State of California – The Resources Agency
DEPARTMENT OF PARKS AND RECREATION
BUILDING, STRUCTURE, AND OBJECT RECORD

Primary # ______________________________________
HRI # ____

DRAFT

***NRHP Status Code** 1S

***Resource Name or #** _Mountain Quarries Railroad Bridge

P1. Other Identifier:

***P2. Location:** ☐ **Not for Publication** X **Unrestricted** ***a. County** _El Dorado and Placer

and (P2b and P2c or P2d. Attach a Location Map as necessary.)

***b. USGS 7.5' Quad** ____________ **Date** __________________ **T**___; **R** ___; __ ¼ **of Sec** ___; ______ **B.M.**

c. Address _No Street address, downstream from the State Highway 49 Bridge over the NF American River, El Dorado/Pacer County Line City Auburn Zip_ 95603

d. UTM: (give more than one for large and/or linear resources) Zone _10___;67200___mE/ _4309480__ mN/ Zone 10 667200 mE/ 4306000mN/

e. Other Locational Data: (e.g., parcel #, directions to resource, elevation, etc., as appropriate)

The Mountain Quarries Bridge is approximately 482 feet in length (not including approaches), 15 feet wide and 70 feet high, consisting of three 140-foot solid barrel skew arch spans.

The approximate acreage of the bridge is less than one acre.

The Mountain Quarries Bridge is shown on the Auburn Quadrangle Sheet of the Unites States Geological Survey and is located in northwest corner of Section 12, Township 12 North, Range 8 East, MDB&M.

The approaches to the Mountain Quarries Bridge represent an integral component of the bridge structure. The approaches at either end are built with longitudinal walls carrying a heavy, reinforced concrete slab. The fill and ballast of the approaches rest directly on the slab. Owing to the steep hills on either side of the river, the line could not be properly projected without curves at either end of the bridge, although the angle of skew is 45-degrees with the direction of the flow of the river at the point crossed. Consequently, both approaches were laid out to permit a 16-degree curve in the line at each end. The curve at each end begins at a point directly over the abutment, permitting the line to parallel the river in side-hill cut. The natural topography necessitated the use, in some cases, of very high approach-walls. The latter were all founded on bedrock, and the horizontal slabs at the top were firmly anchored to the rock of the hillside.

From the attached USGS map Auburn Quadrangle, 1953, the UTM References is:

The coordinates are UTM Zone 10 and are based on the WGS-84 ellipsoid (see attached).

Northing	Easting
4308704N	10 669905E

Latitude	Longitude
38-54-45.700000	121-05-29.700000

***P3a. Description:** (Describe resource and its major elements. Include design, materials, condition, alterations, size, setting, and boundaries)

The Mountain Quarries Railroad Bridge was a very early use of reinforced concrete in railroad bridge construction and the largest such railroad bridge in California and the largest of its type owned by a private concern in the nation, at the time it was built in 1912.

The bridge was designed by John B. Leonard, who would become one of California's most renowned pioneers in the design, engineering and promotion of the use of reinforced concrete in California and the nation. Leonard would eventually design over forty-five reinforced concrete bridges and another twenty-five or more reinforced concrete buildings. This was Leonard's first design of a reinforced concrete railroad bridge. It is the only remaining example of a reinforced concrete railroad bridge designed by Leonard.

The bridge design of the Mountain Quarries Railroad Bridge was the earliest form of concrete bridge construction known as the closed spandrel arch bridge. In this form, the closed spandrel arch portion of the bridge includes a solid barrel of concrete reinforced with 1.5 inch twisted steel bars for the arch itself and the vertical sidewalls or spandrel walls. The abutments and piers were formed in a similar manner with the thickness of the concrete box being 18". The cavities created by the spandrel, abutment and pier walls were filled with material, which in the case of the Mountain Quarries

Railroad Bridge was sand and gravel. Finally, the top portion of the bridge roadbed was poured with more reinforced concrete. This portion was also hollow on top and filled with sand topped by limestone.

The significance of the Mountain Quarries Railroad Bridge was recognized at the time it was built. Shortly after it was completed, two different engineering articles were published detailing and emphasizing the design and construction of the bridge.

The Mountain Quarries Railroad Bridge listed on the National Register of Historic Places on February 11, 2004.

It was designated as an American Society of Civil Engineers (ASCE) Local Landmark in 1976 and is currently under review to be designated an ASCE State Landmark.

Continued on DPR 523L Continuation Sheet, Section P3a

***P3b. Resource Attributes:** (List attributes and codes) HP 19 Bridge, AH 7 Roads/trails/railroad grades

***P4. Resources Present:** Building X☐ Structure ☐ Object Site District ☐ Element of District ☐ Other (Isolates, etc.)

P5b. Description of Photo: (View, date, accession #)

***P6. Date Constructed/Age and Sources:**
☐X Historic ☐ Prehistoric ☐ Both

***P7. Owner and Address:**
US Bureau of Reclamation
Attn: Dan Holsapple
7794 Folsom Dam Road
Folsom, CA 95630

***P8. Recorded by:** (Name, affiliation, address)
Hal Hall, President
Placer County Historical Foundation
P.O.Box 3193
Bowman, CA 95604-3193

***P9. Date Recorded:** October 24, 2012

***P10. Survey Type:** (Describe) n/a

***NRHP Status Code** 1S

***Resource Name or #** Mountain Quarries Railroad Bridge

B1. Historic Name: Mountain Quarries Railroad Bridge
B2. Common Name: No Hands Bridge B3. Original Use: Railroad Bridge B4. Present Use: Pedestrian, equestrian, hiking trail ***B5. Architectural Style:** Closed spandrel arch reinforced concrete railroad bridge.
***B6. Construction History:** (Construction date, alterations, and date of alterations) Constructed 1912, repairs to East pier in 1996

***B7. Moved?** X **No Yes Unknown Date:** ______ **Original Location:** ______ ***B8. Related Features:**
B9a. Architect: John B. Leonard, architect and engineer b. Builder: Duncanson & Harrelson
***B10. Significance: Theme** Railroad transportation **Area** Northern California
Period of Significance 1910 to 1942 **Property Type** Railroad Bridge **Applicable Criteria**

CHL Criteria – Architectural landmark, most significant work of master architect.

