1. NAME OF PROPERTY

Historic Name: California Powder Works Bridge

Other Name/Site Number: Powder Works Bridge; Paradise Park Bridge; Paradise Masonic Park Bridge

2. LOCATION

Street & Number: Spanning San Lorenzo River at Keystone Way, Paradise Park Not for publication:

City/Town: Santa Cruz Vicinity:

State: California County: Santa Cruz Code: 044 Zip Code: 95060

3. CLASSIFICATION

Ownership of Property		Category of Property	
Private:	X	Building(s):	__
Public-Local:	__	District:	__
Public-State:	__	Site:	__
Public-Federal:	__	Structure:	X
		Object:	__

Number of Resources within Property

Contributing	Noncontributing
__ buildings	__ buildings
__ sites	__ sites
1 structures	__ structures
__ objects	__ objects
1 Total	__ Total

Number of Contributing Resources Previously Listed in the National Register: 1

Name of Related Multiple Property Listing:

Draft

4. STATE/FEDERAL AGENCY CERTIFICATION

As the designated authority under the National Historic Preservation Act of 1966, as amended, I hereby certify that this ____ nomination ____ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property ____ meets ____ does not meet the National Register Criteria.

Signature of Certifying Official Date

State or Federal Agency and Bureau

In my opinion, the property ____ meets ____ does not meet the National Register criteria.

Signature of Commenting or Other Official Date

State or Federal Agency and Bureau

5. NATIONAL PARK SERVICE CERTIFICATION

I hereby certify that this property is:

___ Entered in the National Register
___ Determined eligible for the National Register
___ Determined not eligible for the National Register
___ Removed from the National Register
___ Other (explain)

Signature of Keeper Date of Action

6. FUNCTION OR USE

Historic: Transportation Sub: road-related (vehicular bridge)

Current: Transportation Sub: road-related (vehicular bridge)

7. DESCRIPTION

ARCHITECTURAL CLASSIFICATION: Other: Smith truss covered bridge

MATERIALS:
Foundation: wood and concrete
Walls: wood
Roof: metal
Other:

Describe Present and Historic Physical Appearance.

Powder Works Bridge is an outstanding example of nineteenth-century covered bridge construction. Built in 1872, the bridge is historically significant as an essential component of the California Powder Works, which was the first black powder mill on the West Coast. It is an excellent example of a Smith truss, a nationally-significant timber bridge type, of which only twenty-three historic examples survive. Powder Works Bridge is highly significant as the last remnant of Smith Bridge Company operations on the West Coast, which represent the last effort to market timber bridges on a national scale. Patented by Ohio native Robert W. Smith in 1867, the Smith truss had all diagonal truss web members; it was light, strong, and efficient; and for a short time, it allowed wood bridges to successfully compete with iron bridges as an industrial product. Powder Works Bridge is nationally significant under NHL Criterion 4, as a property that embodies the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style, or method of construction and NHL Theme VI, Expanding Science and Technology, under the area of Technological Applications. The bridge has been well-maintained and retains a high degree of historic integrity. The bridge was determined eligible for listing in the National Register of Historic Places in 1985 as part of the California Department of Transportation's "Historic Truss Bridges in California Thematic Survey." It was documented by the Historic American Engineering Record (HAER) in 2002 and 2011. Of the approximately 690 historic (pre-1955) covered bridges surviving in the United States, the Powder Works Bridge stands out as an excellent example of covered bridge construction and preservation.[1]

Setting

The Powder Works Bridge spans the San Lorenzo River in a picturesque natural and historical setting in the San Lorenzo Valley, approximately two miles north of the City of Santa Cruz, California. This portion of the valley was known as "Powder Mill Canyon" in the late-nineteenth century.[2] Surrounded by wooded hills, the property is within the city limits of Santa Cruz and abuts the Henry Cowell Redwoods State Park (est. 1954), which is known for its old-growth redwood groves. The San Lorenzo River, which rises in the Santa Cruz Mountains near Castle Rock State Park (est. 1968), runs twenty-nine miles in a southerly direction through Santa Cruz County on its way to Monterey Bay, where it empties into the Pacific Ocean. In the mid-nineteenth century, the San Lorenzo River was diverted for water power, and a crossing was established here in the 1860s by the California Powder Works, which occupied the site from 1861 to 1914. At its height, the 200-acre industrial site comprised more than seventy buildings, along with a village for the workers. After the powder mill operations moved to Hercules, California in 1914, the site was abandoned for a decade. Since 1924, the covered bridge has been an integral component of a private residential community owned by the Paradise Park Masonic Club. Some remnants of the former California Powder Works survive nearby. The covered bridge is still used for vehicular and pedestrian traffic.

Description

Powder Works Bridge is an impressive and well-maintained timber Smith through truss covered bridge.[3] Overall, the superstructure is 180 feet long (including the portal overhangs), 28 feet deep (including the roof), and 30 feet wide (including the roof overhangs), with a clear span length of 163'-0" and a roadway width of

[1] Approximately half of the 690 extant historic (pre-1955) covered bridges in the United States have been significantly altered, with much loss of historic fabric and character.

[2] "Powder Mill Canyon, *Santa Cruz Daily Surf*, 12 May 1893: 6.

[3] A through truss (sometimes called a high truss) is a bridge truss in which most of the structure is above the travel deck, with lateral bracing overhead, so that traffic passes through the structure.

19'-3". The Douglas fir trusses are fourteen panels long, each panel measuring approximately 11'-3" wide, except the two center panels, which are 8'-10" wide.

The top and bottom chords comprise four 6¼"x12" planks laid on edge and bolted together, with 4"x12"x12" shear blocks between them. Fishplates are bolted across the abutted ends of the lower chord sticks. The chords are connected by end posts (paired 7"x8" verticals) and three planes of diagonal web members along the length of the span. Robert Smith intended this triple-web arrangement, generally recognized today as a Type 4 Smith truss, for spans over 150 feet in length.[4] Tension members angle down toward the center of the span and alternate between single and double members; sizes decrease toward center span from single 8"x12" to single 8"x7" and double 7"x10" to double 7"x7". Compression members angle up toward the center of the span and alternate between single and double members; sizes decrease toward center span from double 7"x10" to double 7"x7" and single 8"x10" to single 8"x8". The posts and braces are bolted together at each intersection with ¾" diameter threaded rods fastened with nuts. The tension members are notched and bolted where they pass through the chords. The ends of the braces are butted against the bottoms and tops of the posts, where they are secured with a bolt and nut. There are iron tension rods running parallel to the inclined posts; the diameter of the rods varies from 5/8" to 1¾", with no discernible pattern (¾" or 1" rods are typical). Each rod passes through the upper and lower chords and is fastened on the outer end with a plate and nut. Cast iron shoes secure the lower ends of the last pairs of compression diagonals at each end of the truss.

The floor system (much of which was replaced in 1968) includes paired transverse 3"x12" wood floor beams, laid on edge and spaced approximately 20" apart on top of the lower chords. 3"x12" flooring is laid diagonally on the floor beams, with running boards laid longitudinally on top. There is a walkway inside the bridge on the north side of the roadway. In addition to pedestrians and wagons, the bridge originally carried horse-drawn freight cars on a narrow-gauge railroad track; the freight cars were used to carry loads of wood and charcoal between the charcoal kilns on the east side of the river and the powder works on the west side of the river. The railroad tracks were removed shortly after the California Powder Works closed in 1914.

The bridge is braced laterally between both the upper chords and the lower chords. In both cases, the bracing consists of 6"x6" sticks crossing at each panel; the sticks are notched together and fastened to the chords with bolts and cast iron brackets. There are sway braces and 8"x8" tie beams at the portals.

The bridge is supported on cast-in-place concrete abutments. The lower chords at the west end of the bridge rest on a short timber bent on top of the abutment. The lower chords at the east end of the bridge rest on a bed timber on top of the abutment. There is a ten-foot high timber bent on a concrete foundation approximately ten feet in front of the east abutment; another ten-foot high timber bent is supported on concrete cylinder piers approximately twenty-five feet east of center span.

The bridge's gable roof is covered with corrugated metal. The metal covering is fastened to several lines of 2"x3" purlins that run longitudinally on top of 2"x4" rafters spaced at approximately two feet on center. The outer ends of the rafters are supported on the upper chords.

The exterior of the bridge is covered with board-and-batten siding to the eaves. The siding is painted white and fastened to 2½"x6½" nailers on the outer faces of the trusses. There are three 2'-6" square windows on each side of the bridge; these were added sometime prior to 1963. The portals bow forward over the approaches by approximately eight feet. The approaches are flanked by white-washed board fences.

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[4] Robert W. Smith, United States Letters Patent No. 66,900, 16 July 1867. See pages 10-11 of this nomination for additional information on Smith truss variations.

The bridge is still used by vehicles and pedestrians, and is currently rated for five tons. Warning signs, height restriction bars, and flashing traffic lights have been installed at both ends of the bridge. A sprinkler system runs the length of the bridge and electric light fixtures are installed inside the bridge and above the portals.

Integrity

The Powder Works Bridge clearly illustrates the character-defining features of the resource type. It retains an uncommonly high level of integrity in location, setting, design, materials, workmanship, feeling, and association.

The Powder Works Bridge is one of the best surviving examples of a Smith truss covered bridge in the United States. The trusses, which are original, exhibit the distinctive features of this truss type, as set forth in the 1867 Smith patent. As was customary for Smith truss bridges, the superstructure was fabricated at a distant site (in this case, the Pacific Bridge Company plant in Alameda, California), shipped to the location by rail, and erected on-site under the supervision of a Smith Company representative. Due to its sturdy construction and low-volume traffic usage, the bridge has required few structural modifications since its construction, and the vast majority of the superstructure is original. The siding, roof, and deck have been replaced periodically as part of routine maintenance, but the essential load-bearing components of the structure are still intact. Originally, the single-span structure was supported by timber pile bents at each end, which were likely chosen for economic reasons.[5] The bridge was reportedly later reinforced with additional timber bents to provide support at the lower chords; at least some of these bents washed away in a flood in 1882.[6] Sometime after 1924, the deteriorated timber supports at each end were replaced with cast-in-place concrete abutments.[7] The NHL registration requirements discussed in the associated document, *Covered Bridges NHL Context Study* (2012), stipulate that abutments and piers "should be largely intact or minimally altered," but timber abutments are a special case and were likely considered to have been an impermanent element at the time of construction. The railroad tracks were removed from the bridge deck during World War I. The bridge's original wood shingle roof was replaced in the twentieth century with corrugated metal. Windows were added to both sides of the bridge and electric light fixtures were installed sometime prior to 1963.[8] A sprinkler system was installed in 1972.[9]

The structure is uniquely suited to its site. In particular, the bridge's location was dictated by the site's topography and the structure's robust construction was necessitated by the fact that it was part of an industrial site. Although the California Powder Works ceased operations at this site in 1914, only a decade lapsed before the covered bridge was put to use again, as an integral part of a summer cottage colony. The Powder Works Bridge retains the feeling of a nineteenth-century covered bridge built for horse-drawn wagons and freight cars. Most of the powder works complex structures were removed after 1914, but scattered remnants of the complex survive. The bridge and its picturesque setting possess a high level of aesthetic and historic integrity that convey a sense of the property's history, first as a black powder manufactory, then as a summer cottage colony turned year-round residential community. The bridge is still used by vehicles and pedestrians. The structure is privately maintained as a working bridge and an historic landmark.

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[5] "California Powder Works Bridge," *The Santa Cruz Sentinel*, 4 May 1872: 3.
[6] Joan S. Hamblin, "California's Covered Bridges," *Highway Patrolman* (October 1982): 46.
[7] Jeanne Baker, *An Undercover Story: Covered Bridges of California* (Chapel Hill, North Carolina: The Chapel Hill Press, Inc., 2000): 10.
[8] Kramer Adams, *Covered Bridges of the West: A History and Illustrated Guide* (Berkeley: Howell-North, 1963): 136.
[9] Baker, 10.

8. STATEMENT OF SIGNIFICANCE

Certifying official has considered the significance of this property in relation to other properties:
Nationally: X Statewide: __ Locally: __

Applicable National Register Criteria:	A X B__ C X D__
Criteria Considerations (Exceptions):	A__ B__ C__ D__ E__ F__ G__
NHL Criteria:	4
NHL Theme(s):	V. Developing the American Economy 3. Transportation and Communications VI. Expanding Science and Technology 2. Technological Applications
Areas of Significance:	Transportation Engineering
Period(s) of Significance:	1872
Significant Dates:	1872
Significant Person(s):	N/A
Cultural Affiliation:	N/A
Architect/Builder:	Pacific Bridge Company, Oakland, California
Historic Contexts:	*Covered Bridges NHL Context Study* XVII. Technology (Engineering and Innovation) B. Transportation

State Significance of Property, and Justify Criteria, Criteria Considerations, and Areas and Periods of Significance Noted Above.

