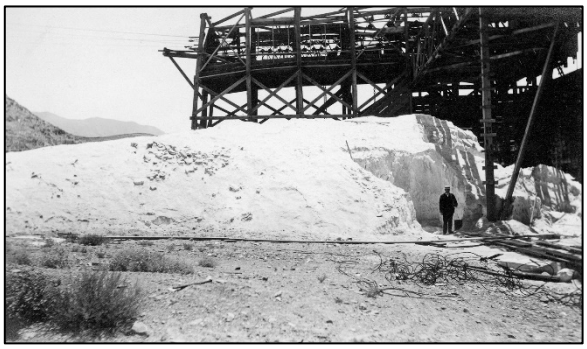


Figure 23, above. Discharge terminal, n.d.

Figure 22, left. Saline Valley loading terminal, right, and first support tower, left, n.d. The first support tower is still extant and one of the subject structure's of this HSR.

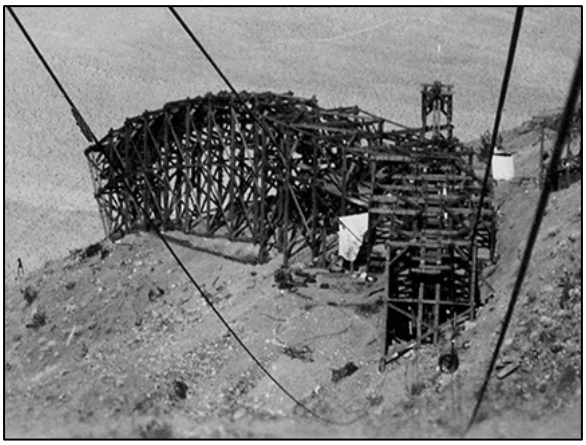


Figure 24. Control Station No. 1 was also a angle station allowing the tramway to turn to the east, n.d. Cropped by author.

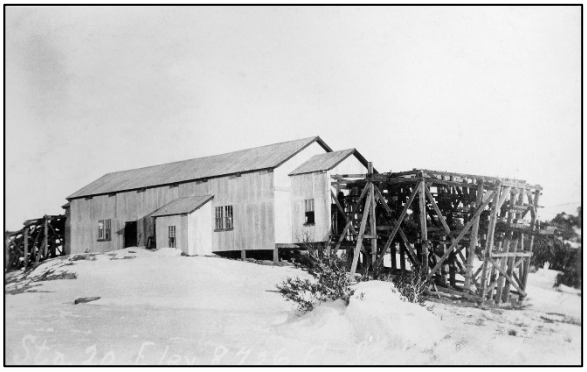


Figure 25. Control Station No. 3 at the summit, was also an angle station allowing the tramway to turn to the south, n.d.

Tramways of considerable length or substantial capacity were sometimes "divided into sections, owing to bends in the line, or on account of the stress in the traction rope, which if operated in one length would be so great as to preclude the ordinary sizes of ropes such as the grips are constructed for." *Connecting stations* were constructed where most advantageous, such as where

the line made an angled turn.[24] At Saline Valley, these were called Control Stations. Four control stations divided the entire tramway into five independent lines; three sections on the east slope from the loading terminal and two sections on the west slope down to the discharge terminal. Three of the four control stations were also angle stations (discussed further below) which allowed the tramway to turn at an angle to the left or right (figs. 24-25).

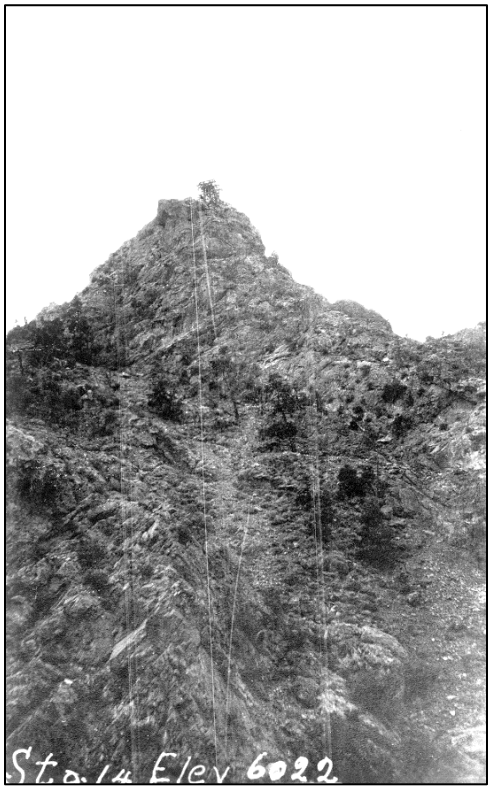


Figure 26. Identified as Station 14 of the Saline Valley Salt Tramway, this station was a rail support station, n.d. Note the extreme angle requiring this station at this location.



Figure 27. Protection saddle.

Trestles, or *rail stations*, were constructed "where much of the vertical angle occur[ed] in passing over a ridge or bluff." These trestles consisted "of a series of bents, from 15 to 20 feet apart, that usually support[ed] lines of rails overlaying the track cables." Where traffic was light, "ordinary saddles [were] sometimes used in place of the rails. The rails, which [were] the same as used at the terminal and other stations, relieve[d] the cables of the undue wear to which they would otherwise be subjected."[25] Nine rail stations and eleven curved rail (or break-over) stations were located along the length of the Saline Valley Salt Tramway (fig. 26).

Spans longer than 1,000 feet, as at ravine, valley, or river crossings, were not "objectionable provided the loads [were] not so great as to produce too sharp an angle at either" end support structure. At such stations, special *protection saddles* were used (fig. 27). These saddles were equipped "with hinged steel hoods that cover[ed] a certain portion of the cable on both sides of the saddle, and protect[ed] it from undue wear." These saddles were also used at support towers where tension caused the cables to lift out of the saddle grooves.[26]

Tension Stations were used in tramways "of considerable length…to apply tension to the track cables at intermediate points on account of saddle friction." At the tension stations, the track cables parted and their ends either rigidly anchored or counterweighted. The carriers would pass from one section of track cable to the next via rails, like those used at terminals, without being detached from the traction rope. This required no interruption in the continuity of the track and allowed a tension station to simply act as special support. "According to the exigencies of the location," the ends of both sections' track cables were either both anchored (referred to as double-anchorage stations), one anchored and one counterweighted (referred to as anchorage-

[24] Ibid, 32.
[25] Ibid, 24.
[26] Ibid, 27.

tension stations), or both counterweighted (referred to as double-tension stations).[27] At the Saline Valley tramway, there was one double-tension station (with four counterweights) located close to the loading terminal within Saline Valley (Station 2; fig. 28), eight anchorage-tension stations (with two counterweights) located throughout the system (Stations 3-5, 9, 17-18, 26, and 35; fig. 29), and four additional anchorage-tension stations that also acted as curved rail stations (Stations 11, 22, 28, and 32).



Figure 28. Judging by the low-slope grade, this unidentified station appears to be the one double-tension station located along the tramway, which is known to have been the first station after the loading terminal in Saline Valley, also known as Station 2, n.d.

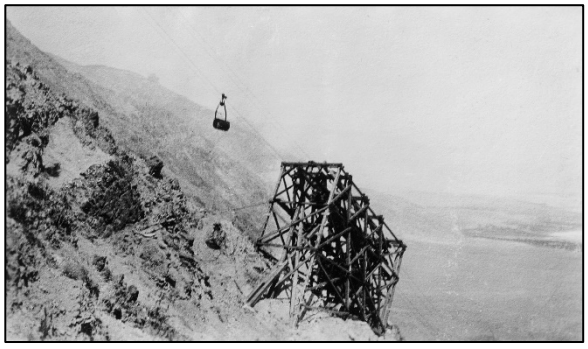


Figure 29. This unidentified station appears to be one of the twelve anchorage tension stations located along the tramway, n.d.

The following occurred when the carriers arrived at any type of station…

> The carriers…[were] automatically detached and shunted to overhead rails of our double-head pattern, made especially for this purpose, by means of which they [were] taken to the various points of loading or discharge, as the case may be, and thence to the opposite cable where they [were] attached mechanically to the traction rope, and again sent out over the line, loaded or empty, as the case may be. At the points where the carriers enter[ed] or depart[ed] from a station, the shunt rails terminate[d] in what [were] known as "terminal shoes"—a special form of saddle so designed that the transition of carriers to and from the cables is without jar. These shoes [were] provided with hinged steel hoods, similar to those used on the "protection saddles" …which save[d] the cables from undue wear.[28]

While a straight and shallow course was preferable for tramway construction, this was often not the situation. Bends or turns in the course were made possible by *angle stations*, by "supporting the necessary deflection sheaves and shunt rails." In systems with overhead grips (not present at Saline Valley), "the carriers…may be passed around the sheaves without detaching from the traction rope," as long as sheaves with a larger diameter were used; this caused more expensive station structures. In systems with underhung grips, like at Saline Valley, the carriers had to detach "from the traction rope upon entering the station, in order to pass the deflecting sheaves, and be re-attached in dispatching them from the opposite sides. Intervening shunt rails [were] used for this purpose and an attendant [was] required to pass the carriers and grip them to the traction rope." These stations were more expensive to include the added equipment and operating expenses. "There [was] no objection, however, to angle stations in cases where these

[27] Ibid, 27.
[28] Ibid, 32.

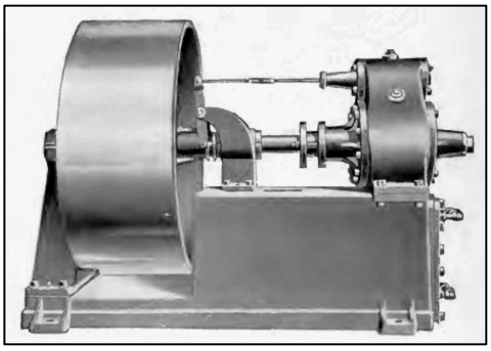


Figure 30. An hydraulic speed controller was used to control speed on a tramway with surplus power due to gravity.

happen[ed] at points of loading or discharge, or where one section of a line connect[ed] with another section, since stations with attendants [were] required at such points in any event."[29] This last sentence especially applies to Saline Valley where three angle-control stations were utilized (see figs. 24-25).

In tramways where the discharge terminal was located at a lower elevation than the loading station and the fall allowed gravity to create too much power to operate the line, *Speed Controllers* were used (fig. 30). When this scenario occurred, brakes, "consisting usually of steel bands lined with hardwood blocks. . .operated by levers or screws," were provided. If the surplus power was less than fifteen horsepower, the brakes were sufficient. If the surplus power exceeded fifteen or twenty horsepower, brakes alone were insufficient, and hydraulic speed controllers were required. These automatically regulated the speed.[30]

The surplus power created from gravity's effects on the line could be used to operate crushers or other machinery or for transporting freight in the other direction; however, it was recommended to not rely on the surplus power alone:

> If this surplus power [was] always in excess of the power required to run the machinery, or raise the back freight, as the case may be, a speed controller such as we have described should be attached to the operating mechanism, as otherwise it would be difficult to maintain a uniform speed, and the operation would be unsatisfactory. If the power required [exceeded] the surplus power developed by the tramway, always or even occasionally, an engine or motor of some kind with a suitable governor should be provided to supply the deficiency in power or absorb the excess, and serve[d] as a controller to maintain a uniform speed.[31]

It is known that the four Control Stations at the Saline Valley Salt Tramway were each equipped with an electric motor to provide uniform power and speed along the tramway line.

Automatic loaders were required at tramways with carriers which were permanently attached to the traction rope via clips. This required carriers to be loaded while in motion. Automatic loaders were considered "the exigency of a condition, and not a means introduced to save operating expense." Tramways with automatic loaders had to be run at slow speeds or the speed had to be slackened while the carriers were loaded. At some tramways, the line had to be completely stopped for loading. Automatic loaders could only be used on tramways with "relatively small capacity. A man [was] invariably required to attend to the brake or driving machinery, and the same man ha[d] also to attend to filling the automatic loading chute from the main bin, to say nothing of having to clean up the material spilled. . ." In Trenton-Bleichert tramways, the empty carriers automatically detached from the traction rope upon entering the loading terminal, "and by its own momentum [ran] to the loading point," at which location, the operator raised "the gate of the loading chute, keeping it open for few seconds until the bucket

[29] Ibid, 34-35.
[30] Ibid, 35.
[31] Ibid, 37.

[was] full, and then quickly clos[ed] the gate, he pushe[d] the carrier along the shunt rail into the mechanical attacher…which grip[ped] it again to the traction rope." This system was much quicker, required no additional labor, could be run at a constant speed, reduced the number of required carriers, reduced wear and tear, lessened cleanup of spilled material, and allowed for sending supplies back from the discharge terminal, versus a system with an automatic loader.[32] This latter system was certainly used at the Saline Valley loading and discharge terminals (figs. 31-32).

Carrier buckets were normally loaded from the holding bins through chutes, as was the case at Saline Valley (fig. 33). Where materials did not "readily flow through a chute," the carrier buckets could "be transferred to surface cars, conveyed directly to the working faces of the quarry or mine, …and after loading, returned to the tramway station, transferred back to the carrier hangers, and thus without rehandling of the material dispatched over the line."[33]

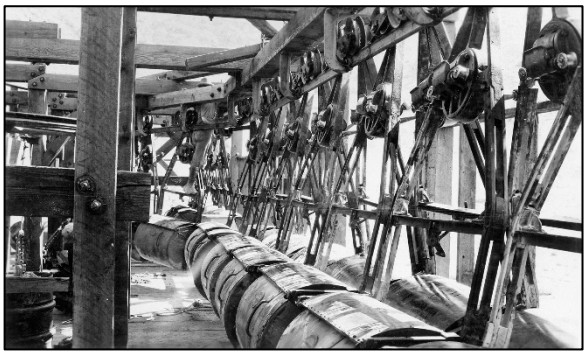


Figure 31. Salt carriers detached from the traction rope wait in line to be filled within the loading terminal, n.d.

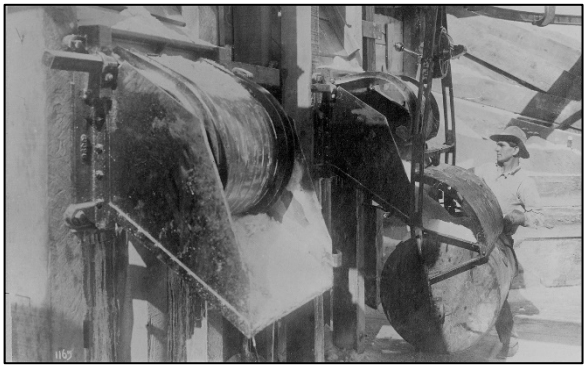


Figure 33. A carrier being loaded with salt at the loading terminal via a chute, n.d.

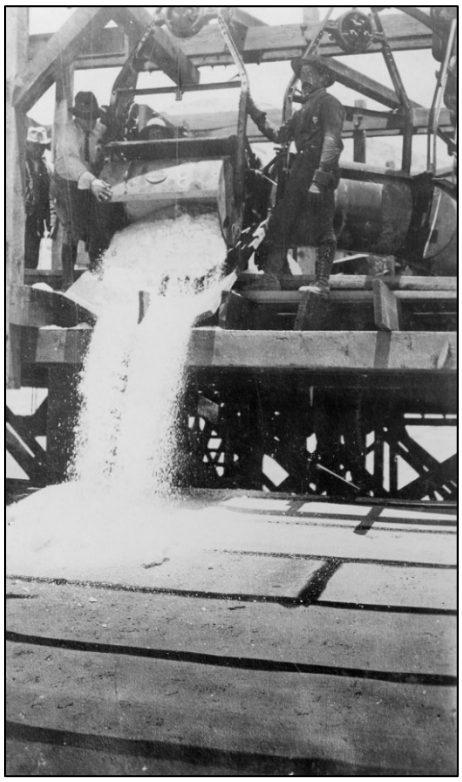


Figure 32. Salt carriers detached from the traction rope wait in line to be unloaded onto a conveyor belt at the discharge station, n.d.

[32] Ibid, 37-39.
[33] Ibid, 41.

USGS Saline Valley Salt Study

Construction of the Saline Valley Salt Company's tramway—noted as a "difficult piece of engineering work"—caught the attention of the United States Geological Survey (USGS). Because of the extensive operation to access the salt reserves within Saline Valley, the USGS believed "this salt deposit perhaps justifies a more extended consideration of the nature of the deposit and the industrial conditions affecting its utilization. . . ." An in-depth study was considered infeasible at the time, but USGS geologist Hoyt S. Gale visited the valley on October 27, 1912, "for the purpose of procuring samples of the salt for analysis to determine whether or not it contains soluble potash and for such incidental data as might be obtained bearing on the deposition of desert-basin salines." His visit and study resulted in an article entitled *Salt, Borax, and Potash in Saline Valley, Inyo County, California.*[34] The following description of salt deposits was included in Hoyt's report:

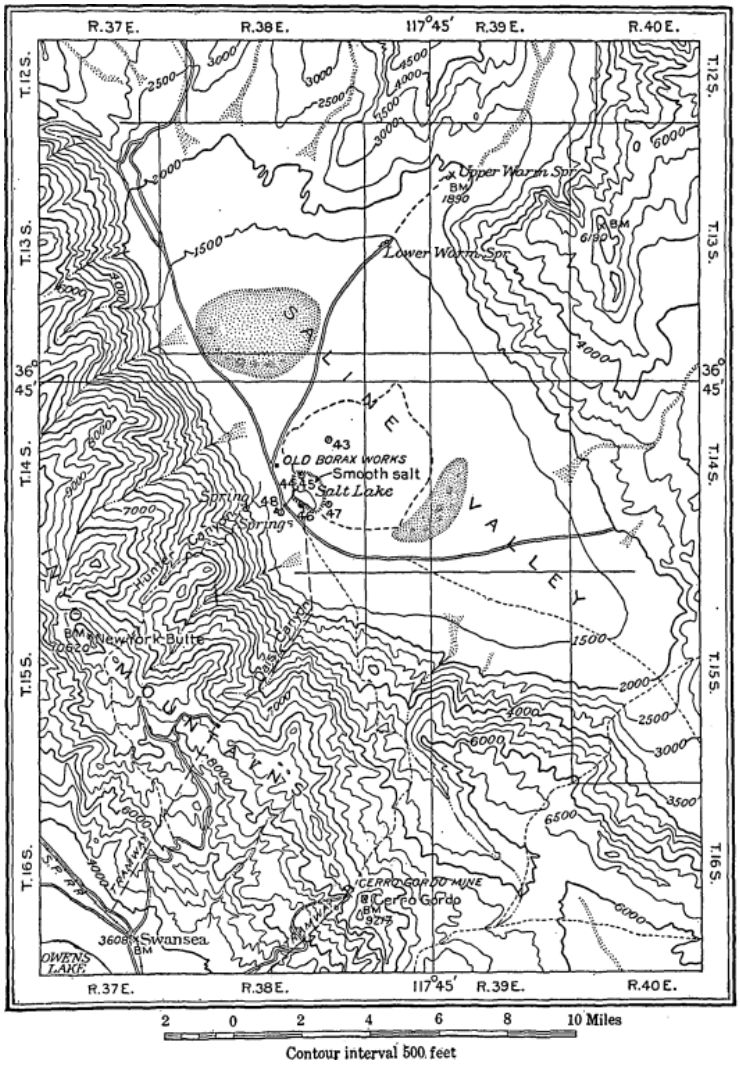


Figure 34. "Map of Saline Valley and vicinity, California, showing location of salt deposits," 1917.

The salt deposits of Saline Valley occupy the lowest part of the depression, which, like other desert basins, is completely inclosed [sic] by high drainage divides and has no outlet. Surface and ground waters derived from this area flow toward the central depression, which has probably been submerged, though perhaps only to shallow depths and for short epochs. No terraces or traces of upper shore marking were observed. The central or playa deposit of salts and mud, lying almost flat at the bottom of the valley, occupies approximately 12 square miles. Of this only about 1 square mile is composed of a smooth, white, salt crust containing a small pond of salt water. It is the white salt from this surface that is proposed to harvest and ship to market. Approximate outlines of these areas are shown on the accompanying map [fig. 34], which is taken from the recently completed map of the Ballarat quadrangle. The playa surface beyond the white salt is, like that of marginal salt crusts in some other desert basins, a

[34] Gale, Hoyt S. "Salt, Borax, and Potash in Saline Valley, Inyo County, California."

rough expanse of broken and tilted salt blocks which, having been partly dissolved by storm waters, now stand with an exceedingly sharp, craggy surface. The rough salt has a dirty brown color, doubtless due to the dust which is blown upon it in windstorms and which does not have an opportunity to settle out by occasional floodings and partial solution such as occur in the area of smooth salt.

The salt company's prospectus states that no refining or treatment other than grinding will be needed before placing the salt on the market, and it is assumed that in the main the product to be shipped will be gathered by scraping on the surface of the smooth salt. At the time of the writer's visit a great amount of salt had been piled in stacks ready for transfer to the tram for shipment when that shall have been completed. Samples of the undisturbed salt in these stacks were collected by the writer, with the intention of making a representative average sample of the salt on the ground. Portions were taken from the inner part of six of these stacks from various parts of the field, and these were combined and later mixed, quartered, and analyzed. The following analysis of this sample was made by R. K. Bailey, in the Geological Survey at Washington.

Ca	0.00		
Mg	.00		
CO_3	.00		
HCO_3	.00		
H_2O	.12		0.12
Insoluble	.17		.17
Cl	59.76	=NaCl	98.52
Na	39.09	$=Na_2SO_4$	1.02
SO_4	.95		
K	.11	$=K_2SO_4$	.37
	100.20		100.20

This analysis shows the salt to be of rather exceptional purity for an entirely natural product. One of the principal factors in its favor is the absence of soluble salts of magnesium or calcium, which would, if present as chlorides, tend to make the salt subject to caking on account of the attraction they have for moisture. With the exception of the small insoluble residue, which is doubtless dust blown in by the wind, the sulphate is the only impurity.

Very little is known of the thickness of the deposit, as it appears from reports that no satisfactory drilling has been done. Shallow holes dug in the surface of the white salt crust for the purpose of obtaining samples of the underlying brines show a surface thickness of 4 inches of a loose-textured, porous white crystalline salt, below which is a layer of dark-greenish or almost black saline mud several inches thick. Other layers of hard salt are encountered below this mud, so that it is difficult to dig the deposit with an ordinary shovel, not only on account of its hardness but also because the pit immediately fills with the freely flowing brine.

The ground water stands so high that either the salt crust is barely submerged or water or brine will fill any hole dug in the salt almost at once, rising practically to the surface level. Thus the salt crust is not so hard as it would be on a dry surface and is readily worked. The salt on the surface of the salt flat is gathered by raking or scraping it into heaps while in a wet or slushy condition. The crystals become dry in the stacks and are benefited if washed by an occasional rain. The outer surfaces of the stacks become "sunburned" or somewhat darkened on exposure. This is probably due to the dust swept over them by the wind.

Although it is stated that the principal harvest is that of the natural salt crop, which continuously replaces itself, a series of evaporating vats have been built about the southwest margin of the salt flat and pond, where, by evaporation of the liquor of the lake or

> recrystallization of the less pure salt from the area surrounding the white salt, the production can be increased.[35]

Hoyt's report went on to comment on the "Market for the Salt":

> The total production of salt in California in 1911 was approximately 150,000 short tons, the average value of which is listed as $3.65 a ton. The price quoted for California salt is considerably higher than the average price for salt in the United States as a whole. The finer dairy salt is sold at prices higher than that given for the average, but much of the coarse solar salt is sold below that price. The market for the refined salt is of course more limited than that for the course. It has been estimated that 12,000 tons of refined salt from the Eastern or the Middle Western States, such as Kansas and Michigan, are shipped for use on the Pacific coast annually. Other than this the California and other western markets are now supplied chiefly by the solar evaporation plants already established on San Francisco Bay, at San Pedro, and elsewhere, and by the smaller output from natural deposits of the desert-basin type.[36]

While on site, Hoyt also collected samples for testing for potassium compounds (potash). "The results of the tests were practically negative. . .," i.e. further exploration could not be justified.[37] He also commented on the borate deposits within the Valley, which had been formerly mined and abandoned. He believed the borax had "been largely worked over and exhausted."[38]

[35] Ibid, 418-419.
[36] Ibid, 419-420.
[37] Ibid, 420.
[38] Ibid, 421.

Chronology of Development and Use

Early Mining in Saline Valley

"Saline Valley is an undrained basin. . .about 15 miles northeast of Owens Lake. A 12-square mile circular area in the lowest part of the valley is occupied by a playa, whose surface is covered with mud and rough, broken blocks of dust-coated salt. A pond of salt water called Salt Lake, fed by a fresh water spring, is to be found on the southeast side of the area of rough salt, and around it is about 1 square mile of smooth, clean salt, recrystallized by occasional floods of storm water."[1] (See map, fig. 35.)

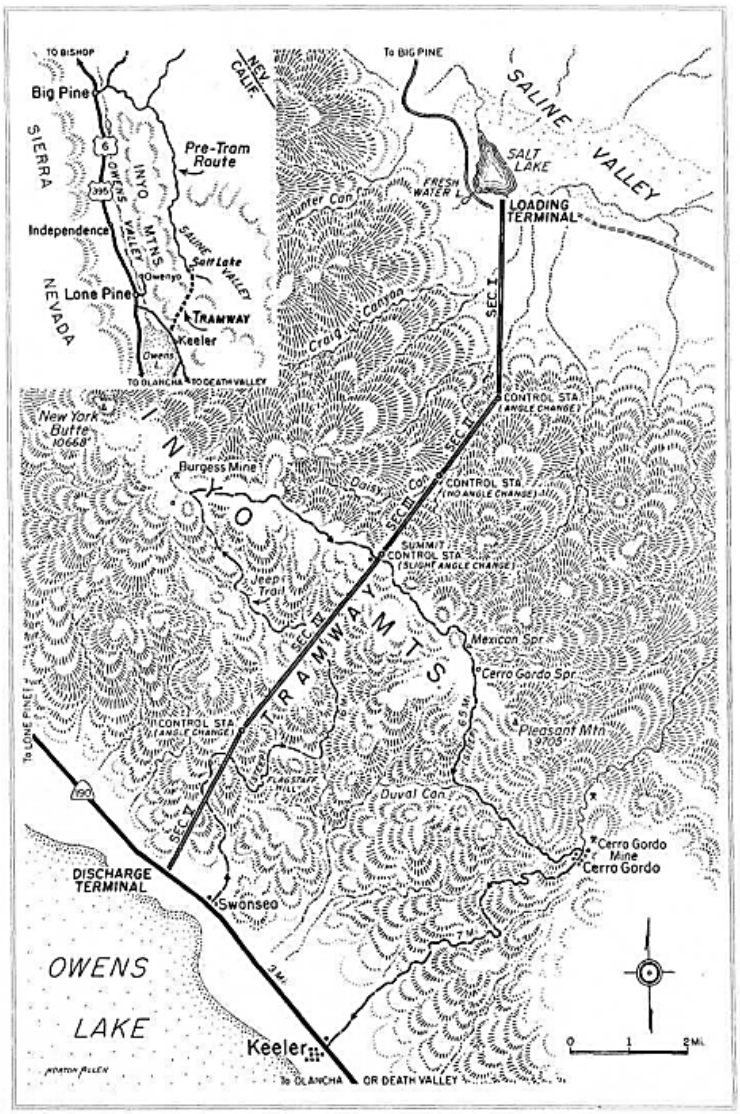


Figure 35. A map of the location of the tramway from the Saline Valley over the Inyo Mountains to the Discharge Terminal on Owens Lake to the southwest, n.d. Note the inset map showing the circuitous route required prior to construction of the tram.

The potential value of the "unusually pure" salt deposit in Saline Valley "must have been known to the early miners in the Ubehebe district," although "lack of transportation delayed its development. Even after the narrow gauge Carson and Colorado Railroad was completed through Owens Valley to Keeler in 1883, the problem was not solved." From Keeler, in the Owens Valley west of the Inyo Range, to the Saline Valley, "a wagon required two days for the roundabout journey across the Inyo Range to the salt deposit by way of Waucoba Canyon, a distance of only about 12 miles by air."[2]

[1] Ver Planck, "Salt in California," 25.
[2] Ibid, 116.



Figure 36. Saline Valley from the southeast, ca. 1958. Source: Ver Planck, "Salt in California," p. 26.

The Saline Valley salt deposit was "discovered" in 1864 by a farmer (surname Smith) from Owens Valley. "Using horse-drawn teams, Smith scraped and removed salt from the surface of several square miles of the salt marsh…"[3] and transported wagon loads of salt back to Owens Valley to the southwest using the circuitous route described above (see inset, fig. 35). He then sold the salt to area residents for domestic purposes, like table salt and butter making. "Because of the difficulties in transporting the salt out of remote Saline Valley, Smith sold the product for a very expensive $20.00 per ton (approximately $318 in 2019). Due to the excellent quality of the product, however, Smith never lacked customers, but he eventually abandoned the project because it was still too costly to haul the salt out of the Saline Valley by wagon."[4]



Figure 37. Salt team in Saline Valley, prior to any mechanized transport means, n.d.

[3] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 88.
[4] Norwood, et al, "A Cultural Resource Overview of the Eureka, Saline, Panamint, and Darwin Region; East Central California,"142.

During the 1880s "a gold stampede took place into the Saline Valley and the Ubehebe Mountains forming its eastern boundary. It is said that more than 2,000 people were camped in this valley during the height of excitement. At that time, it became generally known that there was a great salt deposit of remarkable purity in Saline Valley."[5] In March 1882, the *Inyo Independent* reported that the "well-known salt beds" had "suddenly jumped into public notice." A group of individuals led by "Surveyor J.B. Treadwell and J. Wal. Phillips have located and recorded 18 claims of 160 acres each, each claim being taken by eight individuals or company owners." Judge H. Caleff, a former Inyo County resident, and representative of a Wadsworth, NV company, also made claims for "all sorts of saline properties for the base deposits of the valley—borax, potash, sulphate soda and rock salt in inexhaustible quantities."[6]

In July 1889, the *Inyo Independent* noted a H.H. Spear had hauled "salt from Saline Valley to Owens Valley." The first haul went to Round Valley; the next would go to Long Pine.[7]

"In 1902, the Conn and Trudo Borax Company, which owned several hundred acres in the valley, opened a small facility for borax mining."[8]

In 1903, the Saline Valley Salt Company (SVSC) was incorporated in Arizona with J.L. Bourland as president. SVSC worked the area on a small scale in 1903 and 1904. The death of Bourland in 1905 ended this phase of production.[9] After Bourland's death, White Smith—who reportedly had once been an employee of the Borax Company and had hauled borax in and out of Saline Valley[10]—was determined to develop, along with younger brothers Fred and Eugene, the salt works in Saline Valley. (See Historical Background & Context section for more information on White Smith and his family.)

In 1905, SVSC conducted a study of the transportation issue of conveying Saline Valley salt over the Inyo Mountains to Owens Valley.[11] Construction of a railroad was deemed infeasible, but two other options were considered, and cost estimates were completed.

One option was the construction of a pipeline which would pump the salt as brine from Saline Valley to evaporating vats located at the railroad in Owens Valley.[12] This option made the front page of the *Inyo Independent* in September 1910. W.H. Leffingwell proposed use of "a 4-inch, asphalt-coated steel pipe" to carry a salt solution over the mountain range. On the east side, from Saline Valley to the summit, the solution containing 25-percent salt would be "forced through the pipe by means of many pumps. At each station will be a large tank from which the brine will be pumped to the next station." From the summit down to Owens Valley, gravity would do its job "to carry the solution to the large vats which will be built near Swansea, where it

[5] Carstarphen, "An Aerial Tramway for the Saline Valley Salt Company, Inyo County, California," 527.
[6] "Saline Valley." *Inyo Independent,* March 18, 1882, 1.
[7] "Big Pine Notes." *Inyo Independent,* July 27, 1889, 3.
[8] Norwood, et al, "A Cultural Resource Overview of the Eureka, Saline, Panamint, and Darwin Region; East Central California," 142.
[9] Ver Planck, "Salt in California, 116.
[10] DeDecker, "White Smith's Fabulous Salt Tram," 8.
[11] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 88.
[12] Carstarphen, "An Aerial Tramway…," 528.

will be evaporated and the 'crop' harvested.... This will deliver 100 tons of salt daily to the vats."[13]

The second option was the construction of an aerial tramway. White Smith began surveys of the area in 1908 in preparation of tramway construction "which would link the salt marsh of the Saline Valley with the railroad depot at Keeler." With the tram in place, SVSC conjectured that transportation costs per ton of salt would be reduced from $20 to $4![14]

Upon comparison of the two transport options, each was found feasible. However, the tramway allowed for transportation of supplies and materials in the reverse direction, into Saline Valley, and was therefore considered more versatile.[15]

In September 1910, the *Inyo Independent* reported that a separate interest was set to appear before the Inyo County Board of Supervisors "with the facts and figures" to prove a road into Saline Valley, paid for by the county, would benefit the area and the interests within the Valley.[16] The road did not come to fruition at this time.

The same month, the *Inyo Independent* also reported that George D. Ferrell, of Humboldt, TN, a friend of T.G. Scales of Bishop, CA, had come to Saline Valley. Upon returning to Tennessee he "interested many of his friends in the wonderful proposition" of salt mining in Saline Valley. J.A. Goodman, "cashier of Germania bank in Memphis," and J.C. Penn and Thomas E. Acklen, also of Memphis, travelled to the Saline Valley in August 1910 to ensure their efforts of fundraising in Tennessee were warranted; "they realized that there was no uncertainty of an investment of this kind."[17] Ultimately, White Smith "and 71 others filed claims amounting to 1480 acres." One claimant "included W.W. Watterson, a prominent figure in the history of Owens Valley"[18] and likely brother-in-law of White Smith.

Saline Valley Salt Company Tramway

Design & Construction

Preliminary engineering surveys for placement of the tramway within the Inyo Mountains began in spring of 1911; engineers sought "to determine the best route between the salt fields at Saline Valley and the railroad" on the other side of the mountain range. According to the *Inyo Independent* in March 1911, four surveys were to be conducted, estimates were to be completed, and then the company would determine the most feasible route. The article announced that the enterprise was fully funded and much of the stock was reserved and purchased by Inyo County residents. At this time, the company hoped to have the tramway up and running for salt shipment starting October 1, 1911 (wishful thinking!).[19] Engineers included W.H. Leffingwell,

[13] "Another Great Enterprise for Inyo." *Inyo Independent,* September 9, 1910, 1.
[14] Norwood, et al, "A Cultural Resource Overview of the Eureka, Saline, Panamint, and Darwin Region; East Central California," 142.
[15] Carstarphen, "An Aerial Tramway...," 528.
[16] "Proposed New Road to Saline Valley." *Inyo Independent,* September 23, 1910, 1.
[17] "Another Great Enterprise for Inyo." *Inyo Independent,* September 9, 1910, 1.
[18] DeDecker, "White Smith's Fabulous Salt Tram," 8.
[19] "Saline Valley Salt Co. Survey Started." *Inyo Independent,* March 24, 1911, 4.

chief civil engineer of Mono Power Company and resident of Bishop, CA; Mr. Morton, pacific representative of Trenton Iron Works of New Jersey; and C.H. Wickham, a prominent engineer of Trenton Iron Works and "an authority of tram ways."[20] Due to the rugged topography, survey work was difficult for the team: "...there was great difficulty in reaching the points traversed by the line. In numerous cases, when the survey parties were working in deep canyons, days were consumed in finding a feasible path of ascent to the summits of the cliffs."[21]

Leffingwell oversaw the final survey, beginning in April 1911, to determine a suitable location for the tramway, which would then determine the final cost. "Several trial lines were run, and a location was selected in the latter part of May. Under the direction of...Wickham, ...a final location was completed in July. The profile, together with the topographical surveys, were submitted to the Trenton Iron Company for consideration."[22] Cost estimates ranged from $250,000 to $500,000.[23]

In June 1911, the Saline Valley Salt Company officers, elected by company stockholders, were announced in the *Inyo Independent*:

> President: White Smith
> Vice-President: T.G. Scales
> Secretary and Treasurer: [Frederic Robert] Smith
> Directors: White Smith, N.J. Cooley, Will L. Smith, George D. Ferrell, T.G. Scales, J.A. Goodman, [Eugene Ewart] Smith, [Frederic Robert] Smith, and W.W. Yandell
> Finance and Executive Committee: Will L. Smith, N.J. Cooley, and White Smith[24]

On August 14, 1911, a contract was signed between SVSC and Trenton Iron Company, a subsidiary of the American Steel & Wire Company headquartered in Trenton, NJ. The following description was included in a report to the American Society of Civil Engineers by F.C. Carstarphen in 1917:

> This contract called for the preparation of the designs and finished drawings, as well as the wire cables, carriers, and machinery, for a Trenton-Bleichert tramway to carry salt weighing 60 lb. per cu. ft., the slope length of the line being 69,645 ft., the capacity 20 tons per hour, the elevation of the discharge terminal above the loading terminal, 2,450 ft., the carriers to have a volume of 12 cu. ft., and the speed of the traction rope to be 500 ft. per min. [resulting] in a spacing of 525 ft., or 63 seconds, between contiguous carriers. More than 112 h.p. [would be] required for its operation. The following items occur as prominent parts of the specifications:

Patent locked coil steel track cable, 1¼-in.	13 850 ft.
" " " " " " 1⅛-in.	55 450 "
" " " " " " ⅞-in.	69 300 "
Special steel traction rope, ¾-in.	141 000 "
Special steel buckets, capacity 12 cu. ft., with protecting covers; and hangers, carriages, and patent compression grips	286
Intermediate supports	120
Track cable saddles	240
Steel traction rope rollers, with shafts, bearings, bolts, washers, foot castings, etc.	240

[20] "Salt Company Starts Operations." *Inyo Independent,* April 21, 1911, 1.
[21] Carstarphen, "An Aerial Tramway...," 532.
[22] Ibid, 529.
[23] DeDecker, "White Smith's Fabulous Salt Tram," 10.
[24] "Saline Valley Salt Company." *Inyo Independent,* June 23, 1911, 1.

The specifications also included the erection of the timber work and attaching the machinery; the equipment for one loading terminal, one discharge terminal, five intermediate control stations, twenty-one rail structures, twelve anchorage-tension structures, and one double-tension structure; tools for coupling and splicing track cables and tension rope; the necessary signal gongs for the control of the line when in operation; track cable oiling cars, traction rope oiling tanks, and water carriers.

The difficulties of construction on this line may be inferred from an inspection of the profile, [fig. 38]. . . . The west side of the Inyo Mountains, though broken into a number of precipitous ridges, does not impose extreme difficulties to aerial tramway erection. The average elevation of the crest of these mountains is 10,000 ft. above sea level, and it runs in a northerly and southerly direction. However, there is a saddle in the crest line with an elevation of 8,500 ft., so that it was desirable to have the tramway pass through this gap. By utilizing the difference in elevation between the terminal stations, it was found that the 7,500 ft. required to pass the summit could be obtained by dividing the difference in altitude between the floor of Saline Valley and the summit into three 2,500-ft. sections; also, that the descent from the summit to Owens Lake could be made in two 2,500-ft. sections. The selection of a constant difference in the height of the several control stations was an important factor in deciding on a constant size of traction rope for all the sections. The use of intermediate control and driving stations added flexibility to the location of the line, as any reasonable horizontal angle can be made at such points.[25]

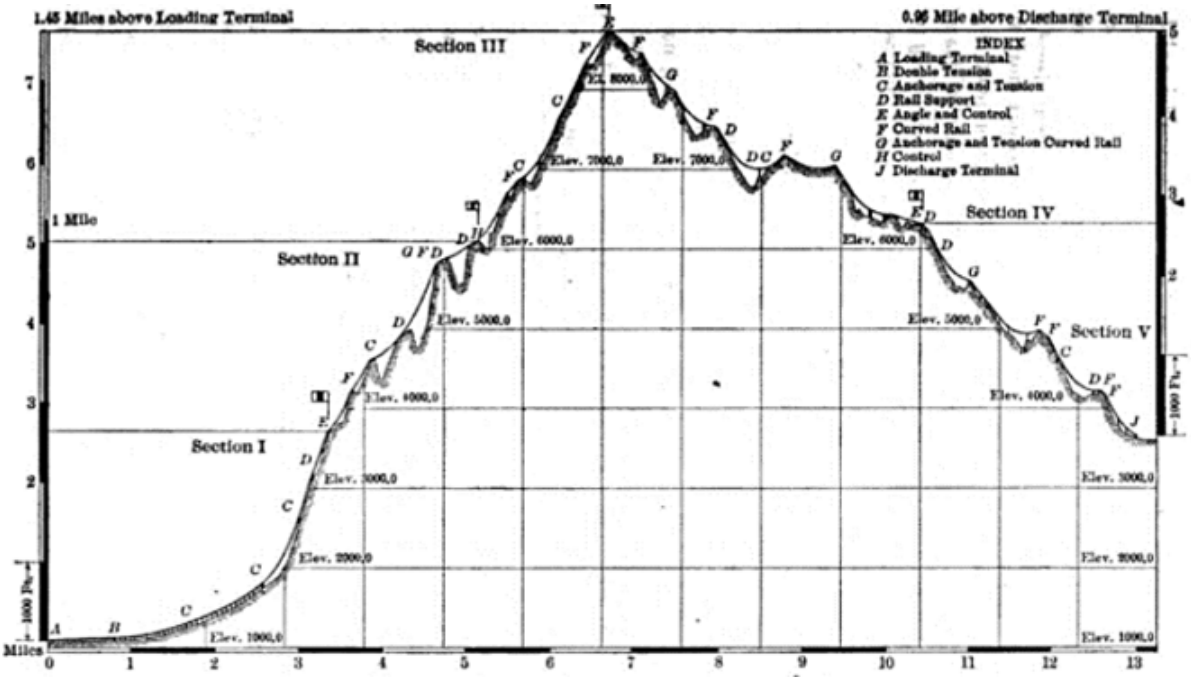


Figure 38. Profile of the Saline Valley Salt Company Tramway, 1917. This profile looks south, with the eastern loading terminal at left and western discharge terminal at right. The five sections of the tramway are distinct, with three on the eastern (left) slope and two on the western slope (right).

[25] Carstarphen, "An Aerial Tramway…," 528-529.

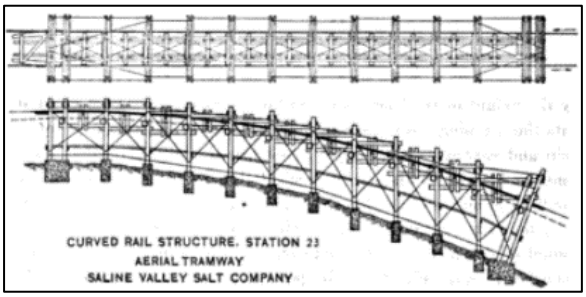


Figure 39. Plan and section drawings of the curved rail structure located at Station 23, on the west side of the mountain, n.d.

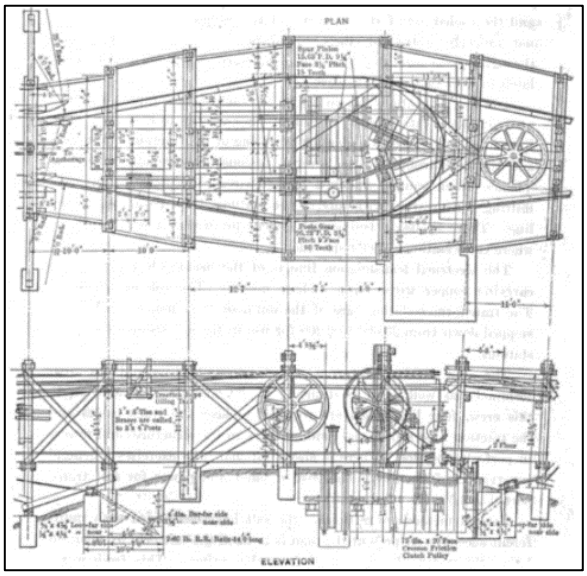


Figure 40, right. Plan and section of Control Station No. 3 at the (also known as Station 20), which commanded control of Section III coming from the west out of Saline Valley and Section IV heading east down into Owens Valley, n.d.

Construction of the tramway began on September 1, 1911 with framing of the timber towers in Section IV[26] on the western side of the Inyo range, as terrain on this side was less formidable. In addition, the Southern Pacific Railroad already had a narrow-gauge line in place on the west side which "skirted the eastern shore of Owens Lake and terminated at Keeler." The line supported 'Slim Princess' engines which were smaller in size to others in use by the railroad. SVSC attempted to persuade Southern Pacific to name the end of the line 'Swansea,' but instead it was named 'Tramway.'[27] Regardless, the extant rail line eased shipment of supplies for the construction of the aerial tramway.

Construction materials—including 650 tons of iron in bolts, nuts, braces, etc. (two box cars held nuts and bolts alone); 1,300,000 board feet of Douglas fir lumber; 5,000 bags of cement; and 265,000 feet of cable—were unloaded by 35 to 50 men at the Tramway railroad stop.[28]

An 'old charcoal road' was already extant on the west slope of the mountain "at a point on the railroad about 3½ miles north of Keeler. . .to within about a mile of the summit crossing." The road was repaired and made serviceable and connected to the summit with new construction. A 300'-long portion of the old road at 5,900' elevation had a 25% grade; without exorbitant expenditure, this grade could not be improved or eliminated. Therefore, "25% became the ruling grade for hauling the material needed for the construction between Control Stations 4 and 1." At this grade, eight horses could only be required to haul 5,000 pounds maximum; ten or twelve horses were required for heavier loads.[29]

The distance between Owens Valley and the summit was approximately ten miles, so a camp was established 3.5 miles west of the summit. "By this arrangement, teams could make one trip per

[26] Ibid, 532.
[27] DeDecker, "White Smith's Fabulous Salt Tram," 10, 13.
[28] Ibid, 13.
[29] Carstarphen, "An Aerial Tramway...," 532.

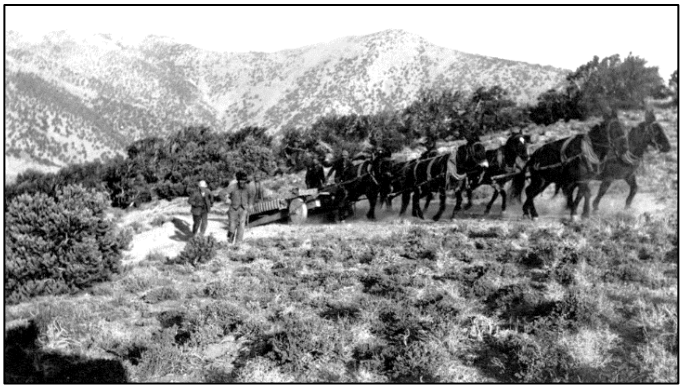


Figure 41. A six-mule team hauling a go-devil (described below), ca. 1911-13.

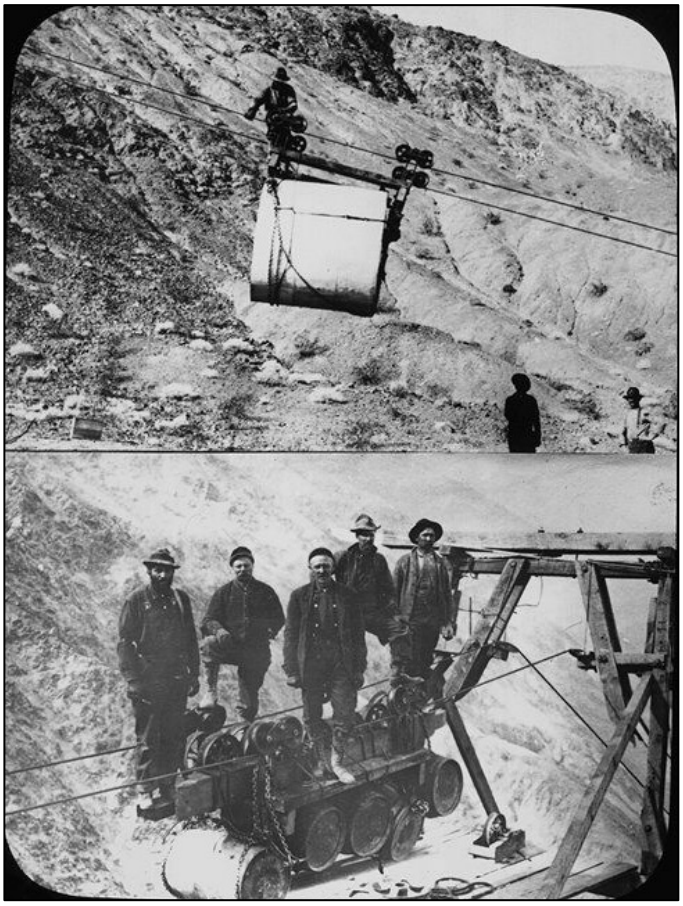


Figure 42. The temporary tramway constructed to haul supplies on the east slope of Inyo Mountains, ca. 1911-13.

day from the railroad to the camp, leaving their loaded wagons for other teams, quartered at the camp, to haul to the summit and unloaded. The camp teams could make three trips in 2 days." An interesting statistic notes that for every 70.3 tons of material hauled for tramway construction, an additional 1.1 tons of grain, 5.4 tons of hay, and 23.2 tons of water had to be hauled from the railroad to the summit camp for the horses! A "team" of one driver and eight horses stationed at the railroad cost $15 per day; due to the cost of hauling their own supplies, the camp team cost $21 per day.[30]

The permanent tramway structures were supported by concrete foundations. Water "for making the concrete was hauled in tanks or packed by mules for distances ranging from 1 to 7 miles. This was also true for the water required at the camps, except those at the railroad, in Daisy Canyon, and Saline Valley." Firewood was not available on the mountains, so this too had to be hauled or packed to the camps.[31]

Construction of a road on the east side of the mountain range was determine impossible. With great difficulty, a 'Zig Zag Trail' was constructed over the summit to Saline Valley in 1912 (fig. 43). United States Geological Survey (USGS) geologist Hoyt S. Gale noted the Zig Zag Trail was "a remarkable rock-cut trail, picturesque in the extreme from its ruggedness and the precipitous gorges and rocky slopes it discloses."[32] When in good condition, a trip from the Saline Valley floor to the summit could be made via the Zig Zag Trail "in one strenuous day."[33] Pack animals were unable to move the heavy machinery required for tramway

[30] Ibid, 532, 537
[31] Ibid, 543.
[32] Gale, "Salt, Borax, and Potash in Saline Valley, Inyo County, California," 417.
[33] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 90.

construction, so "temporary, double-cable, reversible tramways" were constructed (fig. 42). Significant amounts of material were transported in this manner.[34]

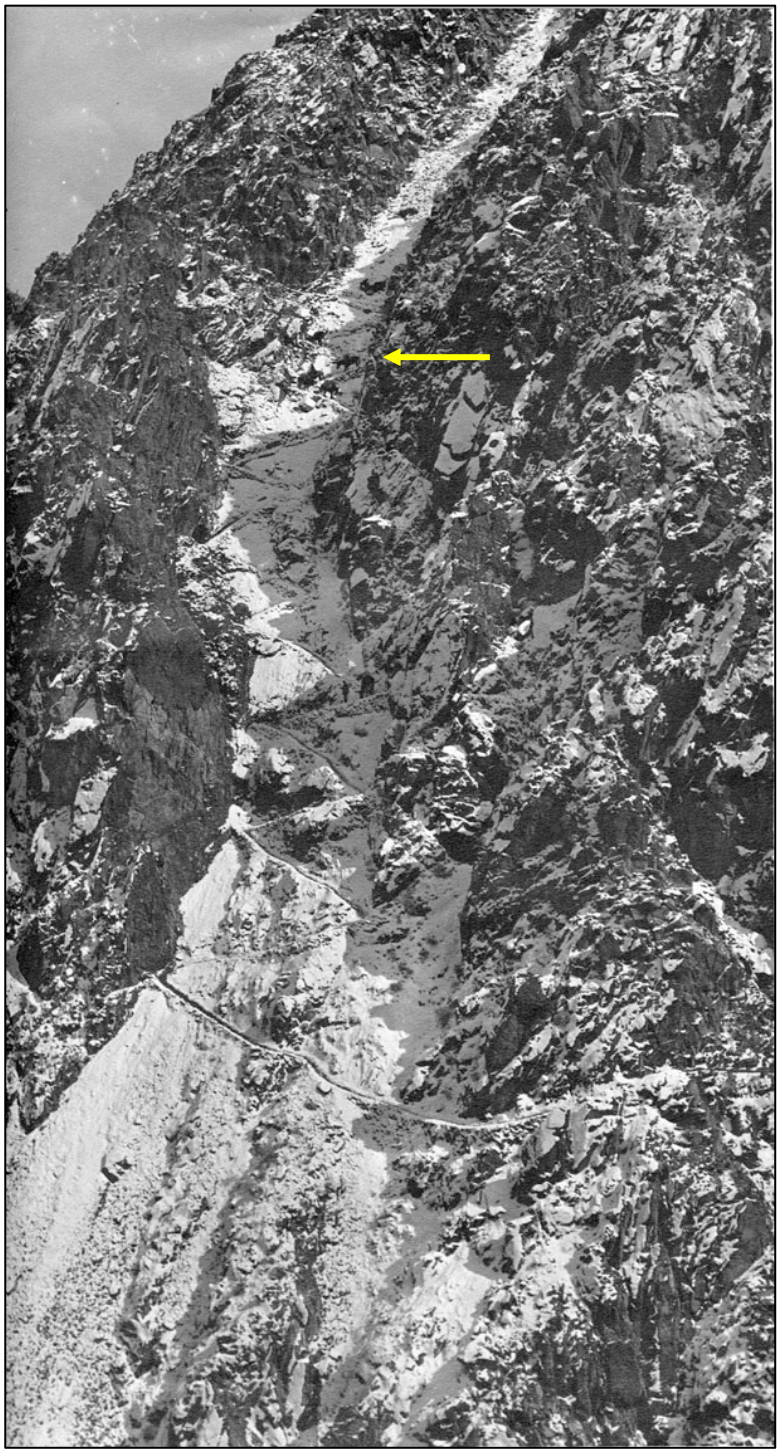


Figure 43. Pack mules descending a steep trail full of switchbacks (arrow), ca. 1911-13. This could be the Zig Zag Trail, both "picturesque and extreme."