.______(Discuss importance in terms of historical or architectural context as defined by theme, period, and geographic scope. Also address integrity.)

Mountain Quarries Railroad Bridge is eligible as a California Historical Landmark as an outstanding example of concrete arch bridge construction, by a pioneer architect of reinforced concrete construction. The special requirements of bearing large steam locomotives and enormous limestone blocks across the American River Canyon required a bridge of enormous strength and monumental scale. The period of significance begins with the start of bridge construction and ends with the removal of railroad tracks from the bridge in 1942.

Mountain Quarries Railroad Bridge

- Mountain Quarries Railroad Bridge was the largest reinforced concrete railroad bridge in California at the time it was built.
- Mountain Quarries Railroad Bridge was the "Longest span concrete arch bridge for railroad traffic owned by private capitol" at the time it was constructed. (*Railway Engineering and Maintenance of Way Magazine*, Dec. 1913).
- Mountain Quarries Railroad Bridge was "A relatively rare early use of the material [concrete] in railroading, the bridge was designed to carry the largest locomotive of the day, as well as cars laden with limestone…" (*Building Bridges for the 20th Century*, *California History Magazine*, Fall, 1984.)
- Mountain Quarries Railroad Bridge was designed by a renowned master concrete engineer and designer John B. Leonard. It is the only existing example of a railroad bridge designed by Leonard. (*Building Bridges for the 20th Century*, *California History Magazine*, Fall, 1984.)
- Mountain Quarries Railroad Bridge was listed in the National Register of Historic Places on February, 11, 2004.

B11. Additional Resource Attributes: (List attributes and codes) **HP 19 Bridge**

***B12. References:** See DPR 523L Continuation Sheet for References

B13. Remarks:

***B14. Evaluator:**

***Date of Evaluation:**

(This space reserved for official comments.)

Continued from DPR 523A, Section P3a

In 1910, a railway was the only practical way to move the heavy loads of limestone out of the canyon to market. Building of the mining infrastructure was extensive and costly. At the height of construction the Mountain Quarries Company employed 1,000 men working on the railroad corridor, concrete bridge, crushing plant and quarry. The cost was estimated at $1,000,000.

On March 23, 1912, the railroad opened and full operations commenced. Shortly afterward in July 1912, that the Pacific Portland Cement Company acquired Mountain Quarries Company which continued to operate it as a wholly owned subsidiary.

The Mountain Quarries Company operation would eventually include three "glory hole" quarry pits, extensive tunneling, a crushing plant, several locomotives and a railroad line that ran along seven miles of track, over 17 trestles, and a concrete bridge.

A significant and enduring structure on the railway is a reinforced concrete arch Mountain Quarries Railroad Bridge listed on the National Register of Historic Places on February 11, 2004 (National Register #04000014). The bridge spans the North Fork American River near Auburn California. It was designed by John B. Leonard who was a renowned architect and engineer in the early use of reinforced concrete in the construction of bridges and other structures.

The Mountain Quarries operation ended in 1941 after which the engines and rolling stock were sold. The rail line was abandoned and the tracks removed for the war effort in 1942. The mining operation after World War II continued under different owners who used trucks to haul the limestone. Today, profitable quarry mining continues in the upper portion of the limestone deposit and the old rail line is now an equestrian and hiking route.

Today, the route can be found much the same as it was 100 years ago and it is used for the most part by the recreating hikers and equestrians. The historic integrity of the railroad remains virtually pristine and original. Only a few short portions of the original route have been altered due to construction activities in the Auburn Dam site and river flooding. Because of the lack of modern intrusions, the railroad route today provides an association between the corridor and the limestone mining history of the Mountain Quarries.

The area is currently managed as parklands by California State Parks as part of the Auburn State Recreation Area.

Architectural Description

Summary: The Mountain Quarries Bridge is located approximately a mile east of the City of Auburn across the American River, just downstream from the confluence of its north and middle forks, and immediately downstream from the State Route Highway 49 crossing. Although massive, the arch bridge is plain in appearance but yet possesses a gracefulness that is in perfect harmony with its rugged surroundings.

The Mountain Quarries Bridge is shown on the Auburn Quadrangle Sheet of the Unites States Geological Survey and is located in northwest corner of Section 12, Township 12 North, Range 8 East, MDB&M.

Historic Account and Description of the Bridge: In 1910 the newly formed Mountain Quarries Company of San Francisco, a subsidiary of Pacific Portland Cement Company, contracted the Duncanson-Harrelson Company to construct a railroad bridge to cross the American River just below the confluence of the North Fork and the Middle Fork, near their limestone quarry. The bridge was a single-track structure used for a standard gauge rail, 482 feet from abutment to abutment. The Placer County approach is 72 feet in length, while the El Dorado County approach is 100 feet long, making the overall length of the structure about 650 feet. The bridge is 15 feet wide and 70 feet high with three 140-foot solid barrel skewed arch spans. At the time of its construction in 1911 the span bore the distinction of being the longest span concrete arch railroad bridge owned by a private concern. The heavy Mallet compound engine used by the company along with the weight being carried behind it required the bridge to be carefully designed. It continued to serve as a railroad bridge until about 1940 after which it was used as an equestrian crossing.