Powder Works Bridge is an outstanding example of nineteenth-century covered bridge construction. Built in 1872, the bridge is historically significant as an essential component of the California Powder Works, which was the first black powder mill on the West Coast. It is an excellent example of a Smith truss, a nationally-significant timber bridge type, of which only twenty-three historic examples survive. Powder Works Bridge is highly significant as the last remnant of Smith Bridge Company operations on the West Coast, which represent the last effort to market timber bridges on a national scale. Patented by Ohio native Robert W. Smith in 1867, the Smith truss had all diagonal truss web members; it was light, strong, and efficient; and for a short time, it allowed wood bridges to successfully compete with iron bridges as an industrial product. Powder Works Bridge is nationally significant under NHL Criterion 4, as a property that embodies the distinguishing characteristics of an architectural type specimen exceptionally valuable for a study of a period, style, or method of construction and NHL Theme VI, Expanding Science and Technology, under the area of Technological Applications. The bridge has been well-maintained and retains a high degree of historic integrity. The bridge was determined eligible for listing in the National Register of Historic Places in 1985 as part of the California Department of Transportation's "Historic Truss Bridges in California Thematic Survey." It was documented by the Historic American Engineering Record (HAER) in 2002 and 2011. Of the approximately 690 historic (pre-1955) covered bridges surviving in the United States, the Powder Works Bridge stands out as an excellent example of covered bridge construction and preservation.

A discussion of the national significance of the Powder Works Bridge is provided in the associated document, *Covered Bridges NHL Context Study*. The study establishes the history and evolution of the property type, and provides a preliminary assessment of the National Historic Landmark (NHL) eligibility of covered bridges that are considered by experts in the field to be the best representative examples of the surviving 690 historic (pre-1955) covered timber bridges in the United States. These properties were selected from the National Covered Bridges Recording Project (NCBRP), undertaken in 2002-2005 by the Historic American Engineering Record (HAER), which is administered by the Heritage Documentation Programs (HDP) Division of the National Park Service, United States Department of the Interior. The project was funded by the Federal Highway Administration's (FHWA) National Historic Covered Bridge Preservation Program (NHCBP), established in 2000 by Section 1224 of the Transportation Equity Act for the 21st Century (TEA21). Over the course of a multi-year project, HAER recorded 75 covered bridges throughout the United States. In 2010, each of these bridges was individually evaluated against National Historic Landmark criteria and a list compiled of twenty covered bridges that have high integrity and are significant as outstanding representative examples of their type, period, and method of construction. Secondary considerations for inclusion in this list were: historical significance, significance of the designer or builder, and aesthetics of the bridge and site.

Covered Bridges in the United States

Covered bridges are pre-eminently—although not exclusively—an American phenomenon. Nowhere else in the world were such impressive timber structures attempted, and nowhere else were they built in such large numbers.[10] Over the course of two centuries, covered bridges have played a significant role in American life, by facilitating settlement, transportation, and commerce. They also represent a period of remarkable achievement in civil engineering, during which bridge building evolved from an empirical craft to a science. At

[10] According to the 7th edition of the *World Guide to Covered Bridges* (2009), there are approximately 1,500 extant historic (pre-1955) covered bridges in the world. More than half of these structures are located in North America. American scholars have recently become aware of large numbers of ancient covered bridges in China, but most were built for pedestrian traffic, and their construction techniques and reason for covering differ from the Western tradition.

the height of covered bridge building, around 1870, there were well over 10,000 covered bridges in the United States.[11]

Timber bridges have been built in forested regions of the world for centuries.[12] Wood is an excellent material for building; it is strong, yet relatively lightweight and easy to work with. Since most species of wood suitable for structural applications deteriorate rapidly when exposed to the weather, European bridge builders quickly learned the value of covering wood bridges with roofs and siding to protect the underlying framework.[13]

Bridges were rare in Colonial America. Small streams were spanned with simple wood beams or stone slabs, and occasionally with stone arches, but with few exceptions, larger waterways had to be crossed by ford or ferry. Travel was hazardous and uncertain; delays and accidents were common. A few ambitious crossings were made with pontoons or a series of simple beam spans supported on timber piles, but long-span bridges were generally not built in America until the volume of transportation justified the expenditure of material and labor.[14] Following the American Revolutionary War, the demand for roads and bridges, coupled with access to abundant forests, spurred the development of timber bridge design in the United States.

Internal improvements were a priority of the new nation. Roads, canals and bridges were desperately needed to expand commerce and unite the country. The Louisiana Purchase of 1803 doubled the land area of the United States and over the next half-century, settlement expanded west to the Pacific Ocean. Timber bridges were an ideal solution to America's many transportation hurdles and settlers built hundreds of them as they moved westward across the continent. They provided for safe, efficient and economical overland transportation that was essential to the new nation's growth.

In 1804-05, Timothy Palmer (1751-1821) built America's first covered bridge across the Schuylkill River at Philadelphia. By 1810, covered bridges were common in southern New England, southeastern New York, Pennsylvania and New Jersey. From this core area, covered bridges spread northward, southward and westward. In the 1820s, town and county governments began to specify covered bridges for construction on local roads. By 1830, covered bridges were commonplace at major river crossings in the eastern United States. The builders of timber bridges utilized readily available materials and common hand tools. Making use of patented truss designs, carpenters with basic woodworking ability could erect an average-sized covered bridge in a short time, usually within a few weeks.

Covered bridges were adapted to the needs of every type of transportation corridor, including turnpikes, canals and railroads and they facilitated the settlement of the United States for over a century. The rapid growth of the railroads in the mid-1800s—in particular, the increasing weight of locomotives and rolling stock—encouraged innovations and technical advancements in the design of timber truss bridges and was an important factor in the rise of civil engineering as a profession. All the major technological improvements in American truss bridge design occurred when wood was the building material of choice.

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[11] This is only a rough estimate of known covered bridges that existed c.1870. Initial data compiled by the "Covered Spans of Yesteryear Project," http://www.lostbridges.org, suggests that this figure may be too low.

[12] In 55 BC, Julius Caesar (100 BC-44 BC) built the earliest known timber bridge across the Rhine River.

[13] Several European covered bridges have survived for more than three centuries, while a few in the United States are nearing the two-century mark.

[14] The Great Bridge (1660) across the Charles River at Boston and the York River Bridge (1761) at York, Maine, were notable exceptions. The Great Bridge consisted of "*cribs of logs filled with stone and sunk in the river—hewn timber being laid across it.*" The York River Bridge was a timber pile bridge, which uses tree trunks or piles driven vertically into the river bed to provide a foundation for a series of simple beam spans.

By 1850, there were covered bridges in most settled regions of the United States.[15] The golden era of covered bridge building lasted for about a century in most areas of the United States, and even longer in areas where timber was plentiful.[16]

Robert W. Smith and the Smith Truss

Following the Civil War, covered wood bridges were still economical, except for very long spans, and there were still opportunities for innovative timber bridge builders to remain competitive, especially in regions where timber was readily available.[17] The surest route to reducing the cost of any construction is to minimize the quantity of materials that goes into it, and many timber bridges were overbuilt for the loads they carried. By employing the methods of mathematical stress analysis described by engineer Squire Whipple (1804-1888) in his 1847 publication, *An Essay on Bridge Building*, builders could proportion structural members in the most efficient manner possible, and in doing so, cut costs.[18] From the 1860s onwards, several inventors addressed this challenge and used the new science to build timber bridges less expensively so they could compete with iron bridge manufacturers.

Robert W. Smith (1833-1898) of Miami County, Ohio was one of the most successful of post-Civil War covered bridge builders and the inventor of the highly successful Smith truss. Growing up in rural Ohio, Smith was home-schooled by his mother and learned woodworking skills from his father, who was a cabinetmaker. As a young man, he apprenticed with a local carpenter and later ran a woodworking shop and lumberyard with his brother William (d.1864). Eventually, Robert Smith's attention turned to the construction of bridges. In 1867, Smith patented a bridge truss that for a short time, allowed wood bridges to successfully compete with iron bridges. The Smith truss, which featured parallel chords connected by a series of diagonal posts and braces, was light, strong, and efficient.[19] It resembled a multiple kingpost truss, but with the tension members slanting up and away from the center of the span and compression members slanting in the opposing direction. Smith subsequently made several modifications to his design, but all Smith truss bridges followed the same general truss layout, with one, two, or three web planes, depending upon the length of the span. Single-web trusses were used for spans of 50 feet or less; double-web trusses were typically used for spans between 50 and 150 feet; and triple-web trusses were typically used for spans over 150 feet in length.

In 1867, Robert W. Smith and several associates organized the Smith Bridge Company at Toledo, Ohio.[20] That year, the company built five bridges; in 1868, they built twenty-two bridges; and in 1869, they built seventy-five bridges.[21] In some cases, the company sold plans and patent rights to clients, but their specialty was cutting and milling bridge timbers at their plant and shipping bridge kits to distant sites, where they could be erected under the supervision of a company agent or foreman. Smith truss bridges were built throughout the Midwest, primarily Ohio and Indiana, but the Smith Bridge Company also had agents on the West Coast, which was the last effort to market timber bridges on a national scale.[22] The Smith Bridge Company was responsible for the erection of hundreds of covered wood bridges during the 1870s, and it successfully made the transition to the

[15] Fred Kniffen, "The American Covered Bridge," *The Geographic Review* 41 (1951): 119.

[16] Covered bridge building ended in New England and the Midwest around 1925, and in the South around 1935. Covered bridges continued to be built in Oregon into the 1950s.

[17] Some areas of the Midwest still had a reasonable supply of local timber, while others imported it from timber-rich regions of the country. In some places, like Pennsylvania or the Midwest, a strong local tradition and/or the presence of a prominent bridge builder, kept covered bridge building competitive into the late-19th or early-20th century.

[18] Squire Whipple, *An Essay on Bridge Building* (Utica, NY: by author, 1847).

[19] Robert W. Smith, United States Letters Patent No. 66,900, 16 July 1867.

[20] Clark Waggoner, ed., *A History of the City of Toledo and Lucas County, Ohio, Illustrated* (Toledo and New York: Munsell, 1888): 786.

[21] Ibid.

[22] Joseph D. Conwill, correspondence with author, 5 July 2013.

manufacture of iron truss bridges in the 1880s.[23] Gradually, competition increased from companies manufacturing iron bridges. The cost-effectiveness of iron led to the eventual abandonment of the Smith truss design in the late-nineteenth century. In 1890, the Smith Bridge Company ceased operations and the plant was sold to the newly-formed Toledo Bridge Company. The Toledo Bridge Company continued operations until 1901, when it became part of the American Bridge Company, which was one of the most prolific bridge builders of the twentieth century, and is still in operation today.

By the early twentieth century, the Smith truss had been largely forgotten, and covered bridge enthusiasts frequently misidentified Smith trusses as more common truss types.[24] In the mid-twentieth century, covered bridge scholars identified many Smith truss bridges through primary historical research conducted during the 1940s and 1950s.[25] In 1967, industrial engineer and covered bridge enthusiast Raymond E. Wilson (1892-1975) of Swarthmore, Pennsylvania established a classification of Smith truss variations, based on the number and configuration of the web members in thirty-three examples identified to that date; this taxonomy is generally still in use today.[26] By 1972, when the National Society for the Preservation of Covered Bridges published the third edition of the *World Guide to Covered Bridges*, nearly all of the Smith truss bridges surviving in the United States had been identified.[27] Today, there are twenty-four known extant (twenty-three historic and one modern) Smith truss covered bridges in the nation. These are listed in order of span length in the following chart.[28]

NR	BRIDGE	STATE	COUNTY	DATE	BUILDER	SPAN	TRUSS WEB	TYPE	REHAB	OPEN	INTEGRITY
	FEEDWIRE ROAD	OH	MONTGOMERY	1870	SMITH BRIDGE CO.	42'	SINGLE		1948		MOVED 1948
	JASPER ROAD	OH	MONTGOMERY	1869	SMITH BRIDGE CO.	50'	SINGLE		1964		MOVED 1964
X	BUCKEYE FURNACE	OH	JACKSON	1871	DENCY, McCURDY & CO.	59'	DOUBLE	3	1999		MOVED 2011
X	BYER	OH	JACKSON	1872	T.C. DENCY	74'	DOUBLE	3	2004		ALTERED
X	JOHNSON ROAD	OH	JACKSON	1870	J.G. STENGELL	78'	DOUBLE	2	2000	X	ALTERED
	RUFFNER	OH	PERRY	1875	WILLIAM BLACK	78'	DOUBLE	3	1986		MOVED 1986

[23] The Smith Bridge Company built timber bridges of other types, including two extant Howe truss covered bridges in Indiana. They also built metal truss bridges throughout the Midwest; a few examples survive in Kentucky, Ohio, and Indiana.