[34] Carstarphen, "An Aerial Tramway…," 537-538.

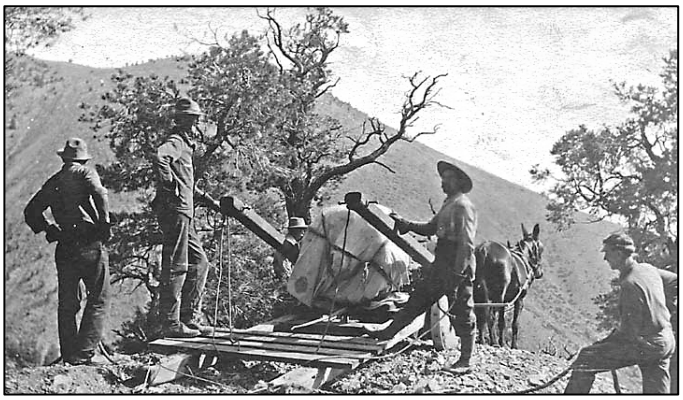


Figure 44. Go-devil team, with two "brakemen," ca. 1911-13.

A "go devil" (fig. 44)—consisting "of a timber frame supported on an axle 8 ft. long which passed through two heavy wheels"—was used between the summit and Daisy Canyon to the east to transport the cables required between Control Stations No. 1 and No. 2, a 75-horsepower motor, transformers, and other heavy station materials (fig. 45). From this point in Daisy Canyon, "the material was moved to Control Station No. 2 on a tramway constructed with two carrying cables mounting four carriers."[35]

The approximately 55-mile-long wagon road extending from the railroad at Big Pine south though Waucoba Canyon into Saline Valley was the original extraction route for early salt mining efforts. This road was used to haul approximately 375 tons of construction material.[36]

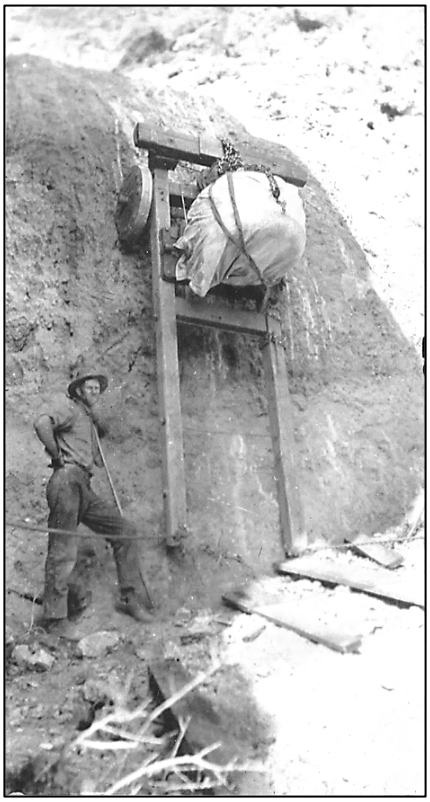


Figure 45. A go-devil being hauled up a cliff, ca. 1911-13.

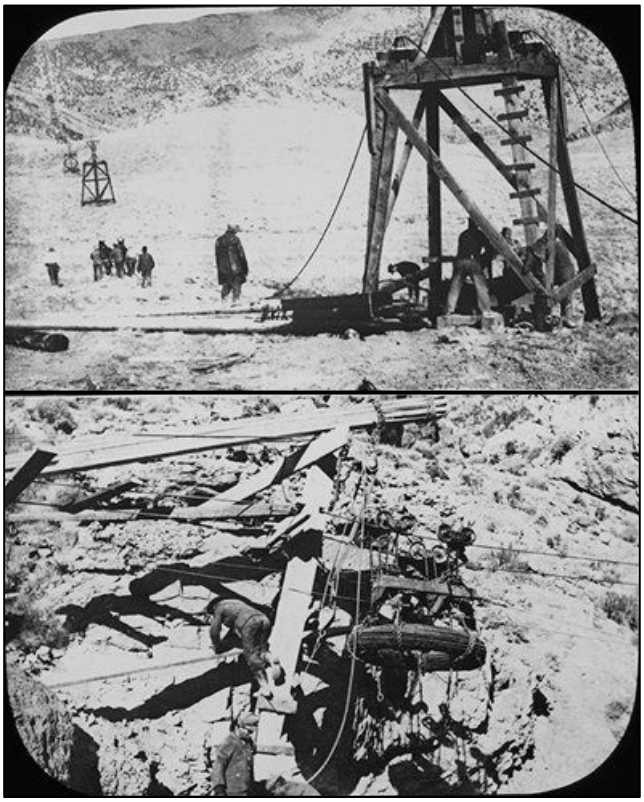


Figure 46. Several methods were used to run the cables atop the support towers, along the length of the tramway, ca. 1911-13.

[35] Ibid, 538.
[36] Ibid, 538.

Different systems were used to run the cables between Control Stations (fig. 46). From the summit Control Station No. 3 east to No. 2 and from Control Station No. 2 east to No. 1, the strategy "consisted of coupling cables together and letting them down the mountain side by gravity [fig. 47]. It was necessary to keep from three to five men at the leading end so as to put the cables on the traction rope guide sheaves of the towers and stations. The velocity of the cable was controlled with 4 by 8-in. blocks bolted together, so that the cable could be squeezed as it passed along." These "brakes" were replaced periodically. Between Control Station No. 1 and "Structure 4" (assumed to be at the loading terminal at the Salt Lake), "the cables were pulled up with a winch driven by a gasoline engine."[37] At tramway Section IV and V on the west side of the mountain, "the cables were strung and placed under tension in the usual manner, except that on Section V the grade was sufficient to make it desirable to use the gravity method."

Snowstorms were frequent between October and April; drifting snow and challenging terrain created hazards for construction, especially above 6,500' elevation. Spring landslides occasionally occurred on the eastern slope and were "disastrous to the construction crews." Work was rescheduled so that all winter work occurred below the snow line.[38]

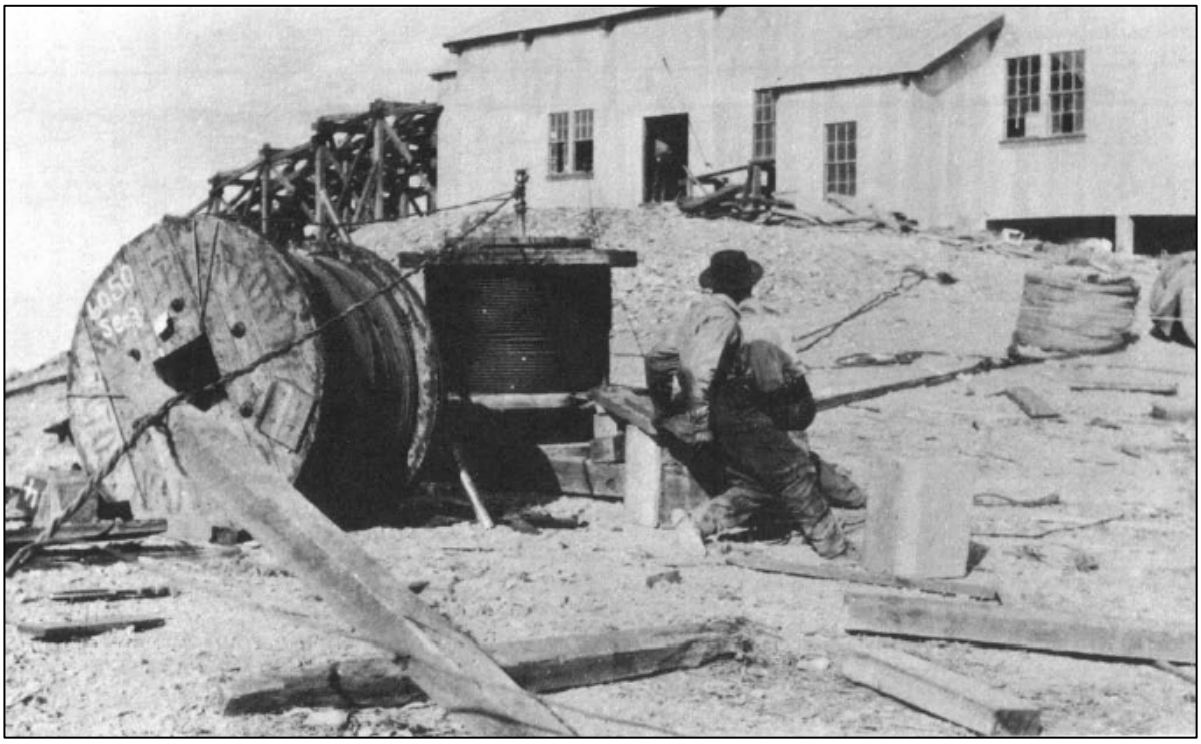


Figure 47. A worker at the summit control station sitting next to spools of cables to be run down into Daisy Canyon, ca. 1911-13.

Construction of the tramway caught the attention of the United States Geological Survey (USGS). Because of the extensive operation to access the salt reserves within Saline Valley, the USGS believed the salt deposit required exploration. USGS geologist Hoyt S. Gale visited the valley on October 27, 1912 to procure samples of the salt for study. His visit and study resulted

[37] Ibid, 538, 543.
[38] Ibid, 543.

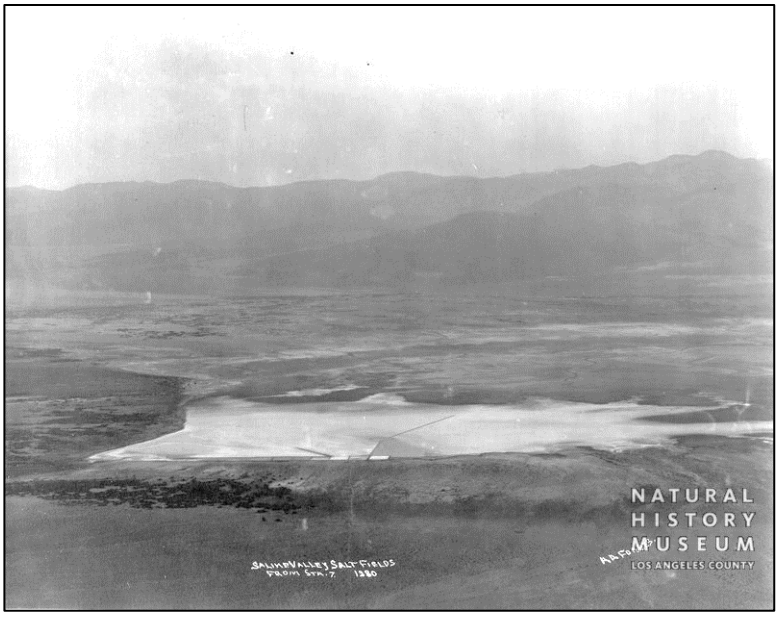


Figure 48. Saline valley salt lake from Station 7 (or Control Station No. 1) above and southwest, n.d.

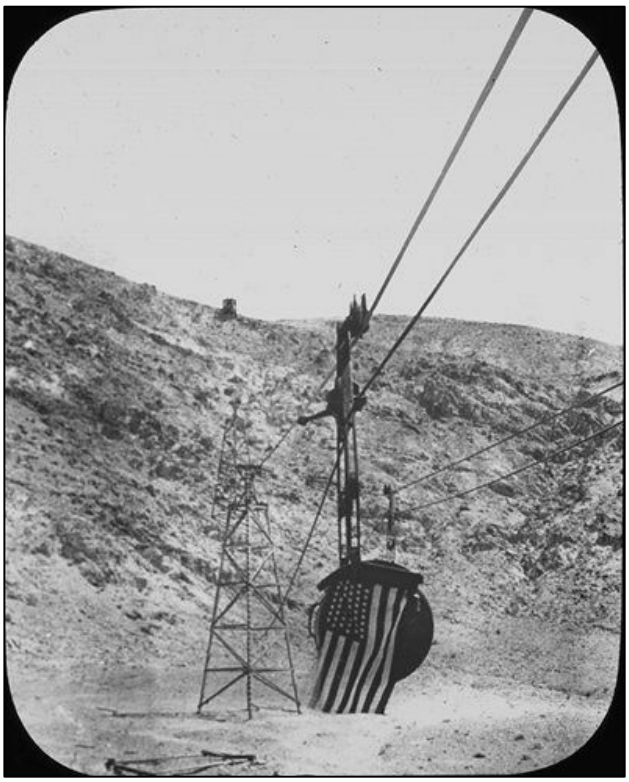


Figure 49. The first salt-filled carrier bucket traversing the tramway on July 2, 1913, decorated with an American flag.

in an article entitled *Salt, Borax, and Potash in Saline Valley, Inyo County, California.*[39] See the Context of Development & Use section of this HSR for more details on this related study of the purity of Saline Valley salt deposits.

By November 1912, the various timber-frame terminals, control stations, and tramway support towers were completed. Machinery still needed to be installed at the loading terminal within Saline Valley and the discharge terminal on the west side of the mountains.[40]

The construction of the tramway was documented by Bishop, CA photographer Andrew Alexander Forbes (1862-1921). His photographs are catalogued at the Los Angeles County Museum of National History and are presented throughout this document (fig. 48).[41] ("Forbes was the first resident photographer in the Owens Valley area of California. He maintained a commercial photo studio in Bishop from 1902 to 1916."[42])

Tram Completion & Initial Use

On June 10, 1913, the tramway was complete and "was ready for a preliminary test…but electrical connections from the power-house of the Los Angeles Aqueduct, which is in Cottonwood Canyon on the [west] side of Owens Lake, were not completed until later." Finally,

[39] Gale, "Salt, Borax, and Potash in Saline Valley, Inyo County, California."
[40] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 93.
[41] Natural History Museum, Los Angeles County. "Andrew Alexander Forbes (1862-1921) Collection, 1890-1915."
[42] Online Archive of California. "Andrew Alexander Forbes (1862-1921) Collection, 1890-1915."

the first salt carried by the tram was delivered at Tramway on July 2 "and was the occasion for a great demonstration"[43] (fig. 49).

Before the processing facilities at Tramway were fully operational, however, the salt was transported to the Albright Mill in Bishop for packaging under the label 'Tramway Salt.'"[44] "Horace Albright, a youth of 22 years, [reportedly] worked at packaging in the early stages. (This was just prior to his leaving for Washington, DC to become an attorney for the Department of the Interior. He was later to become the Director of the National Park Service and the director who motivated the founding of Death Valley National Monument.)"[45]

Finally, the tramway was complete! "Other tramways that had been built were longer and had greater capacity, but the Saline Valley line had steeper grades than any other in the United States."[46] The new tramway could transport twenty tons of "the purest salt in the world" each hour. For the following description, refer to the map and profile below (figs. 50-51).

From its eastern loading terminal within Saline Valley at the salt lake's south shore (elev. 1,058'), the tramway ran south over the mesa for 2¾ miles to the foot of the east face of the mountains (elev. 1,800'). The tramway then abruptly ascended to Control Station No. 1 (elev. 3,720'); this ended Section I. At Control Station No. 1, the tramway line turned 35° 30' to the west and continued up, crossing Daisy Canyon, to Control Station No. 2 (elev. 6,100'); this ended Section II. The tramway line continued, without change in angle, toward the mountain summit where Control Station No. 3 was located (elev. 8,720') between 10,668-foot New York Butte and 9,705-foot Pleasant Mountain; this was Section III. Because the summit station controlled both Section III coming up and Section IV going down, the power developed by the descending loads was used to raise the ascending loads. From Summit Control Station No. 3, the tramway line continued down the west slope of the mountain, turning 2° 28' to the east, to Control Station No. 4 (elev. 6,330'); this ended Section IV. Again, the line continued down, turning 10° 48' to the west, to the discharge terminal at Tramway, CA (elev. 3,625'). A narrow-gauge spur of the South Pacific Railroad joined the discharge terminal to Keeler, CA to the south.[47]

[43] Carstarphen, "An Aerial Tramway…," 543-544.
[44] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 93.
[45] DeDecker, "White Smith's Fabulous Salt Tram," 16.
[46] Ver Planck, "Salt in California," 117.
[47] Carstarphen, "An Aerial Tramway…," 529-532, 554.

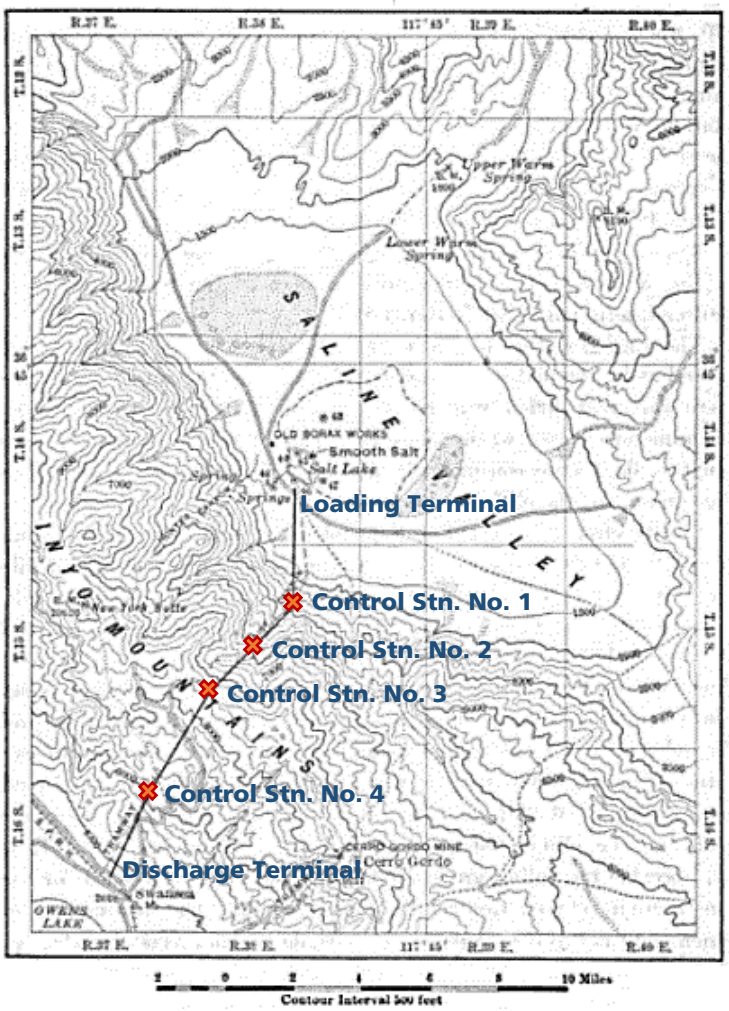


Figure 50, left. A 1917 USGS topography map overlayed with the Saline Valley Salt Tramway line running from the Salt Lake up and over the Inyo Mountains. Xs have been added to the map by the author to denote Control Stations described above.

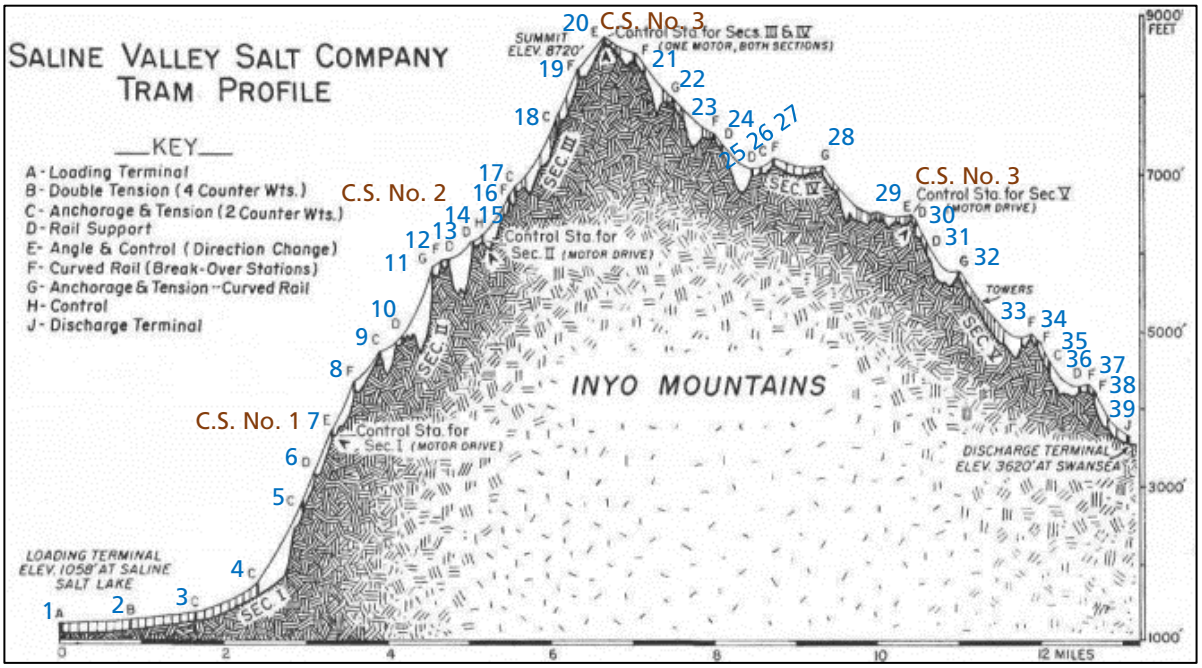


Figure 51, below. A sectional map shows the height profile achieved by the tramway over the Inyo Mountains. This map looks toward the south. At left (east) is the loading terminal at Salt Lake within the Saline Valley; at right (west) is the discharge terminal at Tramway, CA. Blue numbers have been added to denote general station numbers used by SVSC; orange labels denote where the Control Stations were located.
Station 1 = Loading Terminal
Station 7 = Control Station No. 1
Station 14 = Control Station No. 2
Station 20 = Control Station No. 3
Station 29 = Control Station No. 4
Station 39 = Discharge Terminal

The following archival photographs attempt to depict the tramway along its length, from the loading terminal in Saline Valley, east over the mountain range to the discharge terminal in Owens Valley (figs. 52-62).

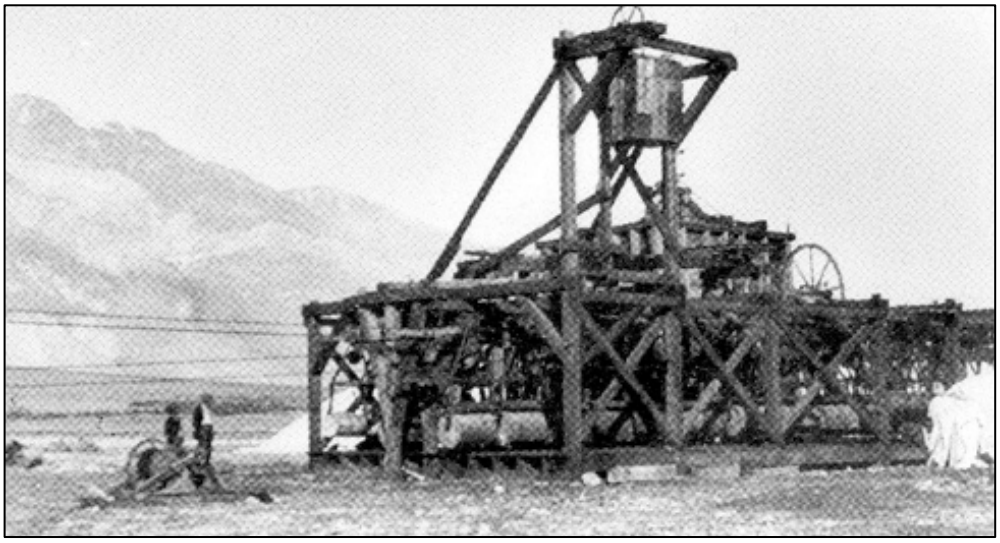


Figure 52. The loading terminal (Station 1) in Saline Valley, the start of the tramway, n.d.

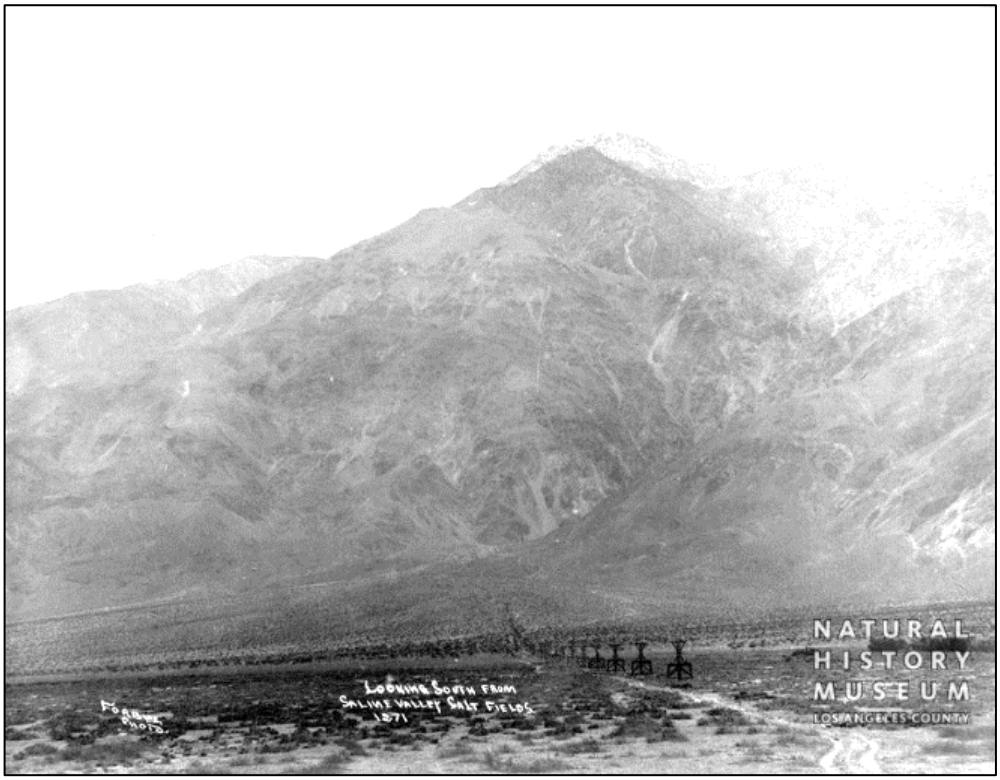


Figure 53. Salt tramway support towers within Saline Valley, looking south from the salt fields, n.d.

Figure 54, right. The view from Control Station No. 1 (Station 7) looking down into the Saline Valley, n.d. Most of this section was flat until it made an abrupt turn up the mountain.



Figure 55, below. Looking down on what is likely Control Station No. 1 (Station 7), n.d.



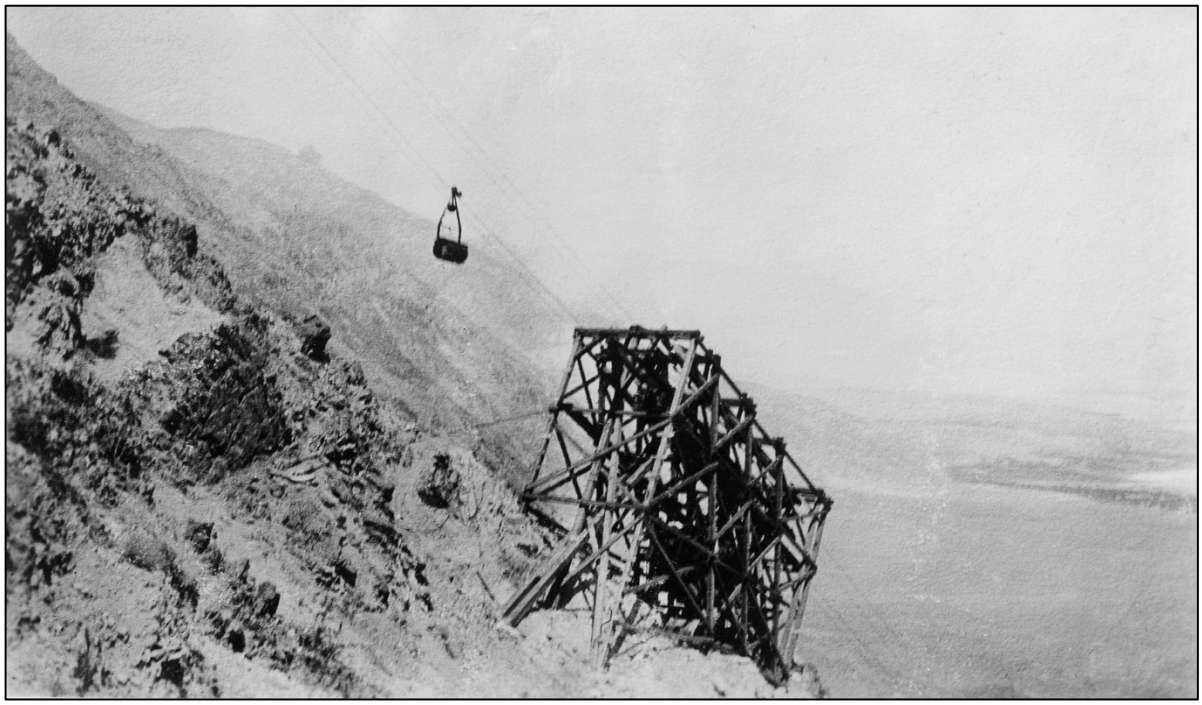


Figure 56. A timber-frame station of unknown number, n.d.



Figure 57. Control Station No. 3 at the summit (also known as Station 20), n.d.



Figure 58. Control Station No. 3 (also known as Station 20), n.d.

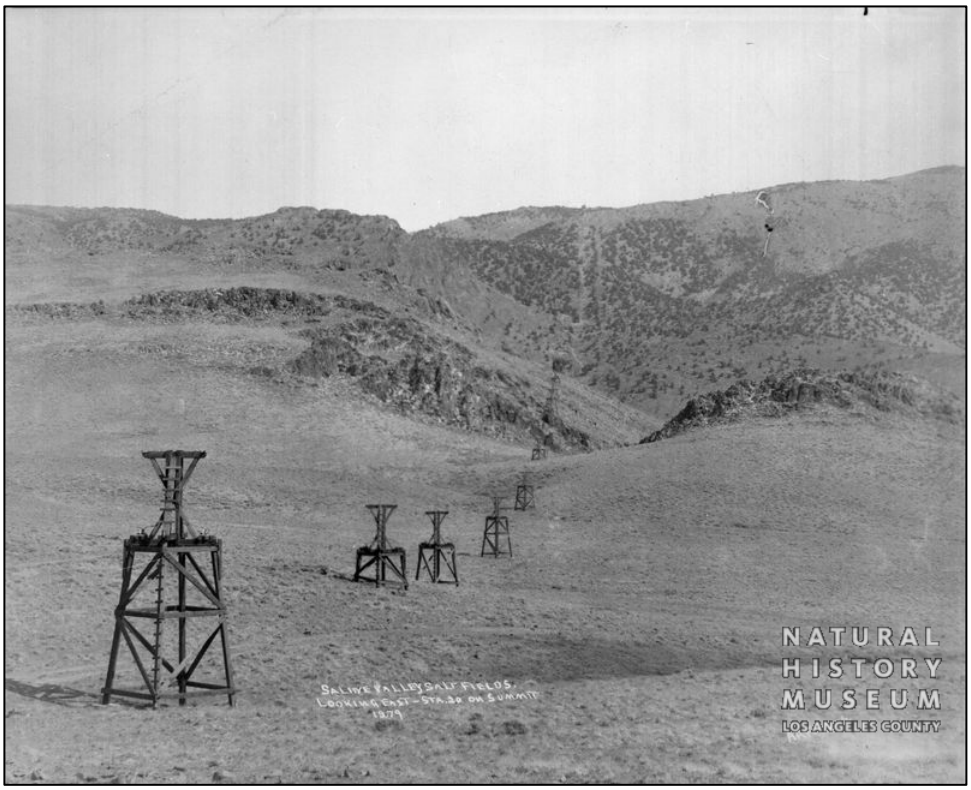


Figure 59. Support towers marching east from Owens Valley toward the summit and Control Station No. 3 (Station 20). No cables have been placed on the support towers, suggesting this photographs dates to ca. 1912-13.



Figure 60. "Saline Valley Salt Fields near Sta. 21- Looking West." The support towers are hung with cables, suggesting this photograph dates to ca. 1912-15.

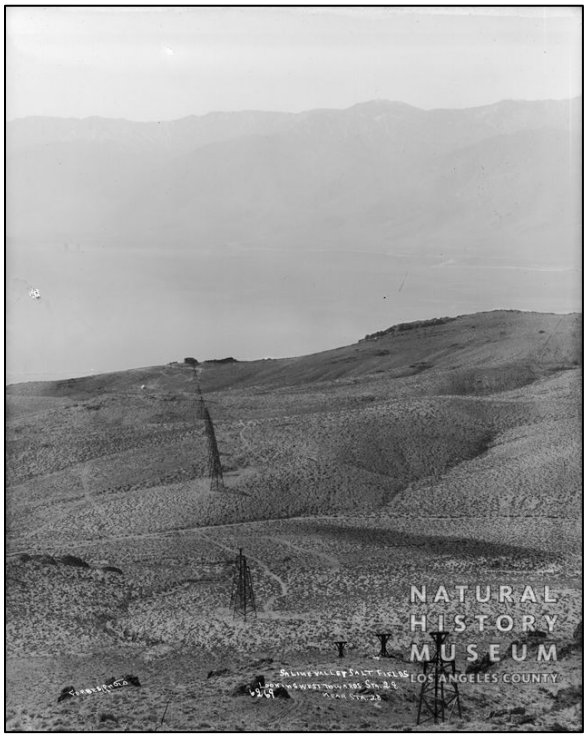


Figure 62. "Saline Valley Salt Fields looking west towards Sta. 28 near Sta. 28," n.d.



Figure 61. Labelled as Station 26, this was an anchorage and tension station with two counterweights. Without cables in place, this photograph likely dates to ca. 1912-13.

A telephone system was installed allowing for communication between the control stations and end terminals. The line riders—who rode the tramway and oiled the traction rope rollers and track cables—had line phones which could be attached to the telephone wire as needed for contact with the control towers. In addition, a bell signal system was used where conversation was not required but communication was.[48]



Figure 63. Electrical line adjacent the tramway support towers, provided power to operate the tramway lines, n.d.



Figure 64. Two tramway carriers passing high above Daisy Canyon, n.d.

Adjacent the tramway ran an electrical transmission line (fig. 63). The poles carried copper wires for a three-phase, 33,000-volt circuit. Exterior transformer stations stepped the voltage down to 2,200 for use by the driving motors at the stations.[49]

Upon completion of the tramway, the contract between SVSC and Trenton Iron Company required "that the capabilities of the tramway should be demonstrated by an operating test of not more than 60 days, under the supervision of the engineers of the buyer and seller." The field engineers placed the carriers on the line and coordinated "the various functions of the machinery, carriers, and signal systems so that the operating test could be undertaken as speedily as possible." The demonstration period determined the tramway ran satisfactorily when the carriers were two-thirds full, but when run a full capacity, an excessive number of accidents occurred due to carriers slipping on the traction rope causing runaway carriers. Investigation of the problem determined the salt had been assumed to weigh sixty pounds per cubic foot. Because much of the mined salt was moisture entrained, it actually weighed in excess of eighty pounds per cubic foot resulting in overloaded carriers, which caused the grips to be insufficient at steep slopes. For several years, experiments occurred with alternative grips, including at least one total replacement campaign along the line. Despite all the experimentation the tramway grips never functioned to their full design capacity, hindering SVSC's full potential. Because of this, "the American Steel and Wire Company voluntarily took over the operation of the line at its

[48] Ibid, 556.
[49] Ibid, 556.

own expense, so as to determine what defects, if any, existed, and what replacement should be made."

This resulted in the installation of new, perfected Universal Wico grips which had "sufficient gripping power on the traction rope to handle safely on the steepest grades a carrier loaded to its utmost capacity with the heaviest salt plus the weight of a line rider."[50]



Figure 65. Two carriers, one ascending and one descending on the tramway at a steep angle, likely above Saline Valley, n.d.



Figure 66. A loaded carrier travelling away from the loading terminal and past the first support tower, ca. 1920s. Note the cylindrical shape with cover above to protect the salt from contamination.

Unsurprisingly, the carriers dealt with excessive wear and tear. Because the tramway was composed of five individual lines (divided at the four control stations), incidents from carrier operations "were five times as great as those on single-section…aerial tramways." At the Saline Valley Tramway, where the round trip totaled more than 26 miles, the carriers were equipped with "a special lubricating system…so as to provide an adequate supply of oil for the wheels and pins." In addition, the carrier hangers were longer than what was standard, "so as to provide proper clearance between the traction rope guide rollers used in the rail structures on the ridges running transversely to the location of the tramway." Further, because the salt transported in the carriers required protection from contamination, the carriers were cylindrical and revolved independently from the covers (fig. 66). A special latch was used to close the cover to ensure that salt did not escape during the ride over the mountain.[51]

Both the loading and discharge terminals (Stations 1 and 39) had a two-man crew. Two men also worked at each of Control Stations No. 1 (Station 7), No. 2 (Station 15), No. 3 (Station 20), and No. 4 (Station 29). Four men were 'line riders' and kept "the track cables and the traction rope rollers and guide sheaves in the structures and towers in perfect condition [figs. 67-68]." A foreman provided general supervision of the entire tramway.[52]

[50] Ibid, 544, 549-553.
[51] Ibid, 553, 555-556.
[52] Ibid, 556.

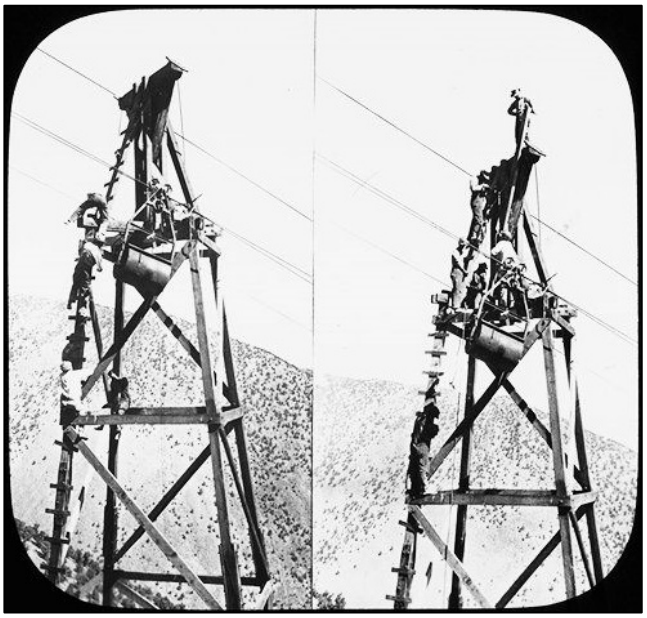


Figure 67. Maintenance to place the cable back in its saddle atop a support tower, n.d.

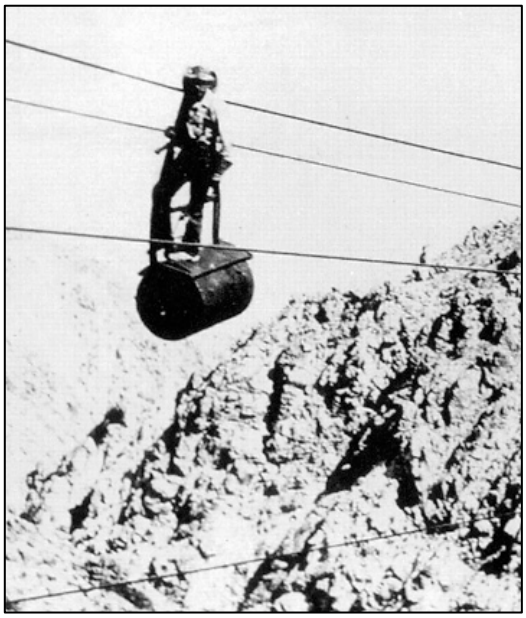


Figure 68. A line rider over Daisy Canyon, n.d.

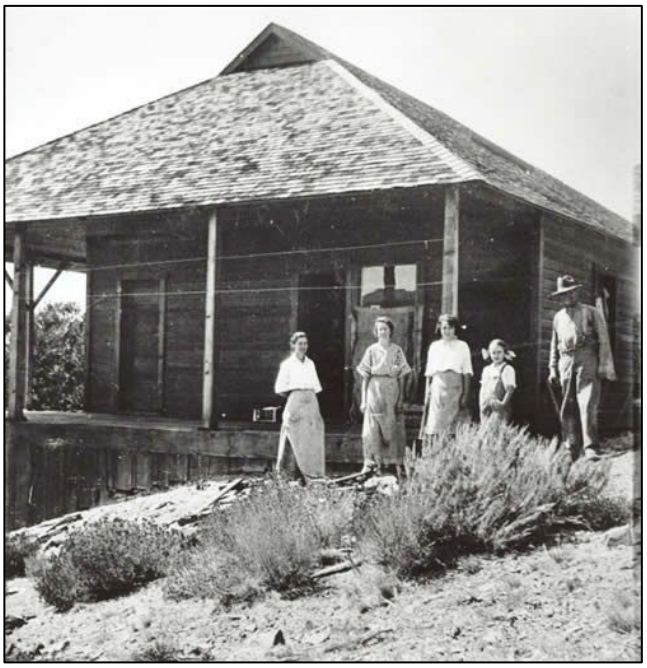


Figure 69. Summit control station residence, ca. 1913-1930.

A settlement developed at Tramway, around the discharge terminal and other processing structures, on the west side of the mountains. The SVSC constructed five employee houses. (The last reportedly collapsed in the late 1980s).[53]

At the summit control station, a six-room house was constructed just below the summit with expansive views west of Owens Valley, for the station's operator (fig. 69). Water for this residence was hauled to the summit and stored in a tank under the tramway. Running water supplied the residence and the corral.[54]

No houses were constructed within Saline Valley. Instead, "workers, most of whom were reportedly Mexicans and Indians, apparently lived in tents, tent houses, or the nearby Saline Valley Indian Ranch."[55] Some of the workers brave enough and those performing maintenance "rode the tram buckets to the job"; others feared failure of the carriers and refused this commute.[56]

[53] DeDecker, "White Smith's Fabulous Salt Tram," 17-18.
[54] Ibid, 17-18.
[55] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 94.
[56] DeDecker, "White Smith's Fabulous Salt Tram," 18, 20.

Salt Preparation

Preparation of the salt in Saline Valley "was mostly a natural process." Fresh water from the spring, which easily dissolved the salt deposits, was transported "in wooden pipes to flood the salt fields. Dikes were used to control the spreading" water (fig. 70). Summer air temperatures provided "plenty of heat to evaporate the water, leaving essentially pure salt crystals ready for harvesting."[57]

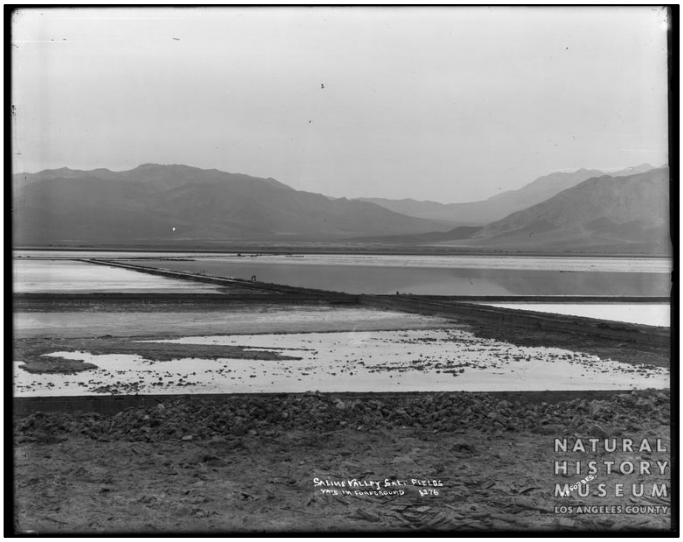


Figure 70. "Saline Valley Salt Fields Vats in Foreground," n.d.

Workers shoveled the recrystallized salt, which resembled flat plates, into conical piles approximately two feet high and 3½ feet in diameter at the base. The piles were spaced in rows twelve feet apart in one direction and six feet apart in the other direction (fig. 71). Each pile weighed 400 to 500 pounds and each worker was expected to shovel eight to ten tons of salt per day. The salt remained in piles for a considerable period to allow the brine to drain away; the brine contained most of the natural impurities which could contaminate the salt.[58]



Figure 71. Mounds of salt draining in Saline Valley, n.d.

After sufficient draining, the salt was loaded into special buggies which could carry 500 to 1,000 pounds of salt (fig. 72). The buggies were constructed of galvanized iron. The salt fields were soft, so the rear wheels were twenty inches in diameter with a twelve-inch face and the front

[57] Ibid, "White Smith's Fabulous Salt Tram," 20.
[58] Carstarphen, "An Aerial Tramway…," 556-557.

wheels were sixteen inches in diameter with a 4½-inch face. The wheel axles were fixed rigidly to the body; turns were made by "slipping" the front wheels. The loading bed was three feet wide, eight feet long, and six inches deep.[59]

Once loaded, the buggies were pulled across the salt field via a ⅜" cable operated by a gasoline-powered engine. At the dumping point, the buggies were "pulled up an inclined plane until they assume[d] an angle of approximately 44° degrees, at which slope the wet salt [slid] freely into a hopper above a car…" (fig. 73). These cars measured thirty inches wide and high and 4'-6" long. The bottom was outfitted with a two-way, 45-degree hopper, allowing the sides, not the ends, to be used for doors. These cars ran on a half-mile-long double-track railway operated "by an endless rope haulage system operating at a speed of 200 ft. per min" (fig. 74). Seven full and seven empty cars could be hauled by a ten-horsepower gasoline engine.[60]



Figure 72. An iron buggie loaded with 1,000 pounds of salt, n.d.

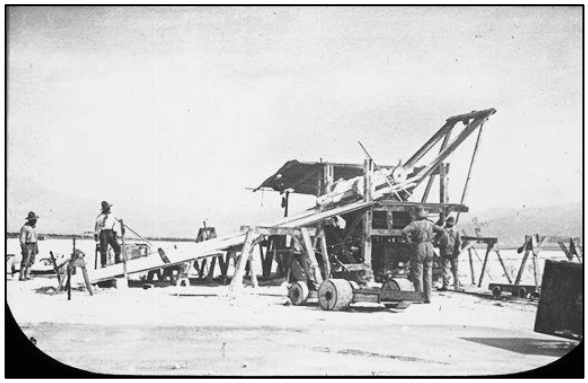


Figure 73. A buggie is pulled up the inclined plane to an angle that the salt would slide into a hopper and a wood car below, n.d.



Figure 74, left. A wood car being conveyed via the railway to the loading terminal, n.d.

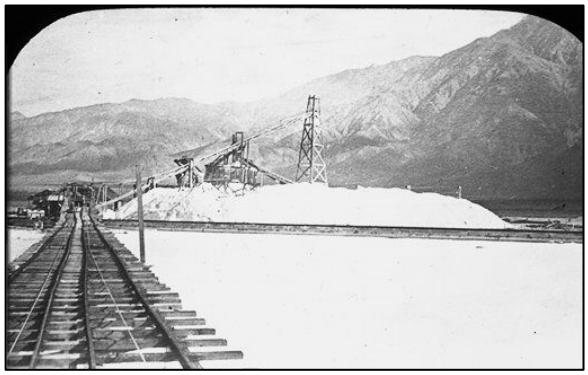


Figure 75, above. The double-track railway ran wood cars to the loading terminal, n.d.