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300 men at a cost of $300,000 completed the bridge in two years.

Details of Design: The arch rings of reinforced concrete with a crown thickness of 3 feet, 3 inches have solid spandrel walls also of reinforced concrete retaining the earth fill and ballast. The rough and precipitous nature of the banks of the river necessitated locating both approaches on 16-degree curves and placing the piers and abutments at a skew of 45-degress with the centerline of the bridge. The traffic over the bridge was exceedingly heavy from which many trainloads of quarried limestone were taken out daily.

The decorative detailing is limited to minor incised panel work at the arches and piers and a concrete cap wall. Modern handrails are 2-inch metal pipe approximately 3 feet high on either topside along the entire length of the bridge. The design details of the bridge include the following:

- Arch Rings - The arches, with a span of 140 feet and a rise of 24 feet have a crown thickness of 3 feet, 3 inches and a vertical thickness of 10 feet at the springing line. The main reinforcement consists of 1 ¼ inch square bars 30 feet long spaced 6 inches on center extending well into the abutments and piers.

- Abutments - The abutments with footings 20 feet by 29 feet 8 inches and 3 feet thick are of plain concrete except for a few bars in the bottom edges of footing course to reinforce the 2 feet projections beyond the abutment proper at sides and back. The footings are founded on solid rock and the bottoms are perpendicular to slope of the intrados at the springing. The back of the abutment has a much flatter slope than the back of the arch ring at the intersection of the two.

- Piers - The piers on a 45-degree skew with the centerline of the arches are of solid plain concrete, resting on bedrock a few feet below the streambed. The width at right angles to the axis of pier is 10 feet 11 ½ inches under the coping that projects 1 foot 3 inches. The bottom width is 15 feet 6 inches due to the constant batter of the faces, while the length of piers at bottom is 49 feet 6 inches. A skewed cutwater extending up to the coping is placed at each end of the pier. The coping is 2 feet thick with a 6-inch bevel to the edge at the top. The total height of piers to springing line is 40 feet.

- Spandrels - The spandrel walls have a top width of 1 foot under the coping 21 inches deep, which projects 6 inches. The face of walls are vertical while the backs have a constant batter such that they are 1 feet thick at the top and 3 feet at the deepest part 10 feet above the springing line. The coping is reinforced with four 1-inch horizontal bars; two near the top and two near bottom. At the junction of the spandrel with the back of the arch ring is placed a 1 1.2 inch triangular coursing groove to emphasize the arch ring and hide the construction joint.

  Over piers and abutments the spandrel was is made 1 foot thicker for a length of 13 feet at the face to form a projecting pilaster with an inset panel. The back of this portion slopes the same as the rest of the spandrel wall. These walls are 21 feet high over the haunch backing of the arches. The spandrel walls are entirely separated from these pilasters by vertical expansion joints, the pilasters projecting over the ends of spandrels to hide the joint. The spandrels are 3 feet 11 inches high at the crown of the arches while the spandrel fill is 3 feet 8 inches deep at this point. Three 3-inch drain holes are at each side of the piers and over abutments to drain the fill.

- Approaches - The approaches at either end consist of heavy reinforced concrete slabs carried on longitudinal walls also of reinforced concrete that follow very closely the curve of the track at the approaches in order to keep the span of slab to a minimum. The fill over these slabs is the same as at the crown of the arches and the spandrel walls are also the same.

  The approach at the quarry end of the bridge on the El Dorado County side is considerably longer than the one at the Auburn end. At points where breaks occur in the alignment of the longitudinal walls, cross-walls 1 foot thick, extend from one side to the other. This necessitates two inner cross-walls in each approach not counting the cross retaining walls over abutments. These latter walls are 2 feet thick and reinforced.

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The longitudinal bearing walls of varying height are 2 feet thick with a 3-foot footing course 1 foot 6 inches deep. Eighteen inch 45 –degree fillets are placed at connection of sidewalls with deck slabs.

The deck slabs with an average span of 12 feet are 3 feet thick and reinforced. Where the slope becomes so steep that one sidewall can be omitted and also at ends where slab intersects the ground line, the slabs are rested directly on the solid rock. The nature of the slopes makes a short retaining wall necessary at each end of the bridge, on opposite sides. These walls have a copinng the same as spandrel walls, a vertical face. The tops of all approach slabs are inclined 2 inches toward the longer longitudinal wall to provide for drainage.

Assessment of Integrity: There is something to be said about the stability of the Bridge. Modern bridge builders have constructed no less than three highway bridges upstream from the bridge, and each time torrential floods have ripped the modern bridges out while the Mountain Quarries Bridge remains unscathed by the ravages of the elements. In 1965 the California State Highway Department used the bridge as a detour while a new bridge was being built to replace one washed out in the great flood on the American River in 1964.

In 1975, portion of the old rail route including the span of the Bridge was designated as the Western States Pioneer Express Recreation Trail for equestrian and hiking purposes (see Recreation Section below).

After a few earlier studies in 1969 and 1992 including one in late 1995, the Bureau of Reclamation deemed the Bridge a concern over the its stability should another major flood event occur. However, after careful consideration by the Bureau of Reclamation the U.S. Congress appropriated sufficient amount of money to stabilize and repair the pier foundation that had considerable erosion after 90 years of torrid currents and river floods. The questionable foundation of the left pier underwent repairs in 1998 without any effect to the historical quality or character of the Bridge.

In September 1990, the U.S. Department of the Interior, Bureau of Land Management, issued the American River National Recreation Area Feasibility Study. The Bridge was determined to be a historic site that is nationally significant in the Outstanding Feature section of the study.