[24] Twentieth-century sources misidentified Powder Works Bridge as a Warren truss until the early 1970s.

[25] Indiana historian Eugene R. Bock identified ten Smith truss bridges in Indiana in 1949. [Eugene R. Bock, "Indiana Bridge Trusses Worthy of Study," *Indiana Covered Bridge Topics* 5, no. 1 (December 1949): 3.] A decade later, Richard Sanders Allen discussed the Kidd's Mill Bridge in Mercer County, Pennsylvania, in *Covered Bridges of the Middle Atlantic States*, stating that the Smith truss was still little-known at that time. [Richard Sanders Allen, *Covered Bridges of the Middle Atlantic States* (Brattleboro, Vermont: Stephen Greene Press, 1959: 74.] Allen's subsequent book, *Covered Bridges of the Midwest* (1970) contains a thorough discussion of Robert W. Smith and the Smith truss, and lists twenty-three Smith truss bridges in the index. [Allen, *Covered Bridges of the Midwest* (Brattleboro, Vermont: Stephen Greene Press, 1970: 20-23.]

[26] Raymond E. Wilson, "The Story of the Smith Truss," *Covered Bridge Topics* 25, no. 1 (April 1967): 3-5. Eleven bridges in Wilson's list have since been lost, and three bridges were later determined to be other truss types; additionally, the list did not include five bridges that were subsequently identified as Smith trusses: Feedwire Road, Jasper Road, Ruffner, Locust Creek, and Powder Works. According to Wilson's classification system: Type 1 follows the drawing shown in the 1867 patent, with opposing diagonals crossing in the center panel; Type 2 follows the drawing shown in the 1869 patent, with opposing diagonals meeting in the center panel; Type 3 is similar to Type 2 but with extra braces in the center panel; Type 4 has double inclined posts and single braces the full length of the truss. Wilson's taxonomy is still in use today; however, it is considered by some scholars to be overly simplistic, primarily because it fails to account for a primary innovation addressed in Smith's first patent: increasing the number of web planes as span length is increased. [Matthew Reckard, "Robert Smith's Trusses," Second National Covered Bridges Conference, Dayton, Ohio, June 5-9, 2013.] Both Wilson's types and the number of truss web planes are noted in the Smith truss chart prepared for this nomination.

[27] The 1972 edition of the *World Guide to Covered Bridges* lists twenty-nine Smith truss covered bridges, although one is not historic and two were later re-identified as Brown trusses. [Oscar F. Lane, editor, *World Guide to Covered Bridges*, 3rd edition (Boston: National Society for the Preservation of Covered Bridges, 1972)]. Locust Creek Bridge was identified as a Smith truss by 1980; the Feedwire Road and Jasper Road bridges were not identified as Smith trusses until recently. The Salt Creek Bridge (1876) in Muskingum County, Ohio, which was previously identified as a Warren truss, was also recently re-identified as a Smith truss.

[28] Dimensions are based on the 2009 edition of the *World Guide to Covered Bridges*.

X	SALT CREEK	OH	MUSKINGUM	1876	THOMAS FISHER	83'	DOUBLE		1998		HIGH INTEGRITY
E	STEVENSON ROAD	OH	GREENE	1877	SMITH BRIDGE CO.	95'	DOUBLE	3	1975		POOR CONDITION
	VERMONT	IN	HOWARD	1875	SMITH BRIDGE CO.	98'	DOUBLE	3	1990s		MOVED 1958
X	BUCKSKIN	OH	ROSS	1873	SMITH BRIDGE CO.	99'	DOUBLE	3	2006	X	HIGH INTEGRITY
X	LOCUST CREEK	WV	POCAHONTAS	1888	R.N. BRUCE	116'	DOUBLE	4	2002		REBUILT 1904 FAIR CONDITION
X	KIDD'S MILL	PA	MERCER	1868	SMITH BRIDGE CO.	122'	DOUBLE	2	1990		SMITH VARIANT
X	OTWAY	OH	SCIOTO	1874	SMITH BRIDGE CO.	127'	DOUBLE	3	1896		ARCHES ADDED
X	BROWN	OH	BROWN	1878	JOHN GRIFFITH	129'	TRIPLE	4	2004		FAIR CONDITION
X	RINARD	OH	WASHINGTON	1876	SMITH BRIDGE CO.	130'	DOUBLE	3	2006		REBUILT 2006
E	WEST ENGLE MILL ROAD	OH	GREENE	1877	SMITH BRIDGE CO.	136'	DOUBLE	3	2012		POOR CONDITION
X	CATARACT FALLS	IN	OWEN	1876	SMITH BRIDGE CO.	140'	DOUBLE	3	2005		HIGH INTEGRITY
X	NORTH MANCHESTER	IN	WABASH	1872	SMITH BRIDGE CO.	150'	TRIPLE	4	1971	X	FAIR CONDITION
E	GEORGE MILLER ROAD	OH	BROWN	1878	JOHN GRIFFITH	154'	TRIPLE	4	1990s	X	HIGH INTEGRITY
X	NORTH POLE ROAD	OH	BROWN	1875	SMITH BRIDGE CO.	156'	TRIPLE	4	1997	X	FAIR CONDITION
X	SPENCERVILLE	IN	DEKALB	1873	JOHN MCKAY	160'	TRIPLE	4	2012		ALTERED
E	WHEELING	IN	GIBSON	1877	WILLIAM T. WASHER	169'	TRIPLE	4			POOR CONDITION
E	OLD RED	IN	GIBSON	1875	WILLIAM T. WASHER	178'	TRIPLE	4			POOR CONDITION
E	POWDER WORKS	CA	SANTA CRUZ	1872	PACIFIC BRIDGE CO.	180'	TRIPLE	4	1968	X	HIGH INTEGRITY

The majority of the bridges listed above have been moved, altered, rebuilt, or are in fair to poor condition. Powder Works Bridge stands out as one of the best surviving examples of the Smith truss in the United States, and, more importantly, as the last surviving example of a Smith truss covered bridge on the West Coast, which represents the last attempt to market covered timber bridges on a national scale.[29]

William H. Gorrill and the Pacific Bridge Company

William Henry Gorrill (1841-1874) was born in Bowling Green, Ohio on January 30, 1841. His parents, William Gorrill (b. 1800) of England and Sarah Morse Gorrill (dates unknown) of New York State were married and moved to Ohio in 1833. William H. Gorrill was one of eleven children. As a boy, he worked on the family farm and attended public school. At the age of 17, he left home to study law at the University of Michigan. He earned his degree and was admitted to the bar in 1862. A year and a half later, he moved to Toledo and formed a partnership with attorney Edward Bissell, Jr. (b. 1824).[30] The firm later did legal work for the Toledo-based Smith Bridge Company.[31]

In the fall of 1869, William Gorrill left for California, where he hoped the climate might slow the progression of his tuberculosis. In order to support himself while there, he became an agent for the Smith Bridge Company. In 1870, he established the Pacific Bridge Company at Vallejo, advertising its specialty as "*all kinds of wooden bridges on Smith's Patent Truss Plan*."[32] Gorrill solicited bridge contracts, prepared plans, and collected royalties for the use of Smith's patent; he initially partnered with local contractors to handle construction.[33] The

[29] The Smith truss was used both in California and Oregon, although no examples survive in Oregon.

[30] Ibid., 520.

[31] Research suggests that Robert W. Smith and William Henry Gorrill knew each other personally prior to their business dealings. William Henry Gorrill's sister Elizabeth was married to Charles F. Swigert, whose brother Jacob J. ("J. J.") Swigert was business manager, and later, Vice President, of the Smith Bridge Company.

[32] "The Smith Patent Truss Bridge," *Mining & Scientific Press: An Illustrated Journal of Scientific and Industrial Progress*, 13 March 1871: 1. The Pacific Bridge Company moved to Oakland in 1871 and was incorporated with a capital stock of $100,000 in March 1872.

[33] Albert Searle Miller (1821-1909) was the first western agent for the Smith Bridge Company. In 1869 he traveled from Ohio to California, but returned home before building any bridges. In 1873, he moved to Oregon, where he worked with the Pacific Bridge Company on several projects before establishing his own firm with his sons, Henry and Frank. A.S. Miller & Sons held patent rights for the Smith truss in Oregon and Washington; the company built Smith truss covered bridges in the Pacific Northwest for over a decade.

successful completion of a 400-foot bridge at Oroville in 1871 was followed by a steady flow of work and the company soon expanded its operations with a permanent mill yard in San Francisco. In the spring of 1873, the company began offering iron bridges as an option for their customers. Though they continued to build wooden bridges, the company eventually abandoned the Smith truss altogether.

On September 12, 1874, William Gorrill died of typhoid fever.[34] His brothers, Charles (1845-1886) and Richard (b. 1848) subsequently took over leadership of the bridge-building firm. In 1880, the Gorrill brothers opened a second office in Portland, Oregon.[35] Richard Gorrill also ran a separate firm, the Pacific Construction Company in San Francisco, in partnership with his brother-in-law, Frank Butler (dates unknown). The Pacific Bridge Company remained a major contracting firm into the 1960s, with projects that included the Hoover Dam (1931-36), piers for the Golden Gate Bridge (1933-37) and Oakland Bay Bridge (1933-36), and major spans across the Willamette and Columbia rivers.[36] The Powder Works Bridge (1872) in Santa Cruz County, California is one of the earliest bridges, and the only extant covered wood bridge, built by the Pacific Bridge Company. It represents the last effort to market covered bridges on a national scale, and is the only surviving Smith truss bridge on the West Coast.

The California Powder Works

The discovery of gold in California in 1848 created a growing demand for blasting powder for mining and railroad construction on the West Coast. Powder imported from the East Coast was often of diminished quality from long sea voyages, and exorbitantly expensive. According to one estimate, the cost of imported powder ran into the hundreds of thousands of dollars annually.[37] When the outbreak of Civil War threatened to eliminate the supply of blasting powder altogether, a group of San Francisco businessmen, led by Capt. John H. Baird (1822-1880), formed the California Powder Works to provide blasting powder to the West Coast.[38] In 1861, the company incorporated with a capital stock of $100,000. The following year, the company purchased a former paper mill site on the San Lorenzo River approximately two miles north of Santa Cruz.[39] This location offered excellent water power, a ready supply of choice timber for charcoal, kegs, and fuel, proximity to transportation facilities, a nearby labor force, and relative seclusion for safety.[40]

They built a dam on the San Lorenzo River, on land that is now part of Henry Cowell Redwoods State Park. In February 1863, construction began on a core group of approximately twenty-five buildings in "Powder Mill Canyon," and by the following summer the mill was producing kegs of black powder.[41] Demand for the company's products was so great that the complex expanded in 1867 with the construction of seventeen new buildings. In 1872, the company enlarged its facilities again, and built a sturdy covered bridge across the

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[34] "William Henry Gorrill," obituary, *Wood County Sentinel*, 1 October 1874: 5; and *Santa Cruz Sentinel*, 26 September 1874.

[35] Elizabeth Gorrill Swigert's son Charles F. Swigert (1863-1935), went to work for the Pacific Bridge Company in the 1880s, and eventually become manager of its Portland, Oregon branch.

[36] R. Bruce Way, *The Life and Careers of William Henry Gorrill: 1841-1874* (Lanham, Maryland: University Press of America, 1996): 200.

[37] "Powder Manufactory," *Nevada Democrat*, 7 January 1862: 1.

[38] Wallace W. Elliott, "California Powder Works," *Santa Cruz County, California: Illustrations with Historical Sketch of the County* (San Francisco: by author, 1879): 49.

[39] Santa Cruz County Book of Deeds, Vol. 15, p: 200-203, 3283. A nearby section of the San Lorenzo River was previously used for industrial purposes: first, for a saw mill established in 1843 by French settler Pierre "Don Pedro" Sainsevaine (1818-1904), and subsequently for a paper mill, established in 1860 by bullion broker Henry Van Valkenburgh (1840-1862).

[40] R. H. Chamberlain, "California and the Three Bears: The History of the California Powder Works," *The Gun Report*, January 1994: 22.

[41] "The Powder Mill at Santa Cruz," *Pajaro Times* 1, no. 1 (1863): 2; and E.S. Harrison, *History of Santa Cruz County* (San Francisco: Pacific Press Publishing Company, 1892): 200. Black powder is a mixture of potassium nitrate, sulphur, and charcoal, which, when ignited, releases gases that produce an explosion.

river.[42] By 1879, the 200-acre site contained approximately seventy-five buildings, including twenty-one powder mills, ten shops, ten wheelhouses, six magazines, a boarding house, and a school.[43] Eventually, a small village of about one hundred residents occupied a site south of the manufactory. By 1887, the California Powder Works yielded four million pounds of powder annually.[44] The California Powder Works was the largest producer of explosives west of the Mississippi River for half a century.