[59] Ibid,.557.
[60] Ibid, 557.

At the end of the track (fig. 75), the cars dumped their salt loads "into a boot serving a drag conveyor which elevate[d] the salt to a point sufficiently high to command the 50-ton bins at the loading terminal." The tramway carrier buckets were then filled by a lever chute (fig. 76) and "dispatched from the loading terminal at the tap of an automatic spacing gong." Fifty-six carriers were sent from the loading terminal per hour, or the rate of 23-24 tons per hour (fig. 77).[61]

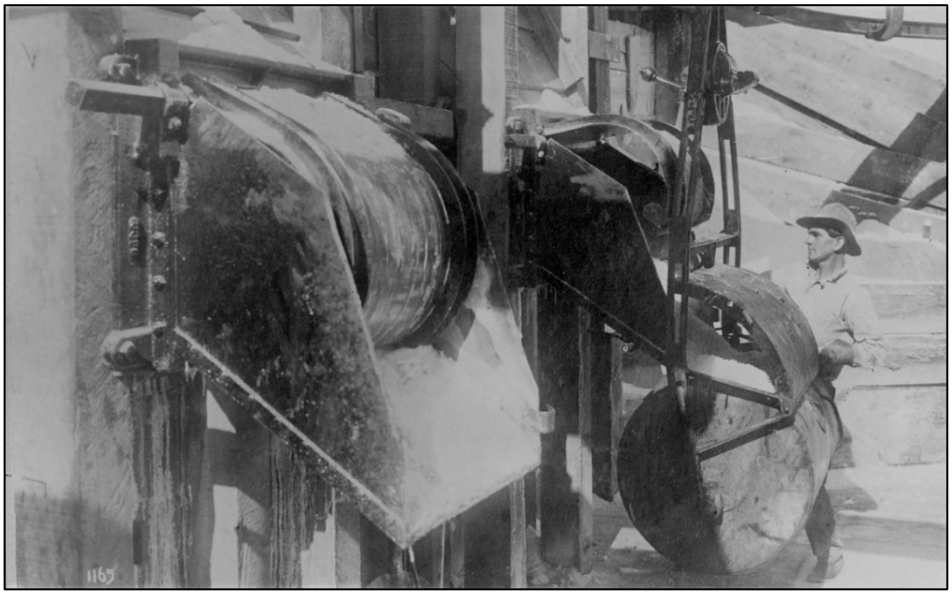


Figure 76, above. Loading salt into the carriers via a lever chute at the loading terminal, n.d.

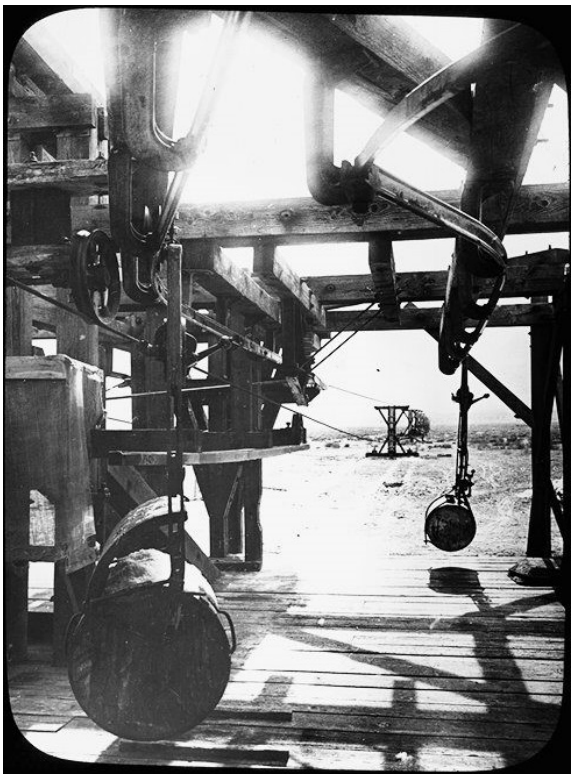


Figure 77, right. The carrier full of salt ready to depart the loading terminal, n.d.

[61] Ibid, 557.
DeDecker, "White Smith's Fabulous Salt Tram," 20.
Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 94-95.

At the discharge terminal (fig. 78), the transported salt was dumped out of the carrier buckets onto a conveyor belt (fig. 79), then dried and "super crystallized" before a mill processed the salt into different grades. The salt was then "sacked for shipment.... Cartons containing salt suitable for table use, crystalized [sic] rock salt in large pieces for use in ice cream manufacture and for tanning as well as powdered salt used in the pancake and other ready-to-use flours, are put out...."[62]

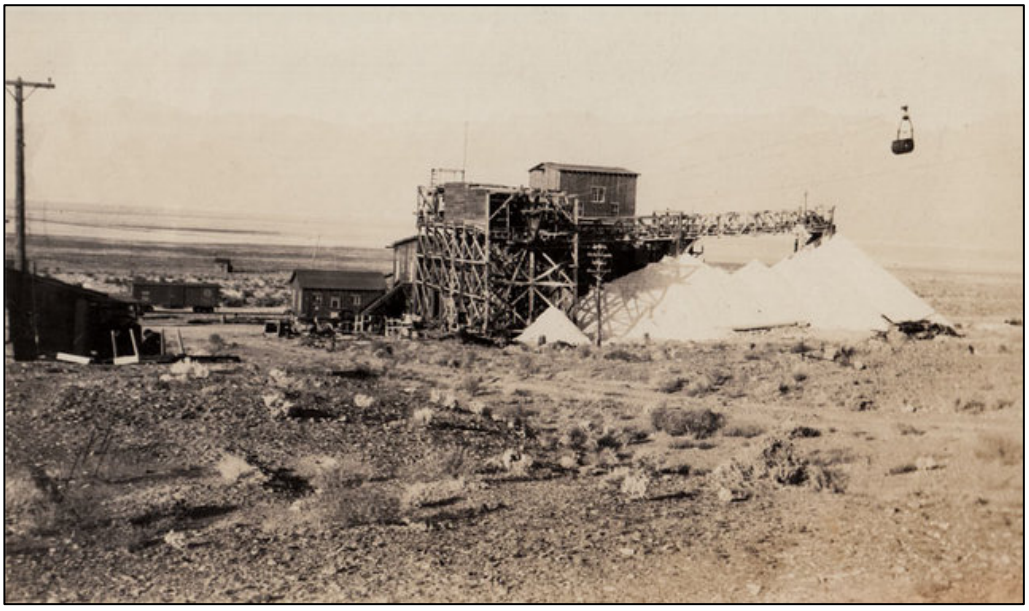


Figure 78, above. The discharge terminal at Tramway in Owens Valley, n.d. Note the size of the boxcar at left is dwarfed by the mound of salt behind the terminal.

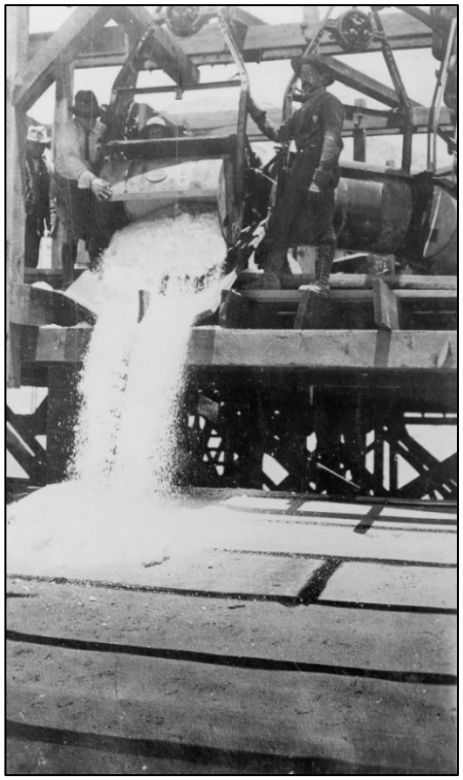


Figure 79, right. Emptying carriers at the discharge terminal, n.d. A conveyor belt appears to be used to transport discharged salt.

[62] Newcomb, "Agricultural and Industrial Survey of Inyo County Calif...."

Continued Use and Eventual Demise

More than 5,000 tons of salt was transported via the tramway in 1913. By February 1914, SVSC "was sending nine to fifteen narrow gauge railroad cars of processed salt per week."[63] For all intents and purposes the tramway proved successful; however, due to the total cost of construction—said to total over $300,000[64] (over $2.6 million in 2019)—the SVSC was financially exhausted and could not pay its bills. At the end of 1914, the company's Board of Directors—choosing between bankruptcy, selling, and leasing—chose to lease the tram and salt fields to the Owens Valley Salt Company (OVSC), who hoped to produce 50,000 tons per year.[65] The lease agreement required half of the revenue be paid to SVSC. OVSC renamed the product 'White Mountain Salt.' The new company was managed by W.J. Savage out of an American Bank Building office in Los Angeles; superintendent of the salt works was John A. Lewis. In 1916, the operation employed forty men during the April-to-December harvest season. The mill, employing thirty men throughout the year, processed 25 to 30 tons of salt per day, and demand exceeded supply.[66]

A report from California State Mineralogist on Mines and Mineral Resources detailed the operation by OVSC during the years of 1915 and 1916, and included two photographs of the mill (figs. 80-81):

> The salt is deposited in an old lake bed covering several square miles. Of this area about one square mile is composed of a smooth, white salt crust, formed by dissolving the surrounding impure salt crust with water from a nearby spring, and recrystallizing it by solar evaporation. The recrystallized salt is said to [be] 99.32% NaCl. It is harvested during the summer months and shipped, over an aerial tramway…to the mill. … Seventeen men are required for the tramway. Operated only during the summer months.
>
> The mill treatment is as follows: The salt is shoveled into a bin which automatically feeds into a large rotary, oil burning, drying furnace. Subsequently elevated to rolls, where the salt is crushed to the desired sizes and passed over shaking screens to classify the different sizes. Five classes of salt are produced, varying from natural crystallized rock salt to pulverized table salt. Approximately thirty tons are produced daily at a cost of $2.75 per ton, segregated as follows:
>
> Gathering salt in field..... $0.50
> Tramming 1.50
> Milling ..... .75[67]

[63] DeDecker, "White Smith's Fabulous Salt Tram," 20.
[64] Belden, L. Burr. "History in the Making: 13-Mile Tram Hauled Salt of Saline Valley." *The San Bernardino Sun-Telegram.* May 23, 1960.
[65] Ver Planck, "Salt in California," 118.
DeDecker, "White Smith's Fabulous Salt Tram," 22.
[66] Unrau "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 95.
DeDecker, "White Smith's Fabulous Salt Tram," 22.
[67] California State Mining Bureau. "Report XV of the State Mineralogist, Mines and Mineral Resources of Portions of California. Chapters of State Mineralogist's Report, Biennial Period 1915-1916," 121-123.



Figure 80. "Mill and tramway terminal of Owens Valley Salt Company, 3 miles north of Keeler," ca. 1915-16.



Figure 81. "Sacking salt at plant of Owens Valley Salt Co.," ca. 1915-16.

A presentation was made to the American Society of Civil Engineers on May 2, 1917 by Associate ASCE member F.C. Carstarphen, entitled *An Aerial Tramway for the Saline Valley Salt Company*, regarding "the prominent features of the location, construction, and operation of an aerial tramway built to carry salt" which the author termed as "one of the most novel aerial tramways ever constructed." He acknowledged the "individual foresight, skill, and untiring energy" of the following men "to the design, erection, and initial operation of the tramway." For SVSC: White Smith, President; Will Smith, Secretary; W.H. Leffingwell, MASCE, Chief Engineer; Daniel Kuhnle, Superintendent; M.O. Bolser, Electrical Engineer; and Harry Hilderman, Foreman of Construction. For Trenton Iron Company: J.W. Smith, Local Manager; S.S. Webber, Chief Engineer; William Hewitt, Mechanical Engineer; S.W. Benson, Chief Draftsman; and C.H. Wickham, L.T. Hays, and T.J. Murphy, Chief Engineers. For the American Steel and Wire Company: R.H. Hall, Field Engineer, and George Hall, Foreman.[68] This fantastic document has been used several times to compose a written history of the Saline Valley Salt Tramway; this HSR is no exception and quotations, photographs, and drawings are located throughout the document.

During the summer of 1917 an agricultural and industrial survey of Inyo County, CA was completed by the California Development Board of San Francisco, CA at the request of the Inyo County Board of Supervisors. At that time, the Saline Valley salt tramway employed eighteen men on the tramway, forty-five men in Saline Valley, and fifteen at the discharge terminal. The tramway could haul two-hundred tons of salt in a nine-hour day, and the mill could process twenty tons of salt in a ten-hour day. Also, at the time, the OVSC was purchasing large amounts of ores in the valley and conveying them via the tramway, in addition to the mined salt.[69]

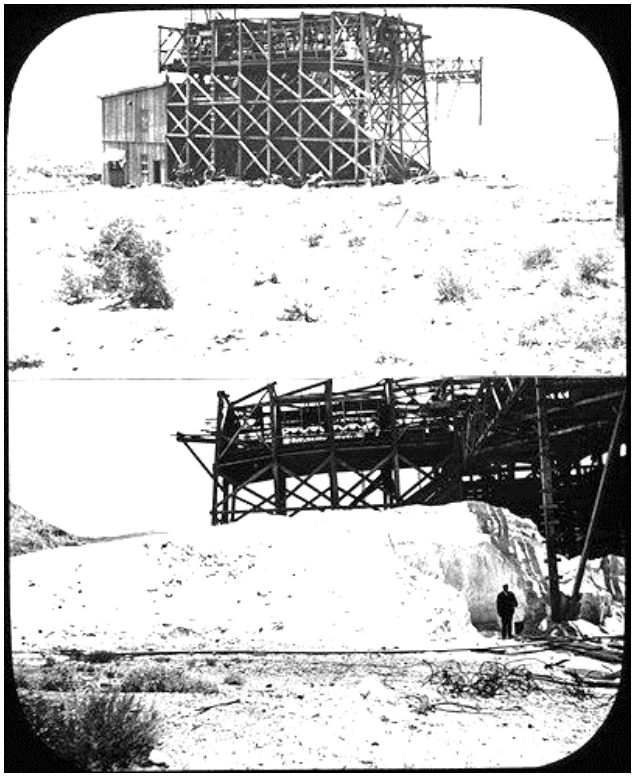


Figure 82. The discharge terminal with abandoned salt pile, ca. 1920s. Note the discarded wire cable in the foreground of the lower photograph.

Difficulties for the Saline Valley Salt Company developed in 1917. "One faction wanted to cancel the contract with the Owens Valley Salt Company and reorganize as 'Tramway.' The majority wanted to merge with the Owens Valley Salt Company and [establish] new directors. There were legal problems too, including law suits filed against the Saline Valley Salt Company. Mr. Leffingwell

[68] Carstarphen, "An Aerial Tramway…," 525, 558.
Carstarphen, F.C. (Associate, ASCE). "An Aerial Tramway for the Saline Valley Salt Company, Inyo County, California," Paper No. *Transactions of the American Society of Civil Engineers, Vol. LXXXI.* Paper No. 1394, May 2, 1917, New York, 709-42.
[69] Newcomb, "Agricultural and Industrial Survey of Inyo County Calif….."

sued for back pay. U.S. Steel sued for money owed on the tram. Finally the tram itself ceased operation [in 1918]."[70]

By 1920, U.S. Steel, of which Trenton Iron Company was a subsidiary, became owner of the Saline Valley salt tramway and salt fields. In 1920, the salt operations were leased to the Taylor Milling Company (TMC) under the direction of George W. Russell of Pasadena, CA. The operation lasted one year.[71]

In 1924, White Smith reappeared in the picture and proposed construction of "a road into Saline Valley from the south by way of San Lucas Canyon" in order "to provide transportation from the salt fields. Inyo County agreed to pay most of the cost, the remainder to be paid by citizens. White Smith won the bid." Thomas Hancock superintended construction of the major engineering effort, with an average of twelve workers. The County supplied an insufficient $20,000 to the effort, but the road was completed. The County formally accepted the road in May 1926, which extended from the Keeler-Darwin road via Lee Flat and Grapevine Canyon.[72]



Figure 83. The supposed first haul of salt out of Saline Valley in June 1926 via the newly completed road. The man standing at left is none other than White Smith.

[70] DeDecker, "White Smith's Fabulous Salt Tram," 22.
[71] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 97.
[72] DeDecker, "White Smith's Fabulous Salt Tram," 22.
"Construction Work on Road Now Under Way." *Inyo Independent,* May 3, 1924, 1.
"New Road Will Tap Big Mineral Resources of Inyo County." *Inyo Independent,* July 26, 1924, 3.
Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 97.
"Saline Road." *Inyo Independent,* September 13, 1924, 3.

During construction of the road, in December 1925, George Russell, formerly of TMC, established a new company to resume the salt operation. Sierra Salt Company (SSC), with offices in Las Vegas, NV, hired White Smith as assistant manager (fig. 83) and technical advisor to Russell. Frank A. Stevens, a Las Vegas attorney in the law firm Stevens & Henderson served as president; Russell served as vice president and general manager.

> According to a company pamphlet printed in June 1926, the firm was capitalized at $750,000. The company's operations consisted of 640 acres of salt lands and 40 acres of semi-agricultural land, the latter acreage containing the spring which provided all the water required for the operation of the salt fields. The 640 acres of salt lands were owned by virtue of 'Placer Salt Mining Claims,' subject to patent from the U.S. Government, and were under a 50-year lease. The 20-acre, semi-agricultural land was owned in fee and leased for 15 years with an option to purchase at a nominal figure at any time during the lease periods. The salt was hauled out of the valley to the railroad at Keeler on the east shore of Owens Lake by six-cylinder, 10-ton trucks via the recently completed Saline Valley road. C.W. Hayes, contractor for harvesting and hauling the salt which was to be marketed under the 'Sun Brand Salt' label, delivered the first shipment to the City Market in Bishop on June 16, 1926. During the summer of 1926, a contract for erection of a milling plant in the Central Manufacturing District of Los Angeles was signed, a preliminary deposit was made on the contract, and ground was broken for the plant's foundations.[73]

White Smith died in 1927. This "marked the end of the major impetus in Saline Valley's salt production, but it did continue for a time."[74]

Sierra Salt Company, through head G.W. Russell, G.W. Goodwin, and associates, purchased the tramway from U.S. Steel Products Company in April 1928. The new owners intended to remodel and rebuild the tramway and terminal at Swansea.[75] The system required repairs but resumed operation in December 1929 and "began transporting some 60 to 100 tons of salt per day." SSC changed how the salt was produced within the valley "by installing crystallizing ponds near the tramway terminal in the salt marsh. . . . Brine was prepared by dissolving the crust in fresh water as in the earlier operation." Unfortunately, "financial difficulties, complicated by plunging prices for salt during the Depression and continuing tramway maintenance problems," SSC closed the salt works in 1930. The "operation went into receivership in 1935."[76]

"Taxes on the tramway went delinquent. Finally, it was sold to Al Noren of Big Pine, a retired forest ranger, for $1. He was the only bidder. Noren salvaged some rusty cable and buckets that were more easily reached but did not attempt to cover some of the more rugged stretches."[77]

After Abandonment

By 1953, after being abandoned for almost two decades, the infrastructure had fallen into disrepair: "The old evaporating ponds, which covered a large part of the smooth salt area, were in poor repair; and the plant had been burned. Erosion of the levees as well as the growth of salt

[73] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," 98.
[74] DeDecker, "White Smith's Fabulous Salt Tram," 23.
[75] "Saline Valley Salt Tram Bought by Sierra Salt Co." *Big Pine Citizen,* April 28, 1928.
[76] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," p. 98.
[77] Beldon, "History in the Making…," p. E-19.

crystals in timbers indicate that the area is frequently flooded to depths of as much as 2 feet. Shoreward of the ponds lies rough and dirty salt. Within the ponds about an inch of pinkish, mushy salt lies on black brine-saturated ooze that is crowded with crystals."[78]

In 1954, D.O. Morrison, J.J. McKenna, and Tony Pinheiro of Bakersfield, CA leased the salt works and tramway from T.K. Temple of Los Angeles. "The dam was rebuilt, levees were constructed, and some salt was recrystallized in place. About 2000 tons of salt were harvested and stockpiled on the northwest side of Salt Lake."[79] The work revealed a four-foot "layer of thenardite. . .lies beneath the ooze. Shallow drill holes are reported to have encountered alternating layers of mud and salines to a depth of 30 feet."[80] Within one year, this operation ceased.[81]

In March 1958, The California Division of Mines released *Salt in California* by William E. Ver Planck. The bulletin detailed salt mining in the state. Several photographs were included of the abandoned salt works of Saline Valley (figs. 84-87).



Figure 84, left. Tramway support towers, looking west from the loading terminal, ca. 1958.



Figure 85, above. An abandoned tramway salt carrier on the floor of the valley, ca. 1958.



Figure 86. Buggies used for hauling harvested salt to a dumping point, ca. 1958.

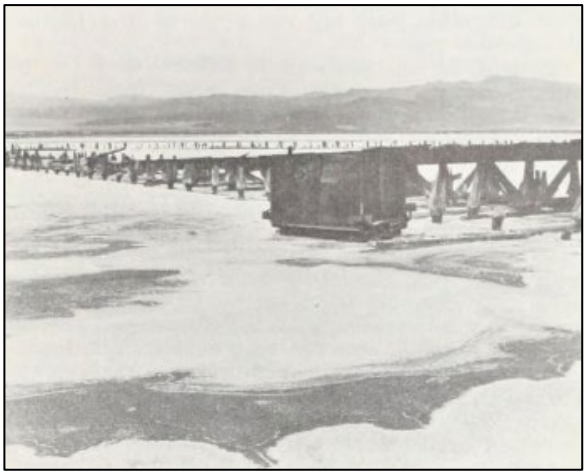


Figure 87, right. A wood car sitting adjacent the double-tracked railway on which it originally ran, ca. 1958. The railway accessed the loading terminal.

[78] Ver Planck, "Salt in California," 25.
[79] Ibid, 25.
[80] Ibid, 25.
[81] Unrau, "A History of Lands Added to Death Valley National Monument by the California Desert Protection Act of 1994," p. 98.

Since its demise, the tramway has been the interest of local residents and tourists alike. An early description of the system was provided in *Desert Magazine* in 1959. The author, Robert O. Greenawalt (fig. 88), visited the tramway during the summer of 1958. Greenawalt's romantic description is included below:

> The daybreak hour of a Saturday morn found five companions and me huddled around a campfire munching breakfast. We had camped off Highway 190 near the several weathered cabins that mark Swansea and the discharge terminal site. Only numerous concrete footings, a small pile of dust-laden salt, and the ruts of an uprooted railway spur give evidence of the discharge terminal's position. Before shipping, the stockpiled salt was crushed at this site.
>
> Our party was split into two teams: hikers and drivers. The hikers. . .would make our ascent of the western face of the mountain that day. The drivers. . .were to take our vehicles over a 16.5 mile roundabout jeep trail and set up camp at the tram summit.
>
> With a "See you before dark, and have supper ready," we were on our way. We climbed the near ridge hand over foot and soon reached our first massive framework. It stands several hundred feet above the highway, but is barely visible to passing motorists. The cables were supported along the 13 mile up-and-down-hill route by 39 major structures. Between them, 123 80-foot-high intermediate towers kept the cargo off the ground along the parallel slopes and more shallow canyons.
>
> All of the structures within easy access of roads, including both terminals, have long since been carted off—easy prey of the wood gatherers and junk dealers. Used lumber can be very precious on the sparsely populated desert. The stout 10x10s are especially prized. But because most of this jagged range is inaccessible, especially the eastern slopes, the mountain will be as reluctant to give up its tram as it was to receive it.
>
> The morning climb was rugged, and the panorama of the broad expanse of Owens Valley became more impressive at each new height. Into view on the far side of the lake came the ribbon formed by the Southern Pacific's "Jawbone" broad gage [sic]. The construction of this railroad north from Mojave in 1911 was largely responsible for the tram's creation. The broad gage [sic] joined the narrow rails at Owenyo.
>
> Near one of the towers we found a small rattlesnake shading itself near a corner footing. In the higher country we came across four remote operators' cabins, a couple in the same condition as they were when their inhabitants left them for the last time.
>
> The western slope's towers, some void of cables, are bleached a dull white. Many of the steel buckets that formed the brigade still cling to their steadfast cables high over deep canyons. Other wire ropes, victims of vandals' hacksaws, lie limply on the ground as their twisted containers rest half-buried in churned-over cloudburst debris.
>
> Near the 7000-foot contour friendly pinyon pines began to appear, and joined by juniper and mountain mahogany, they accompanied us to the summit.



Figure 88. A visitor to the Saline Valley Salt Tram in 1958 next to a carrier "bucket."

> We were well spent as we approached the crest. Within whistling distance of camp, a shout from one of the drivers enlightened our spirits. Dinner was ready, as promised, and the sleeping bags were layed [sic] out on the pleasant veranda of the summit operator's six-room house. This is an impressive campsite—8700 feet in altitude, surrounded by beautifully fragrant forest, and far below the sight of creeping headlights of Sierra motorists.
>
> The sparkling night was void of all sound, but it was not this way when the tram was in operation. This was a busy place with a bucket of Saline salt raising its head over the eastern crest almost every minute. From the opposite direction an empty bucket would come jogging through the pines, and then disappear.
>
> The summit station motors drove two of the five stations that formed the continuous circuit. Each station housed equipment for controlling the electrically-driven traction ropes that provided the thrust for the two-hour journey.
>
> The parallel stationary track cables were eight feet apart, and the buckets, holding 800 pounds of salt and suspended from two-wheel carriages, rode the smooth track cables. Automatic grips attached the buckets to the moving ropes.
>
> The three drivers left early in the morning, their destination the same as ours: the salt lake on the floor of Saline Valley. . . . We hikers took the shorter, but far more difficult, direct route to the lake. It was almost straight-down hiking which can be as arduous as climbing. We entered Daisy Canyon on a poor trail. Here the wooden tram structures were seasoned to a rich reddish hue, reflecting the difference in exposure received on this side of the mountain from that of the western slope.
>
> If the view from the summit station westward across Owens Valley is superb, the view eastward down the dizzy slopes of Daisy Canyon and across forbidding Saline Velley, 7000 feet below, is sensational.
>
> Keeping us company along the way were several coveys of chukar partridges. They had far less trouble than we in following the dim trails down the canyon. The tram line made three wild broadjumps over the gorge, and how the engineers ever pushed this project though is nothing short of incredible.
>
> We stopped to rest at the Section I control station on the lower mountain slopes. From this vantage point the Saline Valley lake became three lakes: the dry playa, the salt lake, and to the west a fresh water lake. The latter body of water is frequented by many birds. A black speck on the shored of the salt lake indicated the position of our transportation.
>
> At this control station, whose stable still contains a supply of straw, the cables turned a sharp angle for a beeline northward to the loading terminal which we reached in later afternoon. The dock is marked today by small pieces of lumber rent into grotesque shapes by salt action. We joined the birds for a dip in the fresh water lake, and much refreshed we settled down for an evening around a cheery campfire.
>
> Behind us, hidden by night, was the half-million dollar monument to a marvelous project that wasn't worth its salt financially.[82]

In 1960, the *San Bernardino Sun-Telegram* wrote a summary of Saline Valley, including the remnants of the salt tram:

> Two miles south of Saline Camp is the abandoned salt works. Evaporation ponds into which portions of the salt lake are divided, the old roads between ponds from which salt was harvested, portions of the old loading platforms [fig. 89] testify as to the size of the former industry. At the site also a row of towers which once carried the Saline Tramway starts [fig.

[82] Greenwalt, "We Hiked the Inyo Bucket Brigade," *Desert Magazine.* August 1959, 19-21.

90] and stretched southwest right up the rugged mountains then down to the shore of Owens Lake on the other side. A trail, once used by pack burros follows the line of the towers.

A few resistance coils and foundations of the power plant are found at the old salt works. Countless tons of unharvested salt lie in one of the old evaporation beds. The salt glistens white in the sun as dazzling to the eye as a blanket of snow.[83]

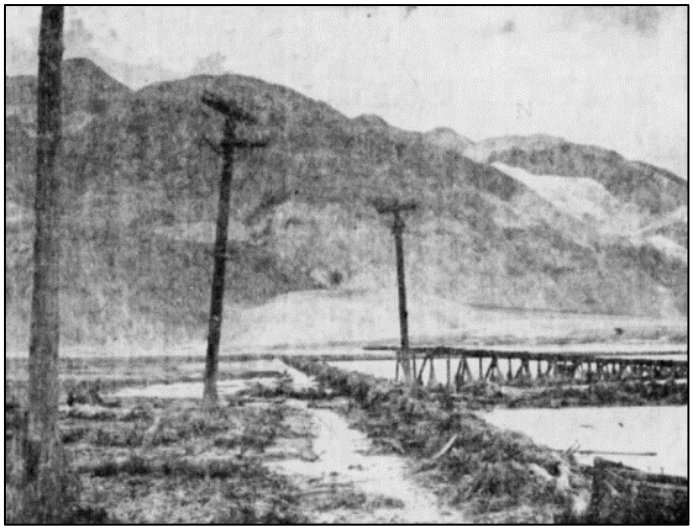


Figure 89. A loading platform as it existed in 1960.

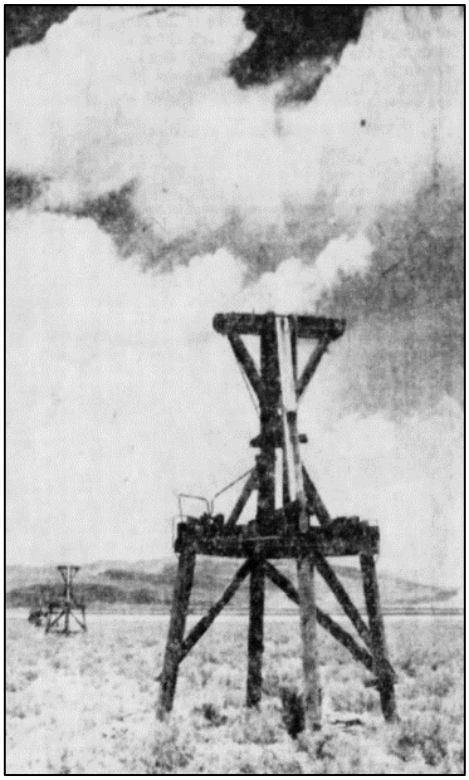


Figure 90, right. The line of support towers running from the salt ponds in Saline Valley, 1960.

Sometime in the 1970s, due to previous removal of the doors and windows, the roof blew off the summit control station cabin because of strong winter winds at the top of the mountain. With a missing roof, the building's foundation, interior structure, and deck began to deteriorate.[84]

In 1974, the Saline Valley Salt Tram was listed on the National Register of Historic Places.[85] The Period of Significance was identified as 1911—the start of construction of the tramway—to 1935—the year the last company went into receivership. The Statement of Significance reads: "Besides being the steepest tramway in the United States, the Saline Valley Salt Tram is one of the most scenic, historic, best preserved, oldest, and largest of its kind remaining today." At the time of listing, the property was entirely owned by the Bureau of Land Management, Bakersfield District.[86] Photographs included with the nomination are included below (figs. 91-95).

[83] Beldon, "History in the Making…," E-19.
[84] Halford, Kirk (Archaeologist, Bishop Field Office, BLM). "The Saline Salt Tram Summit Station Tender's Cabin." *Society for California Archaeology Newsletter.* December 2001.
[85] Conrad, "Saline Valley Salt Tram Historic Structure"
[86] Ibid.



Figure 91. "Control station on crest of Inyo Mountains looking east into Saline Valley, showing tramway towers on steep eastern slope in Daisy Canyon. Note cables still hanging," October 1973.



Figure 92. "Hanging cables between towers on western slope," October 1973.



Figure 93. "Tower on western slope with scenic Owens Valley and Sierras in background," October 1973.



Figure 94. "Control station on crest of Inyo Mountains showing towers down steep slope (western). Note the large timbers, rail and cables," Otober 1973.



Figure 95. "Control station located on crest of Inyo Mountains looking west toward Sierra Mountains," October 1973.

Death Valley National Park

President Herbert Hoover issued Executive Proclamation 2028 on February 11, 1933 establishing Death Valley National Monument under the provisions of the 1906 *Act for the Preservation of American Antiquities*. The Proclamation placed the administration of the 1,601,800 acres under the National Park Service (NPS). The boundaries were enlarged by Executive Proclamation 2228 by President Franklin Roosevelt in 1937 and Executive Proclamation 2961 by President Harry Truman in 1952. These proclamations expanded the land size to about 2,067,793 acres.

On October 31, 1994, Title III of the *California Desert Protection Act* designated the Monument as Death Valley National Park and added over 1.2 million acres previously administered by Bureau of Land Management (BLM); this brought the total acreage to 3,336,000 acres (fig. 96). This new acreage included a small portion of the Saline Valley Salt Tramway.

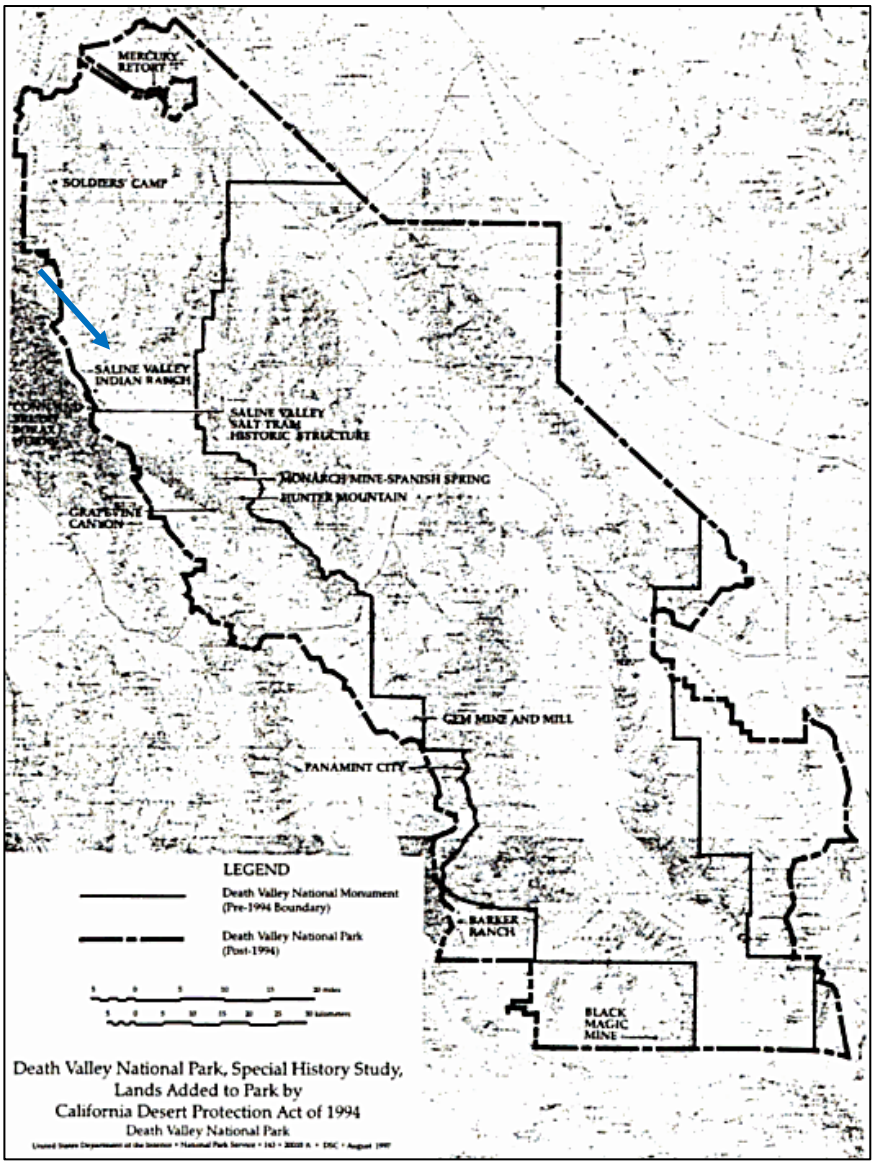


Figure 96. The solid line outlines land of Death Valley National Memorial prior to 1994. The dashed line outlines the area of Death Valley National Park after the California Desert Protection Act of 1994 was enacted. Note the Saline Valley Salt Tram location (arrow), most of which was retained by BLM.

In May 1998, staff from the Bishop Field Office of the Bureau of Land Management and photography students from a local high school assessed and documented the condition of the tramway, concentrating on the structures extant on the gentler western slope of the Inyo Mountains managed by the Bishop Field Office. Later that year, in August, an architect documented and assessed the summit control station cabin (fig. 97). The extant structure was compared to historic photographs; this allowed for the completion of stabilization drawings with details for the restoration of the roof and porch. Starting in September 1999, the Bishop Field Office began the stabilization and restoration of the cabin. The work was completed in October 2001 (fig. 98).[87]



Figure 97. The summit control station residence prior to restoration and stabilization in 1998, with missing roof.



Figure 98. The summit control station residence several years after stabilization and restoration was completed, 2006.

In 2019, the Saline Valley Salt Tramway was the subject of a master's thesis by Laurel Lueders entitled *For the Sake of Salt: A Landscape-Level Management Approach for the Saline Valley Salt Tram*.[88] The goal of the thesis was to determine "whether landscape level management is feasible."[89]

The entire tramway is managed by three federal entities (refer to fig. 99): the Bureau of Land Management Bishop Field Office (western slope of the Inyo Mountains from Owens Valley to ridge), the BLM Ridgecrest Field Office (eastern slope of Inyo Mountains from ridge to base in Saline Valley), and the National Park Service Death Valley National Park (Saline Valley only).[90] Because of this, Leuders found that there are "three different management approaches, resulting in three stages of degradation."[91]

[87] Halford, "The Saline Salt Tram Summit Station Tender's Cabin," *Society for California Archaeology Newsletter,* 32-33.
[88] Leuders, Laurel E. "For the Sake of Salt: A Landscape-Level Management Approach for the Saline Valley Salt Tram."
[89] Ibid, 2.
[90] Ibid, 35.
[91] Ibid, 1.

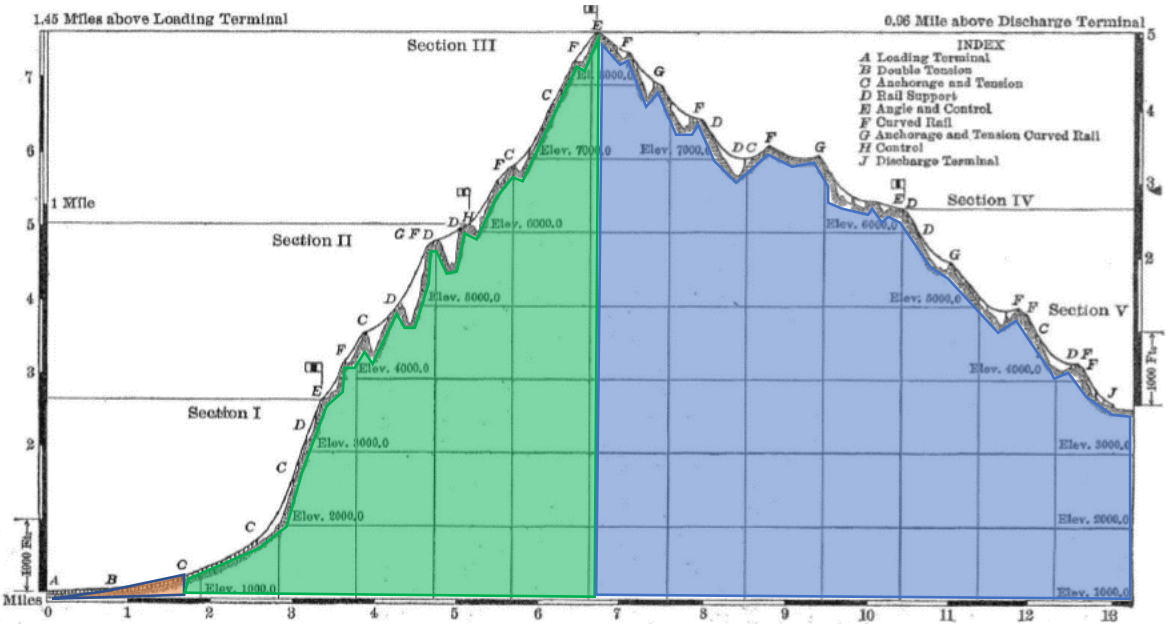


Figure 99. The red section is managed by the NPS. The green and blue sections are managed by BLM; the former by the Ridgecrest Field Office, the latter by the Bishop Field Office.

Death Valley National Park manages the portion of the map above highlighted in orange: from the loading terminal (Station 1) at the east and to about the location of the first anchorage and tension station (Station 3). Four support towers are extant in this section and are the subject of this HSR. Originally "approximately twenty towers linked the salt field terminus to the Inyo Range." The loading terminal, double tension station, and anchorage tension station once located in this section are no longer extant.[92]

The BLM Ridgecrest Field Office manages the portion of the map above highlighted in green: from the location of the first anchorage and tension station (Station 3) to the summit control station (Station 20). According to Lueders, this portion, being difficult to access, is "not frequently visited and portions of it remain virtually untouched." The dry air preserves the structures but also warrants concern for wildfires.[93]

The BLM Bishop Field Office manages the portion of the map above highlighted in blue: from the summit control station (Station 20) west to the discharge terminal (Station 39). This portion is known to be "the most accessible, due to the 4x4 route that interweaves the [tramway] towers on its way to the summit. As a result, this portion has seen lots of desecration by wood scavengers and elemental degradation…from flash floods, high winds, and extreme temperatures." This field office completed a stabilization of the summit caretaker's cabin and summit control station 1999-2001.[94]

[92] Ibid, 38.
[93] Ibid, 41
[94] Ibid, 43-44.

Architectural Description

The NPS Historic Preservation Training Center (HPTC) visited the portion of the Saline Valley Salt Tramway managed by the NPS once over the course of research for this Historic Structure Report; this trip occurred November 17, 2020. A collection of field photographs, notes, and drawings were compiled during the visit. Through this work, detailed physical descriptions of features, a compilation of character-defining features, and condition assessments were completed. Park logistical assistance was provided by the Death Valley National Park Abandoned Mine Lands Program.

Building Feature Master List

The Building Feature Master List (BFML) is an overall outline-format checklist used for creating a physical description of the four Tramway support towers. The BFML describes features using a hierarchal structure based on industry standards adopted by the federal government—the UNIFORMAT II (ASTM E1557 Standard, 2008) used by many facility management industry leaders, including the National Park Service's Park Facility Management Division (PFMD). The BFML uses headings and sub-headings to divide architectural components, structural systems, mechanical systems, etc. into a simple organizational tool (Table 1). Note: not all headings apply or are used for every structure.

A	Substructure	
	A10	Foundations
B	Shell	
	B10	Superstructure
	B20	Exterior Enclosure
	B30	Roof Closure
C	Interiors	
	C10	Interior Construction
	C20	Stairs
	C30	Interior Finishes
D	Services	
	D20	Plumbing
	D30	HVAC
	D40	Fire Protection Services
	D50	Electrical
G	Building Sitework	
	G20	Site Improvements
	G90	Other Site Work

Table 1. The basic UNIFORMAT II Building Feature Master List includes the above headings and subheadings.

Physical Description

The Saline Valley Salt Tramway was constructed 1911-1912 and used intermittently until cessation of salt mining in the area in 1935, and subsequent abandonment of the tramway; this timeframe is considered the Period of Significance. Since abandonment, the tramway has not been maintained and could be classified as a ruin. Amazingly, the tramway retains many historic features, including four support towers managed by the National Park Service, and several components managed by the Bureau of Land Management. Future care of the four NPS-owned support towers (the subject of the physical description, condition assessment, and recommended treatment sections of this report) should be based on the sustainable preservation of traditional construction materials and methodologies, not on replacing historic material with inferior imitations.

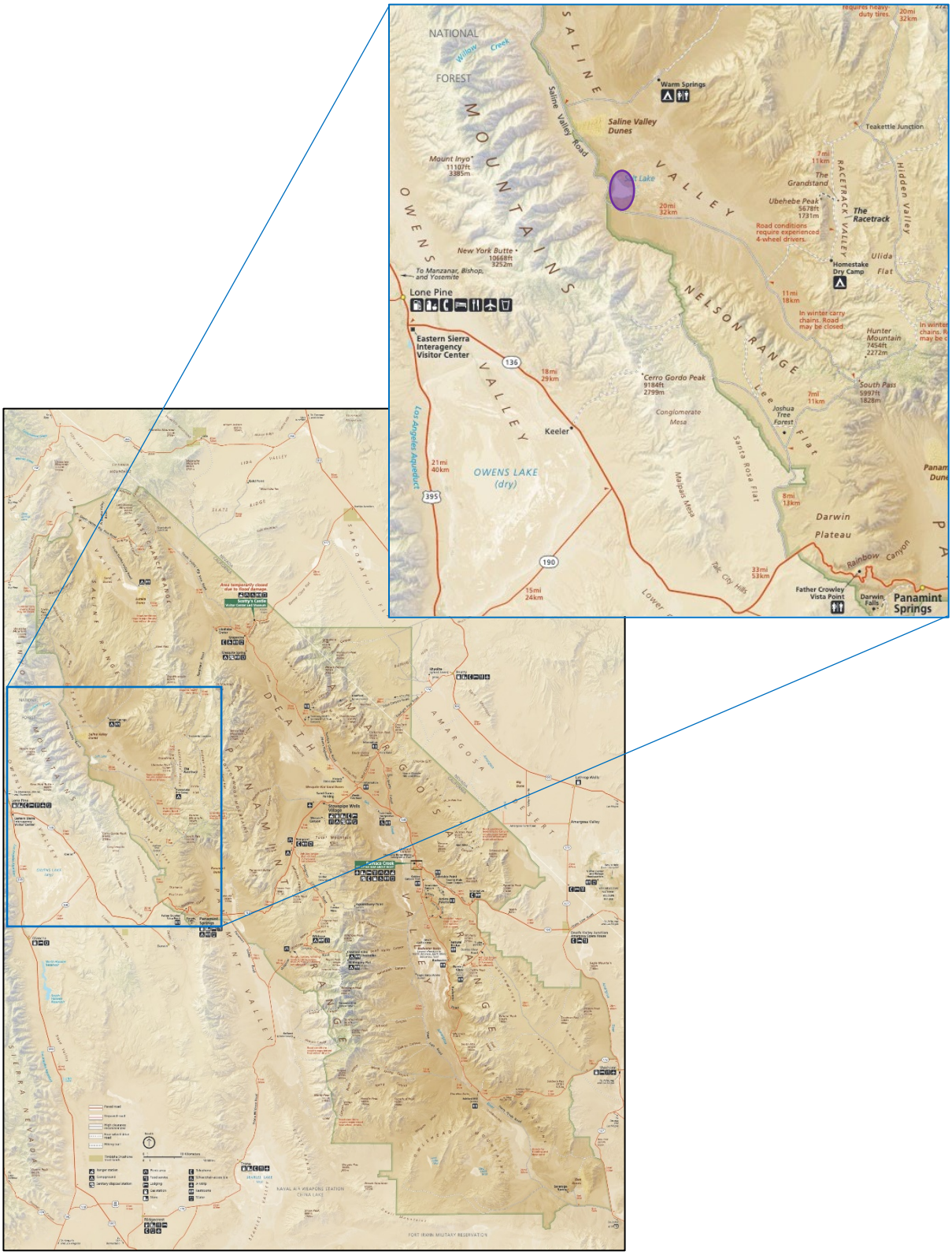


Figure 100. Death Valley National Park is located on the eastern border of California with Nevada and covers 3.4 million acres. Inset: The Saline Valley is located on the western edge of the park boundary. The purple overlay denotes the area that holds the four support towers of discussion in this HSR.

Location within the Park

"To protect its extraordinary natural cultural landscape, in 1994 Congress changed Death Valley from a national monument to a national park, enlarged the park to its present size, and desnigated most of it as wilderness." The park is located on the eastern border of California with Nevada and manages 3.4 million acres and hundreds of historic and pre-historic sites, structures, and buildings (fig. 100).

Saline Valley is located on the western edge of the park, just east of the Inyo Mountain range (fig. 1 inset). Included within the valley is the salt lake from which the historic mining companies mined salt. Salt was transferred over the mountain range to the west via an extensive aerial tramway constructed 1911-12. A large portion of the tramway is currently managed by the Bureau of Land Management (fig. 101); a small portion of the tramway property, including four historic support towers, is managed by the National Park Service (fig. 102).

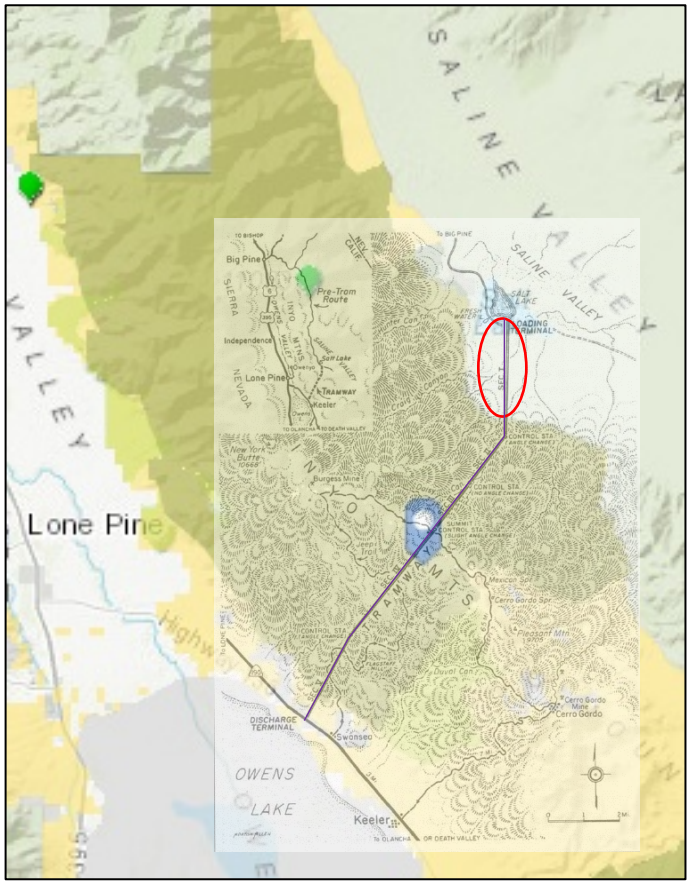


Figure 101. A modern BLM map (colored) overlayed with a historic map of the Saline Valley Salt Tramway. The Tramway route is highlighted with a purple line. A large portion of the route is owned by BLM (dark green map overlay); only a small portion is owned by NPS (indicated by red oval).