In February 1993, the Bureau of Reclamation issued a final report of the American River Water Resources Investigation Technical Team's Inventory and Recommendations for Wild and Scenic Eligibility and Preliminary Classification. This reported included the Bridge as having Outstanding Remarkable Values (ORV) under the cultural section. Prior to this report, in September 1992, the Bridge was a part of a cultural resource survey and based on the various reports and guidelines for ORV's the Bridge met the indicators for ORV designation under the Twentieth Century Era category.

The historical significance of bridge is documented and currently listed on the register of the American Society of Civil Engineers' Historic Civil Engineering Landmarks of Sacramento and Northeastern California. The bridge is also identified in the following records:

- Historic Resources Inventory, Placer County Department of Museums, Auburn, California, June 1992.
- Historic American Engineering Record (Inventory cards), Heritage Conservation and Recreation Services, Library of Congress.

Surrounding Features: The following sections provide further descriptions of the area surrounding the Bridge including the river canyon, area characteristics, landforms, minerals, climate, air quality, vegetation, timber, noise, recreation, cultural features/archaeological and historic sites, bridges, scenic quality, transportation, and landownership and uses.

- River Canyon - The North and Middle Forks of the American River Canyon ("river canyon") are representative of the drainage of the central and northwestern Sierra Nevada mountain range slope. It has a sharply incised, deep, nearly straight river canyon with a low stream gradient and a smooth, gentle regional slope on the ridgelines. The upper portions of the drainage have increased stream gradients and more irregular ridge topography. The rivers flow through long, narrow valleys, being confined by the steep canyon walls that extend some 1,200 to 2,500 feet above the river.

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The river canyon is generally accessible only by paved road and a network of riding and hiking trails. The only access to the bridge is the former railroad grade from either the side of the river canyon. There are two road crossings of the river within this area, State Route Highway 49 and another conventional vehicle bridge both upstream from the Mountain Quarries Bridge near the river's confluence.

- Area Characteristics - The canyon walls move in so that the river canyon becomes a mere hollow with the riverbed varying from 25 to 75 feet in width.

  Vegetation species and density change with almost each bend in the river, with mixtures from small stands of mixed conifer to extensive stands of hardwoods (oak, maple, and bay).

  The north-facing slopes are vegetated with mixed conifer and hardwoods while the south facing slopes support mixed hardwood and brush species.

- Landforms - The canyon lands of the North and Middle Fork of the American Rivers are the western part of the deep; middle reaches of the major Sierra Nevada streams that were formed during the period of erosion that followed the overlying of the range by deposits from volcanic material. This material included ash, andesite mud-flows and other rock flows. Slopes of this area steep, varying from 30 per cent to vertical. The stream gradients are generally low to moderate, and the character of the river canyon faces and slopes vary. In the steeper portions where the exposed rock faces are viewed from the river bottom, it gives an enclosed feeling; when viewed from the canyon rim, it provides a perception of great depth and height.

- Minerals - Metallic mineral resources of the river canyon consist mainly of gold, silver and chrome. Minor amounts of copper, lead and zinc occur in some gold-silver deposits. Most of the gold and silver lode deposits are quartz veins. Placer gold deposits occur in late Tertiary, Pleistocene and Recent gravels.

- Climate - The river canyon have a Mediterranean-type climate marked by warm, dry summers; colder, wet winters; with a fairly large range in daily and seasonal temperatures. Weather varies considerably by elevation and season.

- Air - Air quality within the river canyon is good-to-excellent although there are times when pollutants drift in from the Sacramento valley with the prevailing westerly and southwesterly winds. These winds are also a major influence, which minimize drift of emissions from I-80 to the north into the river canyon.

  The diurnal windflow pattern typical of mountainous regions in which winds flow up drainages during the daylight hours and down in the night-time hours along with prevailing winds being parallel to the drainage helps to "flush" out the river canyon.

- Vegetation - The flora in the two canyons is diverse, interesting and to some extent complex. Geologic variability and climate have combined forces to make the river canyon an interesting mosaic of plant communities.

  The river canyon are considered to be well covered with vegetative types that normally occur in the range of thermic and mesic soil temperature classes and that can also be correlated with aspect and soil types. There are considerable areas of rock and rock outcrops on which little to no vegetation grows. These areas are more extensive on the north canyon walls except where rock slopes and cliffs are predominate on both the north and south sides of the canyon.

  The conifers consist of: digger pine, Douglas fir, incense cedar, jeffery pine, ponderosa pine, sugar pine, California nutmeg, red and white fir. Hardwood species include alder, willow, aspen, big leaf maple, interior and canyon live oak, black oak, California Bay and associated shrubs. Meadows are not common to the river canyon area.

  Except for mining, past uses and activities in and along the river have been minimal and have not contributed in any noticeable alteration of the vegetation. Mining may have had some impact in very small local areas; however, this

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activity took place 40 to 100 years ago and what impact it had on the vegetative composition is not apparent to the average river canyon user at this time.

Poison oak is common to the river canyon area at this elevation.

There are no known findings of threatened or endangered plant species within the river canyon. However, this does not mean that there are none, since the river canyon is within the range of several species on the list.

- Timber - Very little or no timber harvesting has occurred within the immediate river canyon. Most of the timber that has been removed has been along the upper edges of the canyon.

  The steep canyon slopes, inaccessibility, small volumes and scattered timber have all been important reasons for the lack of timber harvest activities within the river canyon in the past. The federal lands within the river canyon continue to be managed for values other than their timber resource.

  With the timber in the river canyon not being a part of a standard timber management component and not expected to be included as such in the future, the average annual potential yield from the federal lands in the area is insignificant.

- Noise - Noise associated with man's activities is limited within the river canyon. It is mainly associated mostly with automobiles and motorcycles, and, to a lessor extent, suction dredges.