In 1903, the Dupont Corporation purchased a controlling interest in the California Powder Works; three years later, they changed the name of the powder manufacturer to "E.I. DuPont de Nemours Powder Company."[45] In 1912, the DuPont holdings were broken up under the Sherman Antitrust decision, and the company was reorganized as the Hercules Powder Company. Two years later, the California Powder Works operations were moved to a modern facility at Hercules, California, where operations continued until 1955.[46] Much of the California Powder Works complex at Santa Cruz was subsequently demolished.

In 1924, members of the Fresno Masonic fraternity purchased the former California Powder Works property for the establishment of a summer cottage colony. They named the site "Paradise Park," because of the beauty of the natural surroundings.[47] A writer in 1938 described the site as follows:

> *You drive under an imposing portal of untrimmed redwood logs and find yourself in a maze of cottages and lawns, with the unobtrusive stream always close at hand to afford boating and swimming. A paradise indeed for vacationers and their children! A one-way road follows up the west bank of the San Lorenzo and near its end you are startled by the sight of a huge white covered bridge turning to the right, square across the placid river.*[48]

As the years passed, residents began winterizing their homes for year-round comfort. Today, Paradise Park is a year-round residential community of approximately 200 households. Among the cottages and trees, a few visible remnants of the former California Powder Works complex remain, including remnants of the charcoal kilns, portions of building foundations, the former superintendent's house, and the covered bridge.

Powder Works Bridge

An early hand-drawn map of the California Powder Works suggests that there was a rudimentary crossing (presumably a ford) at or near this location by the time the plant was completed in 1863.[49] Sometime in the mid-1860s, a non-housed timber truss bridge was built at the present crossing.[50] When that bridge washed out in a flood in December 1871, the superintendent of the California Powder Works contracted with the Pacific Bridge Company of Oakland to erect a more permanent structure here.

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[42] "California Powder," *Santa Cruz Sentinel*, 12 October 1872: 3.
[43] Elliott, 49.
[44] I. H. Raymond, *Santa Cruz County: Resources, Advantages, Objects of Interest* (Santa Cruz: Santa Cruz Development Association, 1887): 67.
[45] The DuPont Company first purchased stock in the California Powder Works in 1868, but it was not until 1903 that they owned a controlling interest. Minute Books of the California Powder Works.
[46] Thomas L. Reedy and Alice M. Reedy, *In the Beginning: A History of the Paradise Park Site* (Santa Cruz: Paradise Park Masonic Club, 1974): 24.
[47] "Powder Mill Canyon," *Santa Cruz Daily Surf*, 12 May 1893: 6.
[48] Morley: 58.
[49] "Map of the California Powder Works, Erected 1863," McHenry Library Map Collection, University of California Santa Cruz, Santa Cruz, California.
[50] Britton & Rey, "The California Powder Works, Santa Cruz County, California," lithograph, c1870.

The new bridge was fabricated at a Pacific Bridge company plant in Alameda, shipped by rail (a distance of 70 miles), and then transported by wagon to the site and erected in the early spring of 1872 by the Pacific Bridge Company, at a cost of $5,250.[51] At the time of its construction, the Powder Works Bridge was the longest single-span bridge in Santa Cruz County and was sturdy enough to accommodate the narrow-gauge railway spur that carried horse-drawn cars of charcoal from the kilns on the east side of the river to the powder works on the west side of the river. On May 4, 1872, the *Santa Cruz Sentinel* reported the completion of the new Powder Works Bridge:

> *The Pacific Bridge Company of San Francisco have completed the bridge…across the San Lorenzo, according to contract made with Bernard Peyton Esq., Superintendent of California Powder works. As the bridge is 168 feet in length and has but one span it deserves something more than a passing notice. The bridge is a Smith patent high truss. …The entire structure is of the best workmanship throughout. It will sustain 1,000 pounds to each lineal foot, which, distributed over its surface, would be more than 80 tons, and is capable of sustaining a moving load of much greater weight than will ever be required of it. ...We believe it is designed by the Powder Company to enclose and roof the bridge, thereby more than doubling the life of the entire structure. Long may it stand as an evidence of the enterprise of the Powder Company, and also reflecting credit on the Pacific Bridge Company as we believe it will.*[52]

Secondary documentary evidence suggests that timber bents may have been added to support the structure soon after its construction. This could have been necessitated by the increasing weight of rolling stock used at the plant. Multiple bents appear in a c.1875 birds-eye view of the California Powder Works; and, according to an article published in 1982, "*The* [bridge] *underpinnings were washed away in the flood of 1882, but research showed they had been added after initial construction and the bridge is perfectly sound without them.*"[53] Photos from the late nineteenth or early twentieth century show a timber bent near mid-span, which may have survived the 1882 flood. Because timber is subject to decay, the existing timber bents were presumably replaced in kind at some point in the twentieth century. Cast-in-place concrete foundations were added to each timber bent at an unknown date in the mid-twentieth century to slow their inevitable decay and protect the substructure from floods.[54]

Due to its sturdy construction and low-volume traffic usage, the bridge has required relatively few repairs or alterations since its construction and the vast majority of the superstructure is original. The siding, roof, and deck have been replaced periodically as part of routine maintenance, but the essential load-bearing components of the structure are still intact. The railroad tracks were removed from the bridge deck during World War I and the original timber abutments were replaced with cast-in-place concrete abutments at an unknown date after 1924. The bridge's original wood shingle roof was replaced in the twentieth century with corrugated metal. Windows were added to both sides of the bridge, and electric light fixtures were installed over the portals, sometime prior to 1963. A sprinkler system was installed in 1972.

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[51] J. Nelson, "Short History of the California Powder Works (1864-1914) and Paradise Park (1924-Present)," unpublished typescript, 2000. Collection of the Santa Cruz Museum of Art & History, Santa Cruz, California. Barry Brown, "The California Powder Works and San Lorenzo Paper Mill, Self-Guided Tour: The Covered Bridge," 2008. http://www. santacruzpl.org/ history/articles/520/, retrieved 9/13/2012.

[52] "California Powder Works Bridge," *Santa Cruz Sentinel*, 4 May 1872: 3.

[53] Bosqui Engraving Co., "The California Powder Works, Santa Cruz County, California," lithograph, c1875; and Joan S. Hamblin, "California's Covered Bridges," *Highway Patrolman* (October 1982): 46.

[54] A late-nineteenth or early-twentieth century photograph from the Santa Cruz Public Library collection shows the bridge's central timber bent without a concrete footing. <http://www.santacruzpl.org/history/articles/508/>, retrieved 9/10/12.

Chronology

1805 America's first covered bridge completed at Philadelphia

1833 Robert W. Smith born at Tippecanoe, Ohio

1841 William Henry Gorrill born at Bowling Green, Ohio

1849 California Gold Rush begins

1850 State of California enters the Union

John T. Little builds California's first covered bridge at Salmon Falls

1861 John H. Baird of San Francisco organizes the California Powder Works

1864 California Powder Works begins manufacturing black powder at Santa Cruz

1867 Robert W. Smith obtains first bridge truss patent and organizes the Smith Bridge Company

1869 Robert W. Smith obtains second bridge truss patent

William H. Gorrill leaves Ohio for California

1870 William H. Gorrill becomes an agent for the Smith Bridge company

William H. Gorrill establishes the Pacific Bridge Company at Vallejo, California

1871 Flood destroys bridges on San Lorenzo River

1872 Present bridge erected at this site

1874 William Henry Gorrill dies in California

1880s Pacific Bridge Company opens offices in San Francisco, California and Portland, Oregon

1891 Smith Bridge Company sold to Toledo Bridge Company

1898 Robert W. Smith dies in Ohio

1900 Toledo Bridge Company becomes part of American Bridge Company

1914 California Powder Works operations moved to Hercules, California

1924 Freemasons purchase former California Powder Works property for use as a summer cottage colony

1938 Powder Works (Paradise Park) Bridge pictured in Griswold Morley's *Covered Bridges of California*

1960s Pacific Bridge Company ceases operations

1968 Powder Works Bridge deck rebuilt

1972 Powder Works (Paradise Park) Bridge identified as a Smith truss in the *World Guide to Covered Bridges*

1985 Powder Works (Paradise Park) Bridge determined eligible for listing in the National Register

2002 Historic American Engineering Record records Powder Works Bridge

2011 Historic American Engineering Record produces measured drawings of Powder Works Bridge

2012 Powder Works Bridge proposed for consideration as a National Historic Landmark

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Previous documentation on file (NPS):

__ Preliminary Determination of Individual Listing (36 CFR 67) has been requested
__ Previously Listed in the National Register
X Previously Determined Eligible by the National Register: "Historic Truss Bridges in California," 1985
__ Designated a National Historic Landmark
__ Recorded by Historic American Buildings Survey
X Recorded by Historic American Engineering Record: HAER CA-313

Primary Location of Additional Data:

__ State Historic Preservation Office
__ Other State Agency
__ Federal Agency
__ Local Government
X University: University of California, Santa Cruz, California
X Other (Specify Repository): Paradise Park Masonic Club, Santa Cruz, California

10. GEOGRAPHICAL DATA

Acreage of Property: Less than an acre

UTM References:

Zone	Easting	Northing
10	586171	4094182

Verbal Boundary Description:

The property consists of the superstructure, housing, substructure and approaches of the Powder Works Bridge. Overall, the superstructure is approximately 180 feet long (including the portal overhangs), 28 feet deep (from the peak of the roof to the bottom of the floor beams) and 30 feet wide (including the overhanging eaves). The bridge, which is aligned on a northwest-southeast axis, carries Keystone Way over San Lorenzo River approximately one mile north of the entrance to Paradise Park, which is approximately two miles northeast of downtown Santa Cruz, California.

Boundary Justification:

The property boundary includes the essential components of the bridge: the superstructure, including the trusses, floor system and bracing systems; the housing, including the siding, roof, and architectural embellishments; the substructure, including abutments, piers, and foundations; and the roadway approaches to the structure.

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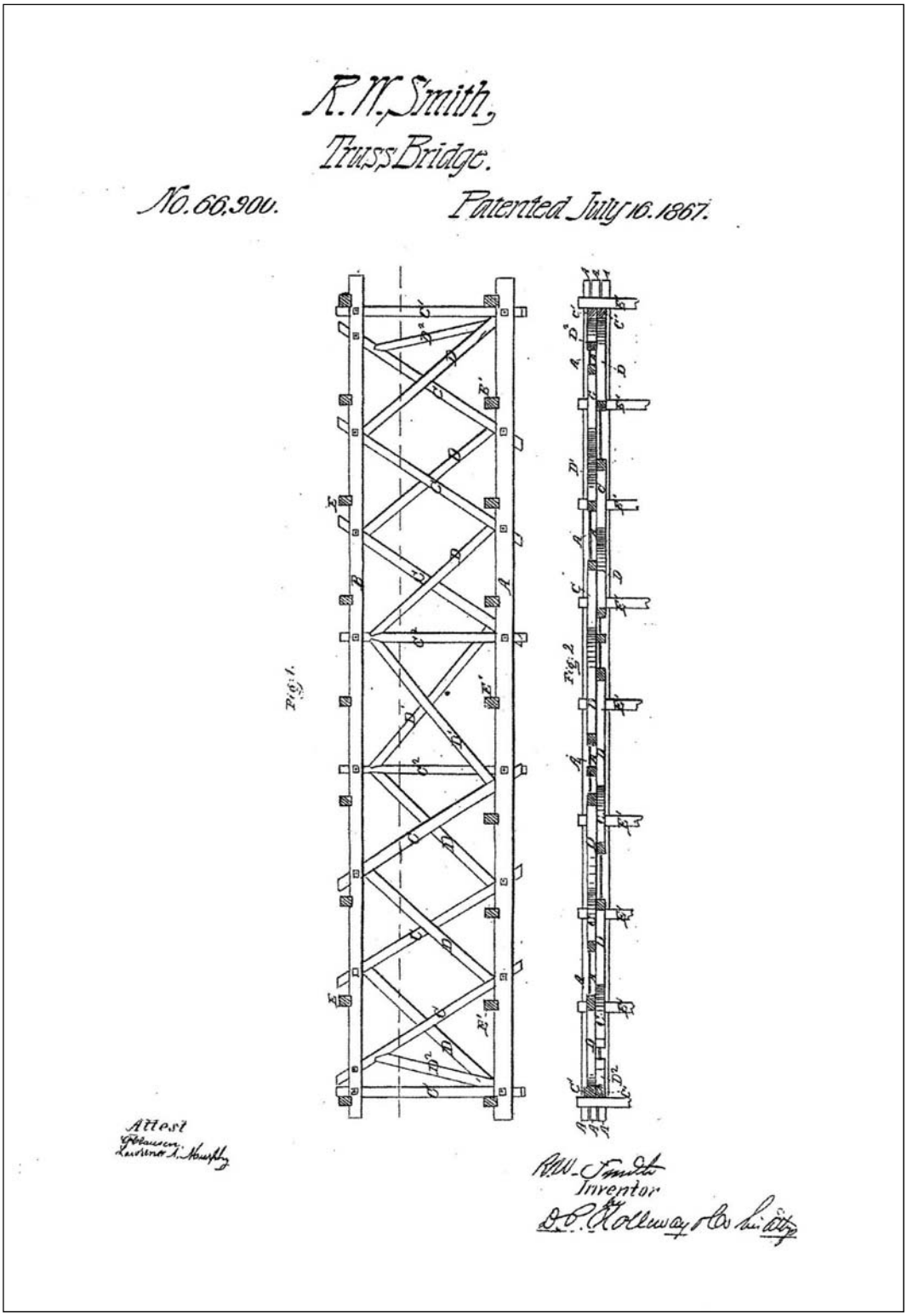
March 27, 2014