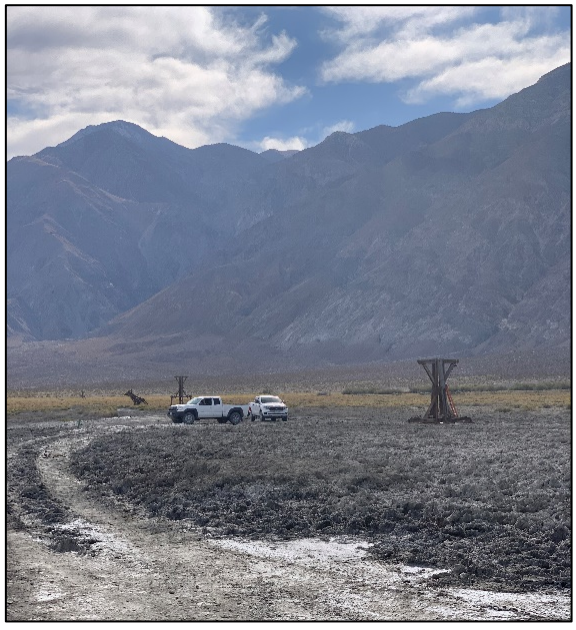


Figure 102. Looking south from the salt lake to the four NPS-managed towers. HPTC, 11/17/20.

In Saline Valley, the tramway ran north-south from the salt lake at the north toward the Inyo Mountains to the south (fig. 103). The first NPS-managed tower south of the Loading Terminal (Station 1) ruins along Salt Lake is extant; this is referred to as Support Tower #1 (fig. 104). The next tower south along the tramway is no longer extant, however its concrete foundation piers mark its location. About 420 feet south of #1 is extant Support Tower #2 (fig. 105). About 220 feet south of #2 is extant Support Tower #3 (fig. 106). A significant gap (about 1,600 feet) is located

south of Tower #3, which, based on distance and spacing between other extant towers, likely held six or seven additional support towers; no evidence (namely foundations) could be located by the HPTC assessment team. The final extant NPS-managed tower is located south of this 1,600-foot gap; it is referred to as Support Tower #4 (fig. 107). Another significant gap is located between Tower #4 and Saline Valley Road to the south. This gap likely held five additional support towers; only one foundation is extant. The park boundary is located approximately two miles south of Saline Valley Road. According to park staff, this two-mile section includes at least twenty-nine towers (foundations or collapsed) and likely three or four others which have disappeared completely. Land further to the south is managed by BLM.

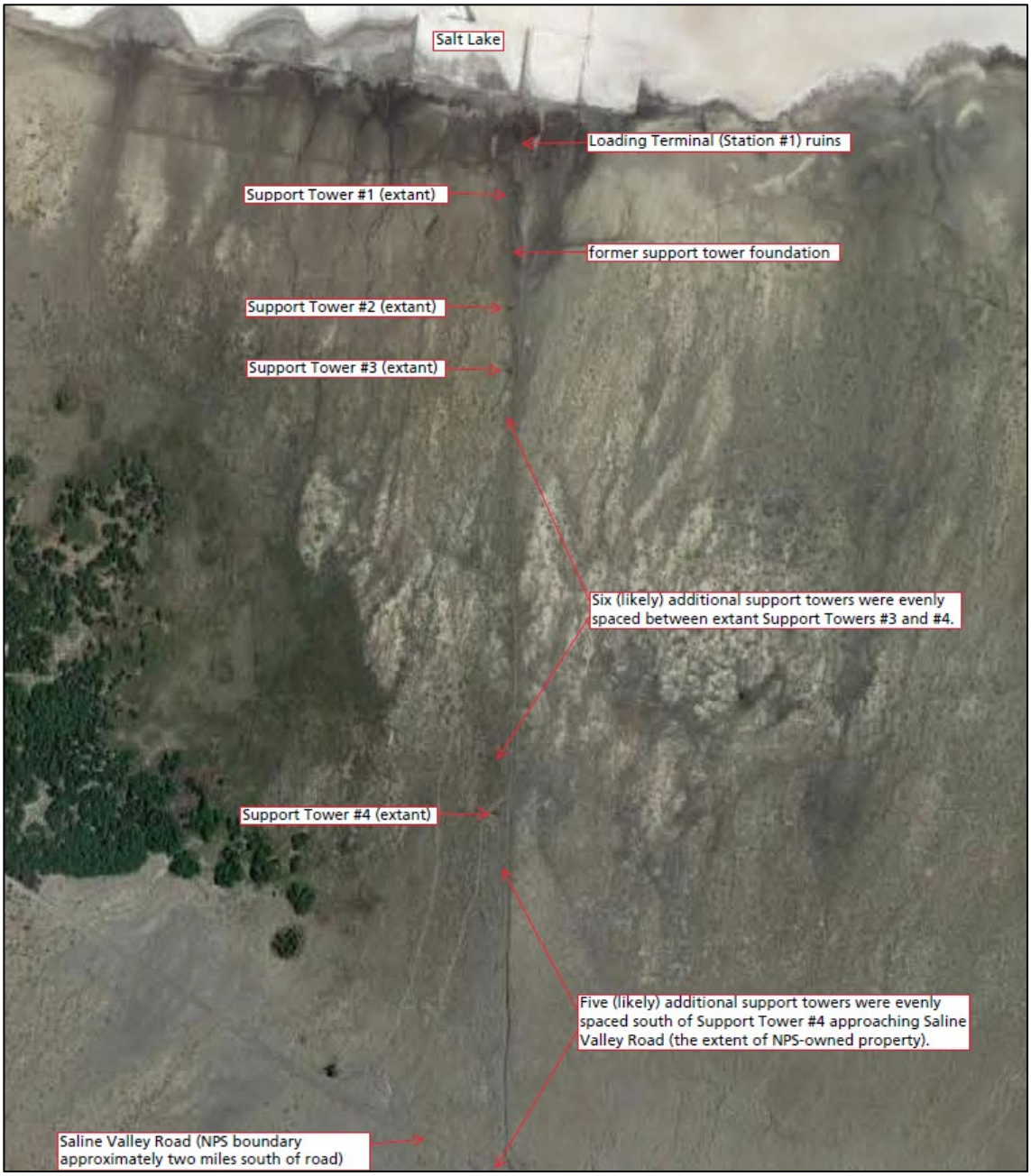


Figure 103. The portion of the former Saline Valley Salt Tramway managed by the NPS with assets identified.



Figure 104. Support Tower #1 from the NE. HPTC, 11/17/20.



Figure 105, right. Support Tower #2 from the N. Support Tower #3 is seen in the background. HPTC, 11/17/20.



Figure 106. Support Tower #3 from the N. HPTC, 11/17/20.



Figure 107. Support Tower #4 from the N. HPTC, 11/17/20.

Structures Overall

The support towers were constructed nearly identically, with the only variant between them being the height of the standards (support legs) between the ground and the horizontal ties. Archival photographs emphasize this phenomenon from the first tower south of the Loading Terminal at grade to a tower near the peak being dozens of feet above grade (see Chronology section for images). This can be subtly noticed at the four support towers owned by the NPS where the heights of the standards vary from 17" at Tower #1 and 137½" at Tower #2.

Each support tower is supported by four cast-in-place (CIP) concrete footings (fig. 108). Each footing supports a wood standard (support leg) angled in at the top and cut at varying heights based on the elevation of the tramway line at each individual tower location (fig. 109). The standards are bolted to the concrete footing below (fig. 110). The standards originally included horizontal wood bracing to prevent twisting of the standards (fig. 111). Short wood boards are nailed to the standards for access up and down the structures.

The angled standards (four per tower) support two sets of paired horizontal wood ties placed perpendicular (fig. 112). The ties are bolted to the top of the standards (fig. 113).

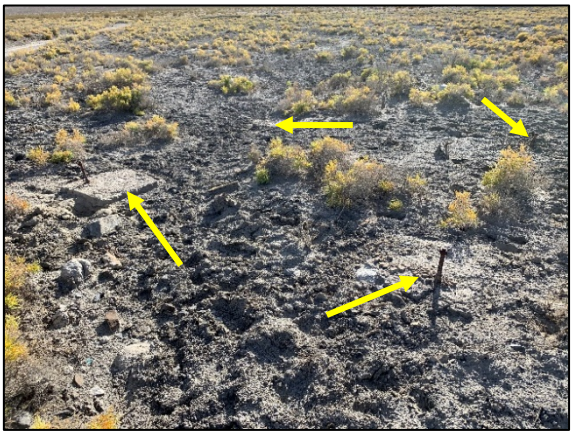


Figure 108. Four CIP concrete footings mark the location of a former support tower (arrows). Iron bolts embedded in the concrete connected to brackets at the base of the wood standards. HPTC, 11/17/20.



Figure 109. Support Tower (ST) #2. The wood standards rise above the concrete footings at an angle and vary in height based on grade and terrain at each support location. Note remnant boards nailed to the standards allowed access to the upper portions of the tower (arrow). HPTC, 11/17/20.



Figure 110. ST #2. An iron bracket is bolted to the bottom of a standard and to the concrete footing below. HPTC, 11/17/20.



Figure 111. ST #3. A horizontal brace between two standards remains (arrow), but is dislodged at one end, on the fallen support tower. HPTC, 11/17/20.

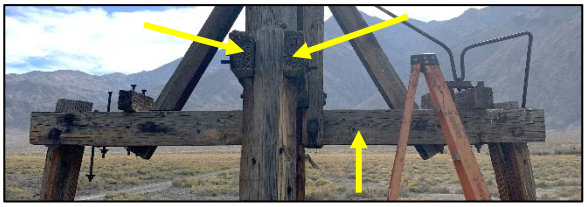


Figure 112. ST #2. Two sets of paired wood ties (arrows), oriented perpendicular to each other, are supported by the standards. HPTC, 11/17/20.

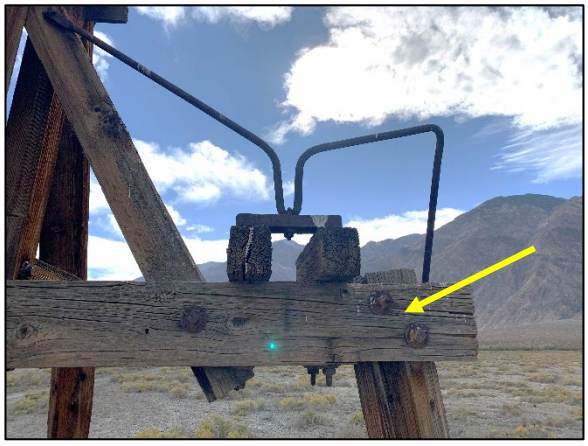


Figure 113, right. ST #2. The top of each angled standard is bolted to a pair of horizontal wood ties (arrow). Note the X-brace also bolted to the ties at left. HPTC, 11/17/20.

The ties support four wood vertical posts at each of the inside corners (fig. 114). The posts are bolted at the bottom to the horizontal ties and are cut to lap over the ties for additional bearing (fig. 115). Encircling the center of the posts are boards the use of which is unknown.

A single wood horizontal cap timber is located at and bolted to the top of the posts (fig. 116). The cap timber originally supported iron saddles at each end of the upper plane. These saddles supported the carrier wires, along which the bucket carriages ran.

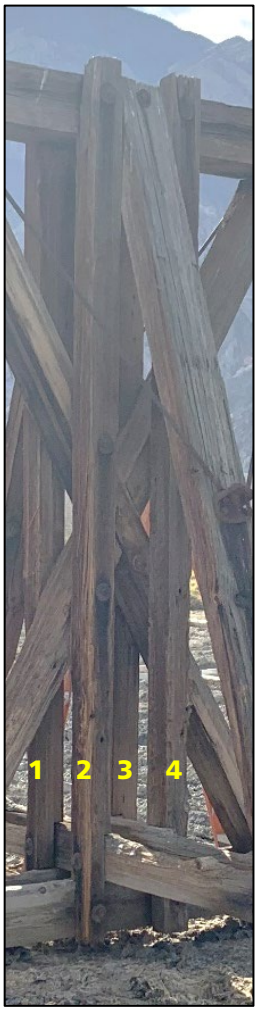


Figure 114. ST #1. Four vertical posts are supported in the corners of the horizontal ties. HPTC, 11/17/20.



Figure 115. ST #4. The posts are bolted to the wood ties below. Note the bottoms of the posts are also lapped over the ties for bearing. HPTC, 11/17/20.



Figure 116. ST #2. The posts are bolted to the cap timber above. Note the X-brace members are each notched into the underside of the cap and also bolted. HPTC, 11/17/20.

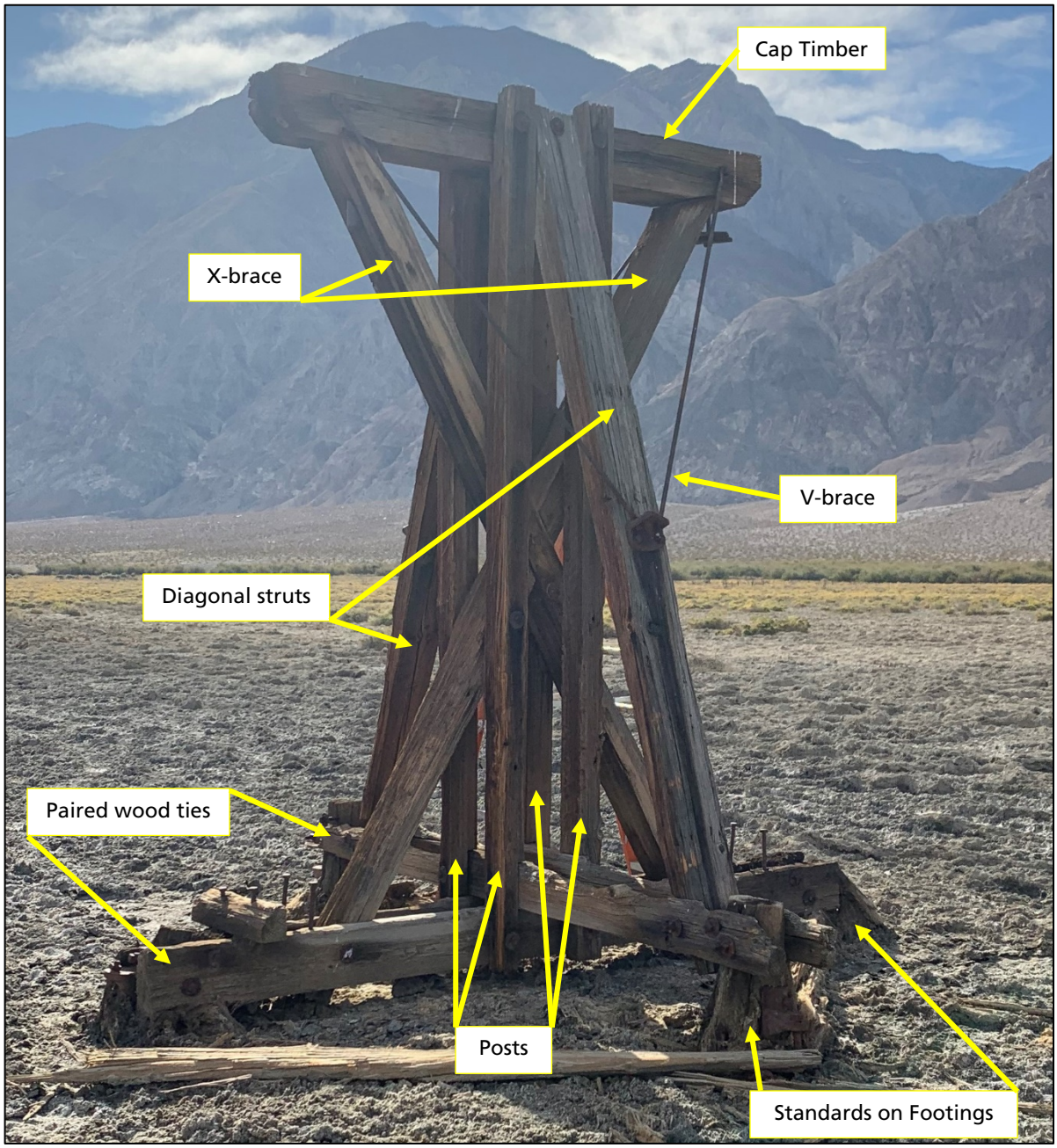


Figure 117. ST #1. Individual components labelled for clarity. HPTC, 11/17/20.

A wood X-brace is located between the posts (see fig. 117) and is bolted to the lower pair of ties at the bottom (see fig. 113). At the top, the brace ends are shoulder-notched to support the cap timber above and also bolted together (see fig. 116). The two crossing members are half-lapped at the center (fig. 118).

Wood diagonal struts are located on the elevations perpendicular to the X-bracing and are bolted to one pair of ties at the bottom and above to the cap timber (see fig. 117). Iron V-braces are also located between the diagonal struts and cap timber, likely to prevent twisting of the

structure near the points of heavy salt loading (fig. 119). Short wood boards are nailed to the struts for access up and down the structures to perform maintenance (see fig. 119).

Other wood blocking can be seen throughout each structure; the purposes and names are unknown (figs. 120-121). An additional piece of curved iron is located just above the paired ties (see fig. 121). The iron braces accommodated an iron wheel which supported the slack of the former moving traction ropes.



Figure 118. ST #1. The X-brace members are lapped in the center where they cross. HPTC, 11/17/20.



Figure 119. ST #3; this tower has collapsed and is no longer upright. Iron V-braces connect the diagonal struts to the timber cap above and provide additional resistance to twisting. Note the remnant boards located on the struts for climbing the tower during maintenance. HPTC, 11/17/20.



Figure 120. ST #2. Wood pieces of unknown use nailed around the center of the posts. HPTC, 11/17/20.



Figure 121. ST #2. The curved piece of iron remains once held a wheel and supported traction rope slack. HPTC, 11/17/20.

Support Tower #1 Building Feature Master List Descriptions

A	SUBSTRUCTURE
A10	FOUNDATIONS
A1010	Standard Foundations

At Support Tower #1, most of the footings are covered with soil (fig. 122). The four concrete footings of all the support towers were cast in place using materials, including water, hauled in by mule or temporary tram for this purpose.

Exposed footings were easily detectable at a former support tower site south of Tower #4 near Saline Valley Road (see fig. 9). Measurements of the footings from that site are assumed to be similar throughout the system. The footings are generally the same size and measure 26" square in plan and 6½-7" deep depending on the underlying soil composition.



Figure 122. The concrete footing is covered with soil under this standard. HPTC, 11/17/20.

B	SHELL
B10	SUPERSTRUCTURE
B10.1	Standards

The four wood standards (support legs) of Support Tower #1 originally measured approximately 7½" in diameter (deterioration does not allow for accurate measurement) and vary in height depending on grade and height of paired ties above: 17-26" (fig. 123). Tower #1 standards may have been replaced as these are round in plan and the other towers retain square standards, or they may be so deteriorated to be deformed from their original shape (fig. 124).

The iron brackets and bolts which attach the standards to the concrete footings are intact (fig. 125). The brackets measure 5" wide x 8" high x 1¼" thick and the flange projects 7".

Wood bracing originally connected the standards together to deter twisting of the base. Remnant wood pieces lie on the ground around the tower; these could be the bracing boards (see fig. 123).



Figure 123. The four standards (arrows) of ST #1 measure approximately 7½" in diameter and vary in height between 17" and 26". Note the remnant board in the foreground which could be a former cross brace. HPTC, 11/17/20.



Figure 124. This standard and the one at the opposite end of the paired ties are round in plan suggesting they were replaced from the original square timbers. The iron bracket is extant. HPTC, 11/17/20.



Figure 125. A deteriorated standard with iron bracket extant at ST #1. HPTC, 11/17/20.

B10.2	Ties

Two sets of paired horizontal wood ties placed perpendicular to each other are located above and supported by the four standards (fig. 126). Three of the four ties are deteriorated, and accurate measurement of these members was not possible. One tie measures 142” long. All are likely original and are likely douglas fir.

A pair of iron bolts connects the paired ties to the top of each standard. All are extant.

On either end of the lower ties, between the standard coming up from below and the X-brace, were two wood blocks (measuring 3¾” thick x 5½” tall x 23½” wide) mounted perpendicular to the ties below. These blocks supported an intricately bent iron rod. One end of the rod was secured to a tie, the center of the rod was secured to the blocking, and the upper end of the rod was secured to the X-brace. Only one wood block is extant. No iron brackets or wheels that once supported the traction ropes are extant at this support tower.



Figure 126. Two sets of paired horizontal wood ties at ST #1. Note the pair of iron bolts which connect the ties to the standards below. HPTC, 11/17/20.

B10.3	Posts

Four vertical wood posts are supported by and located at the inside corners of the pairs of horizontal ties (fig. 127). The posts measure 5½" square in plan and are likely 142-143" tall to match those at the other towers. All are original and are likely douglas fir.

The posts are bolted at the bottom to both sets of horizontal ties (fig. 128) and at the top to the sides of the horizontal timber cap (fig. 129). At both locations, the posts are cut to lap over the ties and cap for additional bearing.

At the center of the posts, small wood boards originally encircled the posts to create a sort of platform (see Tower #2 for example); none are extant.



Figure 127. The four central posts at ST #1 each measure 5½" square in plan. HPTC, 11/17/20.



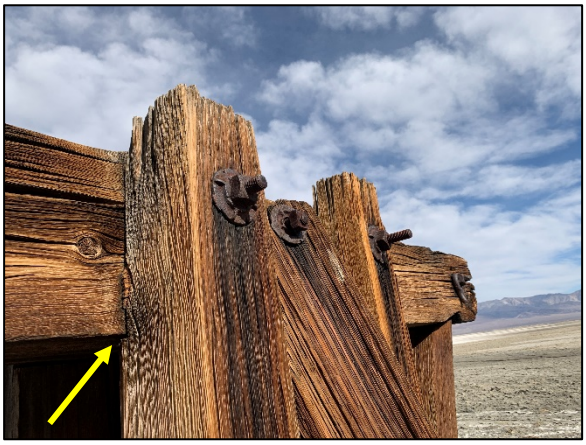


Figure 129, above. The posts are bolted to and lapped (arrow) over the horizontal timber cap at the top. HPTC, 11/17/20.

Figure 128, left. The posts are bolted to and lapped over (arrows) both sets of horizontal ties at the bottom. HPTC, 11/17/20.

B10.4	Cap Timber

A wood horizontal cap timber is bolted to the top of the posts, X-brace (also notched here), and diagonal struts (fig. 130). The cap measures 11¼" wide x 9¼" high and is approximately 96" long. On the underside of each end of the cap the wood is clipped at a 45° angle. The cap is original and is likely douglas fir.

The cap timber originally held a pair of iron saddles at either end which supported the stationary track cables and the moving carriages on wheels. The saddles are no longer extant.



Figure 130. The cap timber of ST #1 is bolted to the top of the posts, X-brace, and diagonal struts. Note the clipped ends (arrows). HPTC, 11/17/20.

B10.5	X-Brace

A wood X-brace is located between the vertical posts (fig. 131). The two crossing members are half-lapped at the center (fig. 132). Each member measures 9¼" wide x 5½" thick; the lengths are unknown. The members are original and are likely douglas fir.

Iron bolts join the X-brace to the lower pair of ties at the bottom. At the top, the brace ends are shoulder-notched to support the cap timber above. Extra-long bolts also secure the X-brace to the cap at each joint.



Figure 131. The X-brace of ST #1 is located between the vertical posts and supported by the lower set of ties. HPTC, 11/17/20.



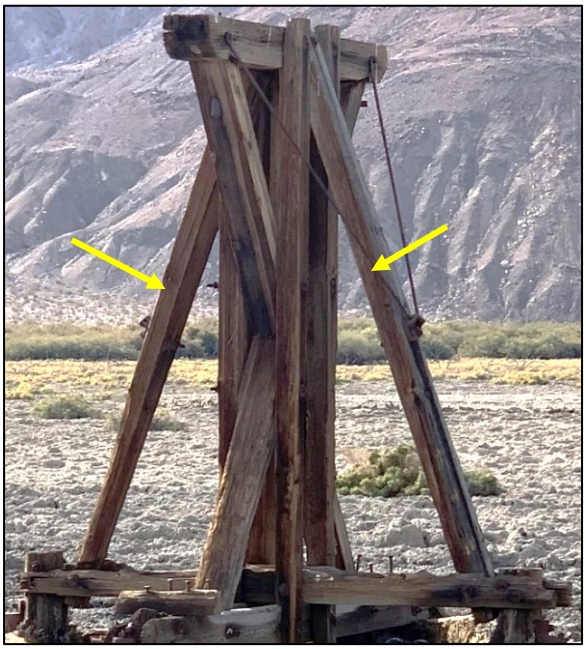
Figure 132. The X-brace members are half-lapped at their centers (arrow). HPTC, 11/17/20.

B10.6	Struts

Wood diagonal struts are located perpendicular to the X-brace (fig. 133). Each strut measures 9¼" wide x 5½" thick and 142" long. The members are original and are likely douglas fir.

Iron bolts connect the struts to the upper set of ties at the bottom and to the side of the cap timber above (fig. 134); the cap timber is also notched at the sides to accept the struts (fig. 135). Iron V-braces—composed of a bracket, threaded rods, and bolts—also stabilize the diagonal struts to the cap (fig. 136).

Wood ladder boards were originally nailed to the struts for access up and down the structure to perform maintenance; no boards are extant.



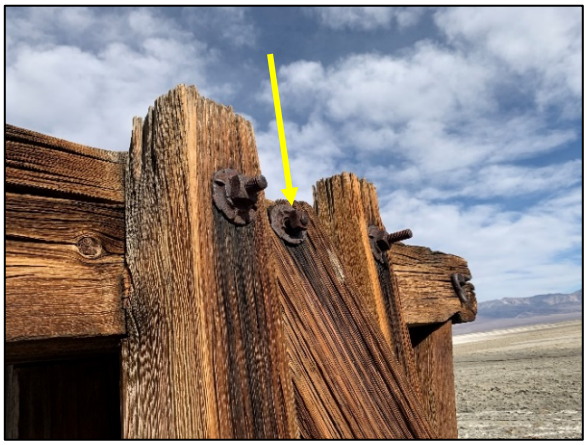


Figure 134, above. The diagonal struts are bolted to the cap timber at the top (arrow) between a set of posts. HPTC, 11/17/20.

Figure 133, left. The diagonal struts of ST #1 are located between the upper ties and cap. HPTC, 11/17/20.



Figure 135. The side of the cap timber is notched to accept the diagonal struts. HPTC, 11/17/20.

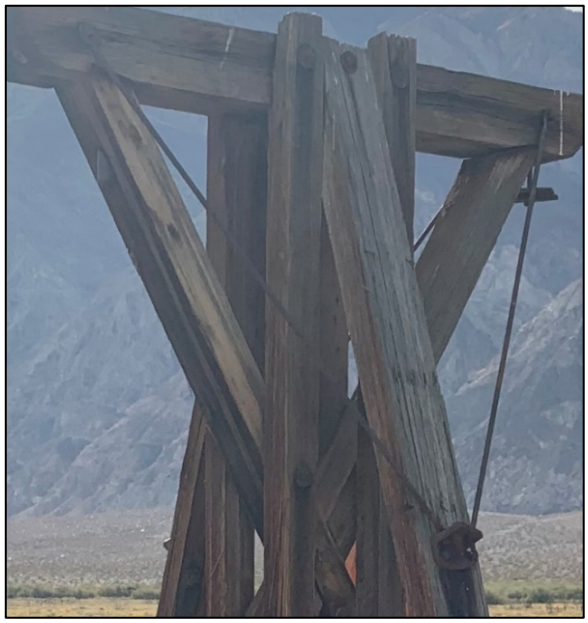


Figure 136, right. Iron V-braces stabilize the diagonal struts to the cap timber. HPTC, 11/17/20.

G	BUILDING SITEWORK
G90	OTHER SITE WORK
G9087	Overall Building Site Drainage

Neutral site drainage surrounds Support Tower #1 meaning that any falling water does not flow toward or away from the structure (fig. 137). This allows water to remain around the base of the structure. Based on deterioration to the lower timber members, it appears that when the nearby Salt Lake floods, Tower #1 can be inundated with flood waters.



Figure 137. Neutral site drainage affects ST #1 when the nearby Salt Lake floods and inundates the structure with water. Source: HPTC, 11/17/20.

Support Tower #2 Building Feature Master List Descriptions

A	SUBSTRUCTURE
A10	FOUNDATIONS
A1010	Standard Foundations

At Support Tower #2, most of the footings were covered with soil; some concrete is exposed (fig. 138). The four concrete footings of all the support towers were cast in place using materials, including water, hauled in by mule or temporary tram for this purpose.

Exposed footings were easily detectable at a former support tower site south of Tower #4 near Saline Valley Road (see fig. 108). Measurements of the footings from that site are assumed to be similar throughout the system. The footings are generally the same size and measure 26” square in plan and 6½-7” deep depending on the underlying soil composition.



Figure 138, right. Partially exposed concrete footing at Support Tower #2. HPTC, 11/17/20.

B	SHELL
B10	SUPERSTRUCTURE
B10.1	Standards

The four angled wood standards (support legs) of Support Tower #2 measure 7½” square in plan and vary in height depending on grade and height of paired ties above: two at 83”, and 89” and 90” (fig. 139). All are original and are likely douglas fir. The standards are placed at a 45° angle in relation to the rest of the structure above.

The iron brackets and bolts which attach the standards to the concrete footings are intact (fig. 140). The brackets measure 5” wide x 8” high x 1¼” thick and the flange projects 7”.

Wood bracing originally connected the standards together at the top and bottom to deter twisting of the base. No brace boards are extant. Bolt holes show the original location of the bracing (see fig. 139).

Wood ladder boards were originally nailed to at least one standard to allow for access up and down the tower. Only one board remains (see fig. 139). It measures 1" thick x 3½" high x 16" wide.



Figure 139. The four standards (support legs) of ST #2 measure 7½" square and vary in height, 83-90". Bolt holes from former wood bracing can be seen (arrows). Note the one remaining ladder board on the standard at rear. HPTC, 11/17/20.



Figure 140, right. All base brackets are extant and connect the standards to the concrete footings (covered here with soil). HPTC, 11/17/20.

B10.2	Ties

Two sets of paired horizontal wood ties placed perpendicular to each other are located above and supported by the four standards (fig. 141). These wood members measure 7½" high x 2¾" thick x 142" long. All are original and are likely douglas fir.

A pair of iron bolts connects the paired ties to the top of each standard. All are extant.

On either end of the lower ties, between the standard coming up from below and the X-brace, were two wood blocks (measuring 3¾" thick x 5½" tall x 23½" wide) mounted perpendicular to the ties below. These blocks supported an intricately bent iron rod (see fig. 141). One end of the rod was secured to a tie, the center of the rod was secured to the blocking, and the upper end of the rod was secured to the X-brace. All wood blocks are intact, but only one bent iron rod bracket is extant.



Figure 141. Two sets of paired horizontal wood ties at ST #2. Note the pair of iron bolts which connect the ties to the standards below; all are extant. The intricately bent iron rod at left is assumed to assist buckets by the tower; only one of two is extant. HPTC, 11/17/20.

B10.3	Posts

Four vertical wood posts are supported by and located at the inside corners of the pairs of horizontal ties (fig. 142). The posts measure 5½" square in plan and are 142" tall. All are original and are likely douglas fir.

The posts are bolted at the bottom to both sets of horizontal ties (fig. 143) and at the top to the sides of the horizontal timber cap. At both locations, the posts are cut to lap over the ties and cap for additional bearing.

At the center of the posts, small wood boards encircle the posts to create a sort of platform (fig. 144).



Figure 142. The four central posts at ST #2 measure 5½" square in plan and are 142" tall. HPTC, 11/17/20.

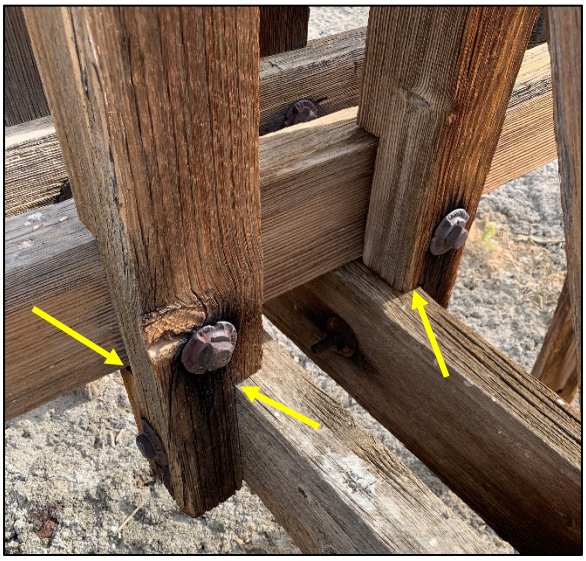




Figure 144, above. Boards of unknown use encircle the center of the posts. HPTC, 11/17/20.

Figure 143, left. The posts are bolted to the horizontal ties at the bottom. Note the laps (arrows) cut into the posts. HPTC, 11/17/20.

B10.4	Cap Timber

A wood horizontal cap timber is bolted to the top of the posts, X-brace (also notched here), and diagonal struts (fig. 145). The cap measures 11¼" wide x 9¼" high and is approximately 96" long. On the underside of each end of the cap the wood is clipped at a 45° angle. The cap is original and is likely douglas fir.

The cap timber originally held a pair of iron saddles at either end which supported the stationary track cables and the moving carriages on wheels. The saddles are no longer extant.
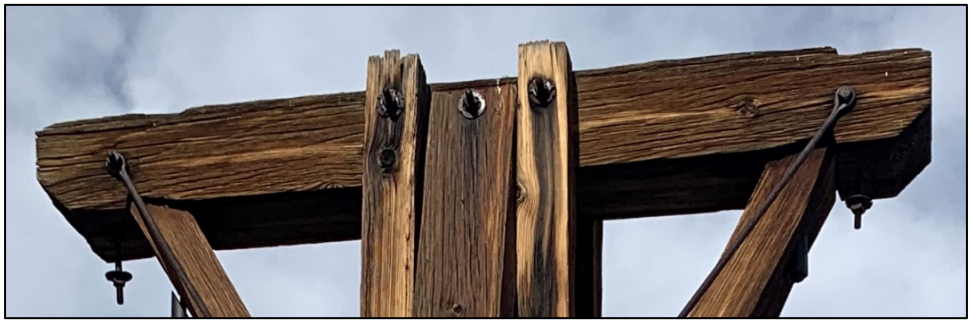


Figure 145. The cap timber of ST #2 is bolted to the top of the posts, X-brace, and diagonal struts. HPTC, 11/17/20.

B10.5	X-Brace

A wood X-brace is located between the vertical posts (fig. 146). The two crossing members are half-lapped at the center. Each member measures 9¼" wide x 5½" thick; the lengths are unknown. The members are original and are likely douglas fir.

Iron bolts join the X-brace to the lower pair of ties at the bottom (fig. 147). At the top, the brace ends are shoulder-notched to support the cap timber above. Extra-long bolts also secure the X-brace to the cap at each joint (fig. 148).



Figure 146. The X-brace of ST #2 is located between the vertical posts and supported by the lower set of ties. HPTC, 11/17/20.



Figure 147. Each member is bolted to the lower pair of ties below. HPTC, 11/17/20.

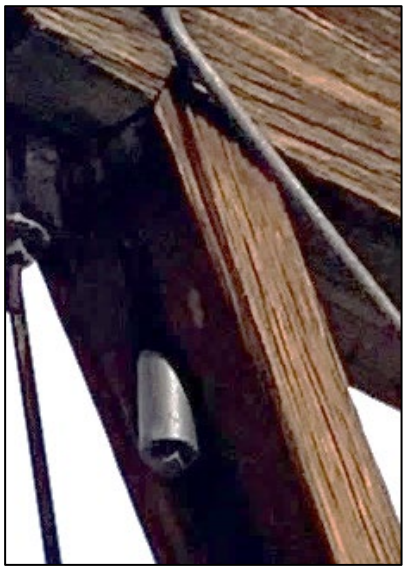


Figure 148. Each member is notched to the underside of the cap timber and mechanically fastened with special bolts and barrel washers/spacers. HPTC, 11/17/20.

B10.6	Struts

Wood diagonal struts are located perpendicular to the X-brace (fig. 149). Each strut measures 9¼" wide x 5½" thick and 142" long. The members are original and are likely douglas fir.

Iron bolts connect the struts to the upper set of ties at the bottom and to the side of the cap timber above; the cap timber is also notched at the sides to accept the struts. Iron V-braces—composed of a bracket, threaded rods, and bolts—also stabilize the diagonal struts to the cap (fig. 150).

Wood ladder boards were originally nailed to one of the struts for access up and down the structure to perform maintenance; many of these boards are extant and measure 1" thick x 3½" tall x 16" wide (see fig. 150).

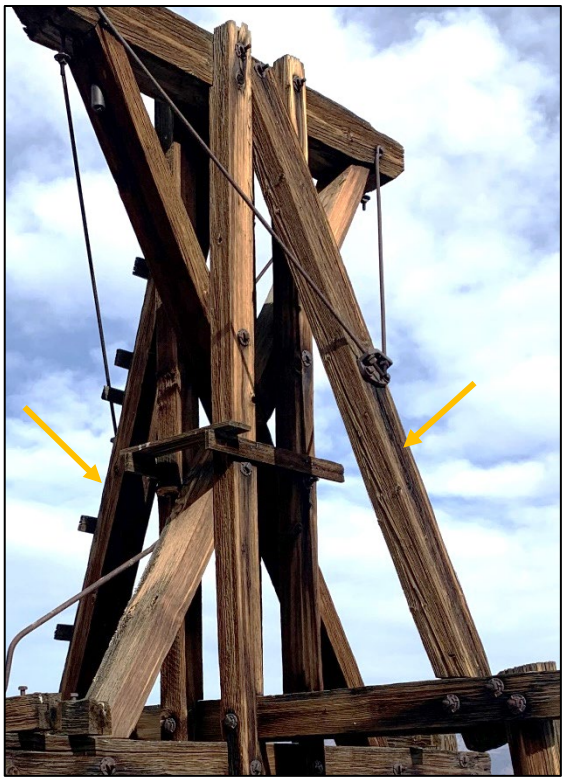


Figure 149. The diagonal struts of ST #2 are located between the upper ties and cap (arrows). HPTC, 11/17/20.



Figure 150. One of the struts retains much of its board ladder. Note the iron V-braces in place. HPTC, 11/17/20.

G	BUILDING SITEWORK
G90	OTHER SITE WORK
G9087	Overall Building Site Drainage

Neutral site drainage surrounds Support Tower #2 meaning that any falling water does not flow toward or away from the structure (fig. 151). This allows water to remain around the base of the structure.



Figure 151. Neutral site drainage around and under ST #2. HPTC, 11/17/20.

Support Tower #3 Building Feature Master List Descriptions

A	SUBSTRUCTURE
A10	FOUNDATIONS
A1010	Standard Foundations

At Support Tower #3, most of the footings were covered with soil (fig. 152). The four concrete footings of all the support towers were cast in place using materials, including water, hauled in by mule or temporary tram for this purpose.

Exposed footings were easily detectable at a former support tower site south of Tower #4 near Saline Valley Road (see fig. 108). Measurements of the footings from that site are assumed to be similar throughout the system. The footings are generally the same size and measure 26" square in plan and 6½-7" deep depending on the underlying soil composition.



Figure 152. ST #3. A fallen standard lies adjacent its concrete footing, which is nearly undetectable due to soil cover. Note the collapsed standard with iron bracket still attached. The bolt connecting it to the concrete footing has been snapped off at grade (arrow). HPTC, 11/17/20.

B	SHELL
B10	SUPERSTRUCTURE
B10.1	Standards

The four angled wood standards of Support Tower #3 have collapsed. Remnant standards measure 7½" square in plan and vary in height originally depending on grade and height of paired ties above: two at 94", and 103" and 106" (fig. 153). All are original and are likely douglas fir. The standards were originally placed at a 45° angle in relation to the rest of the structure above.

Three of the four iron brackets which attach the standards to the concrete footings are intact (fig. 154; see fig. 152). These brackets measure 5" wide x 8" high x 1¼" thick and the flange projects 7". Some of the associated iron bolts are also extant.

Wood bracing originally connected the standards together at the top and bottom to deter twisting of the base. One board is extant; however, bolt holes show the original location of the other bracing boards (see fig. 154).

Wood ladder boards were originally nailed to at least one standard to allow for access up and down the tower. None of these boards remain.

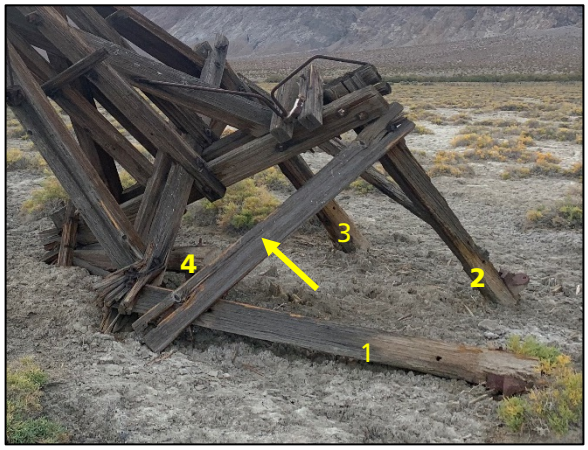


Figure 153. The four standards (numbered) of ST #3 measure 7½" square and vary in height, 94-106". A single brace is extant at this tower (arrow). Bolt holes are evident on the standards where other braces were located. HPTC, 11/17/20.



Figure 154. A collapsed standard with missing iron bracket. The bolt for the bracket is extant (arrow). Just above the bracket bolt are holes showing the location of an original brace. HPTC, 11/17/20.

B10.2	Ties

Two sets of paired horizontal wood ties placed perpendicular to each other are located above and were originally supported by the four standards (fig. 155). These wood members measure 7½" high x 2¾" thick and were likely 142" long (damage from collapse has shortened these members). All are original and are likely douglas fir.

A pair of iron bolts connects the paired ties to the top of each standard. All are extant, but many are disconnected from the standards.

On either end of the lower ties, between the standard coming up from below and the X-brace, were two wood blocks (measuring 3¾" thick x 5½" tall x 23½" wide) mounted perpendicular to the ties below. These blocks supported an intricately bent iron rod (see fig. 155). One end of the rod was secured to a tie, the center of the rod was secured to the blocking, and the upper end of the rod was secured to the X-brace. All wood blocks are intact, but only one bent iron rod bracket is extant.

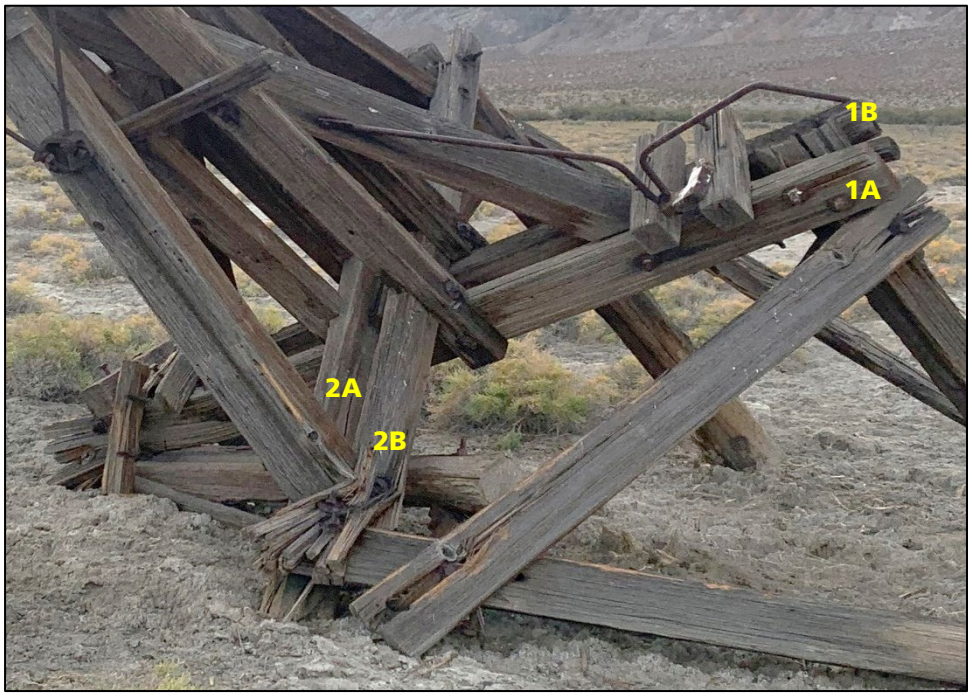


Figure 155. Two sets of paired horizontal wood ties at ST #3. Note the pair of iron bolts which connect the ties to the standards below; all are extant, but several are dislodged from the standard below. The intricately bent iron rod at right supported the slack of the traction rope; only one of two is extant. HPTC, 11/17/20.

B10.3	Posts

Four originally vertical wood posts are supported by and located at the inside corners of the pairs of horizontal ties (fig. 156). The posts measure 5½" square in plan and are 143" tall. All are original and are likely douglas fir.

The posts are bolted at the bottom to both sets of horizontal ties and at the top to the sides of the horizontal timber cap. At both locations, the posts are cut to lap over the ties and cap for additional bearing.

At the center of the posts, small wood boards originally encircled the posts to create a sort of platform; only two are extant.



Figure 156. The four central posts, originally vertical before collapse of ST #3, measure 5½" in plan and are 143" tall. HPTC, 11/17/20.

B10.4	Cap Timber

A wood originally horizontal cap timber is bolted to the top of the posts, X-brace (also notched here), and diagonal struts (fig. 157). The cap measures 11¼" wide x 9¼" high and is approximately 96" long. On the underside of each end of the cap the wood is clipped at a 45° angle. The cap is original and are likely douglas fir.

The cap timber originally held a pair of iron saddles at either end which supported the stationary track cables and the moving carriages on wheels. A small piece of one of these saddles remains on the cap (see fig. 157).



Figure 157. The cap timber of ST #3 is bolted to the top of the posts, X-brace, and diagonal struts. Note the remnant iron piece, part of the original saddle (arrow). HPTC, 11/17/20.

B10.5	X-Brace

A wood X-brace is located between the vertical posts (fig. 158). The two crossing members are half-lapped at the center. Each member measures 9¼" wide x 5½" thick; the lengths are unknown. The members are original and are likely douglas fir.

Iron bolts join the X-brace to the lower pair of ties at the bottom. At the top, the brace ends are shoulder-notched to support the cap timber above. Extra-long bolts also secure the X-brace to the cap at each joint (fig. 159).



Figure 158. The X-brace of ST #3 is located between the vertical posts and supported by the lower set of ties. HPTC, 11/17/20.

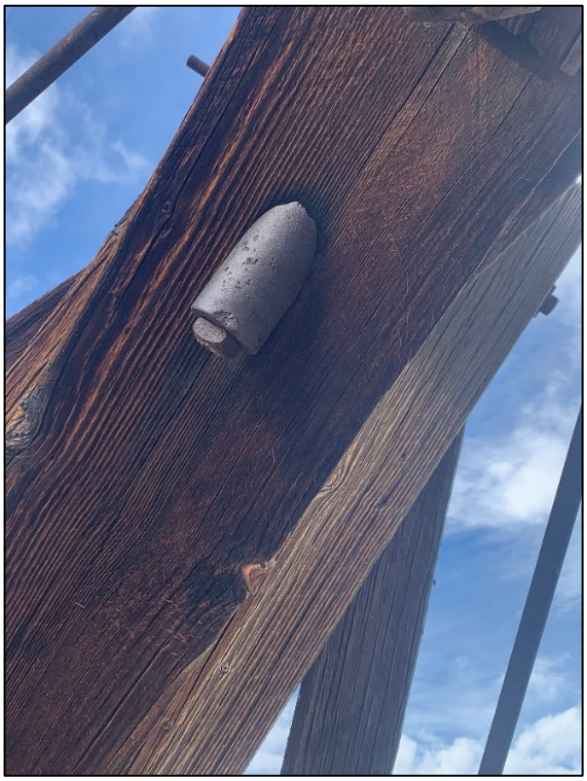


Figure 159. The top of the members fastened to the cap using long bolts. The barrel spacer allows the bolt to be tightened without interfering with the wood. HPTC, 11/17/20.

B10.6	Struts

Wood diagonal struts are located perpendicular to the X-brace (fig. 160). Each strut measures 9¼" wide x 5½" thick and 142" long. The members are original and are likely douglas fir.

Iron bolts connect the struts to the upper set of ties at the bottom (fig. 161) and to the side of the cap timber above; the cap timber is also notched at the sides to accept the struts. Iron V-braces—composed of a bracket, threaded rods, and bolts (figs. 162-163)—also stabilize the diagonal struts to the cap.

Wood ladder boards were originally nailed to one of the struts for access up and down the structure to perform maintenance; a few of these boards are extant and measure 1" thick x 3½" tall x 16" wide (see fig. 160).



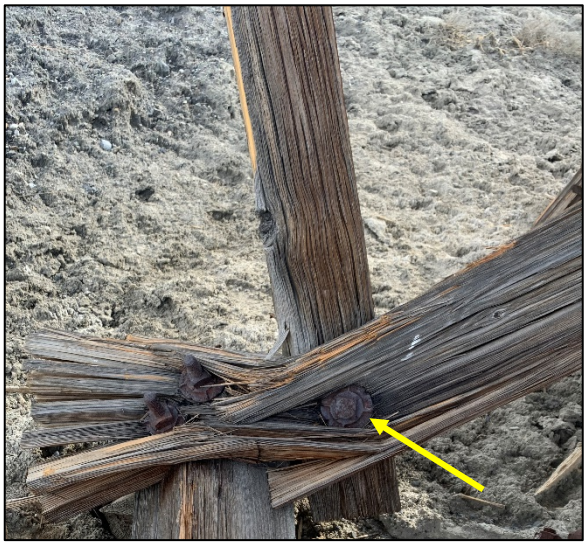


Figure 161, above. The bottoms of the struts are bolted to the upper set of paired ties below (arrow), here damaged from the collapse of the structure. HPTC, 11/17/20.

Figure 160, left. The diagonal struts of ST #3 are located between the upper ties and cap (arrows). Note the two ladder boards extant on the strut at left. HPTC, 11/17/20.



Figure 162. The iron bracket and threaded rod which compose the V-braces located between the struts and cap. HPTC, 11/17/20.