- Recreation - The mountains, forests, rivers, streams and lakes of the Sierra Nevada provide a wide choice of recreational opportunities in northeastern California that contribute substantially to the economy of the area.

  Lake Tahoe, Granite Chief Wilderness, North Fork American Wild and Scenic River, Auburn and Folsom State Parks, and the Middle Fork Feather Wild and Scenic River, are recreation attractions of national significance that exist within a 100 mile vicinity of the Mountain Quarries Bridge.

  There are no developed recreation sites at the Mountain Quarries Bridge site.

  A portion of the railroad grade including the span of the Bridge received National Recreational Trail status by the Secretary of the Interior in 1975, pursuant to the National Trails Systems Act. Approximately 50% of the former rail route is utilized as a riding and hiking trail known as the Western States Pioneer Express Recreation Trail (Western States Trail). The trail extends from Beals Point near Folsom, California, to the Tahoe National Forest near Foresthill, California. The United States Forest Service plans include designating the Western States Trail as a National Recreational Trail to Squaw Valley. It is possible that the remaining portions of the rail route could become functional and expanded for the aforementioned forms of recreation. The designation has provided trailhead type facilities in the area as well as improved trail access and maintenance. In addition, this portion of trail is part of the proposed American Discovery Trail.

  The Rails-to-Trails Conservancy, an organization that promotes the conversion of abandoned rail corridors to trails in the United States, added the railroad grade including the bridge span to their popular directory of existing rail-trails, American's Rail-Trails in 1992.

  All recreation use in the area is in a dispersed form. This use is in close proximately of the bridge is mostly dependent upon the existing trail access into the river canyon.

  The limited access restricts the types of use, as well as the levels of use in the river canyon near the Bridge.

  Although the area has never been sampled for recreation use, the following is a general estimate of existing activities within the river canyon:

  - Fishing

- Recreational Mining
- Motorcycle Use
- Hiking, running and backpacking
- Hunting
- Horseback Riding
- Overnight Camping
- Swimming
- Rafting and kayaking
- Viewing Scenery
- Nature Study
- Enjoying Unusual Environment
- General Knowledge and Understanding

Use is generally found only along the corridor on each side of the river canyon and mostly in the bottom of the canyon and along the Western States Trail and other network of trails leading into and out of the canyon.

Activities vary depending upon accessibility to the river canyon. Use in the rugged forges is limited to gorge scramblers and a few hardy fishermen who enjoy this unique environment. In portions of the river canyon with gentler terrain and better trail access, a wider variety of uses are found.

The Bridge is also a portion of the historic, but grueling, Tevis Cup Western States 100 Mile One Day Ride and the Western States 100-Mile Endurance Run, held annually from Squaw Valley, California to Auburn, California.

It is recognized that many factors could affect recreational use in the future; a continuing drought or increasing fuel shortages would undoubtedly tend to decrease future use. On the other hand, increases in the local population, improved access, additional trails or increased publicity may increase the use in the area.

- Cultural Features/Archaeological and Historic Sites - According to ethnographic accounts, the southern Maidu inhabited the American River area. Before the Europeans arrived, there were several thousand southern Maidu occupying the grasslands and foothills of this region. Like other foothill Sierra groups, they migrated on a seasonal basis from west to east. In the spring and continuing through the summer, they would move up into higher elevations, where they built temporary encampments. During this time, they gathered a variety of seasonal plants, fished, and hunted game that was not available to them at lower elevations (Sanborn 1974).

The geographic distribution and frequency of sites shows a pattern of limited or temporary settlement of the river canyon. This pattern coincides with other accounts that indicate that the peoples of the western Sierra foothills migrated to the higher elevations during the summer months and occupied the ridges instead of the canyon.

During the heyday of the Gold Rush era, there were several thousand people living in the river canyon. Evidence of this activity is found in the remnants of old flume benches and ditches that carried the water from tributary streams. In places where the rivers may have been diverted for this purpose, the heavy spring runoff and floods have obliterated most, if not all, of the evidence.

The historic sites near the Mountain Quarries Bridge are related in some way to the various periods of gold mining in the respective river canyons. Evidence of past mining operations may consisted of stamp mills, compressors, adits and related items used by miners in that era. All of this equipment was brought down into the canyon in pieces by animal (mule, oxen or by horseback) or skidded and then assembled.

The following gold rush sites along the American River are located within a few miles of the Mountain Quarries Bridge:

- Louisiana Bar
- New York Bar

- Murderer's Bar
- Mammoth Bar
- Junction Bar
- Tamaroo Bar

The archeological site of Hawyer's Cave is a few miles away at the former quarry site near New York Bar.

- Bridges - There are two conventional automobile bridges over the North Fork of the American River that are upstream from the Mountain Quarries Bridge. Neither the location nor the scale of these other bridges detracts from the setting of the Mountain Quarries Bridge. The proximately of these conventional bridges to Highway 49 merely facilitates public access to and appreciation of Mountain Quarries Bridge. These bridges do not fall within the period of significance and are not in keeping with the character of the Mountain Quarries Bridge.

- Scenic Quality - The area surrounding the Mountain Quarries Bridge comprises some of the most spectacular and distinctive gorges and canyon lands found within the middle Sierra Nevada Region. The high scenic quality of the river canyon is derived from an unusual diversity of landforms, rock formations, vegetative patterns and water characteristics. The arrangement of natural features within the river canyon creates a variety of unusual landscape settings.

  The canyon bottom, moderately narrow and mildly curving, permits open views of the large-scale, steep canyon walls composed of olive green patches of brush and oak interspersed with gray rock outcrops. Major lateral canyons and ridge lines form dramatic diagonal lines that descend to the canyon bottom and create additional visual interest and a primary focus of attention.