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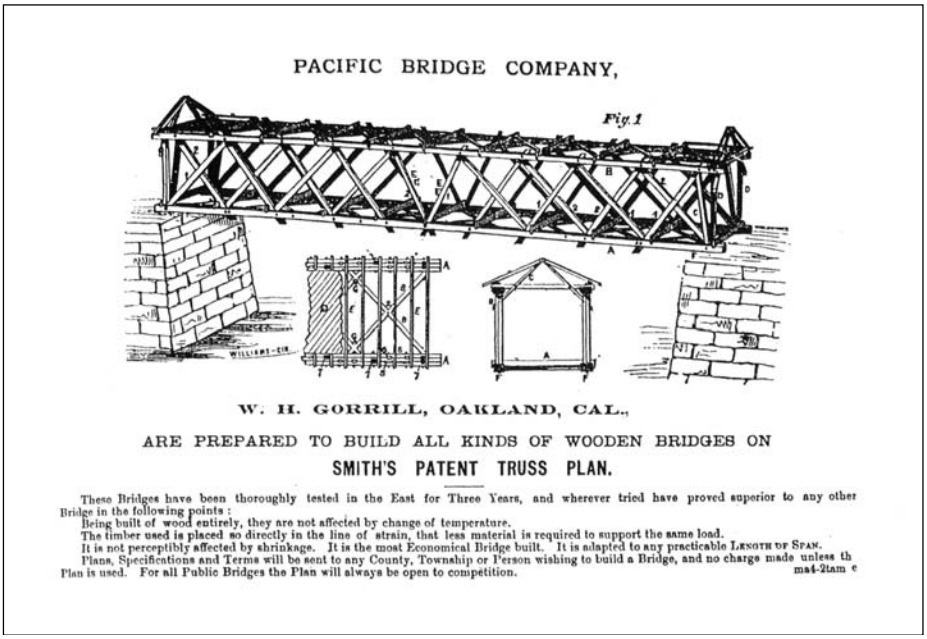


PACIFIC BRIDGE COMPANY,

Fig. 1

W. H. GORRILL, OAKLAND, CAL.,

ARE PREPARED TO BUILD ALL KINDS OF WOODEN BRIDGES ON

SMITH'S PATENT TRUSS PLAN.

These Bridges have been thoroughly tested in the East for Three Years, and wherever tried have proved superior to any other Bridge in the following points:

Being built of wood entirely, they are not affected by change of temperature.

The timber used is placed so directly in the line of strain, that less material is required to support the same load.

It is not perceptibly affected by shrinkage. It is the most Economical Bridge built. It is adapted to any practicable LENGTH OF SPAN.

Plans, Specifications and Terms will be sent to any County, Township or Person wishing to build a Bridge, and no charge made unless th Plan is used. For all Public Bridges the Plan will always be open to competition.

ma4-2tam e

Pacific Bridge Company advertisement, *Mining and Scientific Press*, 13 March 1871.

POWDER WORKS BRIDGE. West portal elevation.
Photograph by Jet Lowe, 2004.
[HAER CA-313-12]

POWDER WORKS BRIDGE. Perspective view to west.
Photograph by Jet Lowe, 2004.
[HAER CA-313-11]

POWDER WORKS BRIDGE. Truss detail at eastern portal.
Photograph by Jet Lowe, 2004.
[HAER CA-313-8]

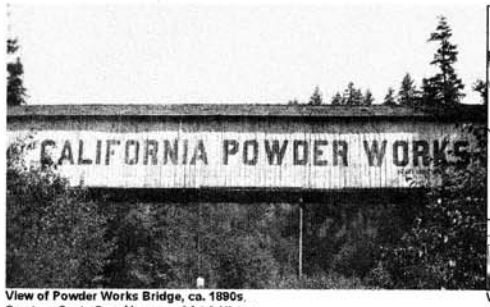
POWDER WORKS BRIDGE. Interior view from east portal.
Photograph by Jet Lowe, 2004.
[HAER CA-313-10]

POWDER WORKS BRIDGE. North elevation.
Photograph by Jet Lowe, 2004.
[HAER CA-313-5]

POWDER WORKS BRIDGE. Timber bent and east abutment detail.
Photograph by Jet Lowe, 2004.
[HAER CA-313-4]

Powder Works Bridge

Spanning San Lorenzo River
Santa Cruz, California



View of Powder Works Bridge, ca. 1890s.
Courtesy Santa Cruz Museum of Art & History

Vicinity Map *Latitude: 37.009681, Latitude: -122.046733*

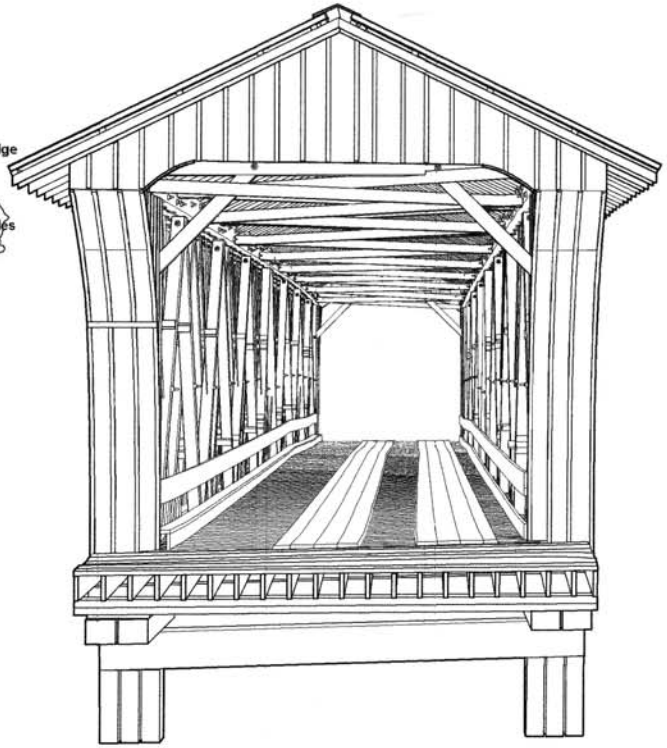
The Powder Works Bridge spans the San Lorenzo River near ruins of a former powder works in the private residential community of Paradise Park, California. The California Powder Works was completed in 1864 to supply blasting powder to the Central Pacific Railroad in nearby Santa Cruz. After the first bridge at this site was washed out in a flood, the Pacific Bridge Company erected a 168' long Smith truss in 1872, sturdy enough to accommodate a narrow-guage railway. Following the closure of the mill in 1914, the Fresno Masonic fraternity purchased the property in 1924 as a private summer colony, renaming it Paradise Park. Today, many residents live in the wooded community year-round, where the Powder Works Bridge continues to serve as a vehicular and pedestrian crossing.

In 1867, Robert W. Smith (1833-1898) patented a wooden bridge truss with parallel upper and lower chords, connected by a series of diagonals and counter diagonals. An early proponent of mass production, he established the Smith Bridge Company in Toledo, Ohio. Here, bridges were prefabricated to order, shipped to the site, and erected under the supervision of a company agent. While not as popular as the Howe truss, perhaps hundreds of Smith trusses were built in at least nine states, mostly in the Midwest and on the west coast. Of the twenty extant Smith truss covered bridges, 90 percent are located in Ohio and Indiana.

There were four variations on the Smith truss. Utilizing double diagonals the full length of the bridge intersecting with single counter diagonals, the Powder Works Bridge is an excellent example of the Type 4 Smith truss. The 168' long bridge is the only surviving example of a Smith truss in the western United States.

After handling legal work for the Smith Bridge Company in Ohio, William Henry Gorrill (1841-1874) moved to California for health reasons in 1870, where he became an agent for the Smith Bridge Company. Establishing the Pacific Bridge Company, Gorrill built several wood and iron bridges, including the Powder Works. Following Gorrill's death in 1874, the Pacific Construction Company remained a major contracting firm into the 1960s, including piers for the Golden Gate and Oakland Bay bridges. The Pacific Bridge Company is noteworthy as a bridge-building firm that began building wooden spans in the nineteenth century and successfully made the transition to steel and concrete spans in the twentieth century.

The National Covered Bridges Recording Project was undertaken by the Historic American Engineering Record (HAER), a long-range program to document historically significant engineering and industrial works in the United States. HAER is administered by the Heritage Documentation Programs Division (Richard O'Connor, Chief), a division of the National Park Service, U.S. Department of the Interior. The Federal Highway Administration's National Historic Covered Bridge Preservation Program funded the project.



Smith Truss, 1872

The 2011 HAER field team consisted of project leader Christopher H. Marston, HAER Architect, Jeremy T. Mauro, field supervisor, and Melissa Alicia Decatur and Pavel Gorokhov, both Catholic University. Ben Shakelton, Montgomery College, assisted with transmittal. The drawings support earlier HAER documentation by historian Lola Bennett, and HAER photographer Jet Lowe, completed in 2004. The Powder Works Bridge was documented using high definition surveying (HDS) technology. The data was collected with a Leica ScanStation 2 and Cyclone v7.3 software. The drawings were rendered using CloudWorx, an HDS plug-in for AutoCAD 2012.