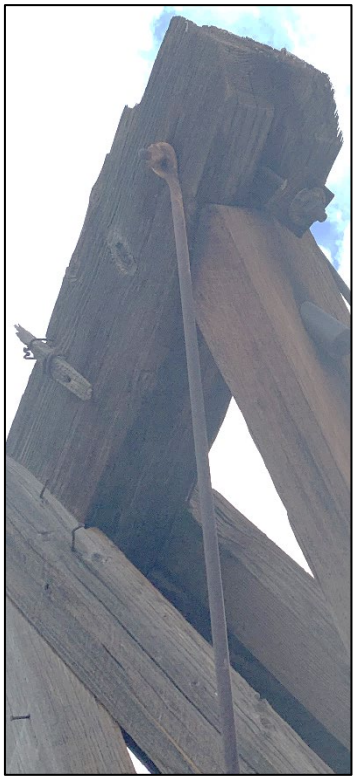


Figure 163. The upper end of the iron threaded rod forms an eye to allow for a bolt to secure it to the cap. HPTC, 11/17/20.

G	BUILDING SITEWORK
G90	OTHER SITE WORK
G9087	Overall Building Site Drainage

Neutral site drainage surrounds Support Tower #3 meaning that any falling water does not flow toward or away from the structure (fig. 164). This allows water to remain around the base of the structure.



Figure 164. Neutral site drainage around and under ST #3. Source: HPTC, 11/17/20.

Support Tower #4 Building Feature Master List Descriptions

A	SUBSTRUCTURE
A10	FOUNDATIONS
A1010	Standard Foundations

At Support Tower #4, most of the footings were covered with soil (fig. 165). The four concrete footings of all the support towers were cast in place using materials, including water, hauled in by mule or temporary tram for this purpose.

Exposed footings were easily detectable at a former support tower site south of Tower #4 near Saline Valley Road (see fig. 108). Measurements of the footings from that site are assumed to be similar throughout the system. The footings are generally the same size and measure 26” square in plan and 6½-7” deep depending on the underlying soil composition.



Figure 165, right. Concrete footings below the standards are covered with soil. HPTC, 11/17/20.

B	SHELL
B10	SUPERSTRUCTURE
B10.1	Standards

The four angled wood standards of Support Tower #4 measure 7½” square in plan and vary in height depending on grade and height of paired ties above: two at 132”, and 134½” and 137½” (fig. 166). All are original and are likely douglas fir. The standards are placed at a 45° angle in relation to the rest of the structure above.

Three of the four iron brackets which attach the standards to the concrete footings are intact (fig. 167). These brackets measure 5” wide x 8” high x 1¼” thick and the flange projects 7”.

Wood bracing originally connected the standards together at the top and bottom to deter twisting of the base. Two extant boards (one measures 7½” high x 2¾” thick x 99¼” long), remnant wood pieces (one measures 7” high x 2½” thick), and bolt holes indicate the original location of the brace boards (see fig. 166).

Wood ladder boards were originally nailed to at least one standard to allow for access up and down the tower. None of these boards remain.

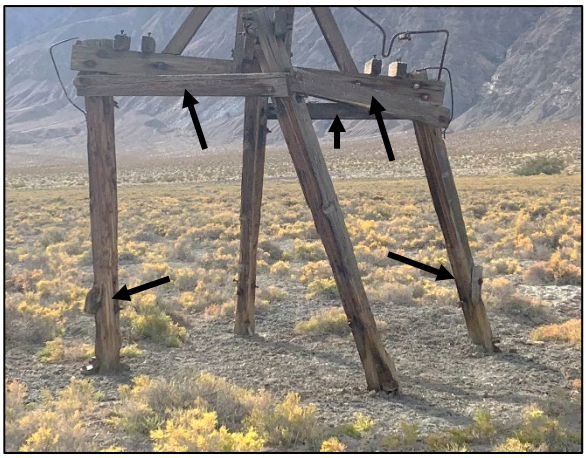


Figure 166. The four standards (support legs) of ST #4 measure 7½" square and vary in height, 132-137½". Extant boards, remnant wood pieces, and bolt holes show the location of the original horizontal bracing (arrows). HPTC, 11/17/20.



Figure 167, right. One of the brackets at the base of the standards is missing. HPTC, 11/17/20.

B10.2	Ties

Two sets of paired horizontal wood ties placed perpendicular to each other are located above and are supported by the four standards (fig. 168). These wood members measure 7½" high x 2¾" thick x 142" long. All are original and have been identified as douglas fir.

A pair of iron bolts connects the paired ties to the top of each standard. All are extant.

On either end of the lower ties, between the standard coming up from below and the X-brace, were two wood blocks (measuring 3¾" thick x 5½" tall x 23½" wide) mounted perpendicular to the ties below. These blocks supported an intricately bent iron rod (see fig. 168). One end of the rod was secured to a tie, the center of the rod was secured to the blocking, and the upper end of the rod was secured to the X-brace. All wood blocks are intact, but only one bent iron rod bracket is extant.



Figure 168. Two sets of paired horizontal wood ties at ST #4. Note the pair of iron bolts which connect the ties to the standards below. The intricately bent iron rod at left is assumed to assist buckets by the tower; only one of two is extant. HPTC, 11/17/20.

B10.3	Posts

Four vertical wood posts are supported by and located at the inside corners of the pairs of horizontal ties (fig. 169). The posts measure 5½" square in plan and are likely 142-143" tall to match those at the other towers. All are original and are likely douglas fir.

The posts are bolted at the bottom to both sets of horizontal ties (fig. 170) and at the top to the sides of the horizontal timber cap. At both locations, the posts are cut lap over the ties and cap for additional bearing.

At the center of the posts, small wood boards originally encircled the posts to create a sort of platform (see Tower #2 posts for example); none are extant.

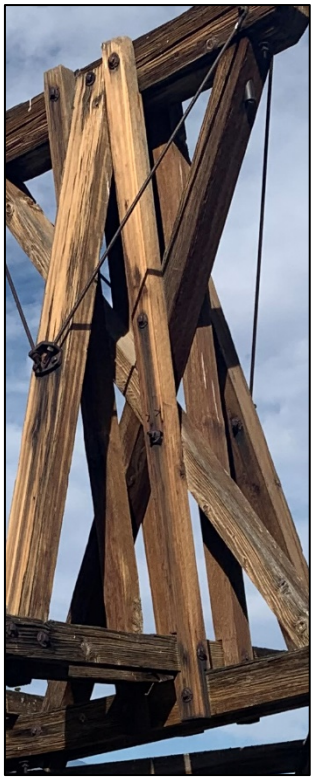


Figure 169. The four central posts at ST #2 measure 5½" square in plan and are 142" tall. HPTC, 11/17/20.



Figure 170. The posts are bolted to the horizontal ties at the bottom. Note the laps (arrows) cut into the posts. HPTC, 11/17/20.

B10.4	Cap Timber

A wood horizontal cap timber is bolted to the top of the posts, X-brace (also notched here), and diagonal struts (fig. 171). The cap measures 11¼" wide x 9¼" high and is approximately 106" long. On the underside of each end of the cap the wood is clipped at a 45° angle. The cap is original and is likely douglas fir.

The cap timber originally held a pair of iron saddles at either end which supported the stationary track cables and the moving carriages on wheels. The saddles are no longer extant.



Figure 171. The cap timber of ST #4 is bolted to the top of the posts, X-brace, and diagonal struts. HPTC, 11/17/20.

B10.5	X-Brace

A wood X-brace is located between the vertical posts (fig. 172). The two crossing members are half-lapped at the center. Each member measures 9¼" wide x 5½" thick; the lengths are unknown. The members are original and have been identified as douglas fir.

Iron bolts join the X-brace to the lower pair of ties at the bottom (fig. 173). At the top, the brace ends are shoulder-notched to support the cap timber above (fig. 174). Extra-long bolts also secure the X-brace to the cap at each joint.



Figure 172, right. The X-brace of ST #4 is located between the vertical posts and supported by the lower set of ties. HPTC, 11/17/20.



Figure 173. The bottoms of the members are bolted to the lower set of ties (arrow). HPTC, 11/17/20.



Figure 174, right. The tops of the members are notched into and bolted to the cap above. HPTC, 11/17/20.

B10.6	Struts

Wood diagonal struts are located perpendicular to the X-brace (fig. 175). Each strut measures 9¼" wide x 5½" thick and 142" long. The members are original and are likely douglas fir.

Iron bolts connect the struts to the upper set of ties at the bottom and to the side of the cap timber above; the cap timber is also notched at the sides to accept the struts. Iron V-braces—composed of a bracket, threaded rods, and bolts—also stabilize the diagonal struts to the cap (fig. 176).

Wood ladder boards were originally nailed to one of the struts for access up and down the structure to perform maintenance; a few of these boards are extant and measure 1" thick x 3½" tall x 16" wide (see fig. 176).



Figure 175. The diagonal struts (arrows) of ST #4 are located between the upper ties and cap. HPTC, 11/17/20.



Figure 176. Iron V-braces stabilize the struts to the cap above. Note the two remaining ladder boards at the top of the left strut. HPTC, 11/17/20.

G	BUILDING SITEWORK	
	G90	OTHER SITE WORK
		G9087 Overall Building Site Drainage

Neutral site drainage surrounds Support Tower #4 meaning that any falling water does not flow toward or away from the structure (fig. 177). This allows water to remain around the base of the structure.



Figure 177. Neutral site drainage around and under ST #4. HPTC, 11/17/20.

Character-Defining Features

Each historic structure is unique, with its own identity and its own distinctive character. Character refers to the visual aspects and physical features that comprise the appearance of historic structures. Character-defining features include the overall shape of the structure, its materials, craftsmanship, decorative details, interior spaces and features, as well as the various aspects of its site and environment. Identifying and preserving a structure's character-defining features is essential.

A character-defining feature (CDF) is defined in Director's Order 28: *Cultural Resources Management Guidelines* (Appendix A: Glossary) as:

> A prominent or distinctive aspect, quality, or characteristic of historic property that contributes significantly to its physical character. Structures, objects, vegetation, spatial relationships, view, furnishings decorative details, and materials may be such features.

To ascertain the important aspects of a structure for future reference and analysis, character-defining features must be recorded. These are prominent or distinctive aspects, qualities, and characteristics of a historic property that contribute significantly to its physical character as represented at the time of intervention or treatment.

The process used in this assessment for determining the character-defining features was adapted from the NPS *Preservation Brief 17: Architectural Character: Identifying the Visual Aspects of Historic Buildings as an Aid to Preserving Their Character* and are in accordance with *The Secretary of the Interior's Standards for the Treatment of Historic Properties* and NPS Management Policies and Guidelines, specifically Director's Order 28: *Cultural Resource Management Guidelines.*

Preservation Brief 17 divides the assessment of character-defining features into three steps:

1. Identify the Overall Visual Aspects,
2. Identify the Visual Character at Close Range,
3. Identify the Visual Character of Interior spaces, Features, and Finishes.

The purpose of *Preservation Brief 17* is to help the owner or architect identify those features or elements that give the building its visual character and that should be considered to preserve to the maximum extent possible. The Brief states:

> There are different ways of understanding old buildings. They can be seen as examples of specific building types, which are usually related to a building's function…. Buildings can be studied as examples of using specific materials…. They can also be considered as examples of historical period, which is often related to a specific architectural style…
>
> There are many other facets of a historic building besides its functional type, its materials, or construction, or style that contribute to its historic qualities or significance. Some of these qualities are feelings conveyed by the sense of time and place or in buildings associated with events or people. A complete understanding of any property may require documentary research about its style, construction function, its furnishings, or contents; knowledge about the original builder, owners, and later occupants; and knowledge about the evolutionary history of the building. Even though buildings may be historic, rather than architectural

> significance for association with specific events or persons and it is those *tangible elements* both on the exterior and interior that should preserved.
>
> Therefore, the approach taken in this brief is limited to identifying those visual and tangible aspects of the historic building. While this may aid in the planning process for carrying out any ongoing or new use of restoration of the building, this approach is not a substitute for developing an understanding about the significance of a historic building and the district in which it is located.
>
> If the various materials, features, and spaces that give a building its visual character are not recognized and preserved, then essential aspects of its character may be damaged in the process change.
>
> A building's character can be irreversibly damaged or changed in many ways, for example, by inappropriate repointing of the brickwork, by removal of a distinctive side porch, by changes to the window sash, by changes to the setting around the building, by changes to the major room arrangements, by the introduction of an atrium, by painting previously unpainted woodwork, etc.

In Summary, *The Secretary of the Interior's Standards for the Treatment of Historic Properties* embodies two important goals:

1. Preservation of historic materials.
2. Preservation of a building's distinguishing character.

By succeeding at these two goals it is likely that a structure's historic integrity will be preserved.

Overall Visual Aspects

Shape

The four support towers retain their original shape (figs. 178-181). The timber-frame supports are nearly identical to each other; only the height of the standards (legs) varies between the four structures.

All include four angled wood standards (legs), supported by concrete footings, which raise the main structure to the originally designed height off grade. The standards support two sets of paired horizontal wood ties laid perpendicular to each other. The lower pair of ties support a wood X-brace set between four vertical wood posts. These support a single wood horizontal cap timber. A pair of wood diagonal struts provide further stability between the upper pair of ties and the cap timber. All connections are secured with iron hardware.

Roof and Roof Features; Openings; Projections

There are no roofs or roof-related features, openings, or significant projections on the support towers.



Figure 178. Support Tower (ST) #1. HPTC, 11/17/20.



Figure 179, right. ST #2. HPTC, 11/17/20.



Figure 180. ST #3. HPTC, 11/17/20.

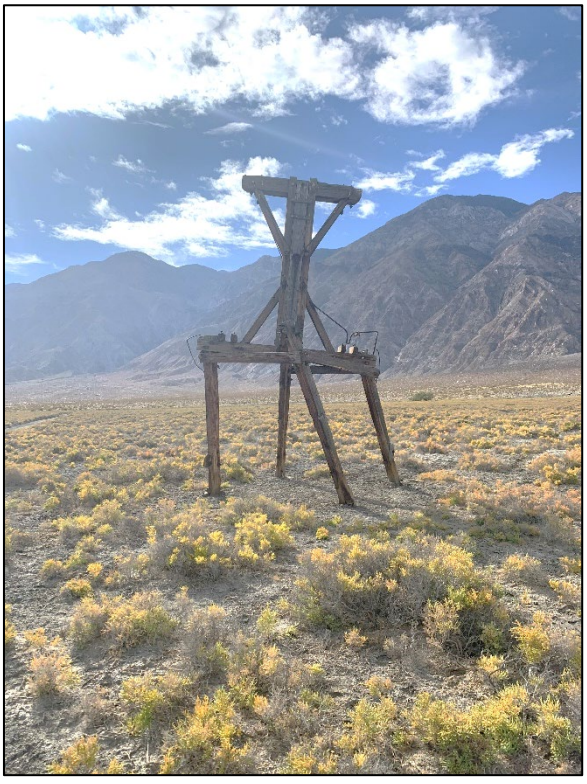


Figure 181. ST #4. HPTC, 11/17/20.

Trim and Secondary Features

Secondary features have largely been removed from the support towers through deterioration and vandalism. Remnant components include:

- Wood blocking on either end of the lower ties which support remnant pieces of a bent iron rod, used for supporting the slack of the moving traction ropes (fig. 182).
- Wood ladder boards nailed to one standard and the diagonal strut above (fig. 183).
- Iron V-braces between the diagonal struts and the cap timber (two at each support tower) (fig. 184).
- Wood cross braces connecting the standards together (fig. 185).



Figure 182. Wood blocks and bent iron rod bracket mounted to cross ties at ST #2. These originally held a wheel and supported the slack of moving traction ropes. HPTC, 11/17/20.



Figure 183. Remnant wood ladder boards nailed to a diagonal strut at ST #3. Boards would have also been nailed to the standard below. HPTC, 11/17/20.



Figure 184. Iron V-braces connecting the struts to the cap timber at ST #4. HPTC, 11/17/20.

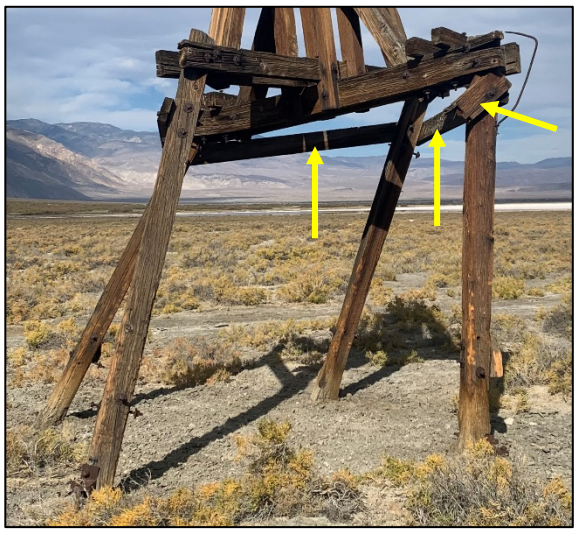


Figure 185. Remnant cross-brace boards connected to the standards of ST #4. HPTC, 11/17/20.

Materials

The footings are composed of cast-in-place concrete (fig. 186).



Figure 186. Remnant concrete footings at another tower site are identical to those at the extant towers. HPTC, 11/17/20.

All wood components, including the standards, paired ties, posts, X-brace, struts, and cap timber are likely composed of douglas fir (fig. 187). Some individual wood components are missing from each of the towers; these are identified previously in the Physical Description section.

All metal hardware, including nuts, bolts, threaded rod, nails, brackets, etc., are composed of iron (figs. 188). No original paint or coatings, if ever in place, are extant. Significant metal components which are missing include the track cable and tension rope running between the towers, and saddles atop the cap timber at either end which supported the track cable and the carriages running along the cable. No salt carriers are extant in this section of support towers.



Figure 187. All wood components are likely douglas fir, seen here at ST #1. Note the laps cut in the posts to bear on the ties. HPTC, 11/17/20.



Figure 188. Iron V-brace bracket, threaded rod, washers, and bolts attached to a diagonal strut at ST #3. HPTC, 11/17/20.

Setting

The four NPS-managed support towers are located within Saline Valley and were part of the first section of the Saline Valley Salt Tramway, between the Salt Lake Loading Terminal (Station 1) at the north and Station 3 to the south. Saline Valley has retained its isolated setting. Other

structures managed by the Bureau of Land Management can be seen from Saline Valley as they climb up the mountains to the east. This entire system is part of a larger cultural landscape discussed in the Context and Chronology sections (fig. 189).

Significant components missing from the surrounding cultural landscape include the infrastructure at the salt lake (fig. 190), including the Loading Terminal (Station 1), and the several other support towers (exact number unknown) located between the Loading Terminal, Station 2, and Station 3.



Figure 189. Looking south to ST #2 (upright) and ST #3 (reclining) from the north. The line of the tramway can still be discerned climbing up the mountains. HPTC, 11/17/20.



Figure 190. The salt lake at the north end of the tramway contains remnants of former mining and tramway infrastructure. HPTC, 11/17/20.

Overall Character at Close Range

Materials

Character-defining, close-range materials are identical to those described above and are not repeated here.

Craft Details

Craft details are minimal due the manufactured quality of the support towers, meaning the towers are not individualized but were constructed in an industrialized fashion. The only difference between the towers is the height of the standards (legs) which were likely cut to

height on site. It is assumed that the other components were cut prior to arriving on site and were only assembled there. Little dimensional variation between identical components at each tower exists which furthers this hypothesis.

Some subtle craft details include:

- Varying heights of standards (see figs. 178-181).
- Lap cuts of posts at bottom for ties and top for cap timber (see fig. 187).
- Shoulder notch cut into underside of cap timber for X-brace (fig. 191).
- Lap cuts on side of cap timber for diagonal struts (fig. 192).
- Half-lap cut into X-brace where the two members cross (fig. 193).



Figure 191. A shoulder notch is cut into the underside of the cap timber to accept the X-brace below, seen here at ST #1. HPTC, 11/17/20.

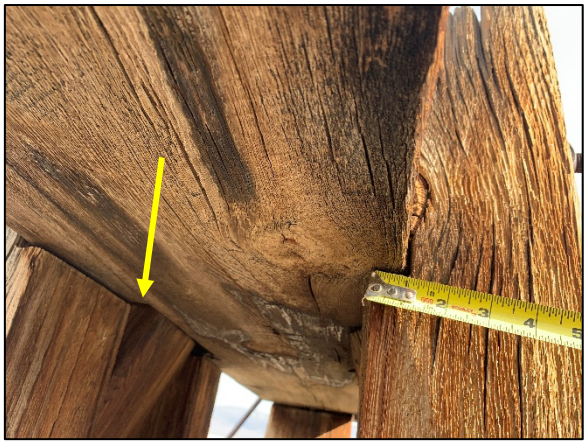


Figure 192, left. A lap is cut into the side of the cap timber to accept the diagonal strut, seen here at ST #1. HPTC, 11/17/20.



Figure 193, above. A half-lap cut into the X-brace where the members intersect, seen here at ST #1. HPTC, 11/17/20.

Interior Visual Character

Individual Spaces; Related Spaces & Sequence of Spaces; Interior Features; Surface Finishes & Materials

The support towers include no interior spaces, therefore associated categories are not discussed here.

Condition Assessment

The conditions assessment definitions used for this HSR are based on those outlined in the NPS PFMD's Asset Management Process (AMP), the Facilities Management Software System (FMSS), and the Facility Condition Assessment Survey (FCAS) and adapted for use by HPTC. For this report, these definitions were strictly adhered to in order to qualitatively assess the current condition of the four support towers.

Condition Assessment Standard Rating Definitions

Qualitative Condition Ratings

Good

- Routine maintenance should be sufficient to maintain the current condition; and/or
- A cyclic maintenance or repair/rehabilitation project is not specifically required to maintain the current condition or correct deficiencies.

Fair

- The feature generally provides an adequate level of service to operations, but
- The feature requires more than routine maintenance, and
- Cyclic maintenance or repair/rehabilitation work may be required in the future.

Poor

- The feature requires immediate attention;
- Routine maintenance is needed at a much higher level of effort to meet significant safety and legal requirements;
- Cyclic maintenance should be scheduled for the current year; and/or
- A special repair/rehabilitation project should be requested consistent with park requirements, priorities, and long-term management objectives.

Maintenance Deficiency Priority Ratings

Minor (Long-Term Priority)

- Standard preventative maintenance priorities and preservation methods have not been followed; or
- There is reduced life expectancy of affected, adjacent, or related materials, and/or systems within five to ten years and beyond; or
- There is a condition with a long-term impact within five to ten years and beyond.

Serious (Short-Term or Immediate Priority)

- Defines a deteriorated condition that if not corrected within one to five years will result in the failure of the feature; or
- A threat to the health and/or safety of the user may occur within one to five years if the ongoing deterioration is not corrected; or
- There is ongoing deterioration of adjacent or related materials and/or features as a result of the feature's deficiency.

Critical (Immediate or Emergency Priority)

- Defines an advanced state of deterioration which has resulted in the failure of a feature or will result in the failure of a feature if not corrected within one year; or
- There is accelerated deterioration of adjacent or related materials or systems as a result of the feature's deficiencies if not corrected within one year; or
- There is immediate threat to the health and/or safety of the user; or
- There is failure to meet a legislated requirement.

Not Rated

- The feature was not extant at the time of the report; or
- The feature is not a character-defining features and is planned for removal without replacement.

Code Compliance

Both NPS policies and federal regulations stipulate that when an historic structure is preserved and/or rehabilitated, attempts should be made to meet applicable nationally accepted model building codes to the maximum extent feasible. Compliance with nationally accepted codes does not automatically trigger a complete code-based upgrade. Alternative criteria exist for alterations to historic structures; these typically encourage flexibility in the literal application of the code intent.

The *Public Buildings Amendment of 1988* instructs Federal agencies to follow "to the maximum extent feasible," as determined by the administrator or head of the agency, the "...nationally recognized model building codes and other applicable nationally recognized codes such as electrical codes, and fire and life safety codes." The National Park Service intends to consult pertinent national, state, and local codes, and typically applies to most strident code requirements. The Pacific West Regional Office (NPS) Structural Fire Safety leader will be the Authority Having Jurisdiction (AHJ) for final determination of code applications for these structures.

The National Park Service has prepared Design Standards for all construction projects, including those affecting historic structures.[1] The design standard presents all codes that should

[1] Denver Service Center. "Design Standards." *Denver Service Center Workflows.* National Park Service, Department of the Interior. 2009. Accessed at http://www.nps.gov/dscw/dstandards.htm on March 6, 2012.

be reviewed and includes the most recent copies of the following major codes and applicable laws, policies, codes, directives, standards, and NPS guidelines. The design standards present requirements for accessibility, civil, and environmental engineering, landscape architecture, architecture, including roofing and waterproofing, structural, mechanical, safety and fire protection, electrical, lighting, and sustainability disciplines.

Major codes, laws, standards, and guidelines that are part of the NPS Design Standards include:

- *Architectural Barriers Act Accessibility Standard* (ABAAS) for Federal Facilities, 2004
- *International Building Code* (IBC), 2009
- *International Existing Building Code* (IEBC), 2009
- *National Fire Protection Association 101* (NFPA 101), Life Safety Code
- *National Historic Preservation Act of 1966* (NHPA), amended
- *The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring, and Reconstructing Historic Buildings* (36 CFR 68), 1995
- *The Secretary of the Interior's Standards for the Treatment of Historic Properties and the Guidelines for the Treatment of Cultural Landscapes*
- *The Secretary of the Interior's Standards and Guidelines for Archeological Documentation*
- *Uniform Code for Building Conservation*
- *Building Construction and Safety Code* (NFPA 5000)
- *National Fire Protection Association 70* (NFPA 70), National Electrical Code
- *Installation of Lightning Protection Systems* (NFPA 780)
- *Code for the Protection of Cultural Resource Properties* (NFPA 909)
- *Code for the Fire Protection of Historic Structures* (NFPA 914)
- *Safeguarding Construction, Alteration, and Demolition Operations* (NFPA 241)
- *Director's Order (DO) 5oB, Risk Management* (Manual 50B)
- *Director's Order (DO) 58, Structural Fire Management* (Manual 58)
- *5 U.S.C § 7902* (Safety Program)
- *15 U.S.C § 2225* (Fire Prevention and Control)
- *29 U.S.C § 668* (Occupational Safety and Health)
- *40 U.S.C § 619* (Construction, Alteration, and Acquisition of Public Buildings)

Support Tower #1 Condition Assessment

The following table provides a summary of condition and deficiency ratings for all BFML categories for this structure. Following are the individual BFML condition descriptions. Additional photographs of all structure features are found in the Physical Description section.

Table 2. Support Tower #1 Summary of Conditions

UNIFORMAT II Outline Data			Qualitative Condition Rating	Maintenance Deficiency Rating
A	SUBSTRUCTURE			
	A10	FOUNDATIONS		
		A1010 Standard Foundations – Concrete Footings	Fair	Minor
B	SHELL			
	B10	SUPERSTRUCTURE		
		B10.1 Standards	Poor	Critical
		B10.2 Ties	Poor	Serious
		B10.3 Posts	Fair	Minor
		B10.4 Cap Timber	Fair	Serious
		B10.5 X-Brace	Fair	Minor
		B10.6 Struts	Fair	Minor
G	BUILDING SITEWORK			
	G90	OTHER SITE WORK		
		G9087 Overall Building Site Drainage	Poor	Critical

End of Table.

A	**SUBSTRUCTURE**	
	A10	FOUNDATIONS
		A1010 Standard Foundations

The cast-in-place concrete footings are predominately covered with soil (fig. 194). Areas which are exposed show exfoliated (fig. 195) and substandard concrete, typical of early CIP concrete components. The condition of all footings is unknown.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 194. The concrete footings at Support Tower (ST) #1 are covered with soil. HPTC, 11/17/20.



Figure 195. Partially exposed concrete footing (arrow) is exfoliated at ST #1. HPTC, 11/17/20.

B	SHELL
B10	SUPERSTRUCTURE
B10.1	Standards

The four wood standards of Support Tower #1 are deteriorated, likely due to flood inundation from the nearby Salt Lake (figs. 196-197). It is unlikely that any are salvageable for continued use.

All iron brackets are extant, but all bolts attaching the brackets to the concrete footings are missing. This could allow movement of the entire structure.

Remnant pieces of the original wood bracing connecting the standards together are extant but are heavily deteriorated. The bracing would no longer deter racking or twisting of the structure.

Qualitative Condition Rating: Poor
Maintenance Deficiency Rating: Critical



Figure 196. This lower portion of this ST #1 standard (arrow) is deteriorated due to flood waters from the nearby salt lake. Note the missing bolt where the bracket would be connected to the concrete footing below. Deteriorated cross braces are located on the ground going off in 45° directions from the standard. HPTC, 11/17/20.



Figure 197. A very deteriorated standard at ST #1 (arrow). Note the missing bolt where the bracket would be connected to the concrete footing below. HPTC, 11/17/20.

B10.2	Ties

The ends of all four wood ties are deteriorated, due to inundation of flood waters from the nearby salt lake and UV degradation. It is likely that only one is salvageable for continued use due to missing pieces, splintering, and checking (figs. 198-199).

All iron bolts connecting the ties to the standards are extant. These can be reused.

Extant wood blocks and bolts from the former traction rope support system can be salvaged and reinstalled on the new wood ties to preserve vestiges of the original features.

Qualitative Condition Rating: Poor
Maintenance Deficiency Rating: Serious

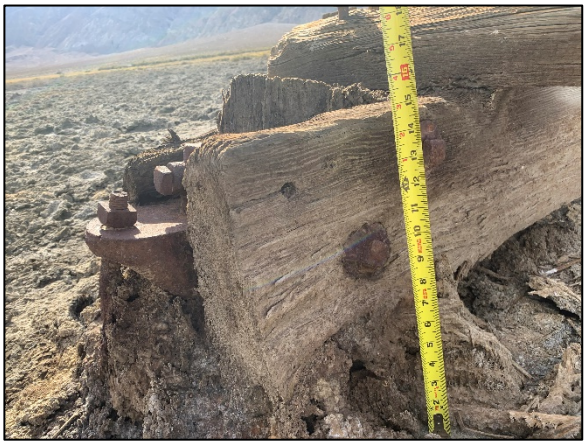


Figure 198. This horizontal tie at ST #1 may be salvageable for reuse, but does show degradation. HPTC, 11/17/20.



Figure 199. These two ties at ST #1 are deteriorated beyond repair and should be replaced. HPTC, 11/17/20.

B10.3	Posts

The four wood posts of Support Tower #1 are in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 200).

All iron bolts are extant.

The wood boards originally located around the center of the posts are missing, but remain at other towers, so do not need to be restored here.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 200. The posts of ST #1 exhibit UV degradation, but are in fair condition. Note the original bolts remain. HPTC, 11/17/20.

B10.4	Cap Timber

The wood cap timber is in fair condition with deterioration due to UV exposure and the harsh desert environment. Significant deterioration is found surrounding the iron bolts from the X-brace below on the skyward-facing surface of the cap (fig. 201).

Neither of the original iron saddles are extant.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Serious



Figure 201, right. Significant deterioration of the skyward surface of the cap timber surrounding the bolt securing it to the X-brace below. The nut is also missing. HPTC, 11/17/20.

B10.5	X-Brace

The wood X-brace of Support Tower #1 is in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 202).

All iron bolts are extant.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 202, right. The wood of the X-brace of ST #1 is deteriorated from UV exposure. HPTC, 11/17/20.

B10.6	Struts

The wood diagonal struts of Support Tower #1 are in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 203).

All iron bolts are extant.

None of the wood ladder boards are extant. Examples of these boards are extant at other towers.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 203, right. The wood struts are degraded due to UV exposure. HPTC, 11/17/20.

G	BUILDING SITEWORK	
	G90	OTHER SITE WORK
		G9087 Overall Building Site Drainage

Based on deterioration to the lower timber members, it appears that when the nearby salt lake floods, Tower #1 can be inundated with flood waters. Due to neutral drainage and standing water, this has already affected the standards and the ties.

Qualitative Condition Rating: Poor
Maintenance Deficiency Rating: Critical



Figure 204, right. Neutral site drainage affects ST #1 when the nearby salt lake floods and inundates the structure with water. HPTC, 11/17/20.

Support Tower #2 Condition Assessment

The following table provides a summary of condition and deficiency ratings for all BFML categories for this structure. Following are the individual BFML condition descriptions. Additional photographs of all structure features are found in the Physical Description section.

Table 3. Support Tower #2 Summary of Conditions

UNIFORMAT II Outline Data			Qualitative Condition Rating	Maintenance Deficiency Rating
A	SUBSTRUCTURE			
	A10	FOUNDATIONS		
		A1010 Standard Foundations – Concrete Footings	Fair	Minor
B	SHELL			
	B10	SUPERSTRUCTURE		
		B10.1 Standards	Fair	Serious
		B10.2 Ties	Fair	Minor
		B10.3 Posts	Fair	Minor
		B10.4 Cap Timber	Fair	Minor
		B10.5 X-Brace	Fair	Minor
		B10.6 Struts	Fair	Minor
G	BUILDING SITEWORK			
	G90	OTHER SITE WORK		
		G9087 Overall Building Site Drainage	Fair	Minor

End of Table.

A	**SUBSTRUCTURE**	
	A10	FOUNDATIONS
		A1010 Standard Foundations

The cast-in-place concrete footings are predominately covered with soil. Areas which are exposed show exfoliated and substandard concrete, typical of early CIP concrete components. The condition of all footings is unknown.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor

B	SHELL	
	B10	SUPERSTRUCTURE
		B10.1 Standards

The four wood standards of Support Tower #2 are in relatively better condition than those at the other towers (fig. 205). Some surface deterioration of the wood is noticeable due to UV degradation and the harsh desert environment.

All iron brackets and bolts are extant.

No original wood bracing connecting the standards together is extant. The absence of these members could allow racking or twisting of the standards and collapse of the entire structure (like that seen at Towers #3 and #4).

Only one wood ladder board remains on the north standard. These are important character-defining features which are missing.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Serious



Figure 205. The four standards of Support Tower (ST) #2 show minor UV degradation, but are in good condition. All bracing boards are missing. All but one ladder boards are missing. HPTC, 11/17/20.

B10.2	Ties

The four wood ties of Support Tower #2 are in relatively better condition than those at the other towers (fig. 206). Some surface deterioration of the wood is noticeable due to UV degradation and the harsh desert environment.

All iron bolts connecting the ties to the standards are extant.

Extant wood blocks, bolts, and bent rods from the former traction rope support system should be retained and preserved.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 206. Two sets of paired horizontal wood ties at ST #2 are in good condition. Bolts and remnants of the traction rope support system are intact. HPTC, 11/17/20.

B10.3	Posts

The four wood posts of Support Tower #2 are in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 207).

All iron bolts are extant.

The wood boards encircling the center of the posts are extant. These character-defining features should be preserved.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 207. Boards of unknown use encircle the center of the posts; this CDF should be preserved. HPTC, 11/17/20.

B10.4	Cap Timber

The wood cap timber is in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 208). The skyward-facing surface of the cap could not be accessed, and the condition is unknown.

Neither of the original iron saddles are extant.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor
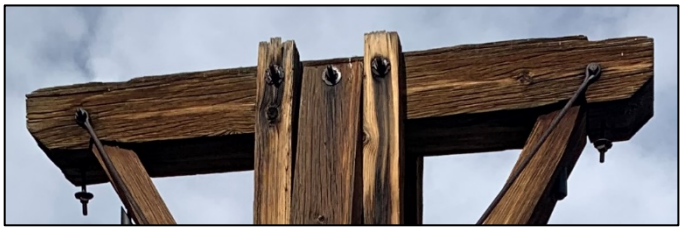


Figure 208. The cap timber of ST #2 is in fair condition. The skyward-facing surface was inaccessible. HPTC, 11/17/20.

B10.5	X-Brace

The wood X-brace of Support Tower #2 is in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 209).

All iron bolts are extant.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 209, right. The wood of the X-brace of ST #2 is deteriorated from UV exposure. HPTC, 11/17/20.

B10.6	Struts

The wood diagonal struts of Support Tower #2 are in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 210).

All iron bolts are extant.

The extant ladder boards should be preserved.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 210, right. The north wood strut retains many of its wood ladder boards. HPTC, 11/17/20.

G	BUILDING SITEWORK	
	G90	OTHER SITE WORK
		G9087 Overall Building Site Drainage

Too few wetting events occur which could allow the extant neutral drainage to affect this structure.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 211, right. Neutral site drainage around and under ST #2. HPTC, 11/17/20.

Support Tower #3 Condition Assessment

The following table provides a summary of condition and deficiency ratings for all BFML categories for this structure. Following are the individual BFML condition descriptions. Additional photographs of all structure features are found in the Physical Description section.

Table 4. Support Tower #3 Summary of Conditions

UNIFORMAT II Outline Data		Qualitative Condition Rating	Maintenance Deficiency Rating
A	SUBSTRUCTURE		
A10	FOUNDATIONS		
A1010	Standard Foundations – Concrete Footings	Fair	Minor
B	SHELL		
B10	SUPERSTRUCTURE		
B10.1	Standards	Poor	Critical
B10.2	Ties	Poor	Critical
B10.3	Posts	Fair	Critical
B10.4	Cap Timber	Fair	Critical
B10.5	X-Brace	Fair	Critical
B10.6	Struts	Fair	Critical
G	BUILDING SITEWORK		
G90	OTHER SITE WORK		
G9087	Overall Building Site Drainage	Fair	Minor

End of Table.

A	**SUBSTRUCTURE**
A10	FOUNDATIONS
A1010	Standard Foundations

The cast-in-place concrete footings are predominately covered with soil. Areas which are exposed show exfoliated and substandard concrete, typical of early CIP concrete components. The condition of all footings is unknown.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor

B	SHELL	
	B10	SUPERSTRUCTURE
		B10.1 Standards

The four wood standards of Support Tower #3 have collapsed (fig. 212). It is unlikely that any are salvageable for reconstruction due to splintering and snapping of the members.

Three of the four iron brackets are intact, as are some of the bolts. These could be reused.

Only one original wood bracing board used to connect the standards is extant. It is unlikely that this would be reusable due to splintering when the tower fell. The absence of these boards is likely what caused the tower to fall.

None of the wood ladder boards remain on the structure. These are important character-defining features which are missing.

Qualitative Condition Rating: Poor
Maintenance Deficiency Rating: Critical



Figure 212. Support Tower (ST) #3 has collapsed likely due the absence of all bracing boards. It is likely that none of the standards can be reused. Ladder boards are also missing. HPTC, 11/17/20.

B10.2	Ties

The four wood ties of Support Tower #3 are likely not reusable due to splintering from the tower's fall (fig. 213).

All iron bolts which originally connected the ties to the standards are extant. These can be reused.

Extant wood blocks and bolts from the former traction rope support system can be salvaged and reinstalled on the new wood ties to preserve vestiges of the original features.

Qualitative Condition Rating: Poor
Maintenance Deficiency Rating: Critical

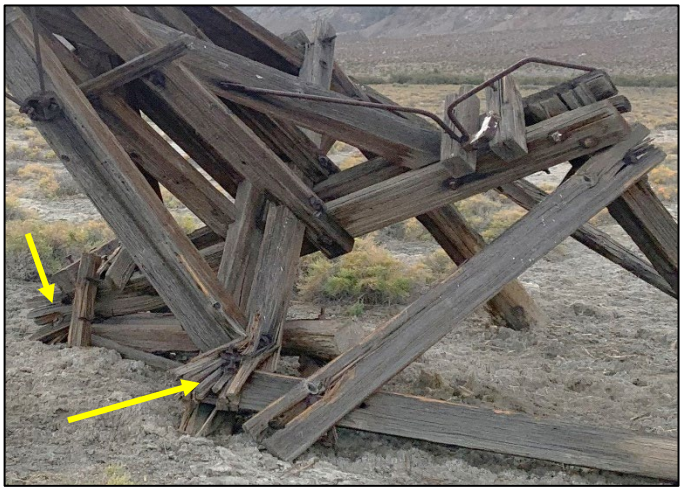


Figure 213. The ends of the ties of ST #3 near the ground are splintered where they originally connected to the standards below (arrows). They are not salvageable; however, the extant components of the traction rope support system should be salvaged. HPTC, 11/17/20.

B10.3	Posts

The four wood posts of Support Tower #3 are in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 214). Because of this tower's collapse, the intact posts are at serious risk for structural failure.

All iron bolts are extant.

Two of the wood boards originally located around the center of the posts are missing. Those extant should be preserved as character-defining features.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Critical



Figure 214. The four central posts are intact despite ST #3's fall, but they are at risk for further structural failure. HPTC, 11/17/20.

B10.4	Cap Timber

The wood cap timber is in fair condition with fair condition with deterioration due to UV exposure and the harsh desert environment. More serious deterioration is found on the skyward-facing surface of the cap (fig. 215). Because of this tower's collapse, the cap is at serious risk for structural failure.

The small remnant piece of the original saddle should be preserved.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Critical



Figure 215. The sky-facing surface of the cap timber of ST #3 is more deteriorated than the sides and bottom. The remnant iron saddle piece should be preserved. HPTC, 11/17/20.

B10.5	X-Brace

The wood X-brace of Support Tower #3 is in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 216). Because of this tower's collapse, the X-brace is at serious risk for structural failure.

All iron bolts are extant.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Critical

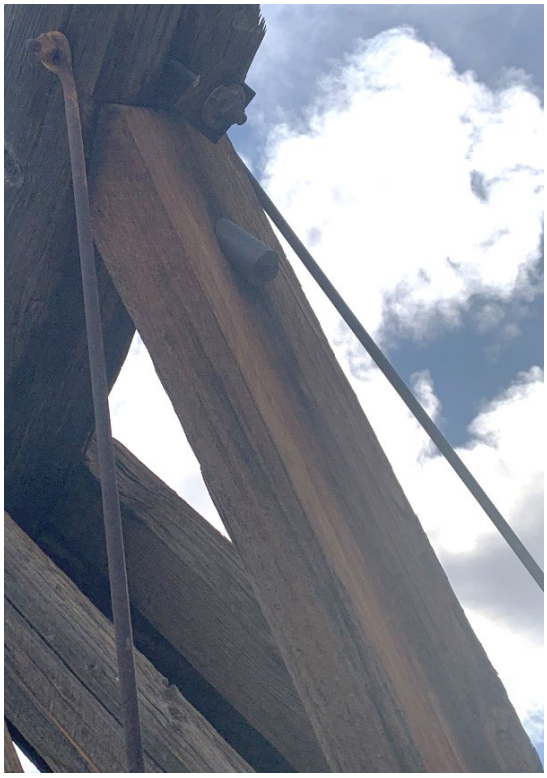


Figure 216, right. The X-brace of ST #3 is in fair condition but is at risk for structural failure. HPTC, 11/17/20.

B10.6	Struts

The wood diagonal struts of Support Tower #3 are in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 217). Because of this tower's collapse, the struts are at serious risk for structural failure.

All iron bolts are extant.

The extant ladder boards should be preserved.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Critical



Figure 217, right. The diagonal struts of ST #3 are at risk for structural failure due to the collapse of the tower. HPTC, 11/17/20.

G	BUILDING SITEWORK	
G90	OTHER SITE WORK	
	G9087	Overall Building Site Drainage

Too few wetting events occur which could allow the extant neutral drainage to affect this structure.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor



Figure 218, right. Neutral site drainage around and under ST #3. HPTC, 11/17/20.

Support Tower #4 Condition Assessment

The following table provides a summary of condition and deficiency ratings for all BFML categories for this structure. Following are the individual BFML condition descriptions. Additional photographs of all structure features are found in the Physical Description section.

Table 5. Support Tower #4 Summary of Conditions

UNIFORMAT II Outline Data			Qualitative Condition Rating	Maintenance Deficiency Rating
A	SUBSTRUCTURE			
	A10	FOUNDATIONS		
		A1010 Standard Foundations – Concrete Footings	Fair	Minor
B	SHELL			
	B10	SUPERSTRUCTURE		
		B10.1 Standards	Poor	Critical
		B10.2 Ties	Poor	Critical
		B10.3 Posts	Fair	Serious
		B10.4 Cap Timber	Fair	Serious
		B10.5 X-Brace	Fair	Serious
		B10.6 Struts	Fair	Serious
G	BUILDING SITEWORK			
	G90	OTHER SITE WORK		
		G9087 Overall Building Site Drainage	Fair	Minor

End of Table.

A	**SUBSTRUCTURE**	
	A10	FOUNDATIONS
		A1010 Standard Foundations

The cast-in-place concrete footings are predominately covered with soil. Areas which are exposed show exfoliated and substandard concrete, typical of early CIP concrete components. The condition of all footings is unknown.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Minor

B	SHELL	
	B10	SUPERSTRUCTURE
		B10.1 Standards

The four wood standards of Support Tower #4 have begun to shift and are near collapse (fig. 219). It is unlikely that any are salvageable for reconstruction due to splintering above the footings.

Three of the four iron brackets are intact, as are some of the bolts. These could be reused. The missing bracket is a contributing factor to the shifting of the tower, as it not secured to the footing in this location.

Only two original wood bracing board used to connect the standards are extant. It is unlikely that this would be reusable due to splintering as the tower is pulled out of alignment. The absence of the boards is a contributing factor to the shifting of the tower.

None of the wood ladder boards remain.

Qualitative Condition Rating: Poor
Maintenance Deficiency Rating: Critical



Figure 219. The missing bracing boards and one missing bracket connecting the standard to the footing (arrow) has caused the tower to shift away from that footing at Support Tower (ST) #4. HPTC, 11/17/20.

B10.2	Ties

Only one of the four wood ties of Support Tower #4 is reusable due to ends splintering from pulled bolts with the tower's shifting (fig. 220).



Figure 220. The ends of the wood ties have splintered from pulled bolts as ST #4 shifts out of plumb. HPTC, 11/17/20.

All iron bolts which originally connected the ties to the standards are extant. These can be reused.

Extant wood blocks and bolts from the former traction rope support system can be salvaged and reinstalled on the new wood ties to preserve vestiges of the original features.

Qualitative Condition Rating: Poor
Maintenance Deficiency Rating: Critical

B10.3	Posts

The four wood posts of Support Tower #2 are in fair condition with deterioration due to UV exposure and the harsh desert environment. Despite the shifting of this tower, the posts are structurally secure and remain plumb (fig. 45); however, if the structure does collapse, the posts could be at risk of structural failure.



Figure 221. The posts are structurally secure to the ties below and plumb despite the tower's shifting. HPTC, 11/17/20.

All iron bolts are extant.

The wood boards encircling the center of the posts are extant. These character-defining features should be preserved.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Serious

B10.4	Cap Timber

The wood cap timber is in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 222). The skyward-facing surface of the cap could not be accessed, and the condition is unknown. Despite the shifting of this tower, the cap is structurally secure and remains level; however, if the structure does collapse, the posts could be at risk of structural failure.

Neither of the original iron saddles are extant.



Figure 222. The cap timber of ST #4 is in fair condition. The skyward-facing surface was inaccessible. HPTC, 11/17/20.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Serious

B10.5	X-Brace

The wood X-brace of Support Tower #4 is in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 223). Despite the shifting of this tower, the X-brace is structurally secure and remains plumb; however, if the structure does collapse, the posts could be at risk of structural failure.

All iron bolts are extant.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Serious

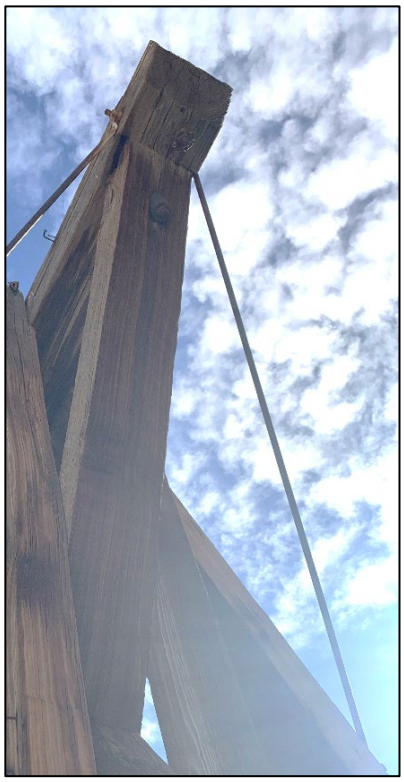


Figure 223, right. The X-brace of ST #4 is in fair condition despite the tower shifting below it. Source: HPTC, 11/17/20.

B10.6	Struts

The wood diagonal struts of Support Tower #1 are in fair condition with deterioration due to UV exposure and the harsh desert environment (fig. 224). Despite the shifting of this tower, the struts are structurally secure and remains plumb; however, if the structure does collapse, the posts could be at risk of structural failure.

All iron bolts are extant.

The extant ladder boards should be preserved.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Serious



Figure 224, right. The diagonal struts of ST #4 are in fair condition despite the tower shifting below them. HPTC, 11/17/20.

G	BUILDING SITEWORK
G90	OTHER SITE WORK
G9087	Overall Building Site Drainage

Too few wetting events occur which could allow the extant neutral drainage to affect this structure.

Qualitative Condition Rating: Fair
Maintenance Deficiency Rating: Serious



Figure 225, right. Neutral site drainage around and under ST #4. HPTC, 11/17/20.

Part 2 | Treatment and Use

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Requirements for Treatment and Use

The treatment and use of the four tramway support towers must be considered within a framework of applicable laws, agreements, and policies. These mandates govern a wide range of management issues beyond the preservation, protection, and interpretation of the Death Valley National Park's cultural resources. They extend to issues of visitor and staff use, lease, life-safety, and universal accessibility, among others.

Death Valley National Park Foundation Document

A foundation document provides "basic guidance for planning and management decisions—a foundation for planning and management." The document includes descriptions of the "purpose, significance, fundamental resources and values, and interpretive themes" for Death Valley National Park.[1]

Park Purpose:

> The purpose of Death Valley National Park, homeland of the Timbisha Shoshone, is to preserve natural and cultural resources, exceptional wilderness, scenery, and learning experiences within the nation's largest conserved desert landscape and some of the most extreme climate and topographic conditions on the planet.

Park Significance: Identifies seven reasons why the park's resources and values are important enough to warrant designation as a unit of the national park system. One justification directly relates to the Saline Valley Salt Tramway, and subsequently the four extant support towers:

> 6. The park's archeological sites, ethnographic resources, historic structures, and museum collections represent more than 10,000 years of human life in the extreme Death Valley environment and provide insight into human adaptation in the face of challenging conditions and its lasting impact on the desert landscape.

Fundamental Resources and Values: Identifies attributes which "warrant primary consideration during park planning and management processes because they are essential to achieving the purpose of the park and maintaining its significance." The Saline Valley Salt Tramway is classified as a fundamental resource under the heading: "Enduring Legacy of Human Interaction with the Landscape." This category clearly defines "historic mining" as a human interaction with the park boundaries.

Interpretive Themes: This section is based on the stated park purpose, significance, resources, and values. One interpretive theme relates to the Saline Valley Salt Tramway: "Resourceful people have visited, lived, and even thrived in this area for more than 10,000 years. Timbosha

[1] National Park Service, U.S. Department of the Interior. "Foundation Document: Death Valley National Park, California, Nevada." February 2017. DEVA 143 136699.