  The river canyon is nearly linear in configuration, with the viewer observing broad-scale open vistas of the river and canyon walls that show broad, uniform slopes. Vegetation patterns show a degree of landscape variety that is common to much of the Sierra Nevada region. The river canyon bottom offers considerable variation in width, shoreline and water flow characteristics.

  Evidences of man's past activities are generally not apparent to viewers from the river. Except for the Bridge in the river canyon and occasional glimpses of the old trails that parallel the river or canyon wall virtually all of the structures, and some of the mining machinery and other past disturbances have been grown over and/or screened by dense vegetation.

  The scenic value of the river canyon near the Mountain Quarries Bridge can be realized by considering the variety of vegetation; the numerous, deep, blue-green pools separated by the rapids and riffles of white water; the gorges and bluffs; and, the occasional view of the higher mountains in the background. These all combine to create the unique scenery along the Bridge.

- Transportation - Although transportation to the river canyon near the Mountain Quarries Bridge is gained by way of State Route Highway 49, the terrain has been the major deterrent in limiting access within the rest of the river canyon to the Bridge.

- Land ownership and Uses - The Mountain Quarries Bridge is in federal ownership (100%). Specifically, the United States Bureau of Reclamation is the federal owner and the California Department of Parks and Recreation now manages land for recreational purposes as part of the Auburn State Recreation Area.

  There are no electric, gas or oil lines within or along Mountain Quarries Bridge area; however, there is a Pacific Telesis telephone line buried in the earth-filled portion of the bridge. The line is not visible and has no effect to the historical quality or character of the Bridge.

Master Architect: John Buck Leonard

(Condensed from the Historic American Engineering Record - Chili Bar Bridge, 1993)
John Buck Leonard was the youngest of three children, born to Joseph C. and Martha (Haynes) Leonard in Union City, Michigan in 1864. After an education in Union City schools, Leonard studied engineering at Michigan State, Illinois University and the University of Michigan. In 1888, he travelled to Los Angeles where he gained a position in that city's Engineering Department. In 1889, he moved north to San Francisco, the city that was to be his home for the rest of his life.

During the early 1890s, Leonard worked for several engineering firms as a civil engineer. In 1897 to 1899, Leonard opened his own business in concrete and artificial stone contracting. In 1904, he opened his own office as a consulting civil engineer.

In May 1905, Leonard's letterhead proclaimed his work to be "Reinforced Concrete and Structural Steel". In 1905, Leonard won a competition for his first reinforced concrete bridge. He was retained to execute the engineering design for what was billed as the largest reinforced concrete building in the world. Perhaps most important was the beginning of publication in May 1905 of Architect and Engineer of California. From 1905 to 1912, Leonard was the magazine's Associate Editor for Reinforced Concrete. Thus, simultaneous events found Leonard achieving recognition of his design skills as evidenced by his commissions, acquiring a lucrative marketing agency, and gaining a vehicle in which to expound his views as a proponent of reinforced concrete, on building code revision, on building inspection and in which to illustrate his own designs.

Leonard gained his first reinforced concrete bridge commission to design a new bridge across the Truckee River in Reno. The bridge, virtually unmodified today, was erected in 1905 as a two-span, filled-spandrel arch, originally carrying two traffic lanes, two sidewalks, and a center streetcar track. Illustrative of Leonard's subsequent bridges, even in this first example the gracefully proportioned arch rings spring to a remarkably thin section at the crown. Moreover, in keeping with the bridge's urban setting, Leonard chose Beaux-Arts detailing in the form of decorative railing and lighting elements.

Shortly thereafter, Leonard had three commissions: the San Joaquin River Bridge at Pollasky near Fresno, the Dry Creek Bridge at Modesto and the Stanislaus River Bridge at Ripon. These San Joaquin Valley bridges demonstrated well Leonard's competence of design and his daring use of a technology and material in which he so strongly believed. The Pollasky Bridge incorporated ten 75-foot spans in a stately march across the bed of the San Joaquin River; and while individual span length was less than at Reno, its composite length made Pollasky the longest reinforced concrete bridge in the United States at that time. At Dry Creek and Ripon, Leonard's designs were noteworthy for their individual span lengths, 112 and 110 feet respectively, with the Ripon Bridge employing two spans.

At this same time, Los Angeles architect Charles Whittlesey engaged Leonard to prepare the engineering design for his Temple Auditorium in Los Angeles. Whittlesey, never overly modest with regard to his own work, termed the structure "...in some respects, the most remarkable building ever erected of this material." Reinforced concrete is used throughout the nine-story building. Leonard's engineering provided reinforced concrete girders up to 42 feet in length, carrying a concentrated center load of 100 tons each. However, it was in the design of the auditorium itself that Leonard excelled. This space then the largest theater west of Chicago measured 165 by 110 feet and seated 3,500 with provision for seating an additional 1,500 for special events. In order to provide the best possible sight lines, Leonard carried the auditorium's enormous balcony on huge reinforced concrete cantilevers, so that there were no supporting columns to obstruct from seats on the main floor below. Moreover, to cover the auditorium Leonard designed a reinforced concrete roof carried on reinforced concrete trusses having a clear span of 110 feet.

On May 11, 1906, they published a notice in Bay Area newspapers calling a meeting of engineers to "...intelligently observe and analyze the structural effects (of) the recent earthquake and fire...for exchange of data...to lead to, a concert of opinion as to future practice." The group, 100 strong, met on May 17, 1906 to form the influential Structural Association of San Francisco. This organization eventually included most engineers, architects, builders and contractors in the Bay Area. The stated purpose of the Association was "...investigation and discussion of earthquake and fire phenomena in San Francisco, and the formulation of conclusions as to the manner in which the best types of building construction should be modified to conform to these observations." Subsequently, Leonard was appointed to head the Subcommittee on Reinforced

Concrete, and to membership on the Executive Committee. These appointments were proof of Leonardo personal and professional standing with his peers.