DELINEATED BY: JEREMY MAURO, MELISSA ALICIA DECATUR, BEN SHAKELTON, PAVEL GOROKHOV, 2012

NATIONAL COVERED BRIDGES
HISTORIC AMERICAN ENGINEERING RECORD
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR

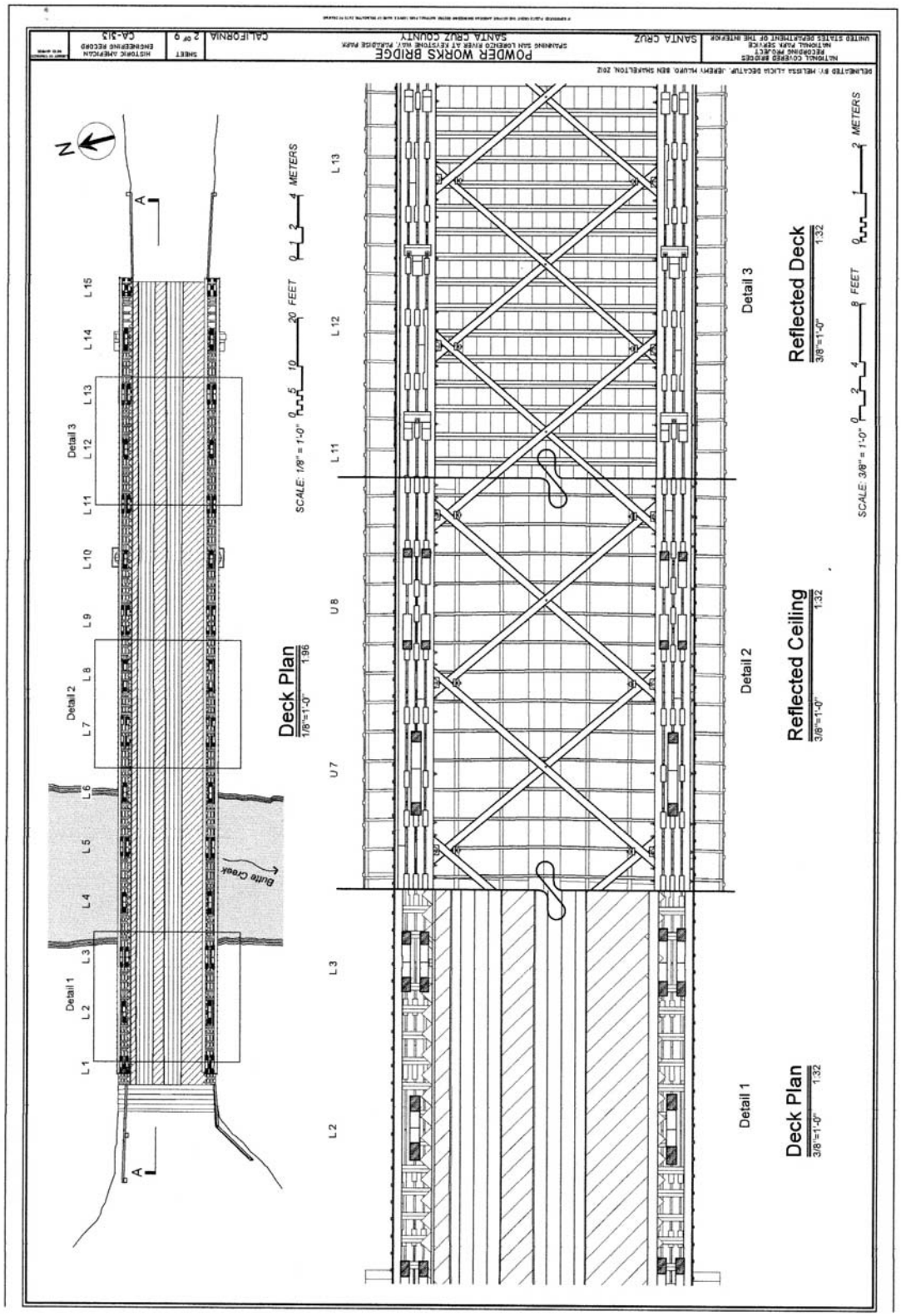
SANTA CRUZ

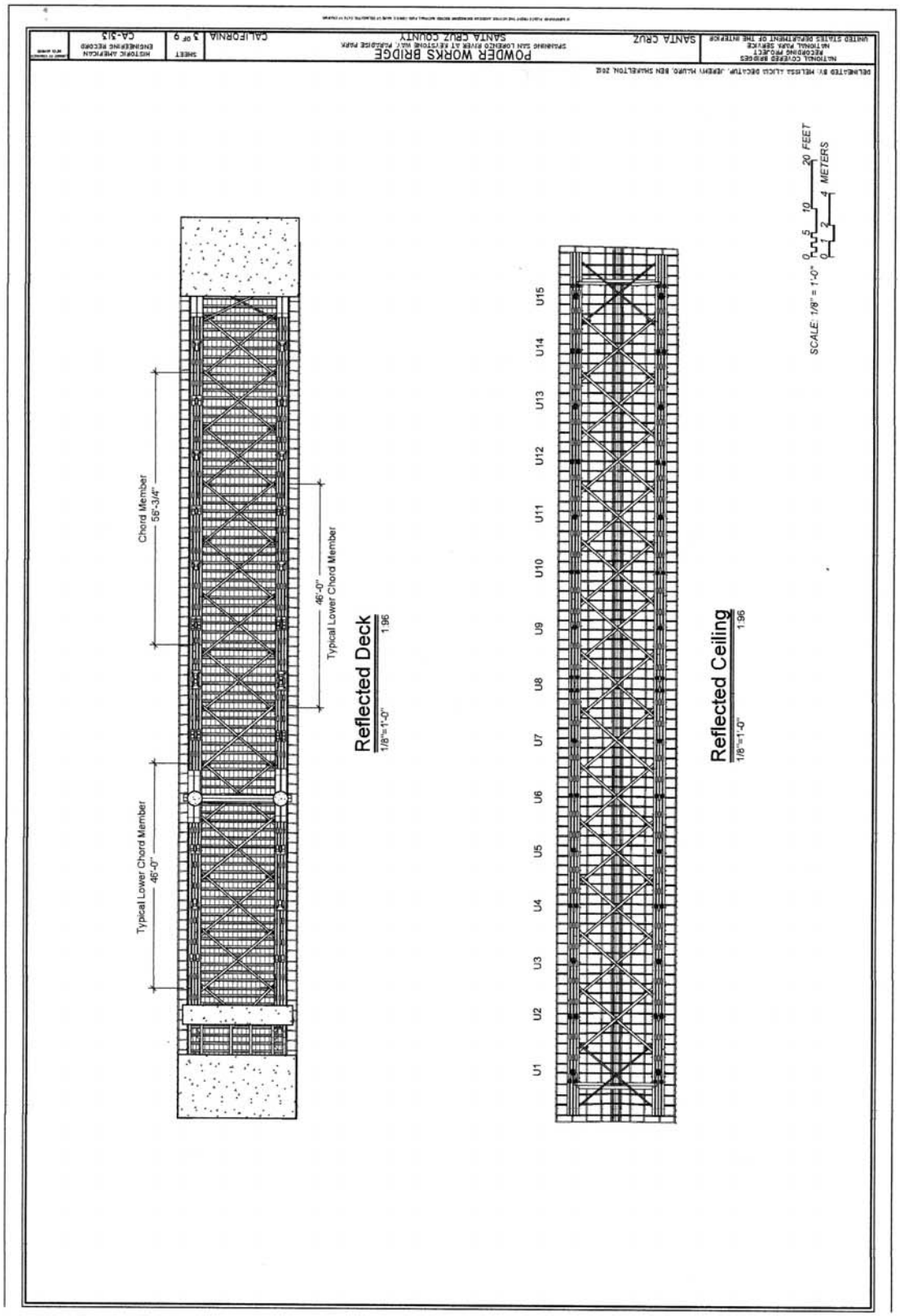
POWDER WORKS BRIDGE
SPANNING SAN LORENZO RIVER AT KESTONE WAY, PARADISE PARK
SANTA CRUZ COUNTY