Shoshone and other American Indians, pioneers, miners, ranchers, and tourists, have all left their mark on this land."

The Foundation Document also recognizes planning needs, both high and minor priorities, based on the Fundamental Resources and Values identified through the planning process.

High Priority Needs:

- **Resource Stewardship Strategy.**

  Rationale—The park needs a way to prioritize natural and cultural resource projects within the constraints of the park's capabilities. A resource stewardship strategy would provide a framework for addressing current and future needs, as well as help focus data collection efforts and systems.

  Scope—The plan would identify priority cultural and natural resources in the park, identify current conditions and trends including climate change projections, and prioritize management strategies to protect resources. The resource stewardship strategy would identify conservation objectives and potential activities for managing resources as well as implementation strategies including inventory and monitoring, project management, restoration, and research. The document would also consider resource condition in addition to funding and staffing requirements.

- **Archeological Surveys.**

  Rationale—Approximately 3% of the park has been surveyed for archeological and cultural resources. Many of these surveys date to the 1950s and 1960s and are inadequate by current standards. Many developed areas, roads, and utility corridors lack adequate survey information. This lack of data can hinder the compliance process necessary for implementation of critical infrastructure projects. Completed surveys would greatly assist park managers to make well-informed decisions, avoid unnecessary project delays, and protect the cultural resources of the park.

  Scope—This effort would complete archeological surveys, including background research; historic context development; and resource recordation for developed areas, roads, rights-of-way, and utility corridors throughout the park. This would involve intensive field study to document cultural resources in developed areas and entry of data into an accessible and searchable system for cultural resource compliance professionals. Information could also be used to update historic asset information in the Facility Management Software System database.

Minor Priority Needs:

- Numerous historic mining sites – individual management/preservation plans
- Cultural resource stewardship plan…
- Identify, evaluate, and document cultural landscapes
- Condition assessments (to support stewardship planning and to meet national goals)
- Enter cultural resources, especially mine sites, backcountry cabins, and ruins in the Facility Management Software System (FMSS) database
- Mining sites survey

National Historic Preservation Act

Section 106 of the *National Historic Preservation Act* (NHPA) mandates that federal agencies, like the National Park Service, take into account the effects of their actions on properties listed or eligible for listing on the National Register of Historic Places and gives the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment.[2] The four Tramway supports are contributing to the National Register of Historic Places nomination for the Saline Valley Salt Tram from 1974. Any undertakings (typically expenditure of federal funds) must be reviewed in accordance to NPS policy and federal historic preservation laws including the *Programmatic Agreement Among the National Park Service (U.S. Department of the Interior), the Advisory Council on Historic Preservation and the National Conference of State Historic Preservation Officers for Compliance with Section 106 of the National Historic Preservation Act* (2008).[3]

Section 110 of the NHPA clarifies the broad historic preservation responsibilities of Federal agencies with the intention of ensuring that historic preservation is fully integrated into the ongoing programs of all Federal agencies by identifying, protecting, and avoiding unnecessary damage to historic properties. Additionally, each agency is required to use historic properties available to it and when managing these properties, must consider preservation of their historic, archaeological, architectural, and cultural values.[4]

Executive Order 11593

Executive Order 11593: Protection and Enhancement of the Cultural Environment (1971) mandates that "the Federal Government shall provide leadership in preserving, restoring, and maintaining the historic and cultural environment of the Nation."[5] Responsibilities of federal agencies include:

- Nominating "...to the Secretary of the Interior all sites, buildings, districts, and objects under their jurisdiction of the control that appear to qualify for listing on the National Register of Historic Places."
- Exert caution "...during the interim period until inventories and evaluation...are completed to assure that any federally owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."
- "Initiate measures to assure that where as a result of Federal action or assistance a property listed on the National register of Historic Places is to be substantially altered or demolished, timely steps be taken to make or have made records, including measured drawings, photographs, and maps, of the property, and that copy of such records then be deposited in the Library of Congress as part of the Historic American Buildings Survey or Historic American Engineering Record for future use and reference."
- "Initiate measures and procedures to provide for the maintenance, through preservation, rehabilitation, or restoration, of federally owned and registered sites professional standards prescribed by the Secretary of the Interior."

[2] The NHPA of 1966 was last amended in 2006. A downloadable copy is located at http://www.achp.gov/nhpa.html.
[3] A copy of this agreement can be found on the NPS's website at http://www.nps.gov/policy/106agreement.pdf.
[4] More information on Section 110 can be found on the NPS's website at http://www.nps.gov/hps/fapa_110.htm.
[5] A copy of this EO can be found on the NPS's website at http://www.nps.gov/history/history/online_books/anps/anps_7b.htm.

Executive Order 13006

Executive Order 13006: Locating Federal Facilities on Historic Properties (1996) mandates that "the Federal Government shall utilize and maintain, wherever operationally appropriate and economically prudent, historic properties and districts. . . ." Furthermore, "any rehabilitation or construction that is undertaken pursuant to this order must be architecturally compatible with the character of the surrounding historic district or properties."[6]

Secretary of the Interior's Standards

Treatment to the Saline Valley Salt Tramway is to be guided by *The Secretary of the Interior's Standards for the Treatment of Historic Properties.*[7] Descriptions of the four standards are as follows:

> Preservation: "the act or process of applying measures necessary to sustain the existing form, integrity, and materials of an historic property. Work, including preliminary measures to protect and stabilize the property, generally focuses upon the ongoing maintenance and repair of historic materials and features rather than extensive replacement and new construction. New exterior additions are not within the scope of this treatment; however, the limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a preservation project."
>
> Rehabilitation: "the act or process of making possible a compatible use for a property through repair, alterations, and additions while preserving those portions or features which convey its historical, cultural, or architectural values."
>
> Restoration: "the act or process of accurately depicting the form, features, and character of a property as it appeared at a particular period of time by means of the removal of features from other periods in its history and reconstruction of missing features from the restoration period. The limited and sensitive upgrading of mechanical, electrical, and plumbing systems and other code-required work to make properties functional is appropriate within a restoration project."
>
> Reconstruction: "the act or process of depicting, by means of new construction, the form, features, and detailing of a non-surviving site, landscape, building, structure, or object for the purpose of replicating its appearance at a specific period of time and in its historic location."

Director's Order 28

DO-28 Cultural Resource Management Guideline is intended to guide the National Park Service through successful cultural resource management through three steps[8]:

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[6] A copy of this agreement is located on the ACHP's website at http://www.achp.gov/EO13006.html.
[7] Weeks, Kay D. and Anne E. Grimmer. "The Secretary of the Interior's Standards for the Treatment of Historic Properties with Guidelines for Preserving, Rehabilitating, Restoring & Reconstructing Historic Buildings." United States Department of the Interior, National Park Service, Cultural Resource Stewardship and Partnerships, Heritage Preservation Services, Washington, DC, 1995.
[8] A copy of NPS-28 can be found at http://www.nps.gov/history/history/online_books/nps28/28contents.htm.

- Research: "identify, evaluate, document, register, and establish other basic information about cultural resources;"
- Planning: "ensure that this information is well integrated into management processes for making decisions and setting priorities;" and
- Stewardship: "planning decisions are carried out and resources are preserved, protected, and interpreted to the public."[9]

Through the development of this HSR, the research and planning (for treatment and use) of the four tramway support towers are addressed. The general preservation philosophy integrated into this HSR is best represented by the following:

> Better to preserve than to repair, better repair than restore, better restore than [re]construct. It is ordinarily better to retain genuine old work of several periods, rather than arbitrarily to 'restore' the whole, by new work, to its aspect at a single period.[10]

Decisions for the future stewardship of the four tramway supports towers are under the purview of Death Valley National Park. As part of NPS-28 "stewardship focuses on five major activities:

- Control of treatment and use,
- Monitoring conditions of deterioration and structural failure,
- Protecting from human and environmental threats,
- Retaining or delegating responsibility for structures, and
- Developing the skills, knowledge, and attitudes needed to support the program."[11]

International Building Code

According to the 1988 Amendment to the Public Buildings Act, any building constructed or altered by a Federal agency must, "to the maximum extent feasible, be in compliance with one of the nationally recognized model building codes and with other applicable nationally recognized codes." The International Building Code (IBC) is one of the allowable recognized model building codes.[12]

Treatments of the structures and the site are to be guided by the International Building Code (IBC).[13] Threats to public life, safety, and welfare are to be addressed; however, where historic structures are involved, alternatives to full legislative and code compliance are recommended where compliance would needlessly compromise the integrity of the historic structures with the removal of character-defining features or infringement upon the NRHP-eligible characteristics of the site and/or structures.

Note: It is unlikely that the IBC will be applicable to the treatment of the four tramway support towers but is included here as it applies to historic structures, in general.

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[9] NPS-28, p. 1.
[10] The Advisory Board on National Parks, Historic Sites, Buildings, and Monuments policy statement (1936). NPS-28, p. 2.
[11] NPS-28, p. 127.
[12] The General Services Administration had more information on this amendment and other accepted building codes at http://www.gsa.gov/portal/content/101288.
[13] IBC is overseen by the International Code Council. More information is located at http://www.iccsafe.org/CS/Pages/default.aspx.

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Ultimate Treatment and Use

The Saline Valley Salt Tramway was used almost continuously from its construction completion in 1911 through 1935 when the last owner went into receivership. Since then the entire tramway has fallen into disrepair and has been susceptible to environmental impacts and looting.

The ultimate treatment and use recommendations provided are meant to guide the ultimate treatment and do not provide a construction or architectural program. The identification of resource impacts should be fully assessed once a construction or architectural program is finalized.

Considering the applicable laws, agreements, and policies discussed above, the *Ultimate Treatment* for the four Saline Valley Salt Tramway support towers owned by the NPS is *Preservation.*

The *Ultimate Use* of the four support towers is to continue as scene-setting, interpretive resources.

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Alternatives for Treatment and Use

The following alternatives were brainstormed during the writing of this HSR. These alternatives could alter the recommendations of the treatments by feature section following and are only meant to spur discussion of future treatment and use of the portion managed by the National Park Service.

- Only Support Towers #1 and #2 receive preservation maintenance to return them to good condition. As a result, Support Tower #3 remains lying on grade in ruinous state and Support Tower #4 remains out of alignment (with the potential for imminent collapse).
- Reconstruction of missing support towers between Support Towers #1-4 and Control Station No. 1. Alternatively, former support tower locations could be marked on valley floor with low markers to interpret the number of support towers once extant.
- Reconstruction of the Loading Terminal in Saline Valley. Alternatively, the location of the former Loading Terminal could be marked on the valley floor with a lower to interpret its former presence.
- Reconstruction of at least two towers with cables and carrier bucket, to be placed in Furnace Creek Visitor Center area, perhaps at "The Ranch" Museum, for interpretation purposes.

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Recommended Treatments by Feature

Support Tower #1 Recommended Treatments

Recommended treatments for Support Tower #1 components are included under the Uniformat II layout by condition and deficiency rating in Table 6 below.

Table 6. Support Tower #1 Prioritized Treatment List

Major Group Element	Group Element	Individual Element	Condition Rating	Deficiency Rating
CRITICAL				
G BUILDING SITEWORK	G90 OTHER SITE WORK	G9087 Overall Building Site Drainage	Poor	Critical
B SHELL	B10 SUPERSTRUCTURE	B10.1 Standards	Poor	Critical
SERIOUS				
B SHELL	B10 SUPERSTRUCTURE	B10.2 Ties	Poor	Serious
B SHELL	B10 SUPERSTRUCTURE	B10.4 Cap Timber	Fair	Serious
MINOR				
A SUBSTRUCTURE	A10 FOUNDATIONS	A1010 Standard Foundations – Concrete Footings	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.3 Posts	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.5 X-Brace	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.6 Struts	Fair	Minor

End of Table.

G9087 Overall Building Site Drainage	Poor	Critical

Support Tower #1 is the closest tower to the salt lake. Because of its proximity, it is periodically inundated with flood water. With the neutral site drainage around the tower, the area does not drain and standing water can remain for periods of time. This has affected the four standards and wood bracing and the horizontal ties.

No recommendations are provided to correct the flooding or the neutral site drainage, as these would negatively affect the cultural landscape intact within Saline Valley. Alternatively, refer to B10.1 Standards and B10.2 Ties below for immediate recommendations for those elements which would prevent further deterioration to the entire structure.

B10.1 Standards	Poor	Critical

All four wood standards of Support Tower #1 should be replaced. New Doug Fir standards should match the details of the standards located at Towers #2-4, as the extant standards at Tower #1 were likely replaced and do not retain the same details as the others. New standards should be square (7½" x 7½") and placed at a 45° angle in plan. New standards should match the

height of those being replaced (17-26”), as it is known that Tower #1 was the shortest of all tramway support towers.

Extant iron brackets should be reused to the extent feasible. New bolts will be required to attach the brackets to the concrete footings; every effort should be made to reuse the original bolts attaching the brackets to the wood standards.

All four Doug Fir horizontal bracing boards (2¾” thick x 7½” high” x differing lengths) located between the four standards should be replaced.

B10.2 Ties	Poor	Serious

All four wood ties of Support Tower #1 should be replaced. New Doug Fir ties should match the details of the ties located at Towers #2-4, as the extant standards at Tower #1 are too deteriorated to be properly matched. New ties should measure 2¾” thick x 7½” high x 142” long. Extant iron bolts should be reused to the extent feasible.

Extant wood blocks and bolts from the former traction rope support system should be salvaged and reinstalled on the new wood ties in their same relative location to preserve remnants of original features.

B10.4 Cap Timber	Fair	Serious

Consideration could be given to the full replacement of the cap timber of Support Tower #1. The skyward-facing surface of the cap exhibits significant deterioration due to UV exposure. A missing nut at one of the bolts from the X-brace connection could allow the bolt to slip and the structure to twist. The new cap should be composed of Doug Fir, measure 11¼” wide x 9¼” high x approximately 96” long, and should include original details, such as notches and 45° clips on the underside of each end.

A1010 Standard Foundations – Concrete Footings	Fair	Serious

All soil covering the top of the concrete footings of Support Tower #1 should be removed to determine condition of all four footings. If any footings are found to be completely deteriorated or show significant cracking, the footing should be replaced in kind. Replacement footings should be cast in place, as the originals were, and measure approximately 26” square in plan and 6½-7” deep. Modern concrete mixes are acceptable for use to differentiate the new footings from the original footings.

B10.3 Posts	Fair	Minor

The four wood central posts and associated iron bolts are extant at Support Tower #1. These components should be periodically assessed to ensure they remain in fair condition.

The wood boards originally located around the center of the posts are missing, but remain at other towers, so do not need to be restored here.

B10.5 X-Brace	Fair	Minor

The wood X-brace and associated iron bolts are extant at Support Tower #1. These components should be periodically assessed to ensure they remain in fair condition.

B10.6 Struts	Fair	Minor

The wood struts and associated iron bolts are extant at Support Tower #1. These components should be periodically assessed to ensure they remain in fair condition.

Support Tower #2 Recommended Treatments

Recommended treatments for Support Tower #2 components are included under the Uniformat II layout by condition and deficiency rating in Table 7 below.

Table 7. Support Tower #2 Prioritized Treatment List

Major Group Element	Group Element	Individual Element	Condition Rating	Deficiency Rating
SERIOUS				
B SHELL	B10 SUPERSTRUCTURE	B10.1 Standards	Fair	Serious
MINOR				
A SUBSTRUCTURE	A10 FOUNDATIONS	A1010 Standard Foundations – Concrete Footings	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.2 Ties	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.3 Posts	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.4 Cap Timber	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.5 X-Brace	Fair	Minor
B SHELL	B10 SUPERSTRUCTURE	B10.6 Struts	Fair	Minor
G BUILDING SITEWORK	G90 OTHER SITE WORK	G9087 Overall Building Site Drainage	Fair	Minor

End of Table.

B10.1 Standards	Fair	Serious

The four wood standards, one ladder board, and associated iron bolts are extant at Support Tower #2. These components should be periodically assessed to ensure they remain in fair condition.

All wood bracing boards (2¾" thick x 7½" high" x differing lengths) should be restored to the structure to deter racking or twisting of the standards and collapse of the entire structure. Ghost lines and bolt holes should be used to determine the original configuration of the Doug Fir braces (both horizontal and diagonal). New bolts will be required. Extant bolts located at Support Tower #4 should be used to find a close match to the originals.

A1010 Standard Foundations – Concrete Footings	Fair	Serious

All soil covering the top of the concrete footings of Support Tower #2 should be removed to determine condition of all four footings. If any footings are found to be completely deteriorated or show significant cracking, the footing should be replaced in kind. Replacement footings should be cast in place, as the originals were, and measure approximately 26" square in plan and 6½-7" deep. Modern concrete mixes are acceptable for use to differentiate the new footings from the original footings.

B10.2 Ties	Fair	Minor

The wood ties and associated iron bolts are extant at Support Tower #2. These components should be periodically assessed to ensure they remain in fair condition.

B10.3 Posts	Fair	Minor

The four wood central posts, central boards, and associated iron bolts are extant at Support Tower #2. These components should be periodically assessed to ensure they remain in fair condition.

B10.4 Cap Timber	Fair	Minor

The cap timber and associated iron bolts are extant at Support Tower #2. These components should be periodically assessed to ensure they remain in fair condition.

B10.5 X-Brace	Fair	Minor

The wood X-brace and associated iron bolts are extant at Support Tower #2. These components should be periodically assessed to ensure they remain in fair condition.

B10.6 Struts	Fair	Minor

The wood struts, many ladder boards, and associated iron bolts are extant at Support Tower #2. These components should be periodically assessed to ensure they remain in fair condition.

G9087 Overall Building Site Drainage	Fair	Minor

The overall site drainage should be periodically monitored to ensure neutral drainage is not negatively affecting Support Tower #2.

Support Tower #3 Recommended Treatments

Recommended treatments for Support Tower #3 components are included under the Uniformat II layout by condition and deficiency rating in Table 8 below.

Table 8. Support Tower #3 Prioritized Treatment List

Major Group Element	Group Element	Individual Element	Condition Rating	Deficiency Rating
CRITICAL				
B SHELL	B10 SUPERSTUCTURE	B10.1 Standards	Poor	Critical
B SHELL	B10 SUPERSTUCTURE	B10.2 Ties	Poor	Critical
B SHELL	B10 SUPERSTUCTURE	B10.3 Posts	Fair	Critical
B SHELL	B10 SUPERSTUCTURE	B10.4 Cap Timber	Fair	Critical
B SHELL	B10 SUPERSTUCTURE	B10.5 X-Brace	Fair	Critical
B SHELL	B10 SUPERSTUCTURE	B10.6 Struts	Fair	Critical
MINOR				
A SUBSTRUCTURE	A10 FOUNDATIONS	A1010 Standard Foundations – Concrete Footings	Fair	Minor
G BUILDING SITEWORK	G90 OTHER SITE WORK	G9087 Overall Building Site Drainage	Fair	Minor

End of Table.

B10.1 Standards	Poor	Critical

All four wood standards of Support Tower #3 should be replaced. New Doug Fir standards should match the details of the collapsed standards. New standards should be square (7½" x 7½") and placed at a 45° angle in plan. New standards should match the height of those being replaced (94-106").

Extant iron brackets should be reused to the extent feasible. At least one bracket will new to be recast. New bolts will be required to attach the brackets to the concrete footings and the new bracket to its new standard; every effort should be made to reuse the original bolts attaching the brackets to the wood standards.

All wood bracing boards (2¾" thick x 7½" high" x differing lengths) should be restored to the structure to deter racking or twisting of the standards and another collapse of the entire structure. Ghost lines and bolt holes from the extant standards should be used to determine the original configuration of the Doug Fir braces (both horizontal and diagonal). New bolts will be required. Extant bolts located at Support Tower #4 should be used to find a close match to the originals.

B10.2 Ties	Poor	Critical

All four wood ties of Support Tower #3 should be replaced. New Doug Fir ties should match the details of the extant ties. New ties should measure 2¾" thick x 7½" high x 142" long. Extant iron bolts should be reused to the extent feasible.

Extant wood blocks and bolts from the former traction rope support system should be salvaged and reinstalled on the new wood ties in their same relative location to preserve remnants of original features.

B10.3 Posts	Fair	Critical

The four wood central posts, two wood boards, and associated iron bolts are extant at Support Tower #3 and can likely be reused despite the structure's collapse. These components should be periodically assessed to ensure they remain in fair condition.

B10.4 Cap Timber	Fair	Critical

The cap timber, remnant piece of saddle, and associated iron bolts are extant at Support Tower #3 and can likely be reused despite the structure's collapse. These components should be periodically assessed to ensure they remain in fair condition.

B10.5 X-Brace	Fair	Critical

The wood X-brace and associated iron bolts are extant at Support Tower #3 and can likely be reused despite the structure's collapse. These components should be periodically assessed to ensure they remain in fair condition.

B10.6 Struts	Fair	Critical

The wood struts, many ladder boards, and associated iron bolts are extant at Support Tower #3 and can likely be reused despite the structure's collapse. These components should be periodically assessed to ensure they remain in fair condition.

A1010 Standard Foundations – Concrete Footings	Fair	Minor

All soil covering the top of the concrete footings of Support Tower #3 should be removed to determine condition of all four footings. If any footings are found to be completely deteriorated or show significant cracking, the footing should be replaced in kind. Replacement footings should be cast in place, as the originals were, and measure approximately 26" square in plan and 6½-7" deep. Modern concrete mixes are acceptable for use to differentiate the new footings from the original footings.

G9087 Overall Building Site Drainage	Fair	Minor

The overall site drainage should be periodically monitored to ensure neutral drainage is not negatively affecting Support Tower #3.

Support Tower #4 Recommended Treatments

Recommended treatments for Support Tower #4 components are included under the Uniformat II layout by condition and deficiency rating in Table 9 below.

Table 9. Support Tower #4 Prioritized Treatment List

Major Group Element	Group Element	Individual Element	Condition Rating	Deficiency Rating
CRITICAL				
B SHELL	B10 SUPERSTUCTURE	B10.1 Standards	Poor	Critical
B SHELL	B10 SUPERSTUCTURE	B10.2 Ties	Poor	Critical
SERIOUS				
B SHELL	B10 SUPERSTUCTURE	B10.3 Posts	Fair	Serious
B SHELL	B10 SUPERSTUCTURE	B10.4 Cap Timber	Fair	Serious
B SHELL	B10 SUPERSTUCTURE	B10.5 X-Brace	Fair	Serious
B SHELL	B10 SUPERSTUCTURE	B10.6 Struts	Fair	Serious
MINOR				
A SUBSTRUCTURE	A10 FOUNDATIONS	A1010 Standard Foundations – Concrete Footings	Fair	Minor
G BUILDING SITEWORK	G90 OTHER SITE WORK	G9087 Overall Building Site Drainage	Fair	Minor

End of Table.

B10.1 Standards	Poor	Critical

All four wood standards of Support Tower #4 should be replaced. New Doug Fir standards should match the details of the shifting, splintered standards. New standards should be square (7½" x 7½") and placed at a 45° angle in plan. New standards should match the height of those being replaced (132-137½").

Extant iron brackets should be reused to the extent feasible. At least one bracket will new to be recast. New bolts will be required to attach the brackets to the concrete footings and the new bracket to its new standard; every effort should be made to reuse the original bolts attaching the brackets to the wood standards.

All wood bracing boards (2¾" thick x 7½" high" x differing lengths) should be restored to the structure to deter racking or twisting of the standards and another collapse of the entire structure. Ghost lines and bolt holes from the extant standards should be used to determine the original configuration of the Doug Fir braces (both horizontal and diagonal). New bolts will be required. Extant bolts should be used to find a close match to the originals.

B10.2 Ties	Poor	Critical

Three of the four wood ties of Support Tower #4 should be replaced. New Doug Fir ties should match the details of the extant ties. New ties should measure 2¾" thick x 7½" high x 142" long. Extant iron bolts should be reused to the extent feasible.

Extant wood blocks and bolts from the former traction rope support system should be salvaged and reinstalled on the new wood ties in their same relative location to preserve remnants of original features.

B10.3 Posts	Fair	Serious

The four wood central posts, center wood boards, and associated iron bolts are extant at Support Tower #4 and can likely be reused despite the structure's movement. These components should be periodically assessed to ensure they remain in fair condition.

B10.4 Cap Timber	Fair	Serious

The cap timber and associated iron bolts are extant at Support Tower #4 and can likely be reused despite the structure's movement. These components should be periodically assessed to ensure they remain in fair condition.

B10.5 X-Brace	Fair	Serious

The wood X-brace and associated iron bolts are extant at Support Tower #4 and can likely be reused despite the structure's movement. These components should be periodically assessed to ensure they remain in fair condition.

B10.6 Struts	Fair	Serious

The wood struts, few ladder boards, and associated iron bolts are extant at Support Tower #4 and can likely be reused despite the structure's collapse. These components should be periodically assessed to ensure they remain in fair condition.

A1010 Standard Foundations – Concrete Footings	Fair	Minor

All soil covering the top of the concrete footings of Support Tower #4 should be removed to determine condition of all four footings. If any footings are found to be completely deteriorated or show significant cracking, the footing should be replaced in kind. Replacement footings should be cast in place, as the originals were, and measure approximately 26" square in plan and 6½-7" deep. Modern concrete mixes are acceptable for use to differentiate the new footings from the original footings.

G9087 Overall Building Site Drainage	Fair	Minor

The overall site drainage should be periodically monitored to ensure neutral drainage is not negatively affecting Support Tower #4.

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Effects of Recommended Treatments

The potential effects of the recommended treatments for the four tramway support towers are outlined below by individual tower (Tables 10-13). Each table is ordered by priority (matching the order in Recommended Treatment section above). Effects to historic fabric, recommended mitigating measures for recommendations with effects, and beneficial outcomes of each action are examined. Treatment recommendations which include periodic housekeeping and maintenance, reassessment, or are in good condition with minor deficiencies, are not discussed.

Table 10. Support Tower #1 Effects of Recommended Treatments

Recommended Treatment	Potential Effect on Historic Fabric	Mitigating Measures	Beneficial Effects
B10.1 Standards Replace all four wood standards. Reattach iron brackets to footings. Replace all four wood bracing boards.	No adverse effect.	New standards will match original design features present at other support towers and currently missing at Support Tower #1.	Components returned to good condition. Structure will be structurally sound.
B10.2 Ties Replace all four wood ties.	No adverse effect.	New ties will match extant original design features.	Components returned to good condition. Structure will be structurally sound.
B10.4 Cap Timber Replace cap timber.	No adverse effect.	New cap timber will match extant original design features.	Component returned to good condition.
A1010 Concrete Footings Replace footings deteriorated beyond feasible repair.	No adverse effect.	New footings will be cast in place to match extant and differentiated from original by modern concrete mix.	Components returned to good condition. Structure will be structurally sound.

End of Table.

Table 11. Support Tower #2 Effects of Recommended Treatments

Recommended Treatment	Potential Effect on Historic Fabric	Mitigating Measures	Beneficial Effects
B10.1 Standards Replace missing wood bracing boards.	No adverse effect.	New bracing boards will restore missing original design features.	Structure will be structurally sound.
A1010 Concrete Footings Replace footings deteriorated beyond feasible repair.	No adverse effect.	New footings will be cast in place to match extant and differentiated from original by modern concrete mix.	Components returned to good condition. Structure will be structurally sound.

End of Table.

Table 12. Support Tower #3 Effects of Recommended Treatments			
Recommended Treatment	Potential Effect on Historic Fabric	Mitigating Measures	Beneficial Effects
B10.1 Standards Replace all four wood standards. Reattach iron brackets to footings. Install new bracket, where missing. Replace missing wood bracing boards.	No adverse effect.	New standards will match original, damaged features. New bracket will match historic. New bracing boards will restore missing original design features.	Components returned to good condition. Structure will be structurally sound.
B10.2 Ties Replace all four wood ties.	No adverse effect.	New ties will match the extant original design features. Remnant features will be salvaged and reinstalled on new ties.	Components returned to good condition. Structure will be structurally sound.
A1010 Concrete Footings Replace footings deteriorated beyond feasible repair.	No adverse effect.	New footings will be cast in place to match extant and differentiated from original by modern concrete mix.	Components returned to good condition. Structure will be structurally sound.
End of Table.			

Table 13. Support Tower #4 Effects of Recommended Treatments			
Recommended Treatment	Potential Effect on Historic Fabric	Mitigating Measures	Beneficial Effects
B10.1 Standards Replace all four wood standards. Reattach iron brackets to footings. Install new bracket, where missing. Replace missing wood bracing boards.	No adverse effect.	New standards will match original, damaged features. New bracket will match historic. New bracing boards will restore missing original design features.	Components returned to good condition. Structure will be structurally sound.
B10.2 Ties Replace three of four wood ties.	No adverse effect.	New ties will match extant original design features. Remnant features will be salvaged and reinstalled on new ties.	Components returned to good condition. Structure will be structurally sound.
A1010 Concrete Footings Replace footings deteriorated beyond feasible repair.	No adverse effect.	New footings will be cast in place to match those extant and differentiated from original by modern concrete mix.	Components returned to good condition. Structure will be structurally sound.
End of Table.			

Appendix A

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Appendix B

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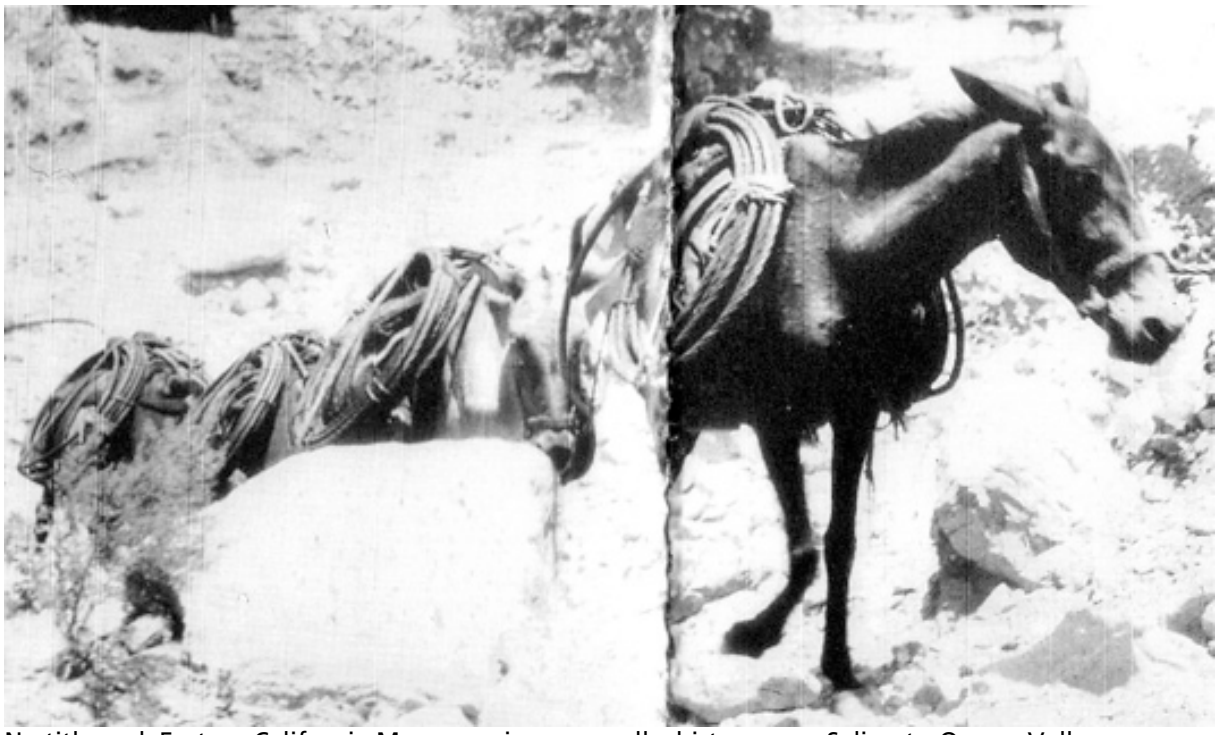
Appendix B: Archival Photographs

Archival photographs were found at the following repositories:

- Eastern California Museum via blogspt.salttram.com and owensvalleyhistory.com
- Colorado School of Mines, Arthur Lakes Library, Russell L and Lyn Wood Mining History Archive, via owensvalleyhistory.com.
- Seaver Center for Western History Research, Natural History Museum of Los Angeles County, Andrew Alexander Forbes Collection, 1890-1915.