In addition to his role with the Structural Association, the Board of Trustees of Stanford University retained Leonard, along with engineer John D. Galloway and architect Henry A. Schulze to inspect earthquake damage to the University and to recommend the best means of reconstruction to provide an earthquake and fire proof campus. This was yet another tribute to Leonard's professional status, as Stanford's engineering faculty and school were second only to the University of California within the state.

The post-earthquake period in San Francisco produced a hiatus in Leonard's bridgework as the engineer found his services in great demand for building design. By September 1907, Leonard had undertaken the reinforced concrete design for more than a score of San Francisco buildings. In the design of at least two of these buildings, Leonard found himself in association with leading architects. In 1906, he executed the design of the Sheldon Building, one of San Francisco's first large reinforced concrete buildings. The structure, with a terra cotta exterior, was built in 1907 and was the produce of architect Benjamin G. McDougall, himself an important early user of reinforced concrete. Also in 1906, Leonard handled the engineering of the MacDonough Estate Building for architect William Curlett. This seven-story structure, whose facade was finished in a stucco mixture of marble dust, cement and sand, was completed in less than six months, attesting to Leonard's claims of the ability of reinforced concrete to provide the investor a completed structure more quickly than any other material

Leonard's building designs in 1906 also appeared outside San Francisco. In Oakland, he again teamed with McDougall in the design of the Hotel St. Mark. This nine-story building of eclectic design provided the engineer with yet another chance to highlight the design and construction possibilities of reinforced concrete. Leonard chose flat slab design with supporting beams between columns in order to facilitate rapid construction. Careful placement of reinforcing provided all-important monolithic continuity to the structure. Leonard also successfully handled such design difficulties as a spiral stairway to the basement and a circular stairway to the orchestra balcony, both executed in reinforced concrete. The building, whose reinforced concrete construction was selected as a result of the earthquake and fire in San Francisco, was hailed as combining "...aesthetic appearance and excellence of design with stability of construction."

In Salinas, the owners of the Ford and Sanborn Department Store chose Leonard to design a building to replace their earthquake-damaged store. The building was designed by Leonard, and its straightforward, unornamented use of reinforced concrete exterior and unobstructed, spacious interior marks an early awareness of the potential of the material to express its own characteristics. The unadorned, planar surfaced, broken only by the broad display windows marks a design well ahead of its time, presaging the International Style.

Around 1905, Leonard was at the forefront of his profession in the field of reinforced concrete in California. A foreword to one of his articles termed him "...the coast's foremost authority on reinforced concrete construction."

Leonard embarked upon another facet of his consulting career, this time as engineer for the Western Inspection Bureau. This role brought Leonard into contact with still more major architects, making them aware of the engineer's skills and versatility, and reinforcing Leonard's belief of the need for close interaction and cooperation between architect, engineer and contractor.

At this same time, Leonard took advantage of opportunities to speak to architects and other audiences apart from his San Francisco colleagues. Attending the 15th Annual Irrigation Congress in Sacramento in 1907, Leonard was interviewed by the staff of the Sacramento Union, who introduced him to readers as "...one of the best known authorities on the Pacific Coast in reinforced concrete..."

The hiatus in Leonard's bridgework ended in late 1907 as the engineer, his reputation boosted by his building design and publication work, found time to return to the structures that remained his prime interest. He quickly undertook a number of commissions, designing a pair of bridges that were built in San Luis Obispo in 1909. The same period saw him win a competition for a group of five bridges in Ross, Marin County, and for another bridge in nearby San Anselmo. As at Reno, he used Beaux-Arts detailing to produce bridges quite in keeping with the architecture of what was, even then, an exclusive suburb of San Francisco. It was at this time that he designed the Gianella Bridge, one of only two steel bridges that can be credited to him.

The year 1911 climaxed Leonard's design work with the filled spandrel arch bridge. Fernbridge crosses the Eel River south of Eureka in northwestern California with seven 200-foot spans. Monolithic abutments aid it in withstanding heavy winter runoff and the battering-ram effects of large logs washed away from upstream mills. Similarly, each of the bridge's massive piers is founded on 250 piles and pier cutwaters shaped like ships' prows reduce stream restriction and deflect debris. Since its construction, Fernbridge has met the river on its own terms. In 1955 and 1964, when the Eel and its tributaries destroyed many newer bridges upstream and obliterated entire towns, Fernbridge stood as if an extension of the bedrock itself. Indeed, during the 1964 floods, water level was almost up to the deck and a large jam of debris lodged against the upstream side of the structure. With the bridge vibrating from the current and from repeated blows of debris, workers resorted to dynamiting the jam. Fernbridge survived both debris and dynamite, and continues to carry traffic today* It has been designated a National Historic Civil Engineering Landmark by the American Society of Civil Engineers.

In 1911, he completed a reinforced concrete railroad bridge design across the American River near Auburn for the Mountain Quarries Company. The structure, designed to carry the largest locomotives of the day as well as cars laden with limestone, is composed of three 140-foot spans towering above the river. Due to the engineering difficulties inherent in the restricted canyon site, the bridge had to be skewed rather than crossing the stream at the preferred right angle. Leonard met the requirement with a bridge that proved to be fully twenty percent cheaper than a steel structure designed for the same site. Like Fernbridge, the Mountain Quarries Bridge was designed for permanence. With its tracks removed during World War II, the bridge has stood unmaintained in quiet abandonment. Yet, in the 1960s, it was pressed into emergency service as a vehicular bridge when floods washed out the highway bridge a few hundred yards upstream.