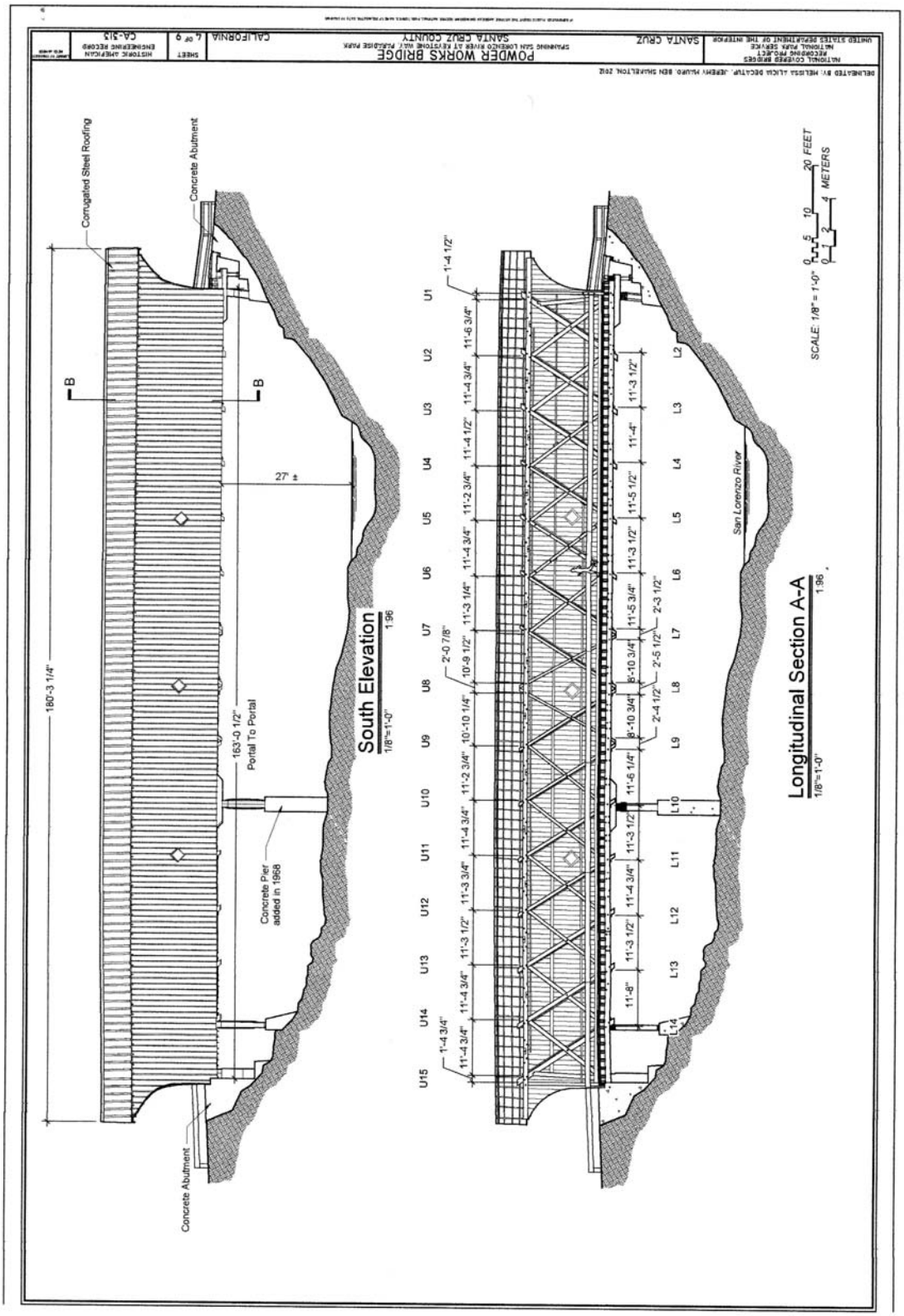
CALIFORNIA

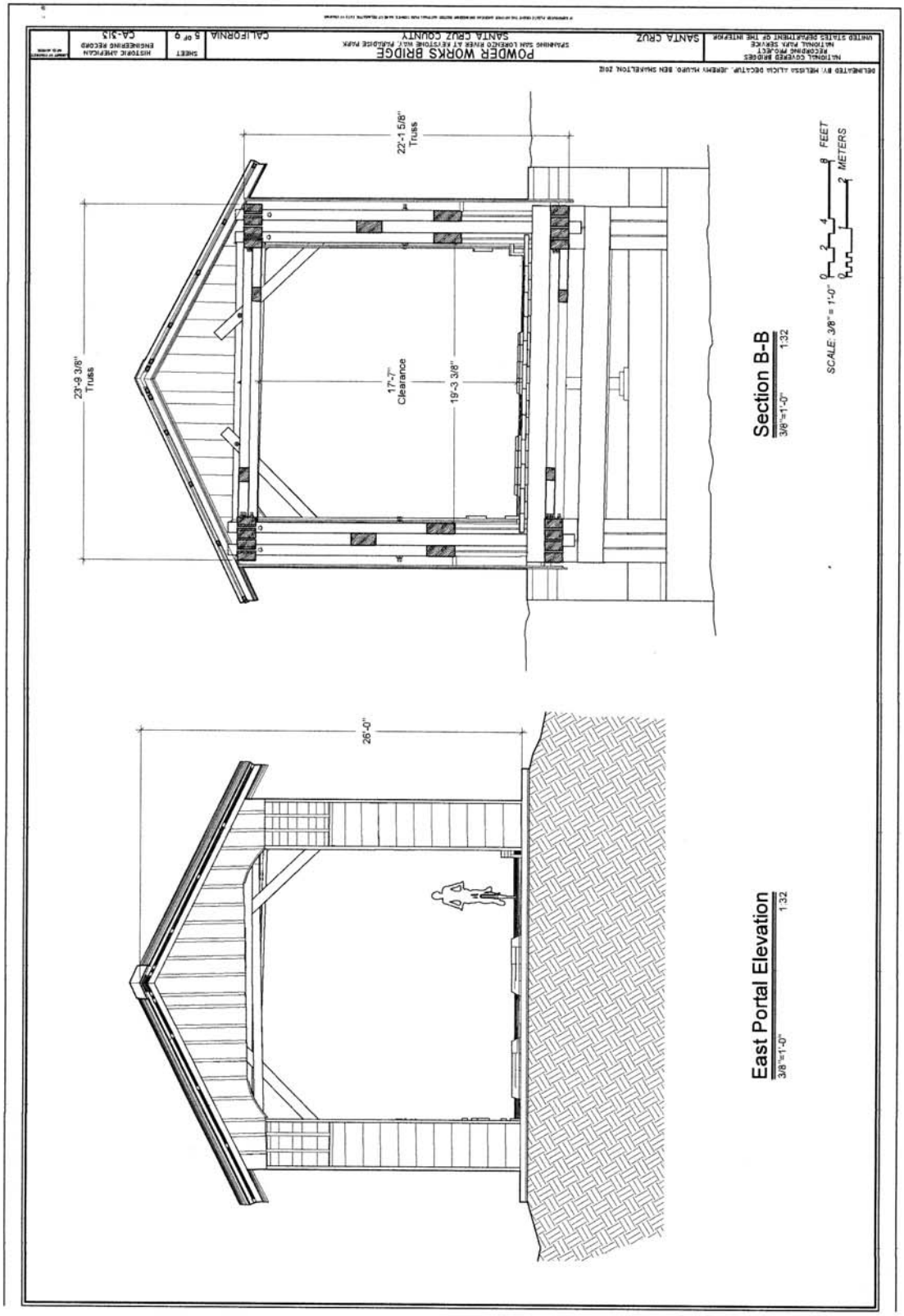
SHEET 1 OF 9

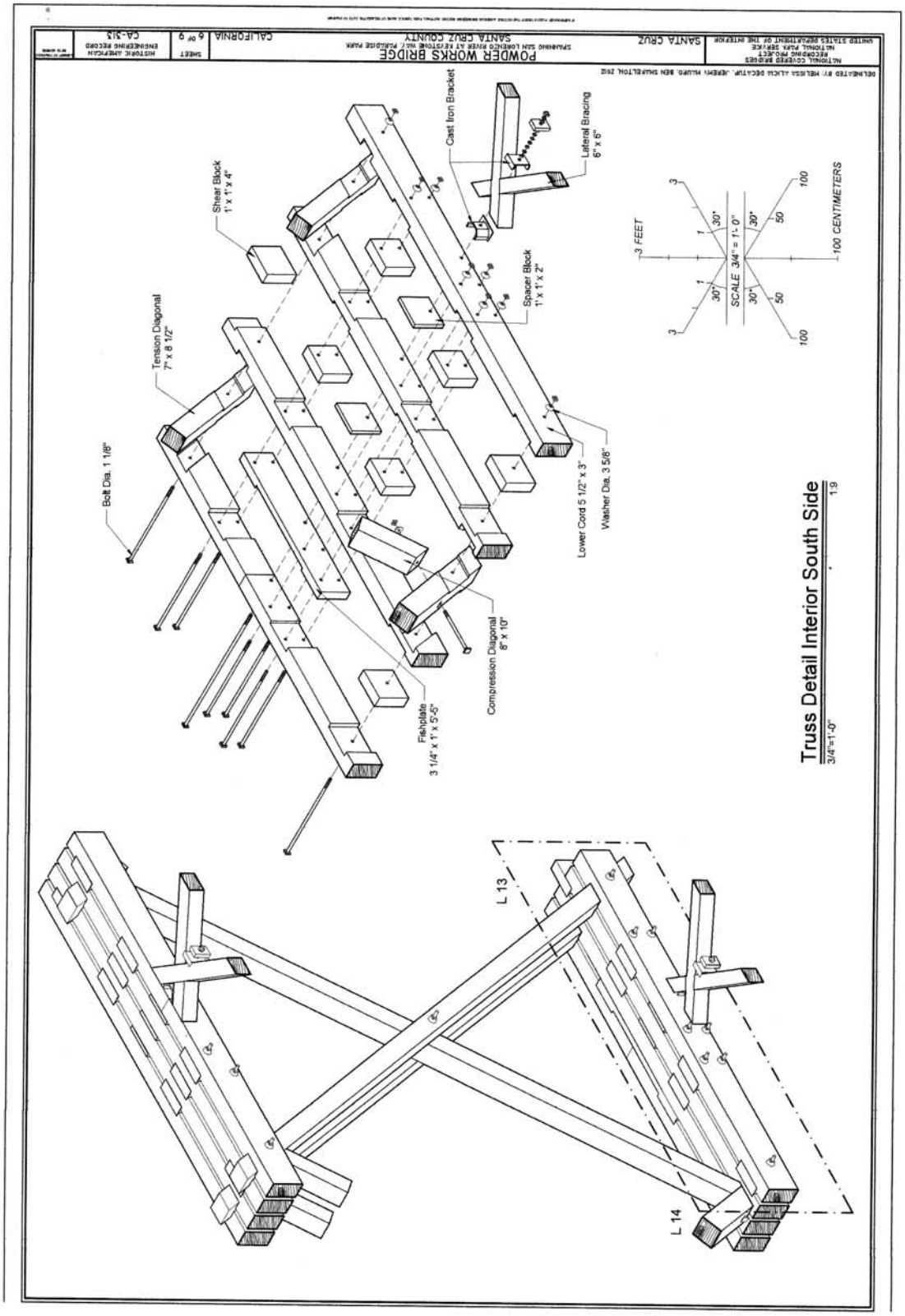
HISTORIC AMERICAN ENGINEERING RECORD
CA-315

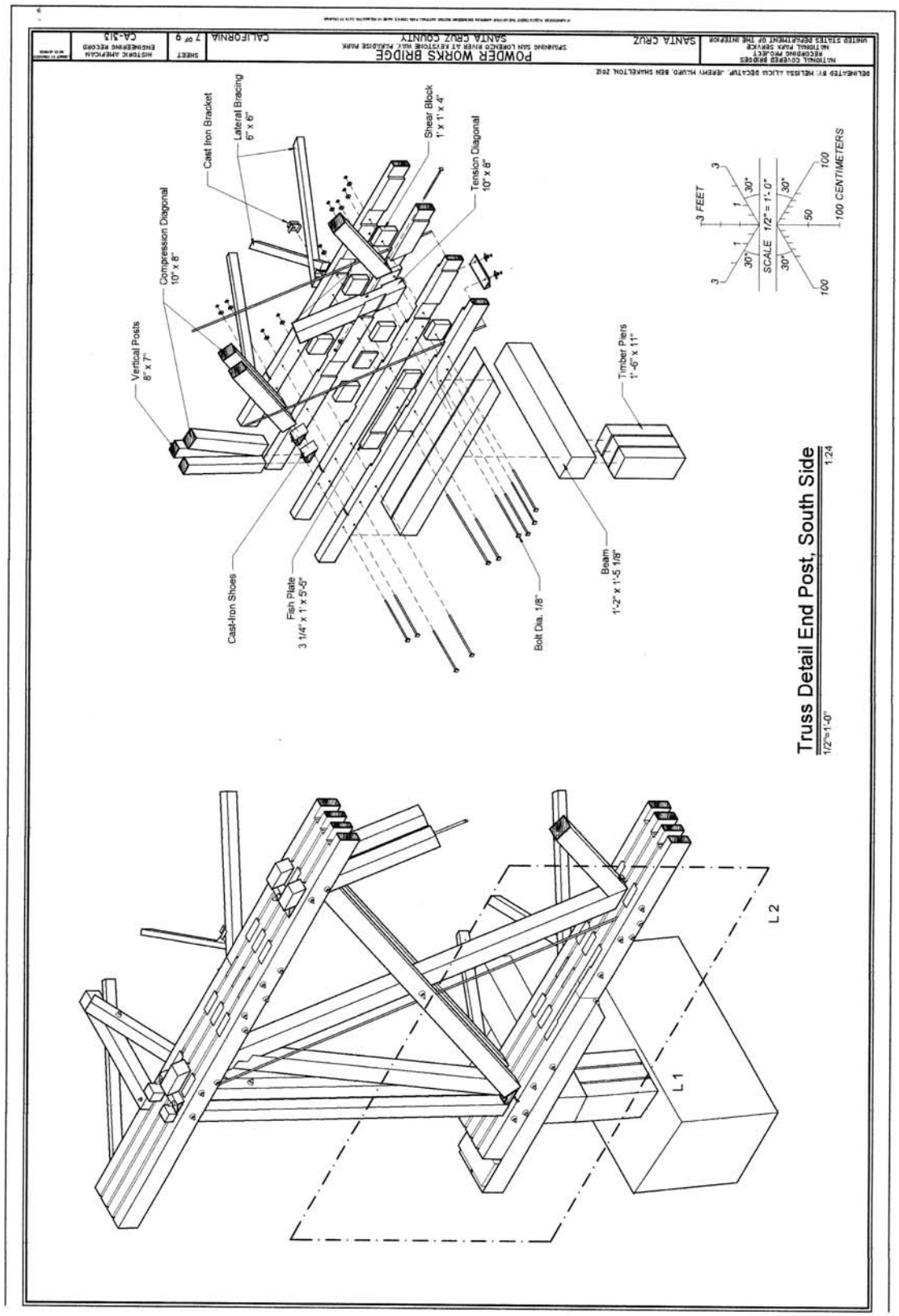

POWDER WORKS BRIDGE
SPANNING SAN LORENZO RIVER AT RESTONE MILL PUBLIC PARK
SANTA CRUZ COUNTY
SANTA CRUZ
CALIFORNIA
SHEET 2 OF 9
HISTORIC AMERICAN ENGINEERING RECORD
CA-312
NATIONAL COVERED BRIDGES
RECORDING PROJECT
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
DELINEATED BY: MELISSA LUCIA BECKATH, JEREMY HUNO, BEN SHARELTON, 2012
N
A
A
Detail 1
Detail 2
Detail 3
L1
L2
L3
L4
L5
L6
L7
L8
L9
L10
L11
L12
L13
L14
L15
Butte Creek
Deck Plan
1/8"=1'-0" 1:96
SCALE: 1/8" = 1'-0"
0 5 10 20 FEET
0 1 2 4 METERS
L2
L3
U7
U8
L11
L12
L13
Detail 1
Detail 2
Detail 3
Deck Plan
3/8"=1'-0" 1:32
Reflected Ceiling
3/8"=1'-0" 1:32
Reflected Deck
3/8"=1'-0" 1:32
SCALE: 3/8" = 1'-0"
0 2 4 8 FEET
0 1 2 METERS

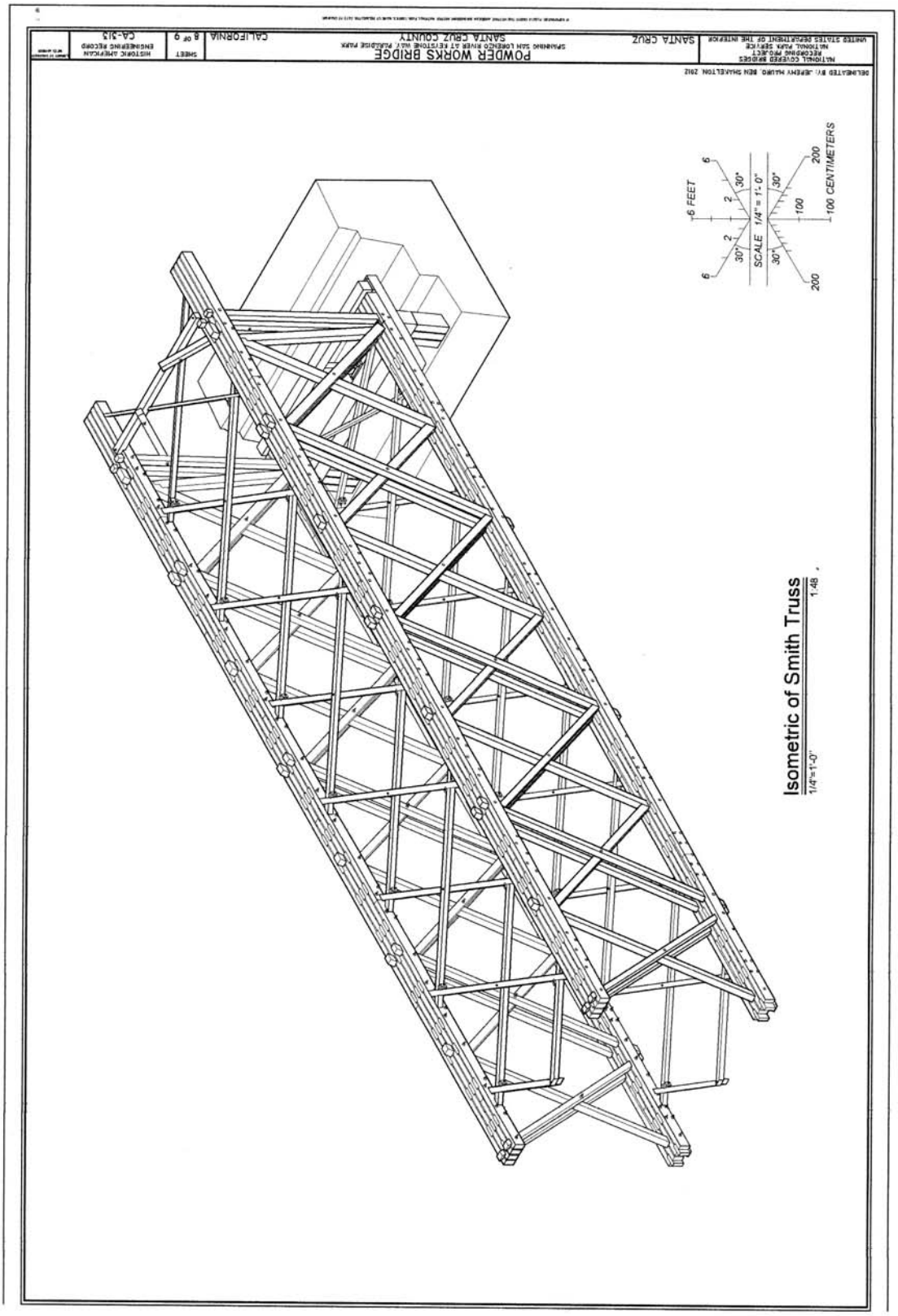

Chord Member
56'-3/4"
Typical Lower Chord Member
46'-0"
Typical Lower Chord Member
46'-0"
Reflected Deck
1/8"=1'-0"
1.96
U1
U2
U3
U4
U5
U6
U7
U8
U9
U10
U11
U12
U13
U14
U15
Reflected Ceiling
1/8"=1'-0"
1.96
SCALE: 1/8" = 1'-0"
0 5 10 20 FEET
0 1 2 4 METERS
POWDER WORKS BRIDGE
SANTA CRUZ COUNTY
CALIFORNIA
SANTA CRUZ
SHEET 2 OF 9
HISTORIC AMERICAN ENGINEERING RECORD
CA-312