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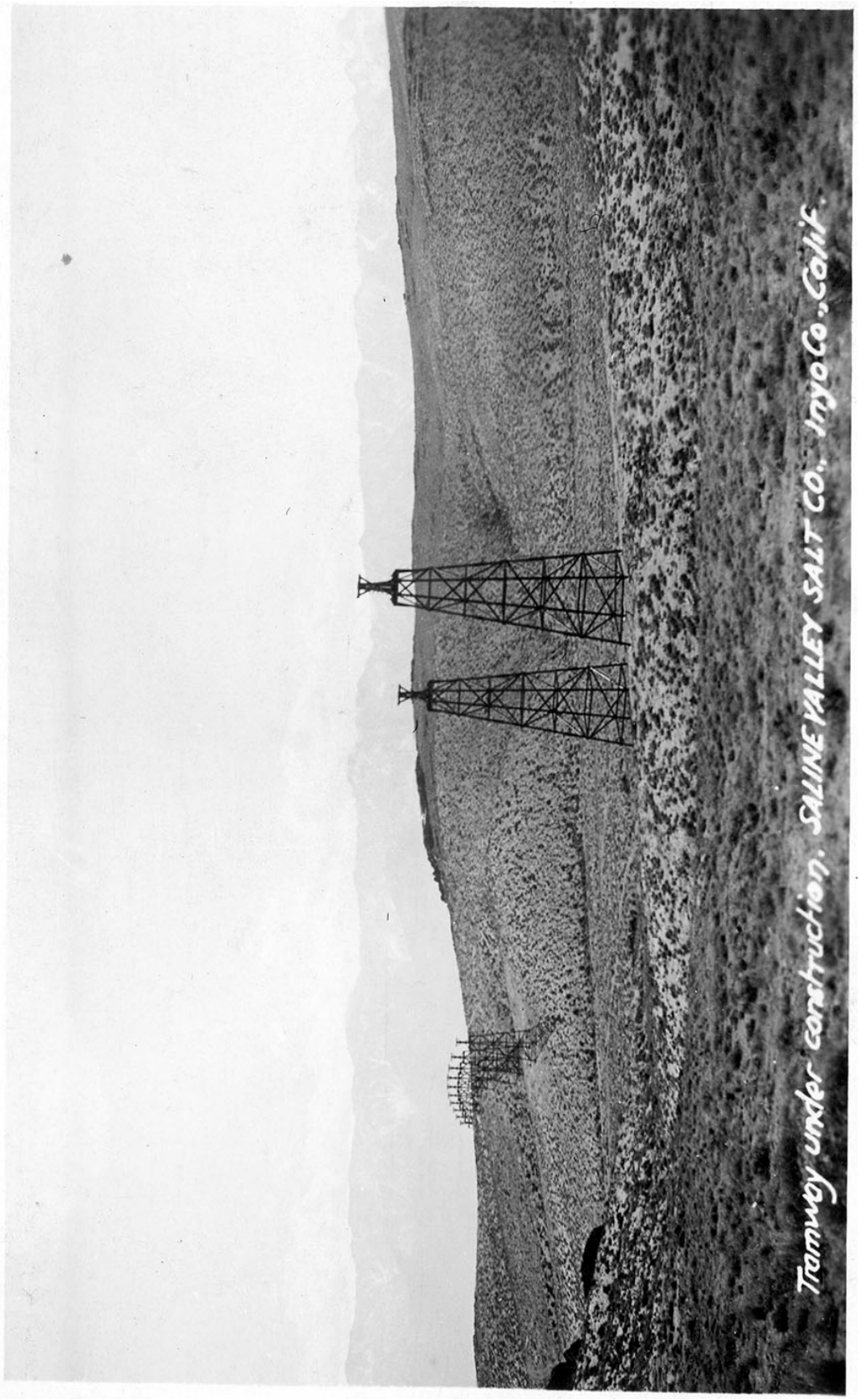
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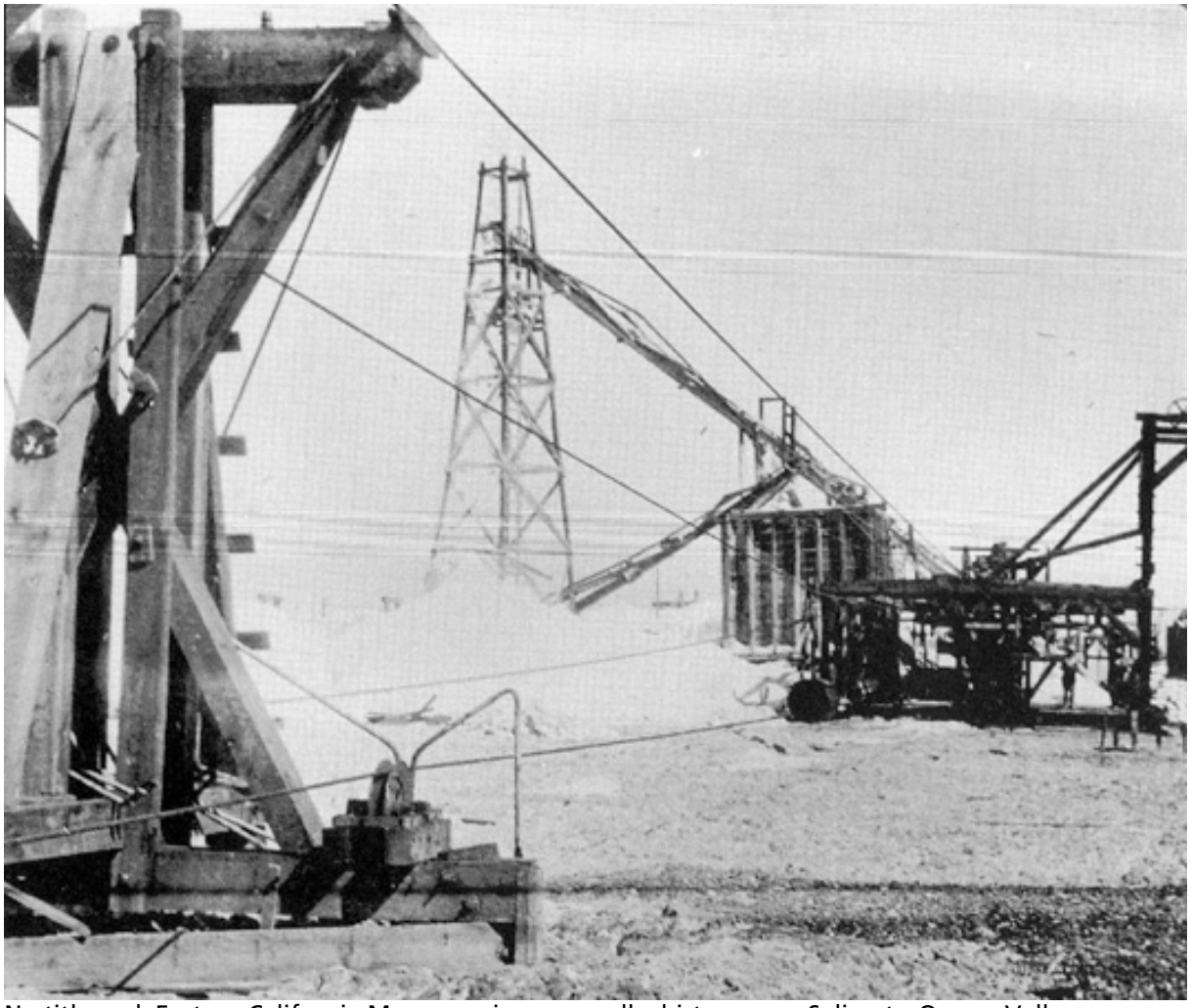
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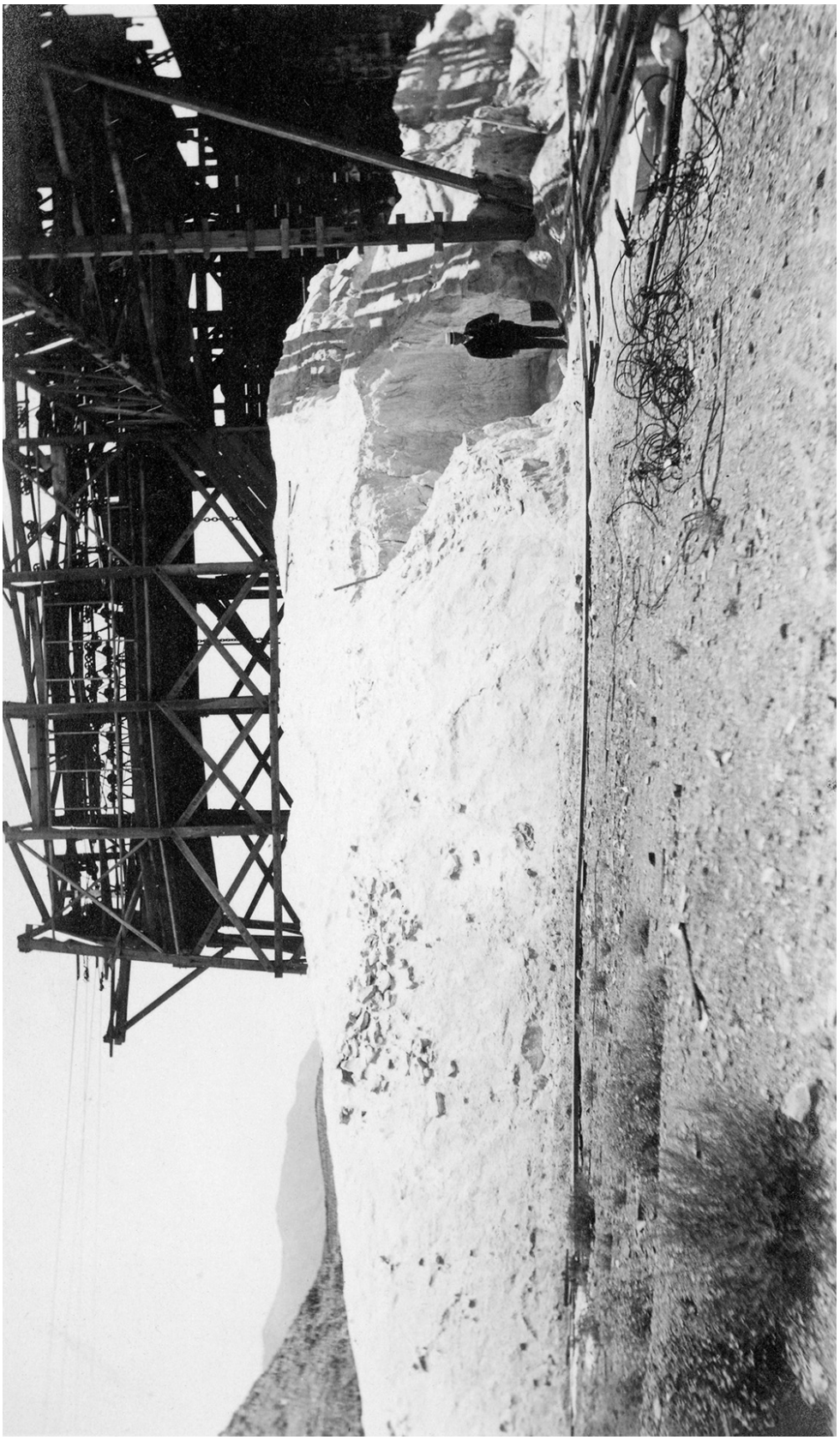
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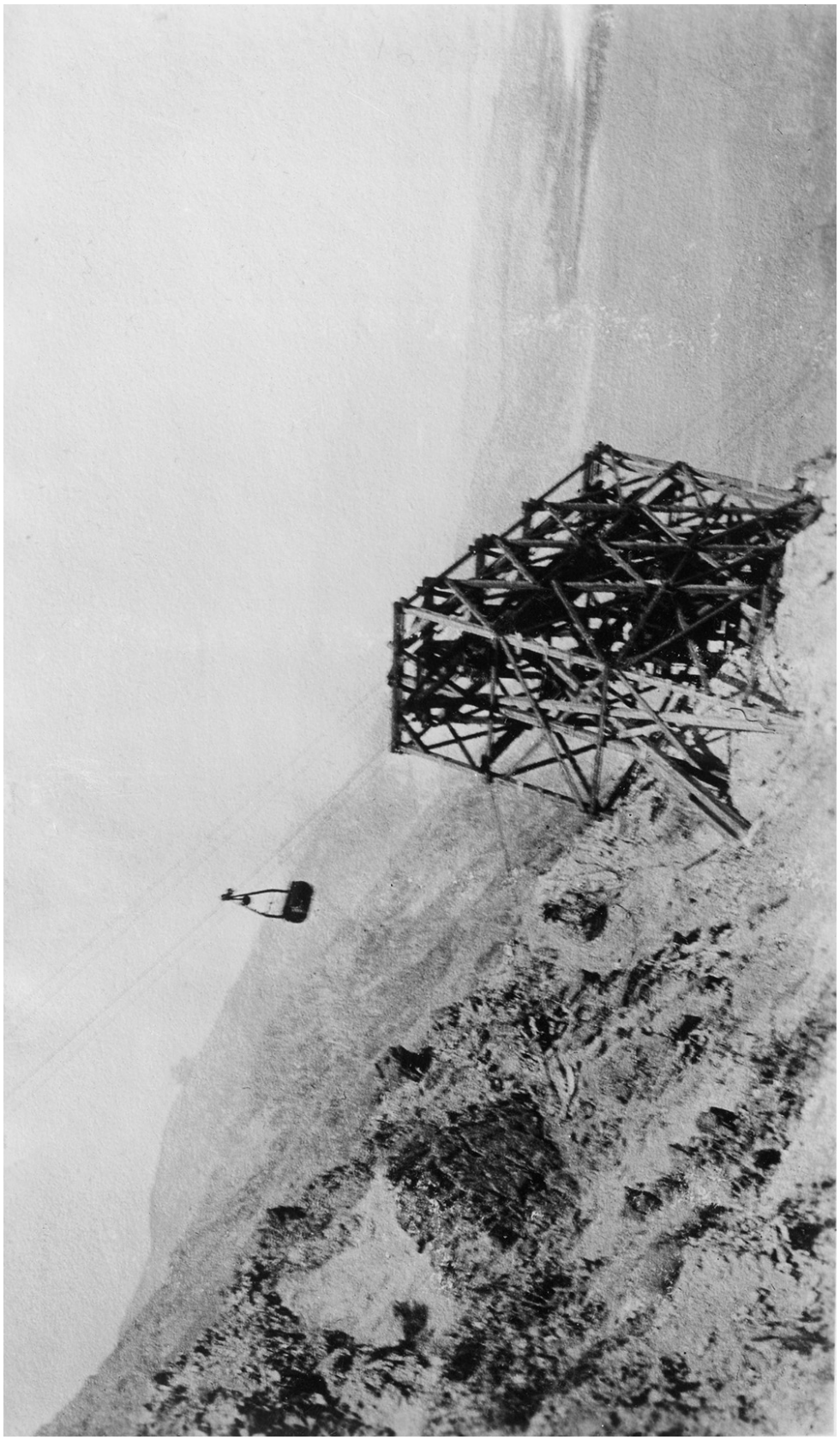
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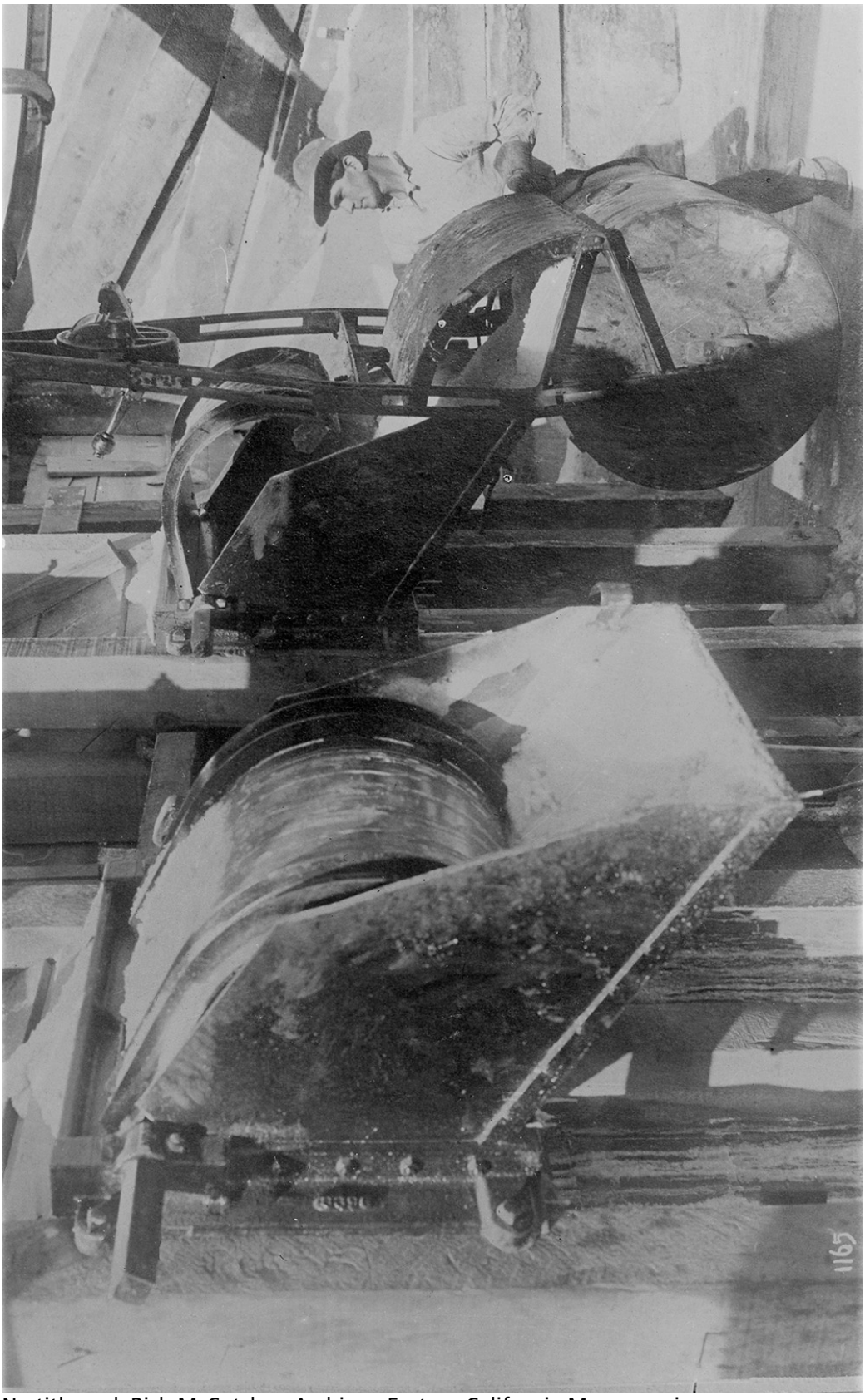
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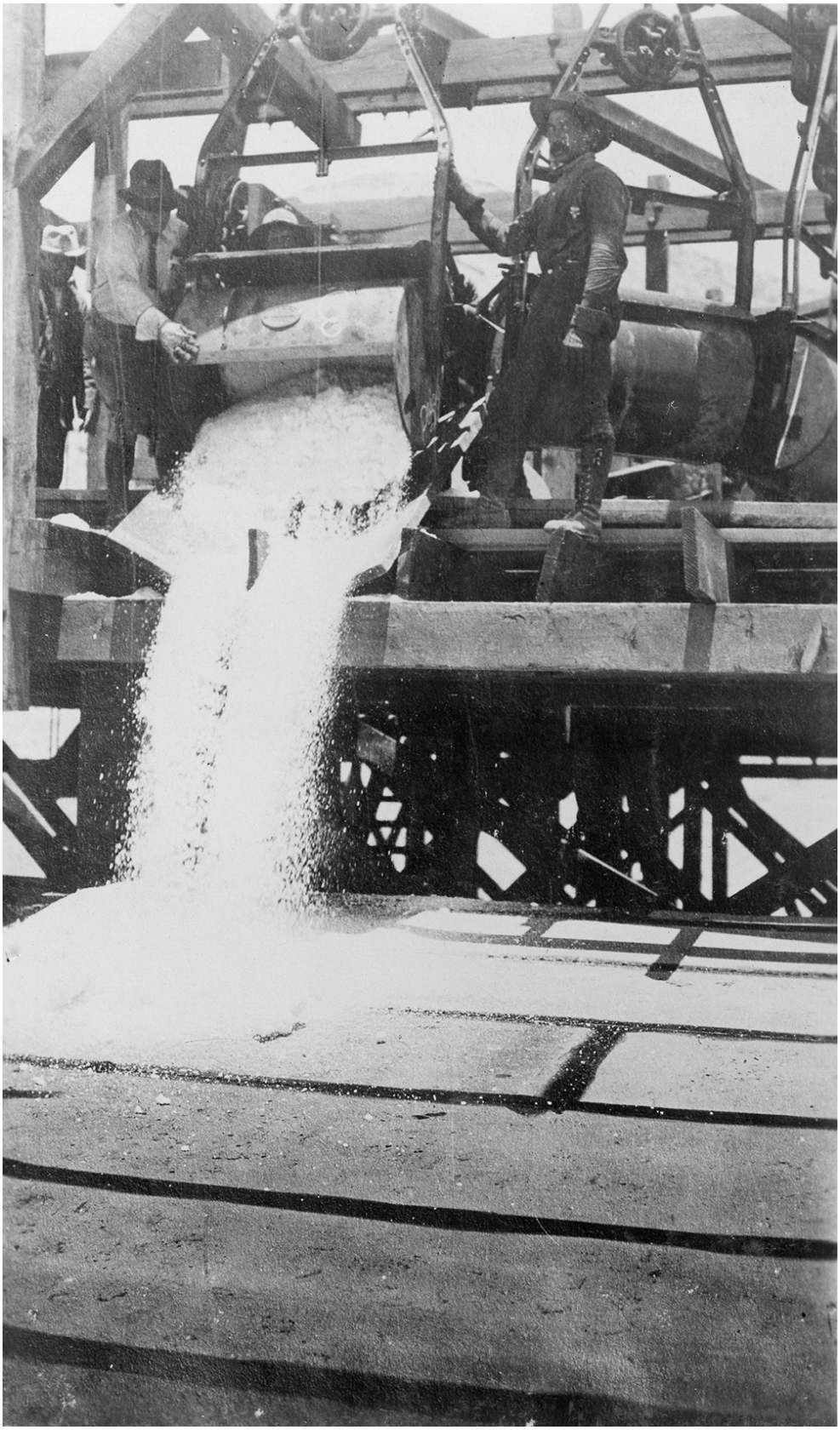
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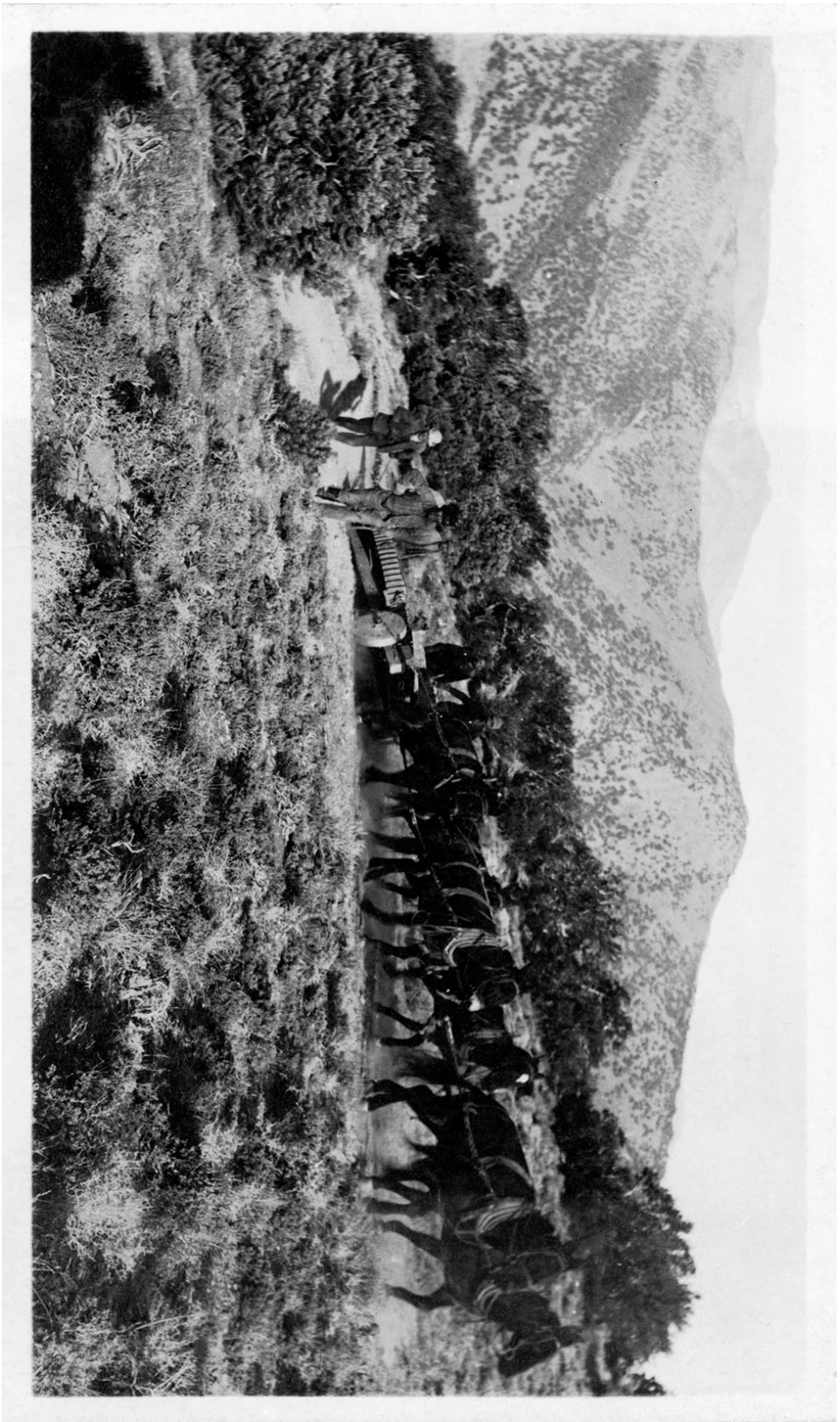
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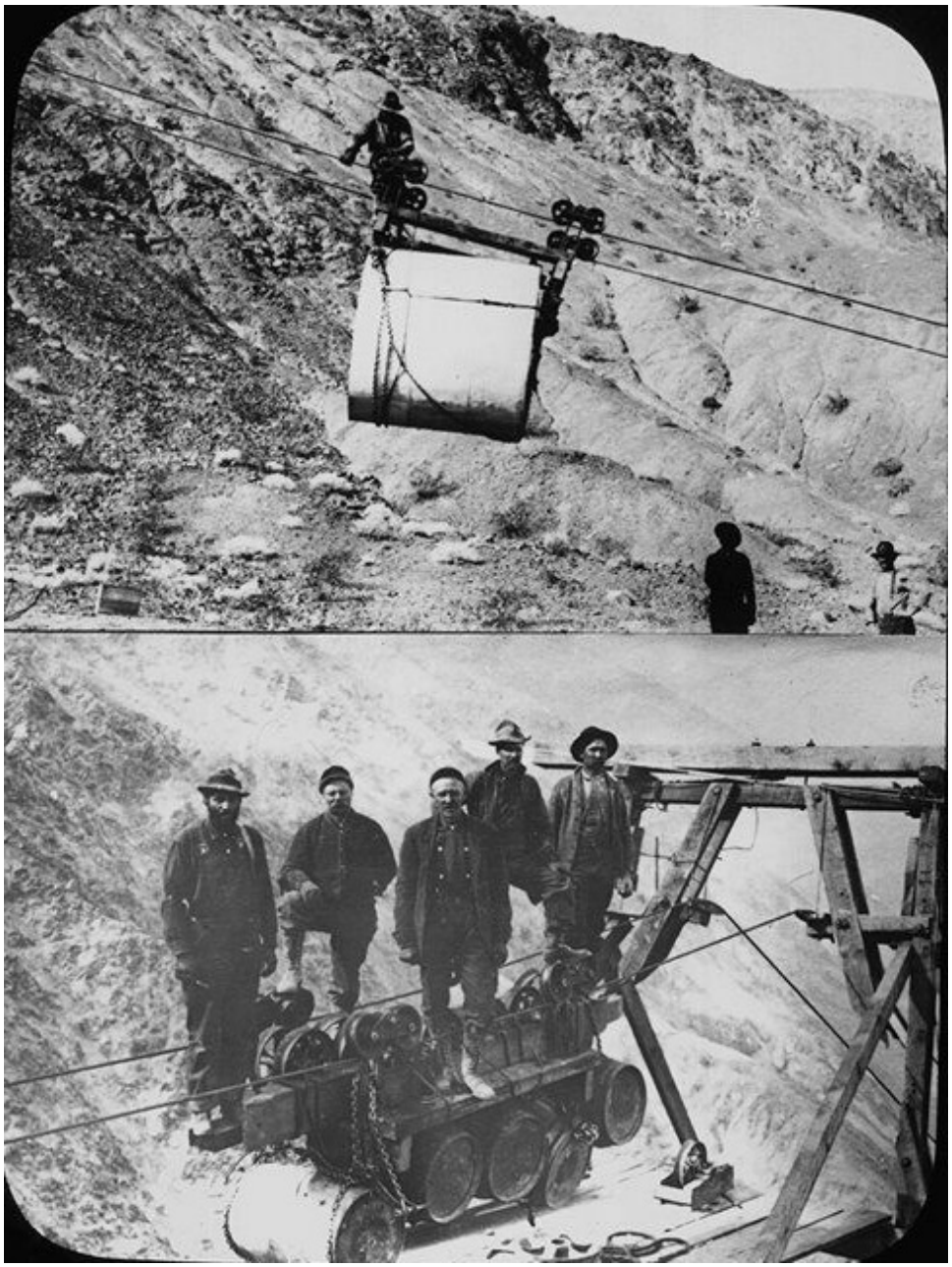
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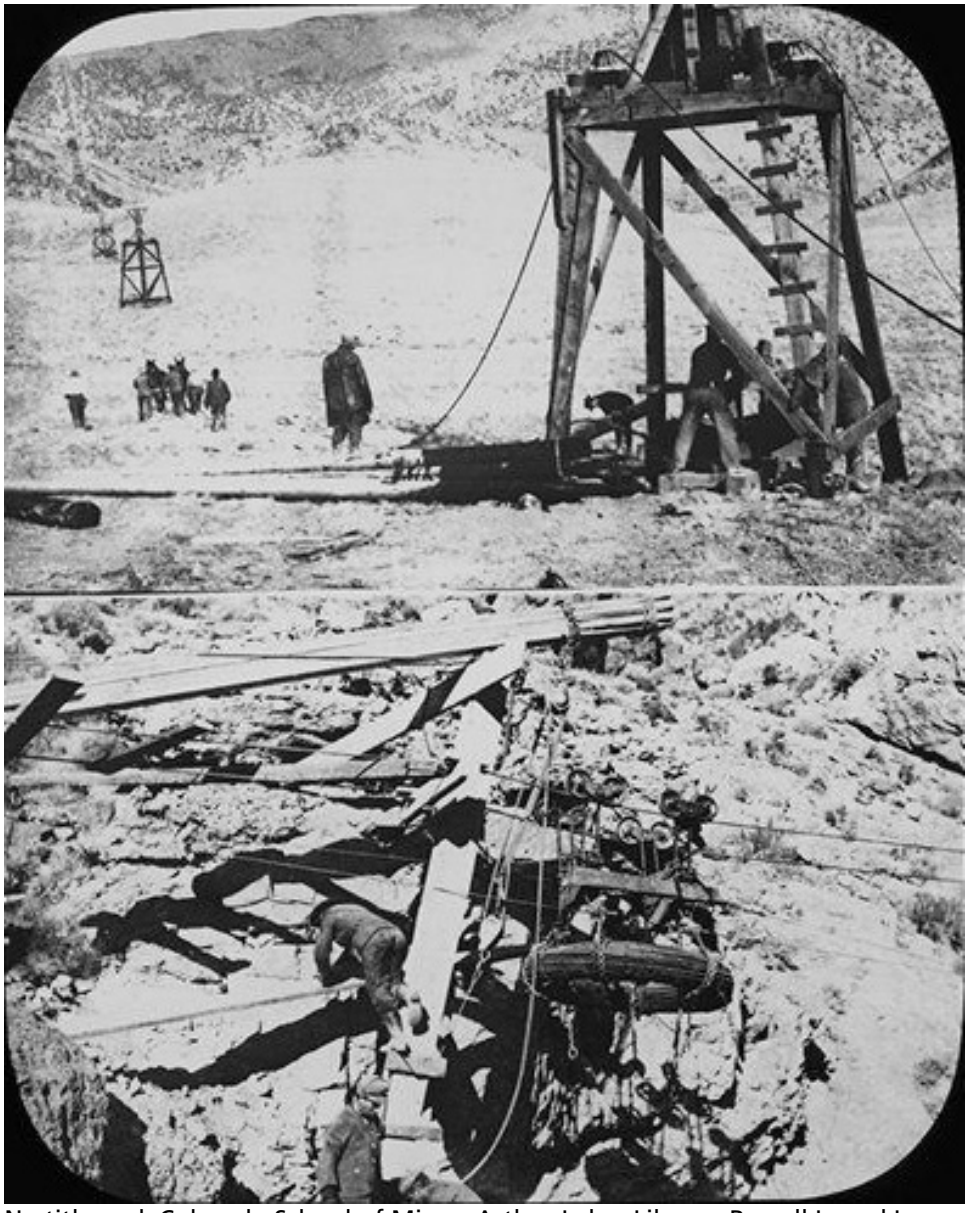
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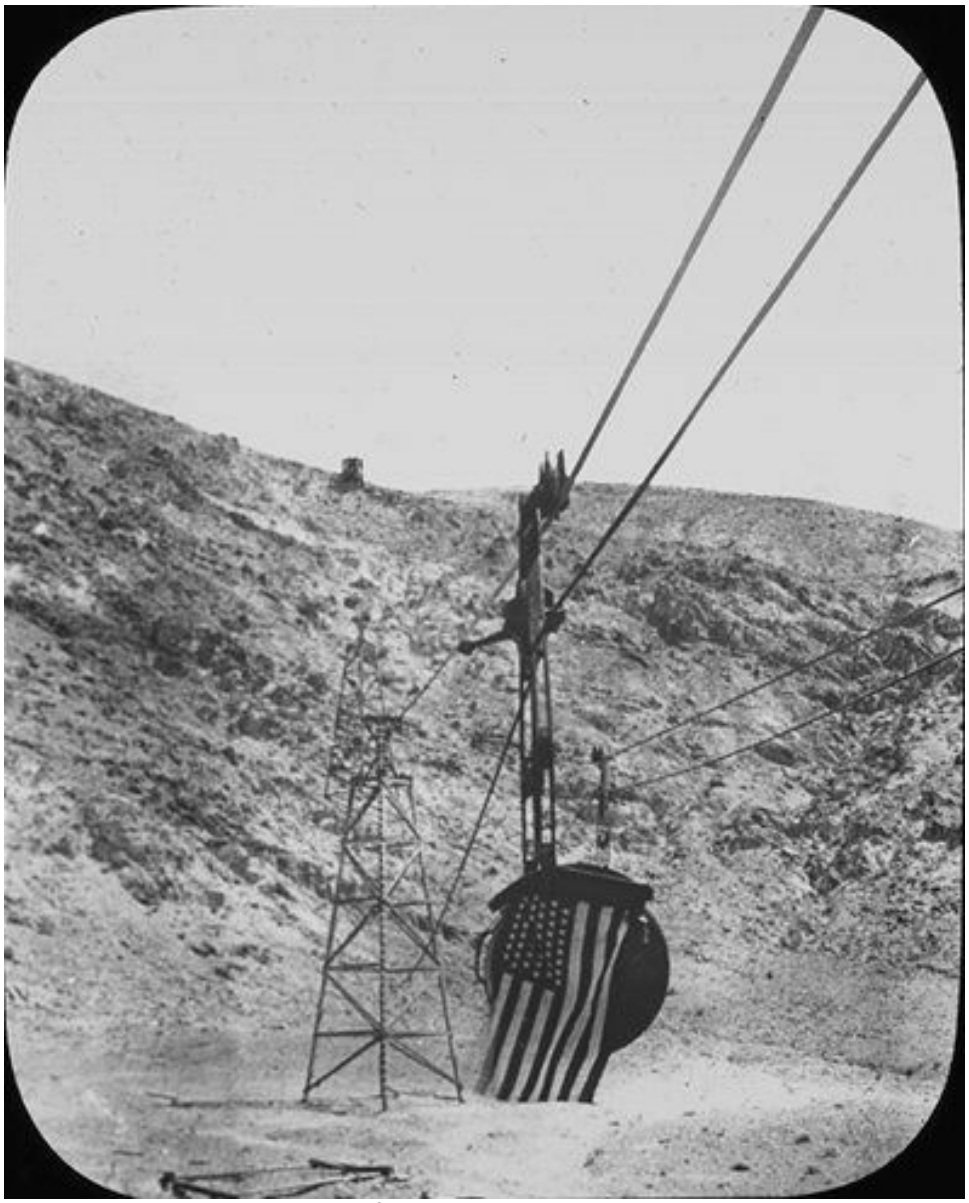
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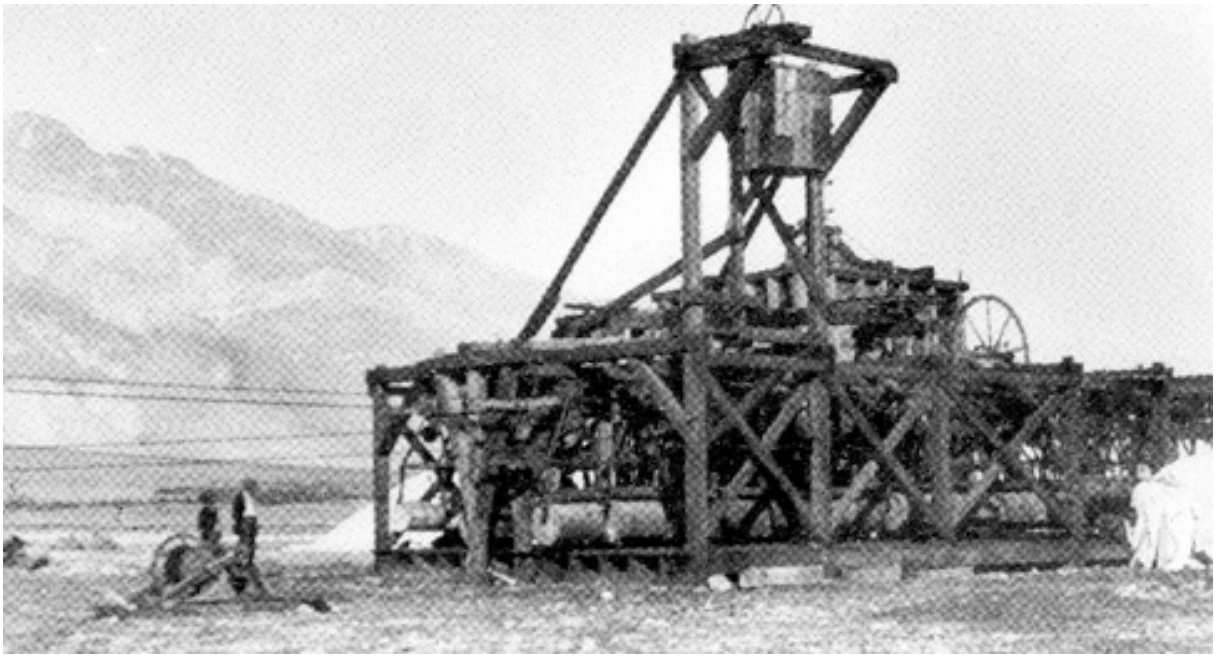
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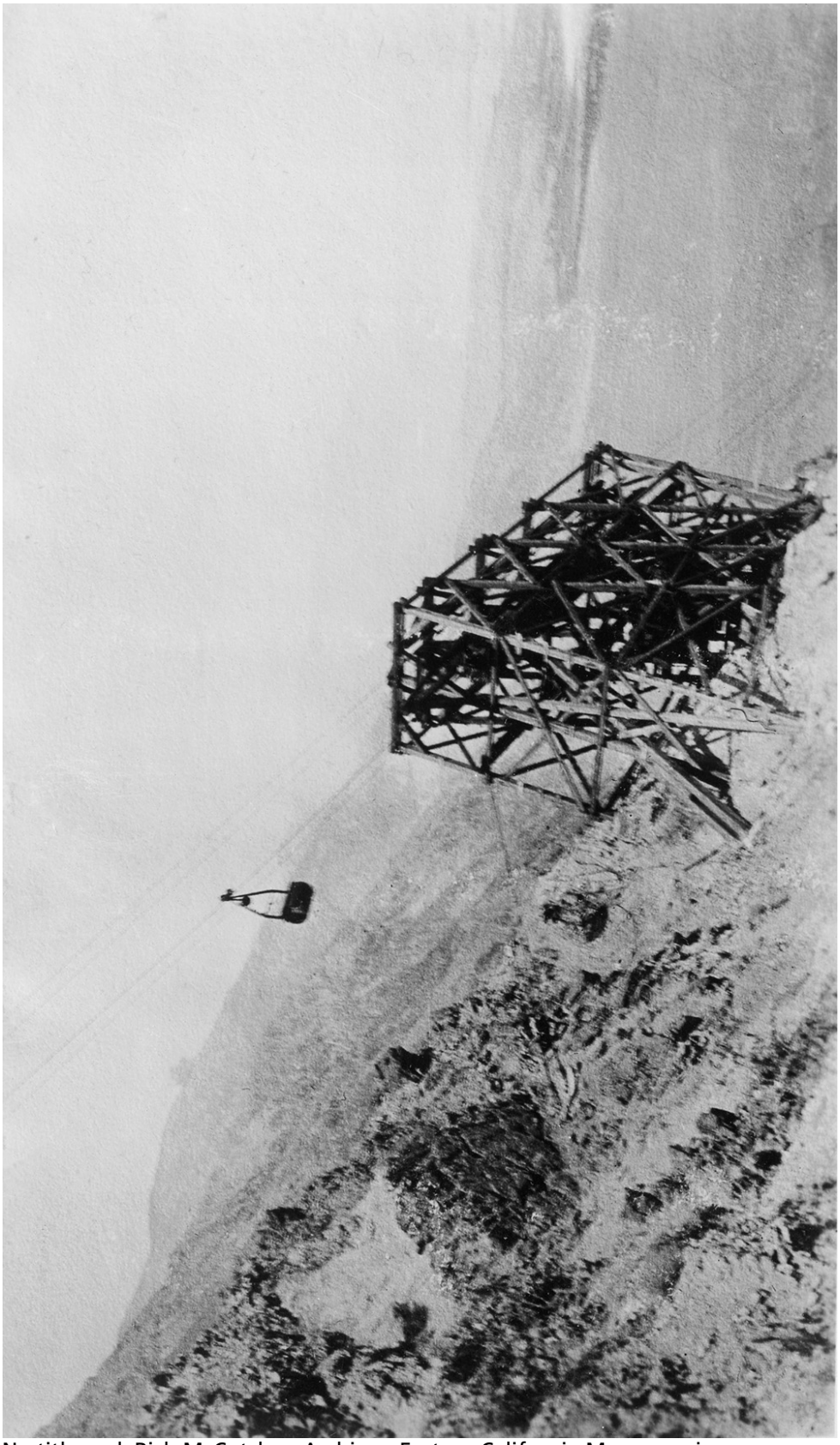
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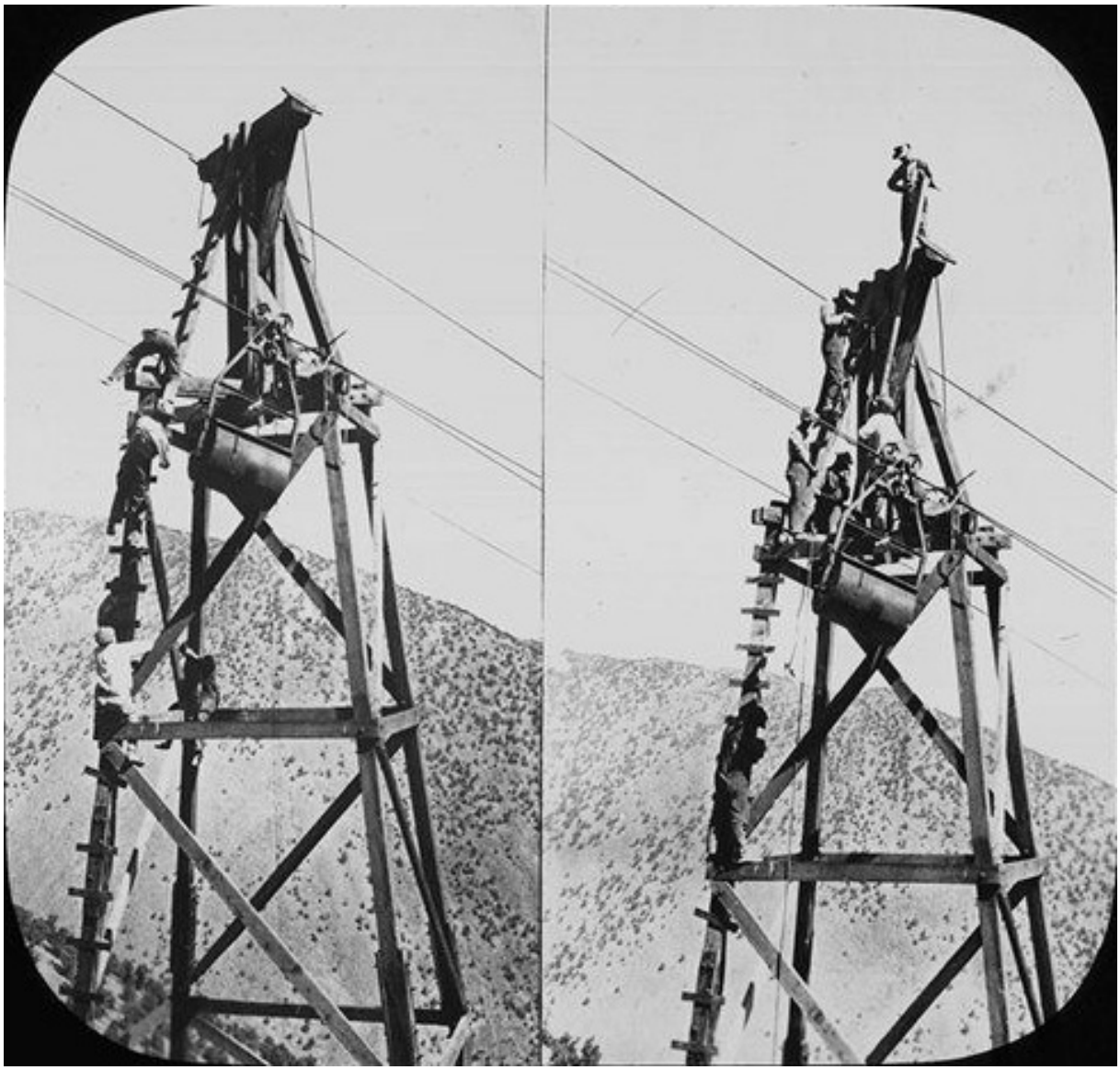
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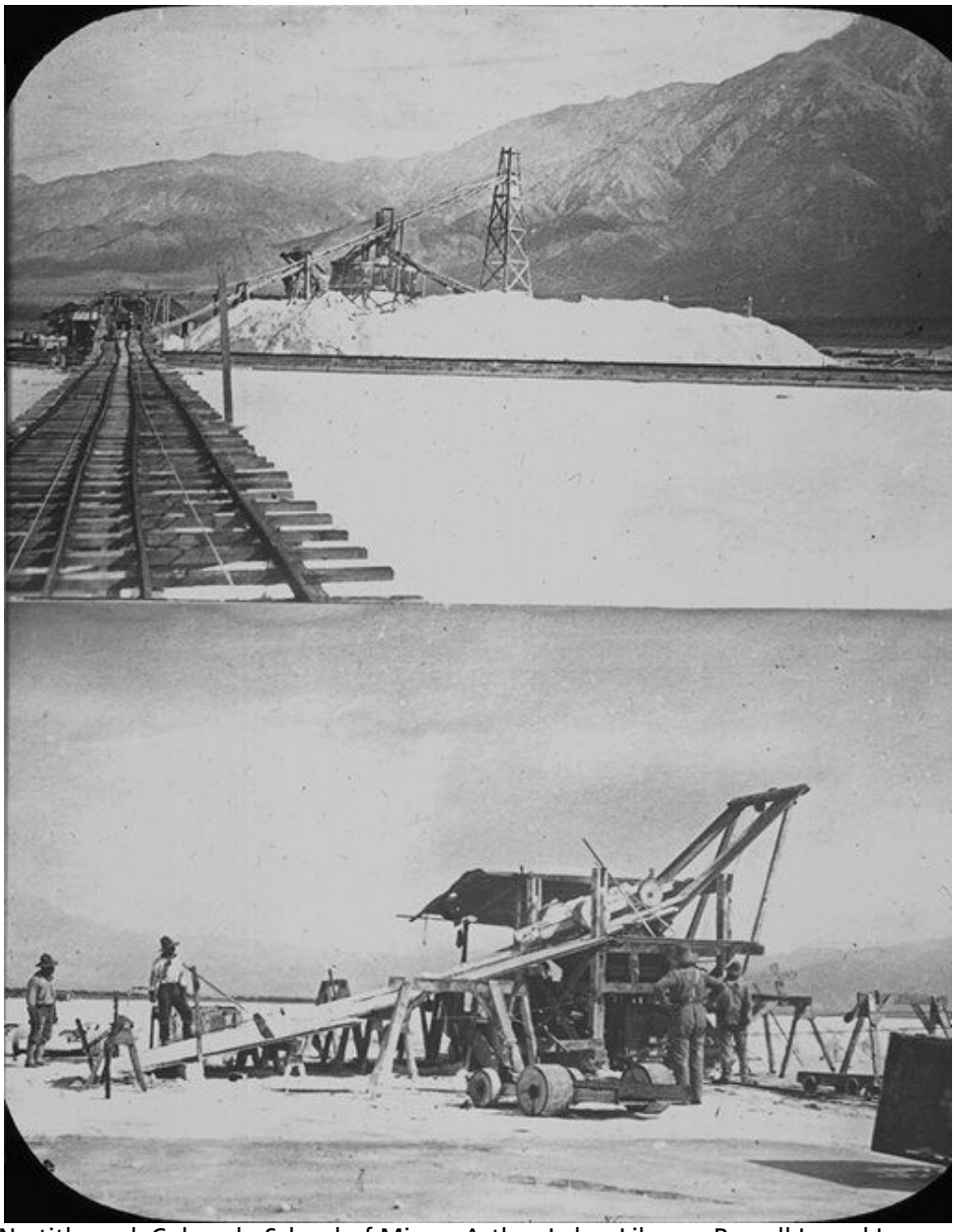
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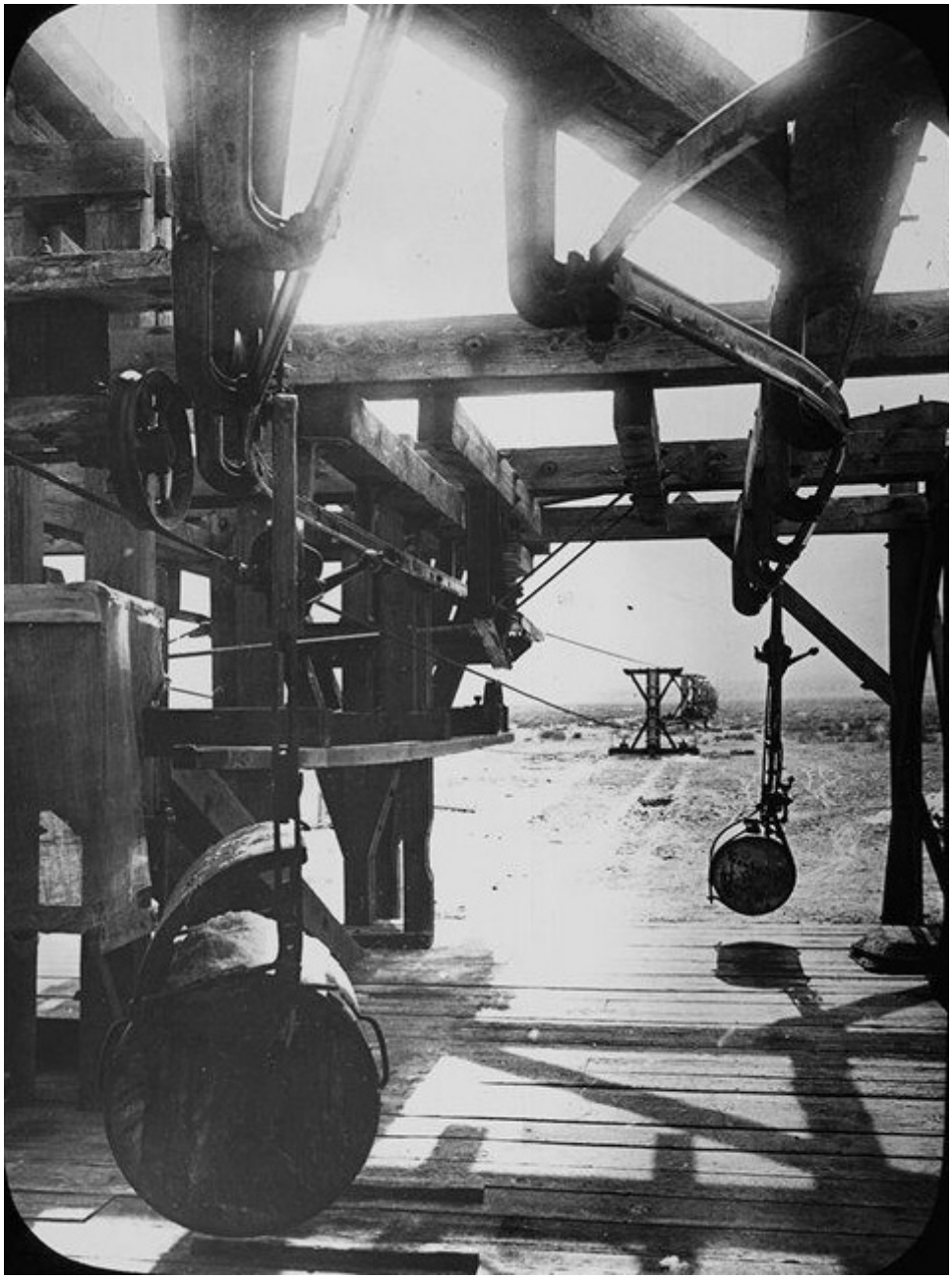
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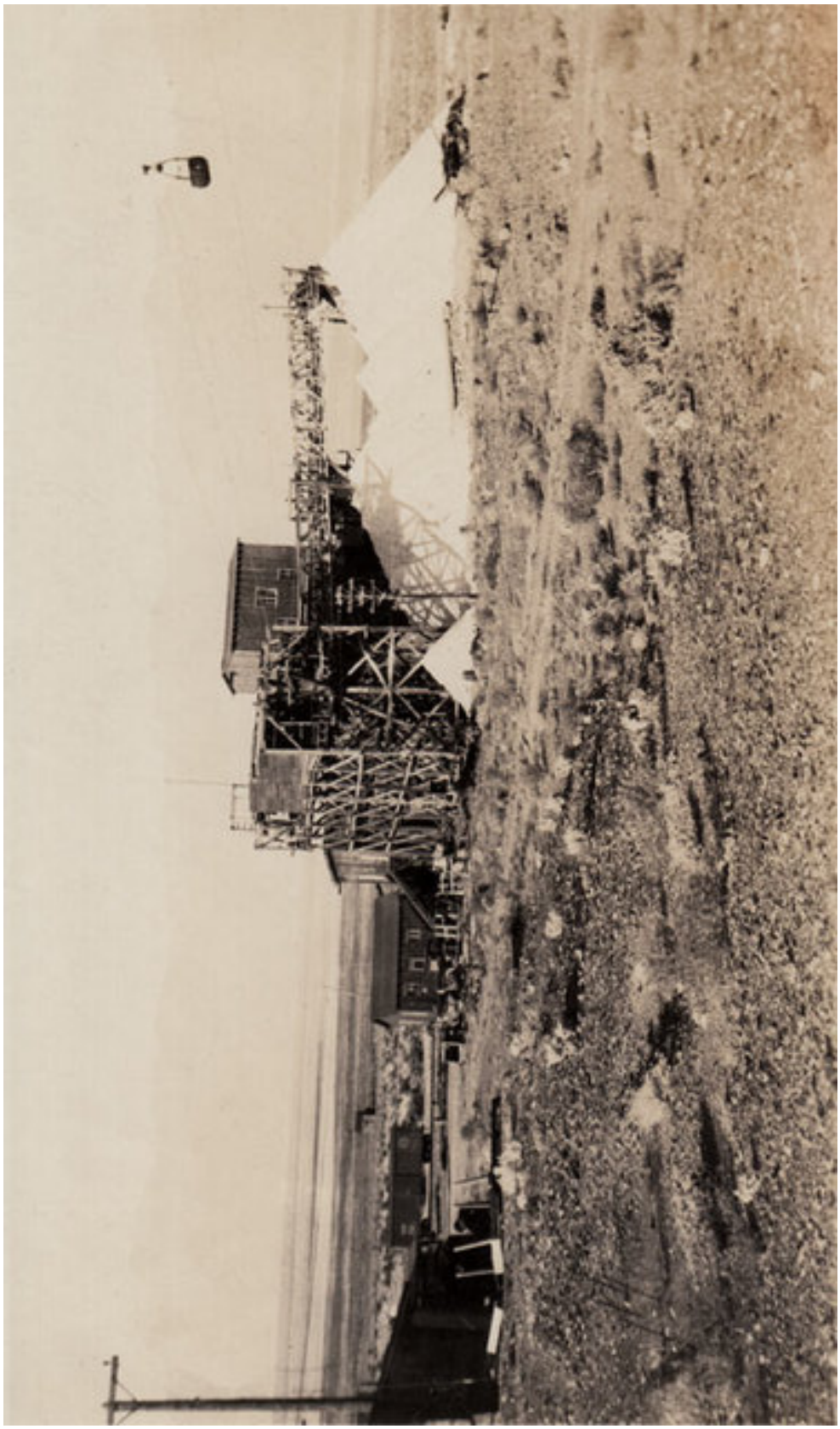
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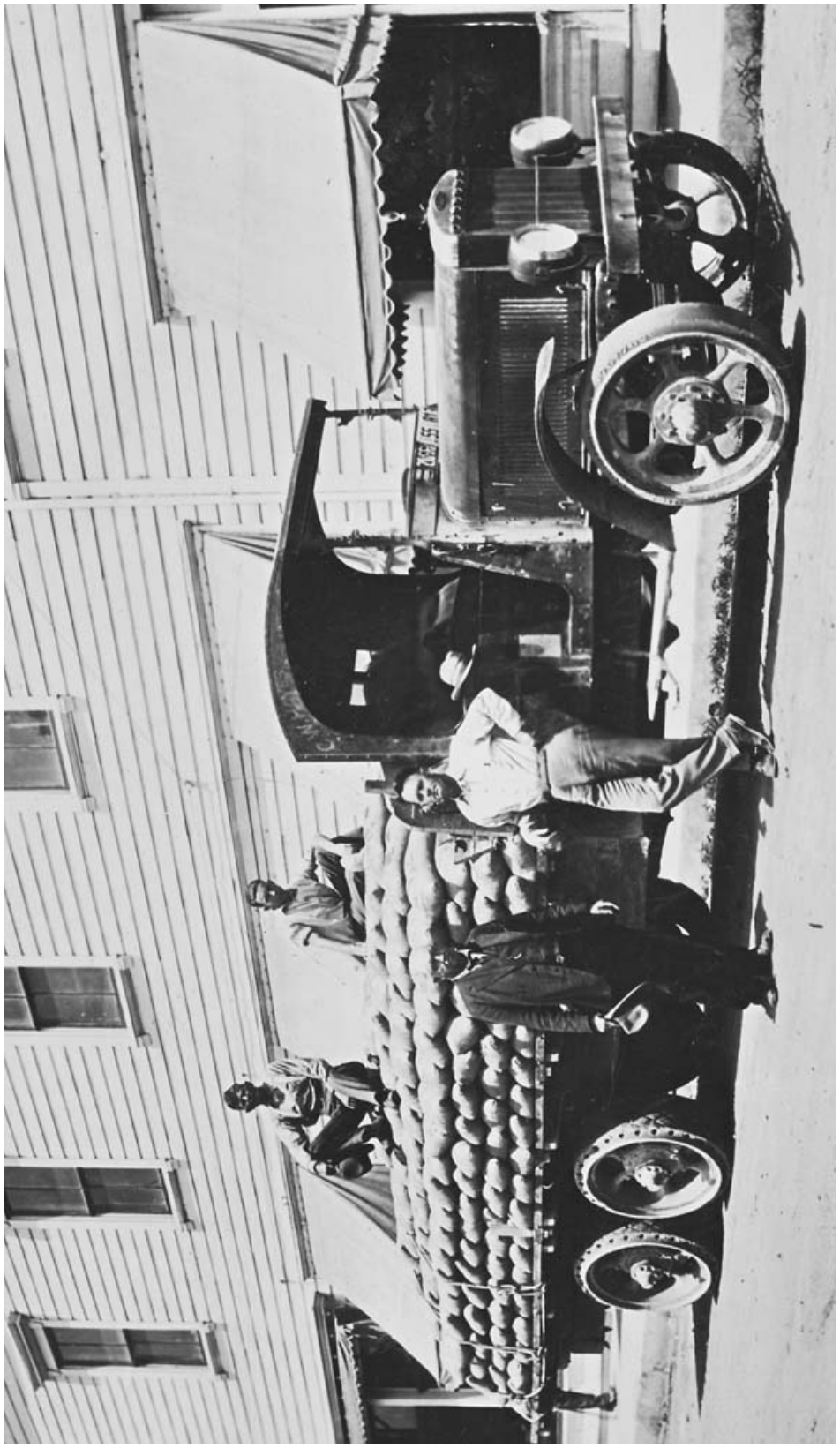
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No title, n.d. Eastern California Museum; via owensvalleyhistory.com, Saline-to-Owens-Valley Tramway 2.



"City Market, Bishop, Sierra Salt Co, White Smith. 6 cylinder 6 wheel Moreland Truck. Loaded with salt. Brought out over new Saline Road. Delivered to City Market Bishop, CA June 16, 1926. Whit Smith. C.W. Hays on truck." Eastern California Museum, UNK 635, via salttram.blogspot.com/2010/05.

Appendix C

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Appendix C: Photogrammetric Drawings

Drawings in this appendix were completed by Scott Ernst of Southwest Scanning. Each support tower is in a different state of disrepair and completeness, and some components are missing from each. The following drawings were assembled digitally utilizing components of each support tower, as photogrammetrically scanned by Ernst:

Support Tower #1
- East Elevation
- South Elevation
- Plan
- Isometric

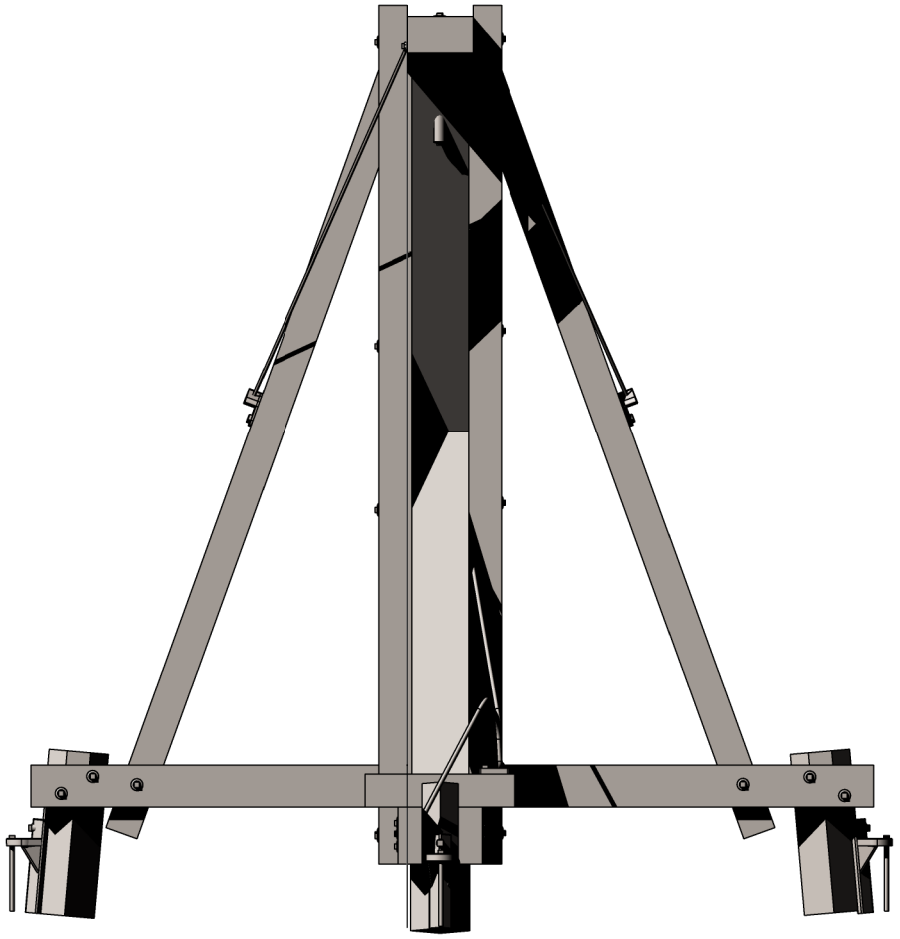
Support Tower #2
- East Elevation
- South Elevation
- Plan
- Isometric

Support Tower #3
- East Elevation
- South Elevation
- Plan
- Isometric

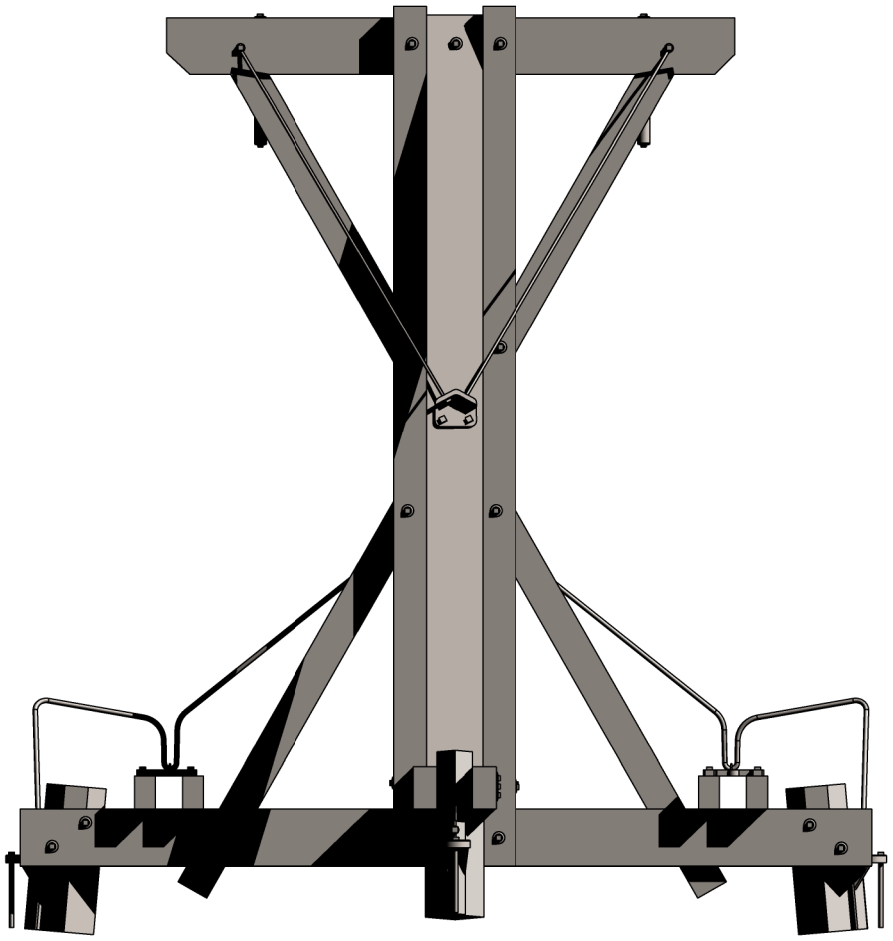
Support Tower #4
- East Elevation
- South Elevation
- Plan
- Isometric

These drawings were completed from a photogrammetric model of the four extant support towers in situ. The model is available digitally through Death Valley National Park.

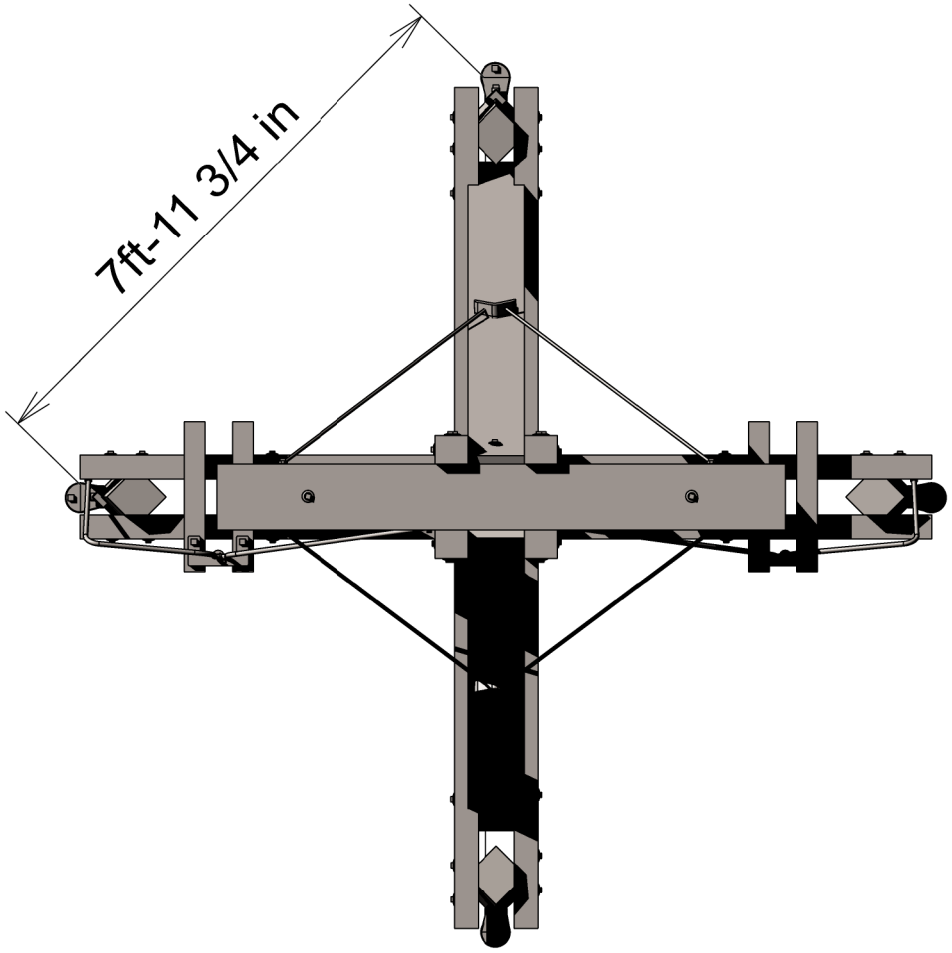
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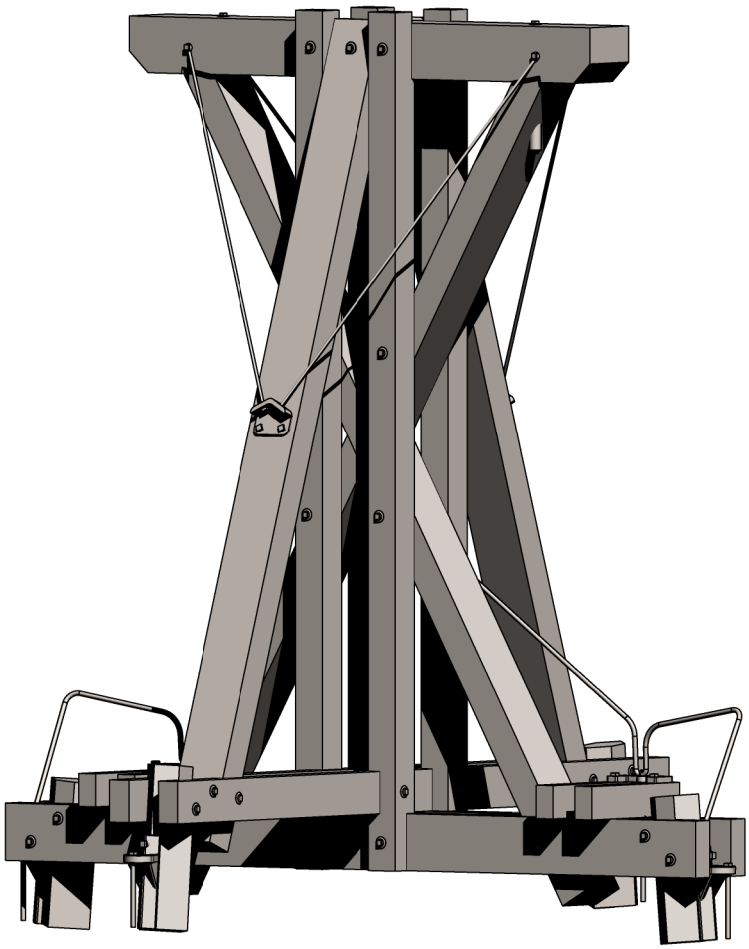
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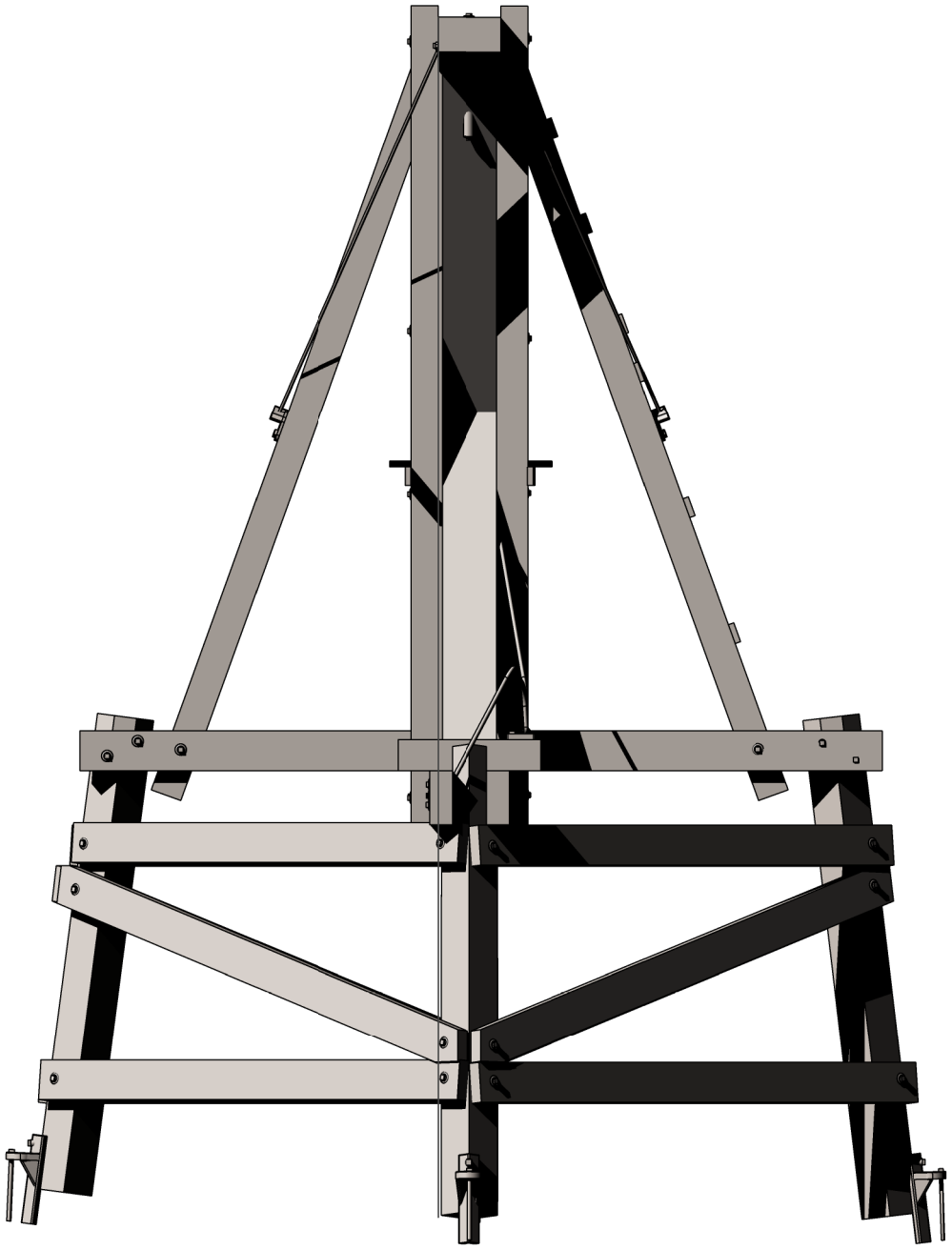
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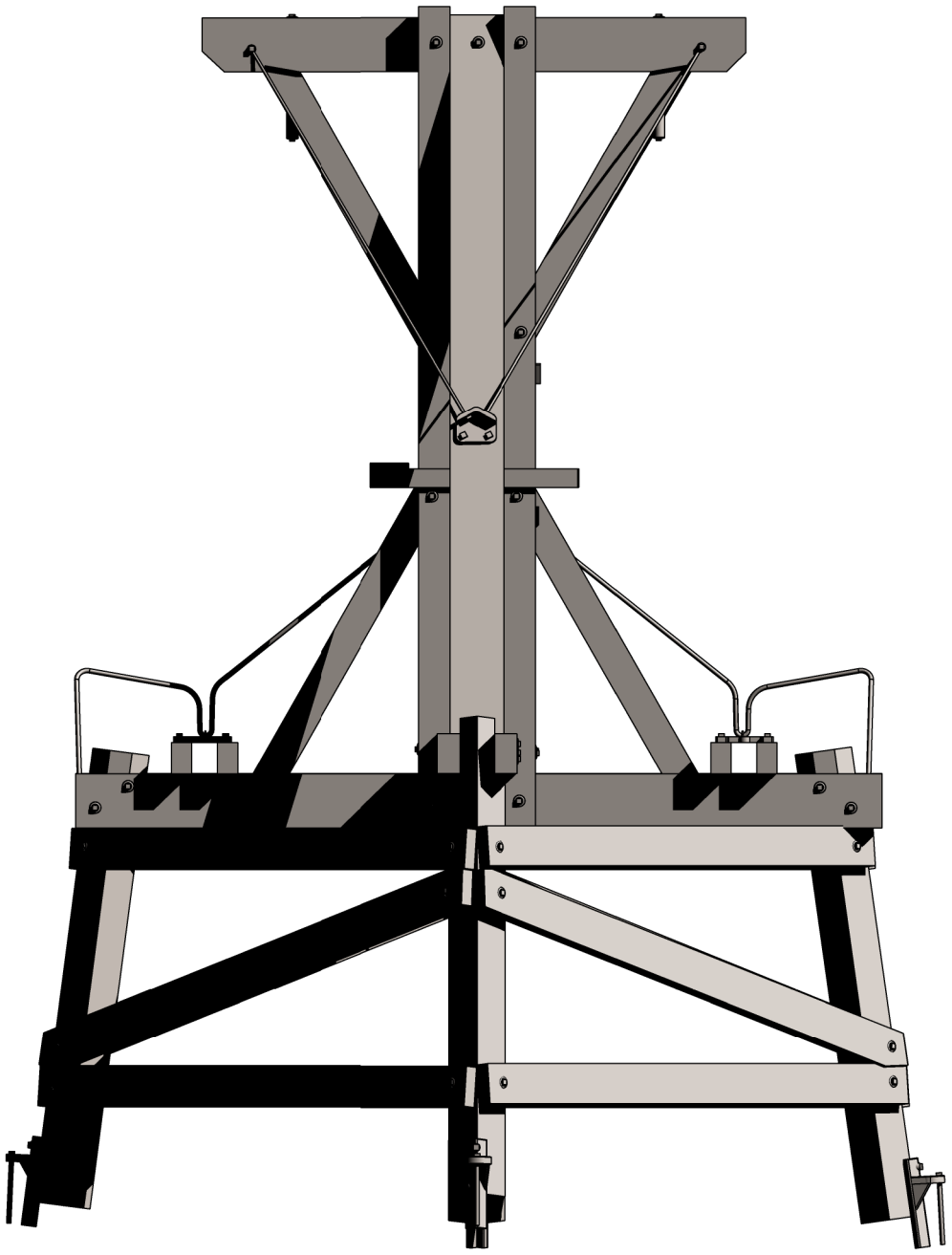
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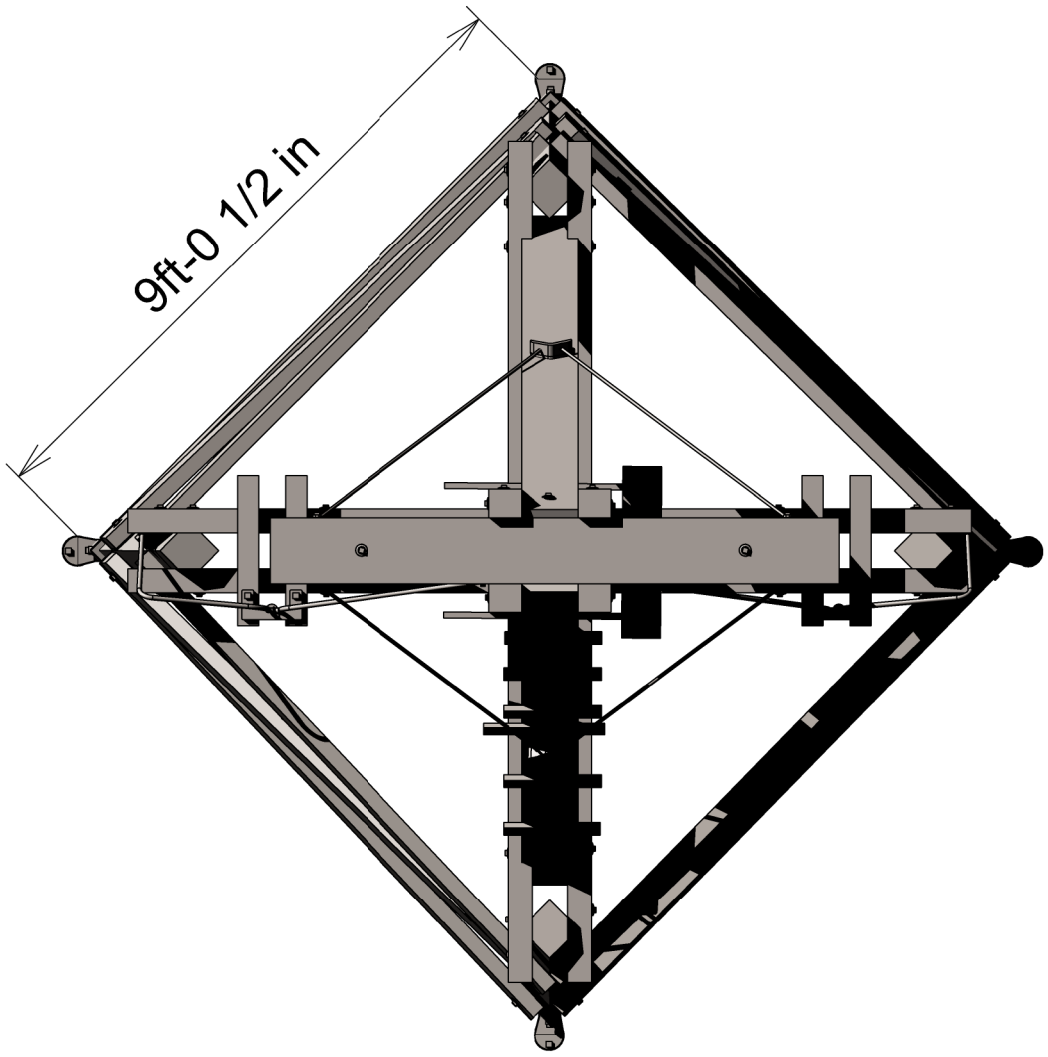
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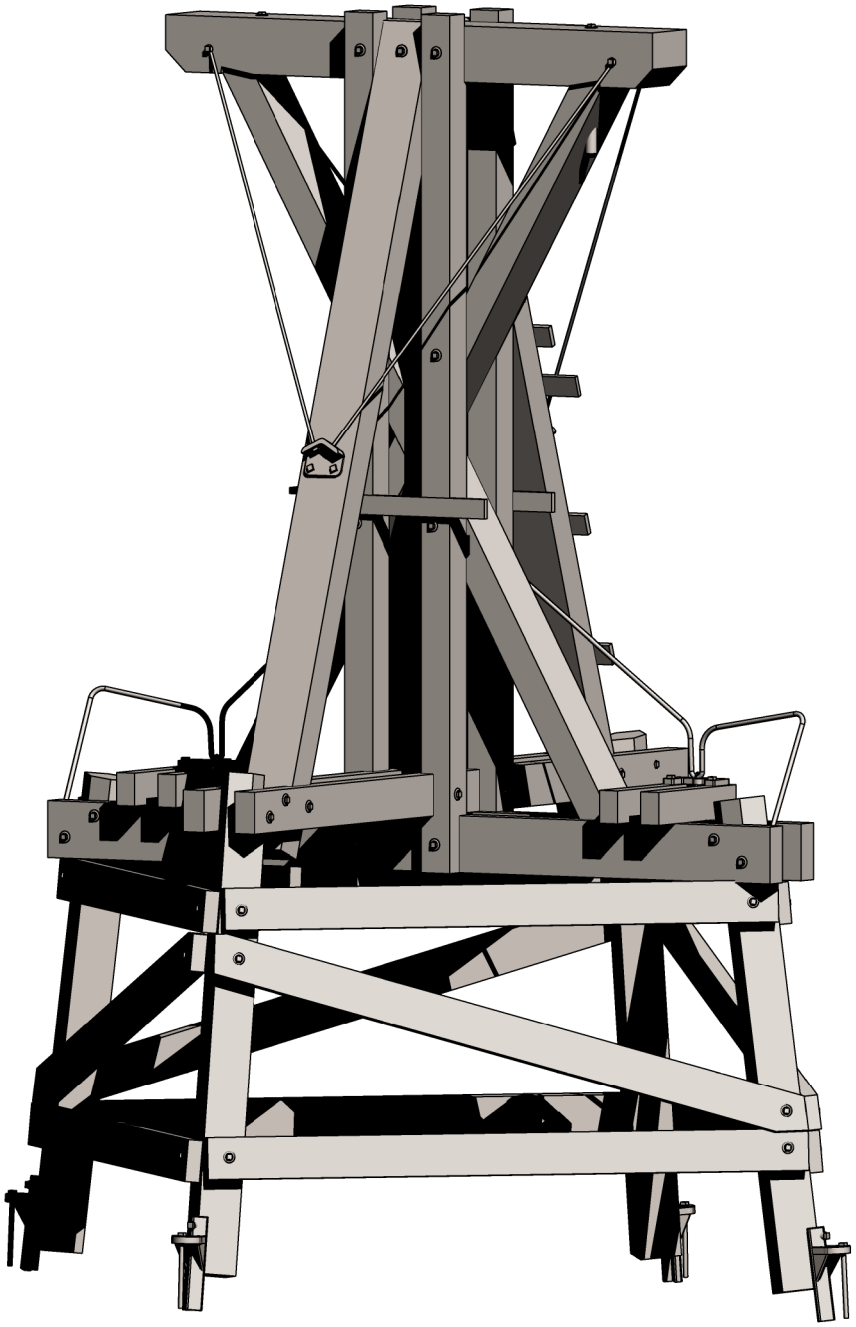
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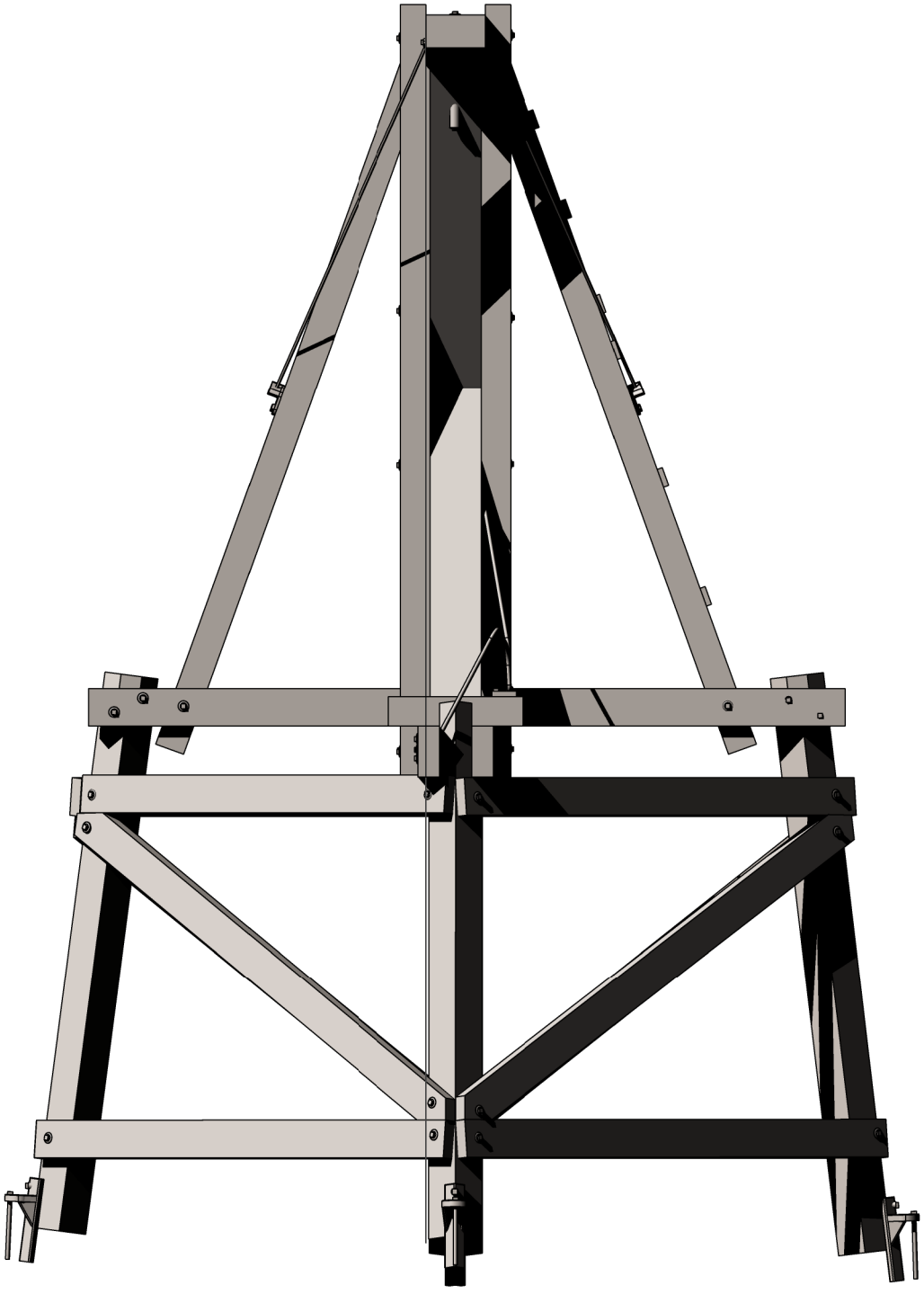
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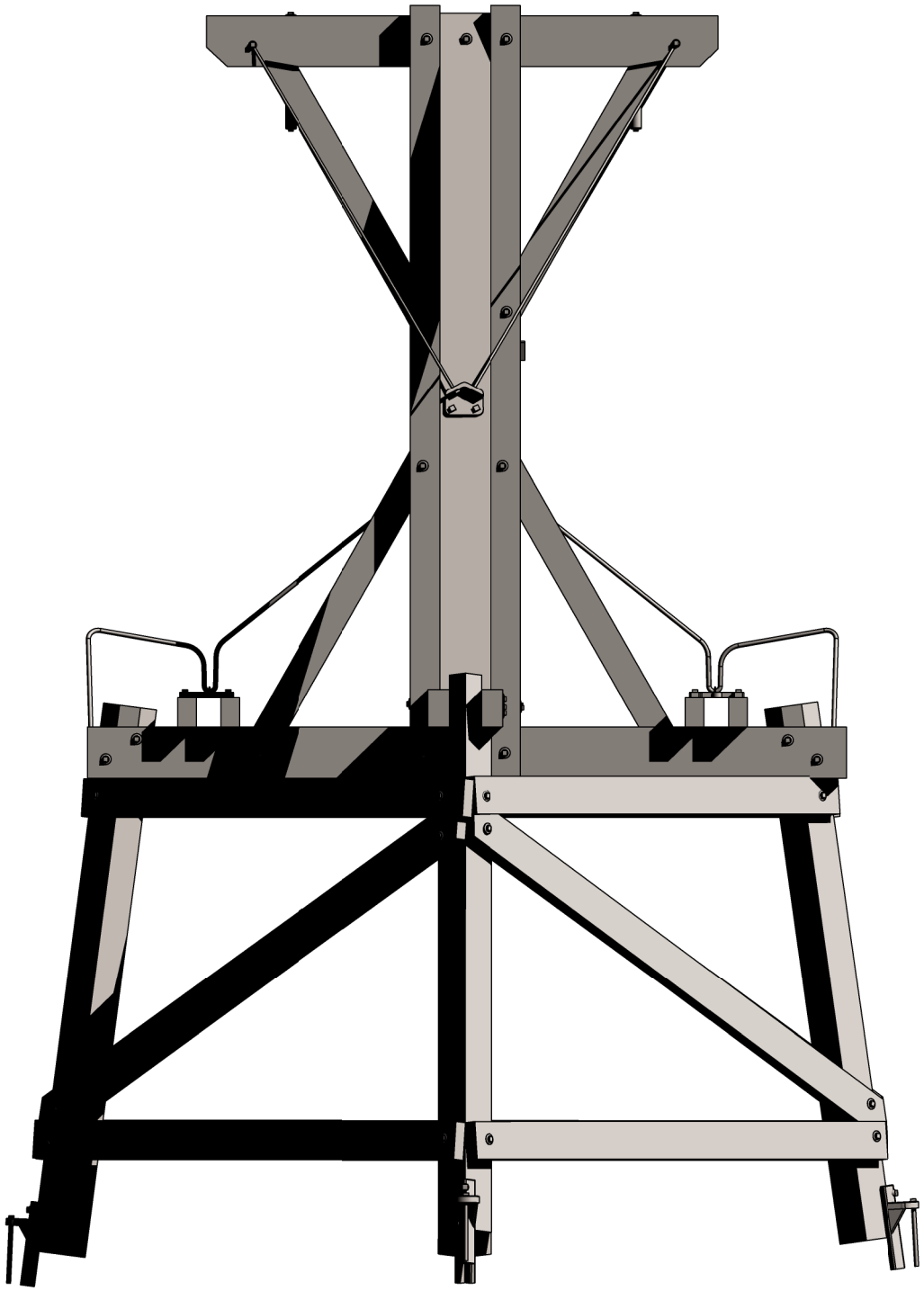
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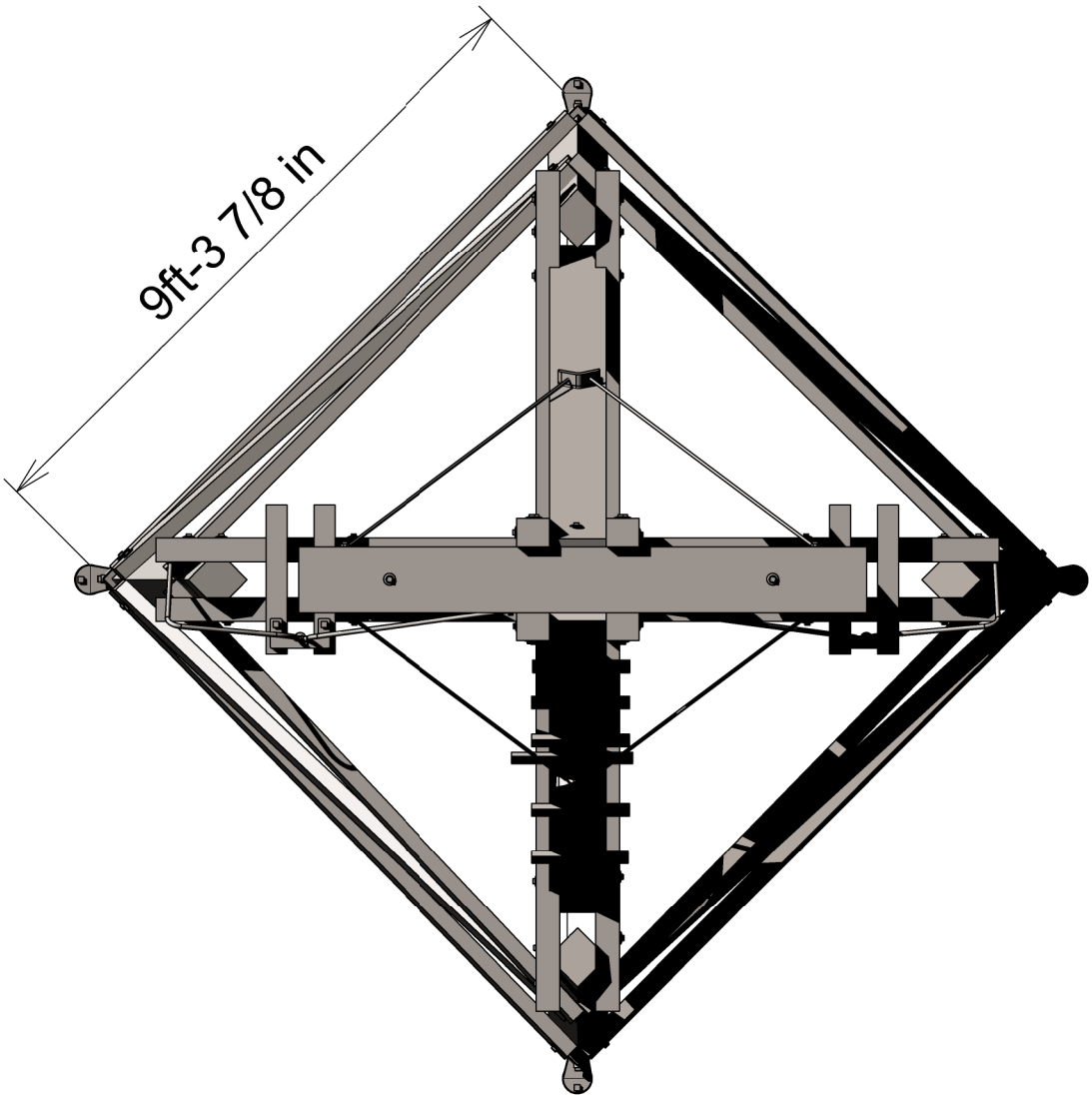
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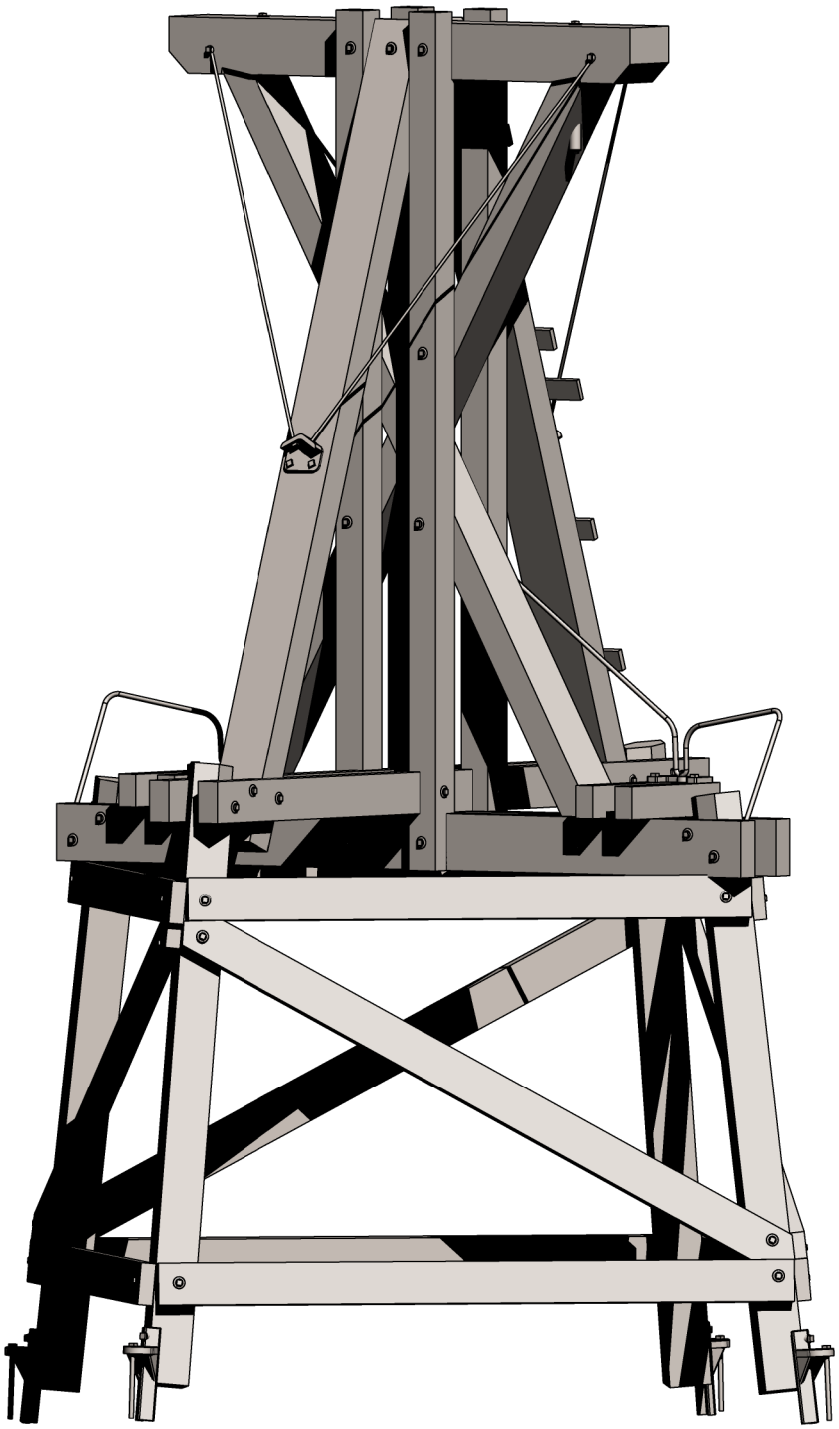
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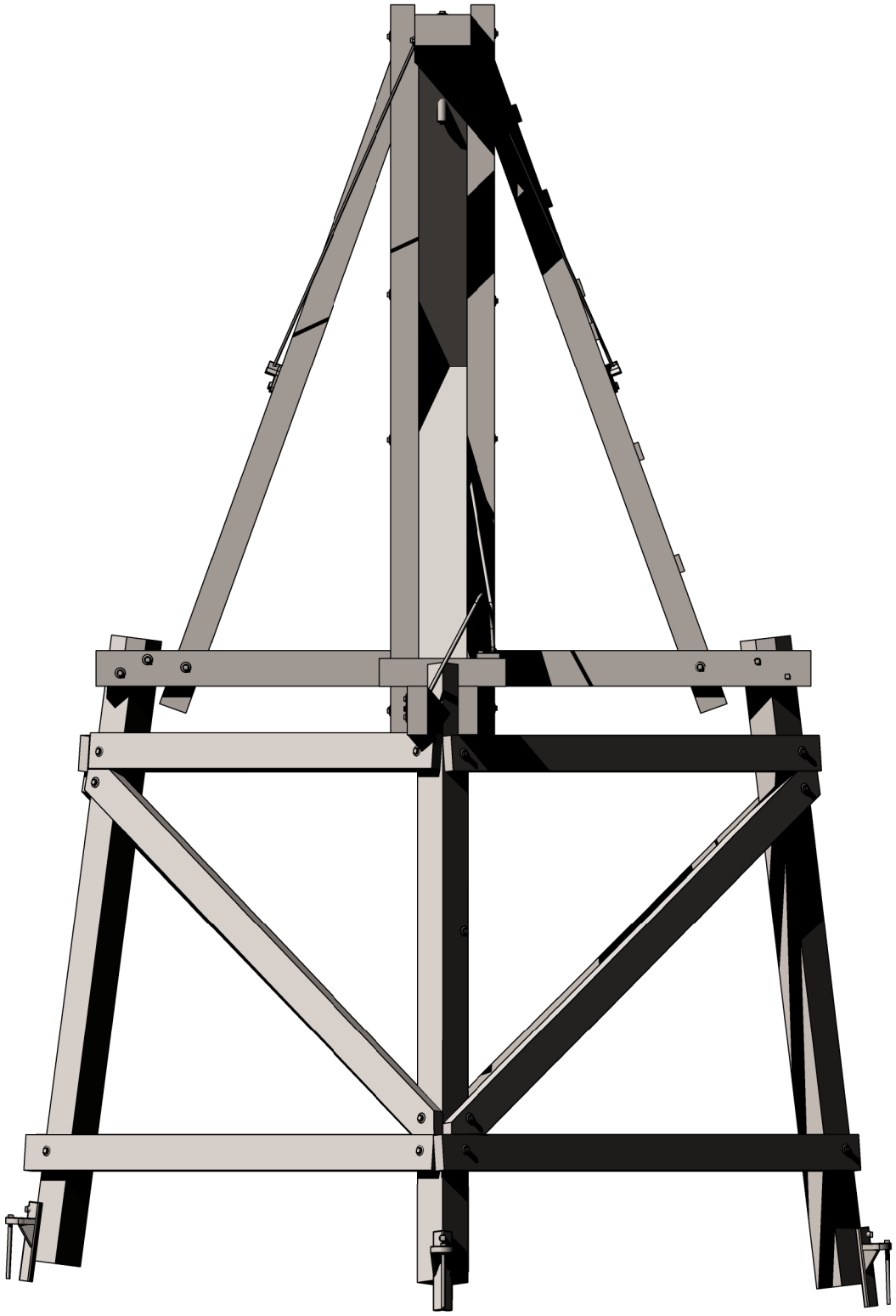
SVST TOWER 3	0 1' 2' 3' 5'	SCALE: 3/8" = 1'-0"	DRAWN BY: SCOTT ERNST	SOUTHWEST scanning



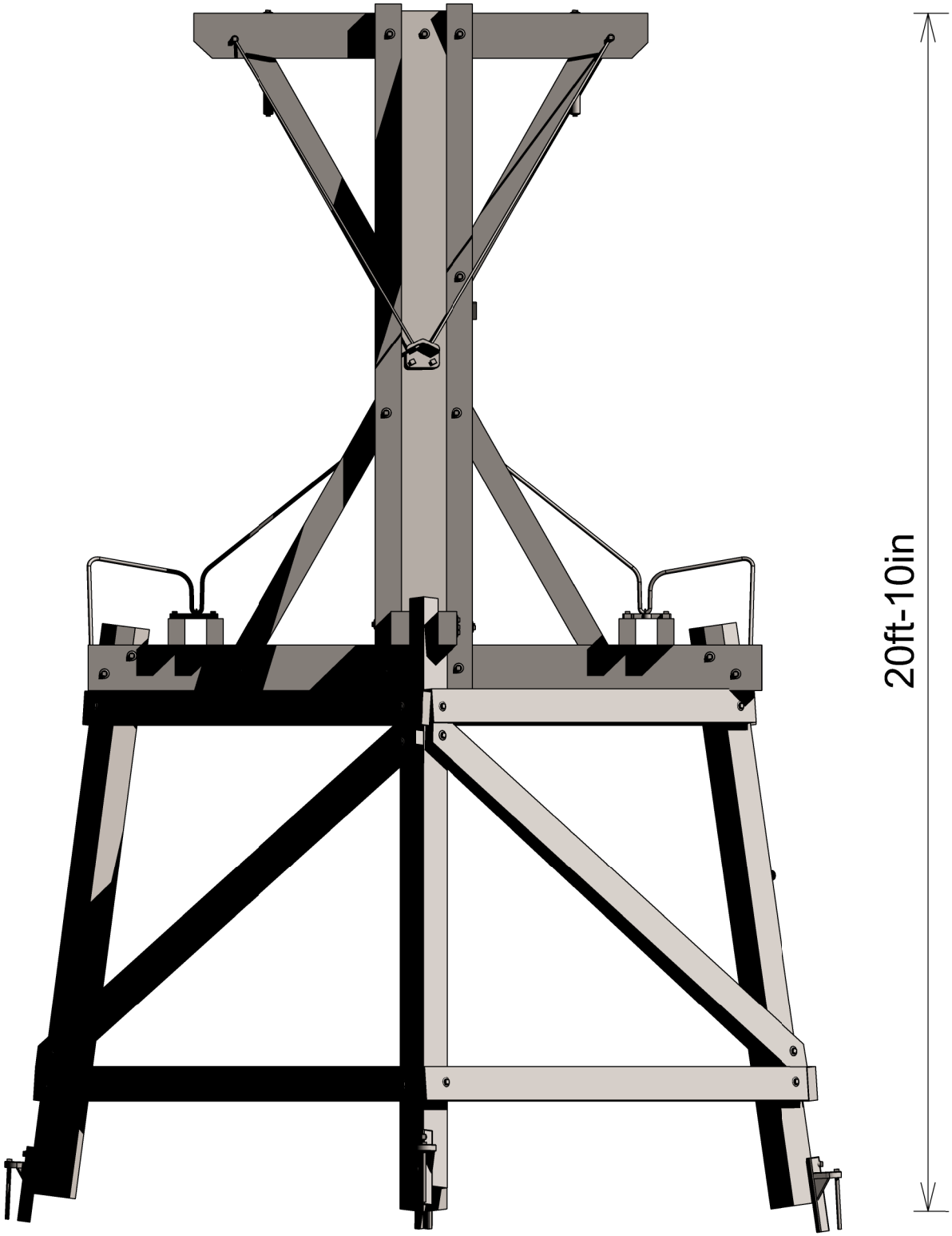
SVST TOWER 3	0 1' 2' 3' 5'	SCALE: 3/8" = 1'-0"	DRAWN BY: SCOTT ERNST	SOUTHWEST scanning



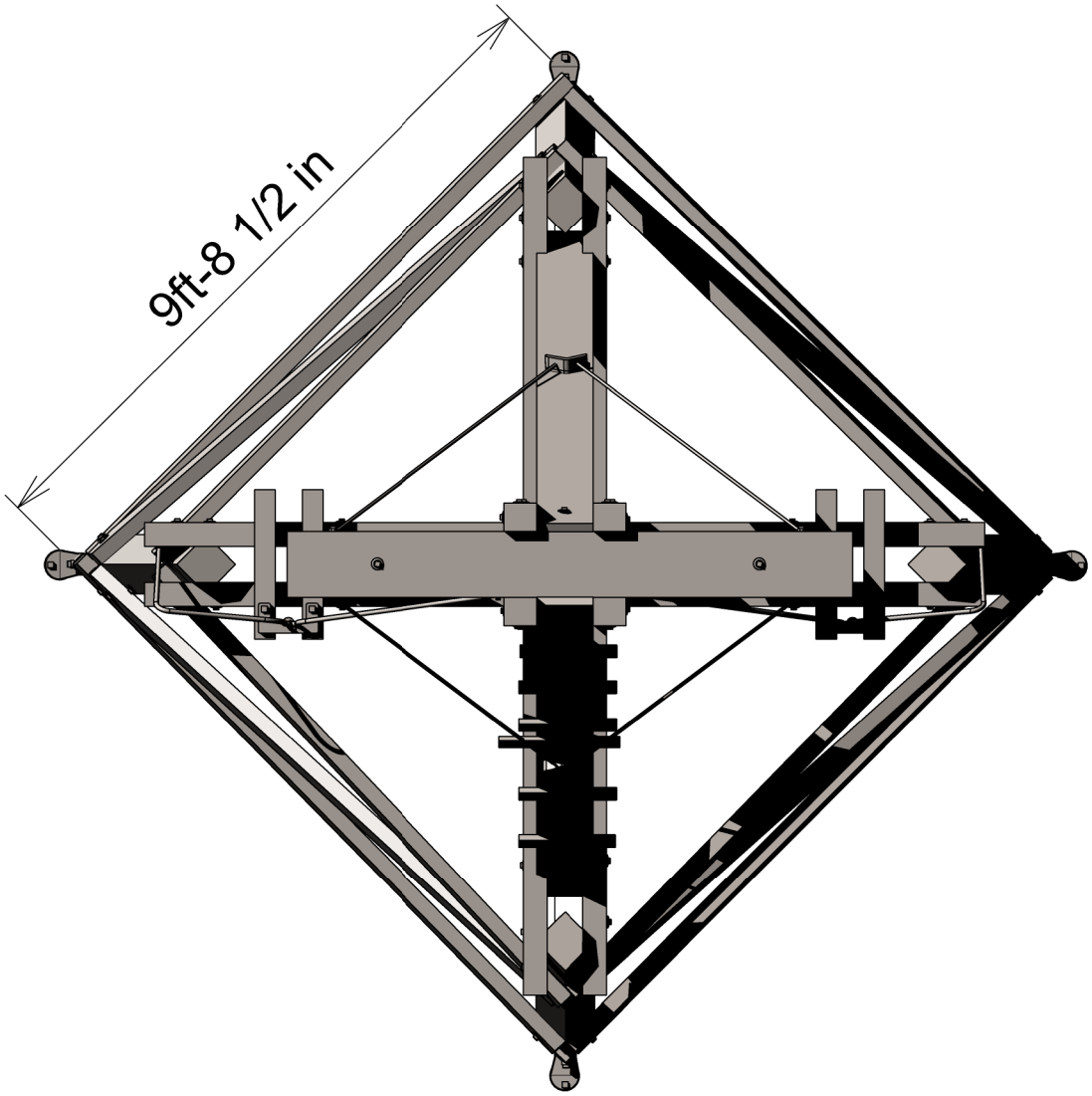
SVST TOWER 3	0 1' 2' 3' 5'	SCALE: 3/8" = 1'-0"	DRAWN BY: SCOTT ERNST	SOUTHWEST scanning



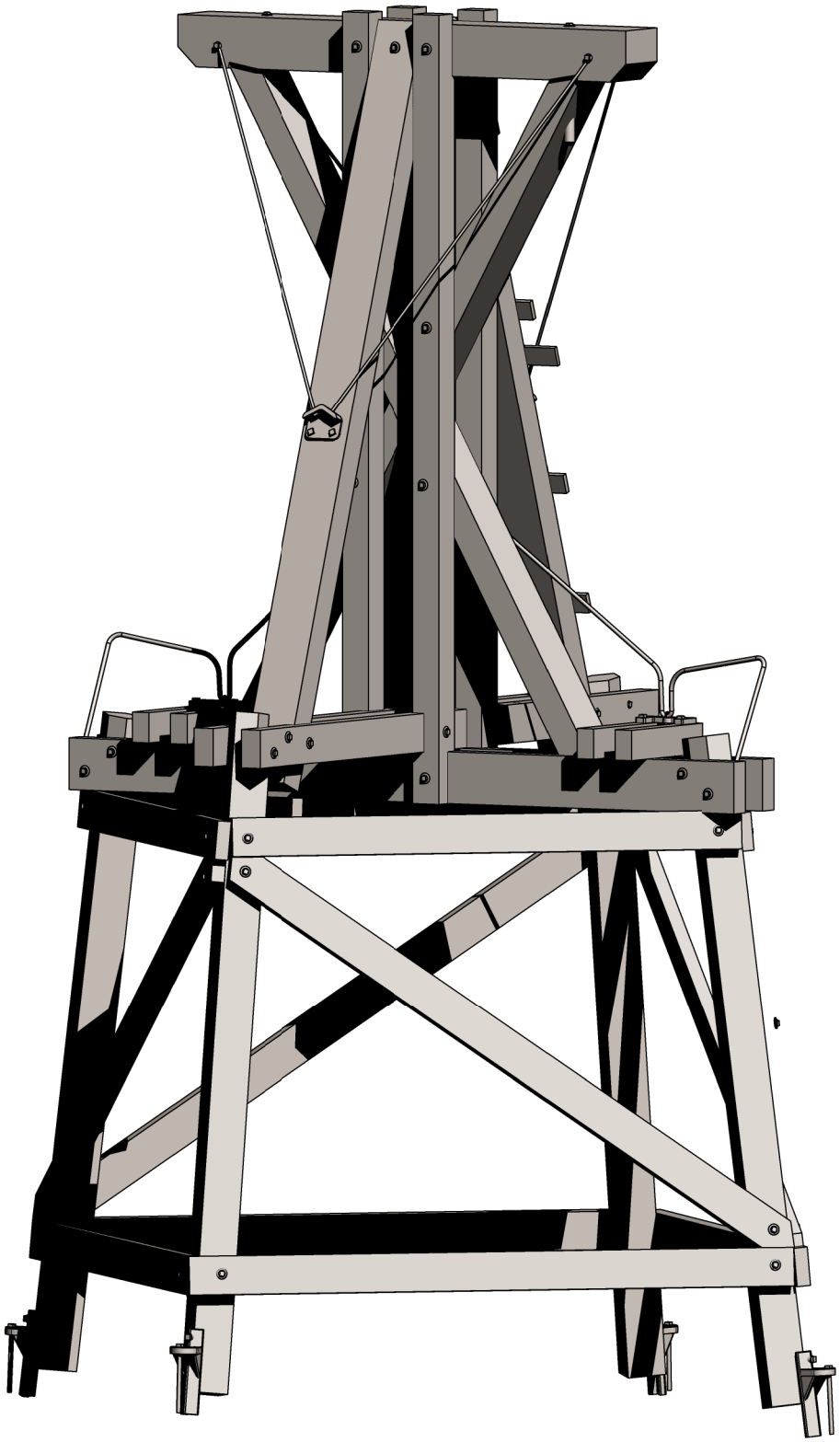
SVST TOWER 4	0 1' 2' 3' 5'	SCALE: 3/8" = 1'-0"	DRAWN BY: SCOTT ERNST	SOUTHWEST scanning



SVST TOWER 4	0 1' 2' 3' 5'	SCALE: 3/8" = 1'-0"	DRAWN BY: SCOTT ERNST	SOUTHWEST scanning



SVST TOWER 4	0 1' 2' 3' 5'	SCALE: 3/8" = 1'-0"	DRAWN BY: SCOTT ERNST	SOUTHWEST scanning



SVST TOWER 4

0 1' 2' 3' 5'

SCALE:
3/8" = 1'-0"

DRAWN BY:
SCOTT ERNST

SOUTHWEST scanning





As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. Administration.

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