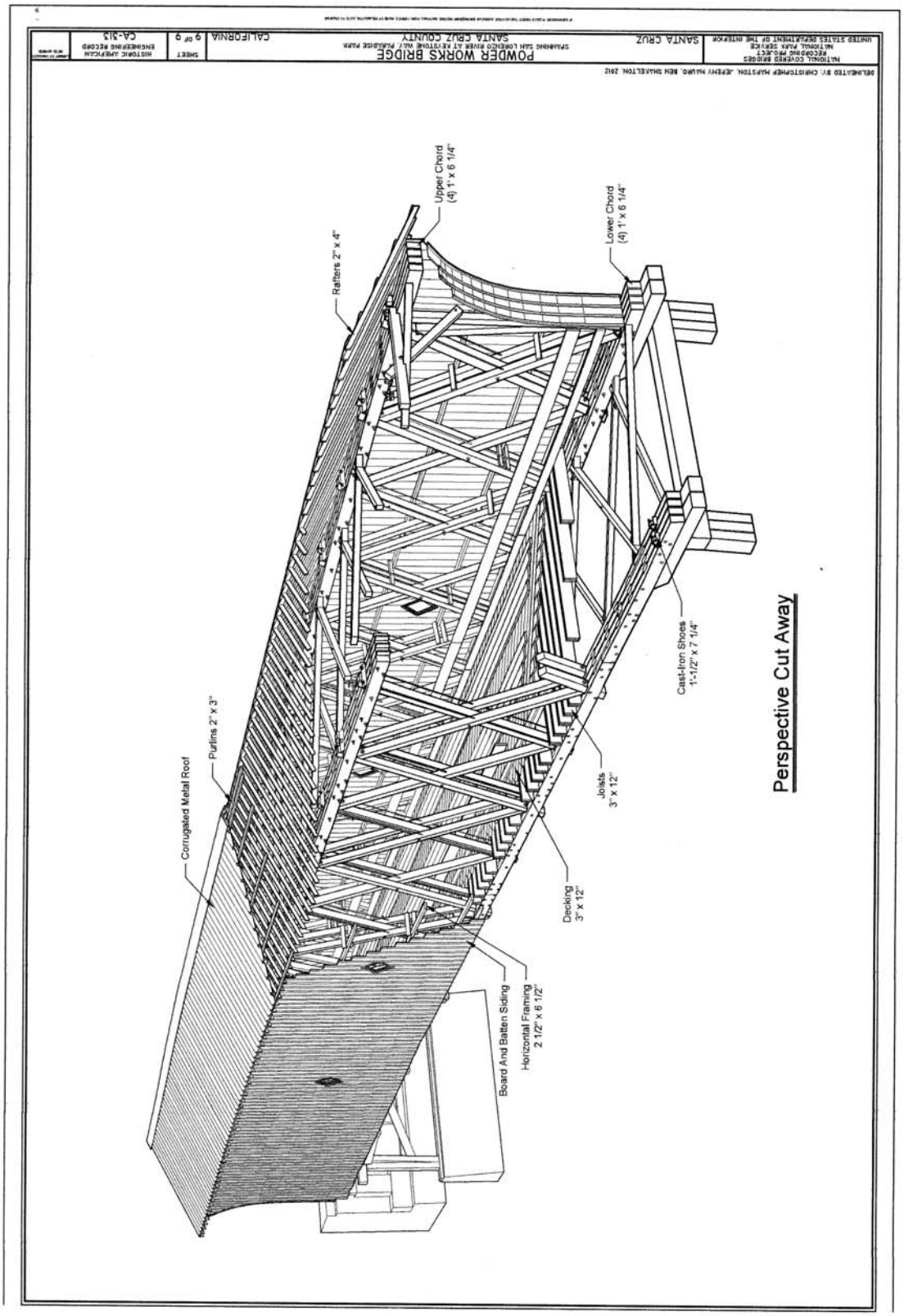

POWDER WORKS BRIDGE
SANTA CRUZ COUNTY
CALIFORNIA
SANTA CRUZ
Corrugated Steel Roofing
Concrete Abutment
Concrete Pier added in 1968
Portal To Portal
163'-0 1/2"
180'-3 1/4"
27' ±
B
B
South Elevation
1/8"=1'-0"
1:96
Longitudinal Section A-A
1/8"=1'-0"
1:96
San Lorenzo River
SCALE: 1/8" = 1'-0"
20 FEET
4 METERS

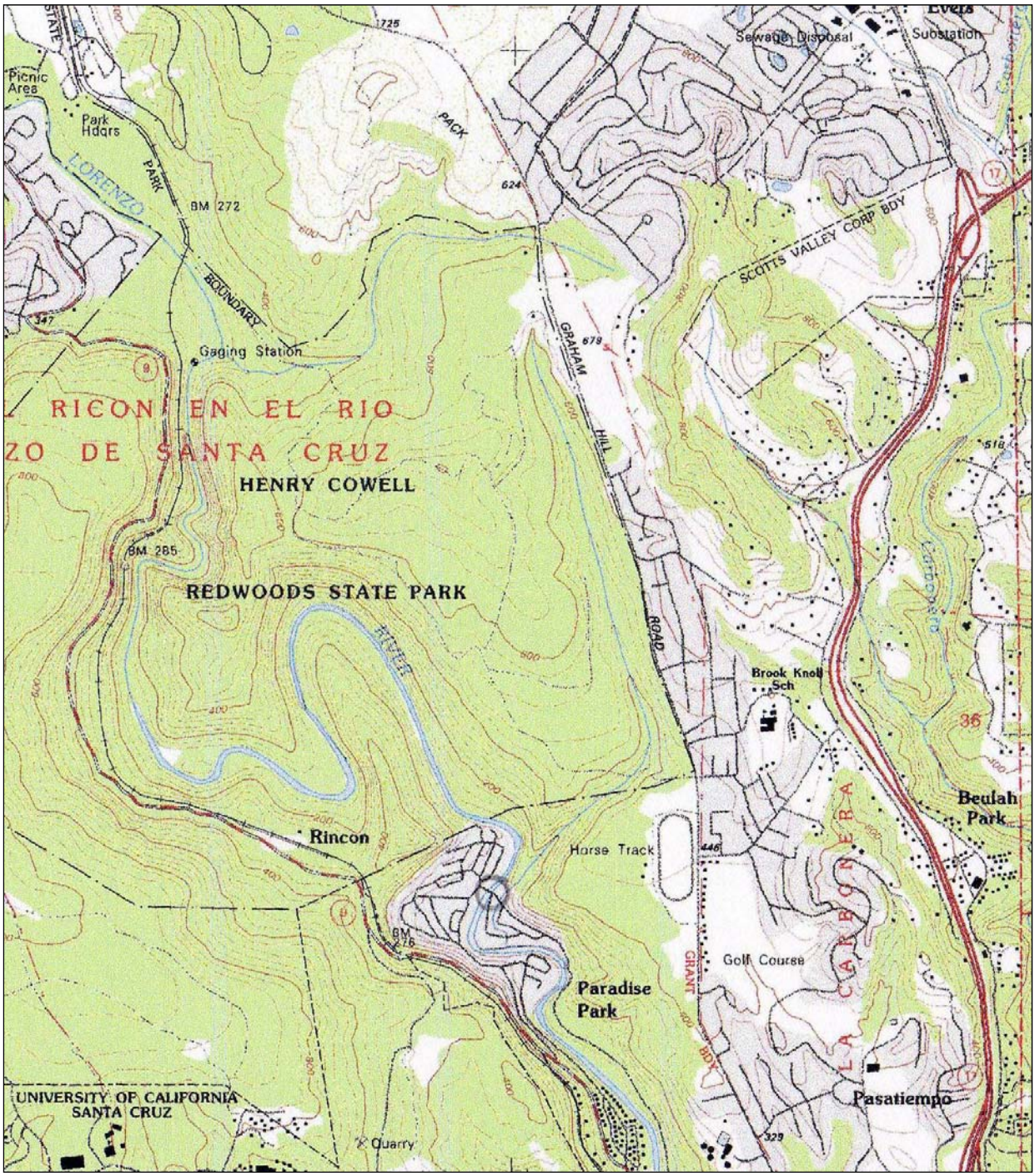

NATIONAL COVERED BRIDGES
RECORDING PROJECT
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
POWDER WORKS BRIDGE
SPANNING SAN LORENZO RIVER AT KEYSTONE WAY, PAUL BIXBY PARK
SANTA CRUZ COUNTY
SANTA CRUZ
CALIFORNIA
SHEET 5 OF 9
HISTORIC AMERICAN ENGINEERING RECORD
CA-312
DELINEATED BY: MELISSA ALICIA DECATUR, JEREMY HUURE, BEN SHARELTON 2012
23'-9 3/8" Truss
22'-1 5/8" Truss
17'-7" Clearance
19'-3 3/8"
Section B-B
3/8"=1'-0" 1:32
SCALE: 3/8" = 1'-0"
FEET
METERS
26'-0"
East Portal Elevation
3/8"=1'-0" 1:32


Truss Detail Interior South Side
3/4"=1'-0"
1:9
Bolt Dia. 1 1/8"
Tension Diagonal 7" x 8 1/2"
Shear Block 1" x 1' x 4"
Cast Iron Bracket
Lateral Bracing 6" x 6"
Spacer Block 1" x 1' x 2"
Lower Cord 5 1/2" x 3"
Washer Dia. 3 5/8"
Compression Diagonal 8" x 10"
Fishplate 3 1/4" x 1" x 5'-5"
SCALE 3/4" = 1'- 0"
3 FEET
100 CENTIMETERS
L 13
L 14
POWDER WORKS BRIDGE
SANTA CRUZ COUNTY
CALIFORNIA
SANTA CRUZ
CA-313


Vertical Posts
8" x 7"
Compression Diagonal
10" x 8"
Cast Iron Bracket
Lateral Bracing
6" x 6"
Shear Block
1' x 1' x 4'
Tension Diagonal
10" x 8"
Timber Piers
1'-6" x 11"
Cast-Iron Shoes
Fish Plate
3 1/4" x 1' x 5'-5"
Bolt Dia. 1/8"
Beam
1'-2" x 1'-5 1/8"
Truss Detail End Post, South Side
1/2"=1'-0"
1:24
3 FEET
SCALE 1/2" = 1'-0"
100 CENTIMETERS
L1
L2


NATIONAL CURRENT BRIDGES
RECONDITIONING PROJECT
NATIONAL PARK SERVICE
UNITED STATES DEPARTMENT OF THE INTERIOR
SANTA CRUZ
POWDER WORKS BRIDGE
SPANNING SAN LORENZO RIVER AT KEYSTONE MAY PUBLIC PARK
SANTA CRUZ COUNTY
CALIFORNIA
SHEET 8 OF 9
HISTORIC AMERICAN ENGINEERING RECORD
CA-313
DELINEATED BY: JEREMY HUBBS, BEN SHAKELTON, 2012
6 FEET
SCALE 1/4" = 1'-0"
100 CENTIMETERS
Isometric of Smith Truss
1/4"=1'-0"
1-48


Upper Chord
(4) 1" x 6 1/4"
Lower Chord
(4) 1" x 6 1/4"
Rafters 2" x 4"
Cast-Iron Shoes
1'-1/2" x 7 1/4"
Perspective Cut Away
Purlins 2" x 3"
Corrugated Metal Roof
Joists
3" x 12"
Decking
3" x 12"
Board And Batten Siding
Horizontal Framing
2 1/2" x 8 1/2"
POWDER WORKS BRIDGE
SANTA CRUZ COUNTY
SANTA CRUZ
CALIFORNIA
9 OF 9
CA-313



POWDER WORKS BRIDGE
Spanning San Lorenzo River at Keystone Way
Paradise Park, Santa Cruz, Santa Cruz County, California
UTM: 10.586171.4094182, Felton, California USGS Quadrangle (1991)

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