Also in 1911, Leonard met the requirements of civic officials of the Oakland suburb of Piedmont, who wanted a bridge out of the ordinary. For the second time Leonard retained a consulting architect, this time Oakland architect Albert A. Farr. The collaborative result was a bridge far more architectonic than any other Leonard designed. To the graceful 130-foot arch of Leonard's design, Farr added details to give the town a bridge in the Mission Revival style, then at its height. Tile-roofed pylons at each end of the structure featured ornamental lights, while intermediate kiosks, supported by concrete columns and capped "...in the regulation manner with Spanish S tile...," provided shelter for pedestrians. Corbelled arches carried sidewalks along the bridge's flanks.

In 1913, Leonard and junior partner W.P. Day published *The Concrete Bridge*. In it, they reiterated all of Leonard's arguments for concrete bridges and invited inquiries from their readers. In addition to economy and strength, the book stressed other qualities that served to make the reinforced concrete bridge desirable. Aesthetically, it offered "...conformity with environment...pleasing outline and appropriate use of ornament..." And beautiful bridges," Leonard wrote, "...are a sure indication of a progressive community." The use of California products—cement, sand, gravel and reinforcing steel—negated the often-lengthy wait for Eastern materials associated with steel bridges. Of course, Leonard also addressed the need for careful and competent design. Profusely illustrating Leonard's bridges, and in the tradition of a builder's catalog, the book represented a unique step for a consulting engineer to have taken and underscores Leonard's drive and salesmanship for his products and services.

Leonard at this time began designing "Canticrete" bridges. Essentially, the "Canticrete" bridge utilized a cantilever steel truss to provide sidewall and floor substructure. Steel reinforcing bars were placed following erection of the truss and the entire structure was then encased in concrete. The cantilever was self-supporting during construction, keeping falsework and its attendant costs to a minimum. Due to the strength of the truss, less reinforcing steel was required, and sidewalls and floor could be thinner in section, using less concrete. Records indicate that Leonard designed at least eleven "Canticrete" bridges between 1914 and 1921. Of this number, only three remain, one each in Monterey, Yuba and Stanislaus counties. After 1921, Leonard returned to more conventional reinforced concrete bridge designs.

In 1921, Leonard undertook yet another project that was to have great impact on California transportation. Aware of tests proposed in Illinois and Virginia by the U.S. Bureau of Public Roads, Leonard approached W.E. Creed, President of Columbia Steel Company at Pittsburg, California. Leonard proposed to build a concrete test highway to study types and thicknesses of concrete surfaces, reinforcement and adobe soil subgrades peculiar to California. The result was a 1,371-foot oval, 18 feet wide, utilizing 13 sections of various types of concrete pavements. Initially the only direct government involvement was the supplying, by the State, of 40 surplus trucks. Four tunnels under the track contained instrumentation devised by Leonard to record slab flexure. By the time the tests ended in 1922 after two seasons, the trucks had rolled the equivalent of 80 continuous days, subjecting the highway to an accumulated load of 7.36 million tons. The results of the test were provided to the California Department of Public Works in an exhaustive illustrated report. The agency put the data to immediate use, and Leonard's project is credited with giving California's highway program its first great impetus on its way to becoming, by the 1960s, the acknowledged finest such system in the world.

Between 1921 and 1926, Leonard prepared designs for at least nine bridges, of which six were built between 1922 and 1925. In 1921, he designed a three-span open spandrel arch bridge to cross the Russian River at Healdsburg, marking his first use of the fully open spandrel type. Leonard designed a three-span open spandrel bridge at Chili Bar on the American River near Placerville the same year. With its longest span measuring only 114 feet, the Chili Bar Bridge was not noteworthy in terms of scale. Yet the open spandrel design, lighter in feeling than that of the earlier bridges, represented a refinement of the aesthetics long espoused by Leonard.

Humboldt County turned to Leonard for a series of five bridges in the rugged Van Duzen River canyon. The first two were built in 1922 at Upper and Lower Blue Slide. Two-span open spandrel arches, they had span lengths of 207 feet. Like the Chili Bar Bridge, these structures traversed their setting gracefully, respecting it without overwhelming it, recalling Leonard*s notion of "conformity with environment," The fine proportions seen in all of Leonard's designs reached maturity here. Leonard built the remaining bridges over the Van Duzen in 1925. Two of these bridges were totally unique among all of Leonard's designs. These were the bridges erected at the Upper and Lower Blackburn Grade Cutoff. With the road virtually at river level at these points of crossing, the use of a deck arch was not practicable. Such a design would have meant arching the deck to allow sufficient stream clearance and flow beneath the bridge. This in turn would have produced an unacceptable vertical curve in the deck resulting in lack of sight distance for the motorist—a hazardous situation. Leonard thus chose a design that carried the roadway between gracefully soaring arch ribs. Instead of being supported from below, the deck was suspended from the arch above. Again, the engineer provided a suitable engineering solution while meeting his principles of bridge aesthetics.

The mid-1920s were a busy period in Leonard's career. In addition to marking the culmination of his bridgework, the period also saw him return to the position of Associate Editor for Reinforced Concrete for Architect and Engineer in 1924. Now the main thrust of his attention was given over to inspection.

Leonard's continuing efforts to improve codes and inspection, as well as his high professional standing, did not go unnoticed. In February 1928, San Francisco City Engineer M.M. O'Shaughnessy sent a letter to Mayor James ("Sunny Jim") Rolph recommending Leonard's is appointment as the city's chief building inspector. O'Shaughnessy stated, "He ranks highly as a structural engineer." On May 17, 1928, the Board of Public Works appointed Leonard to the position of Chief Building Inspector. When he retired in August 1934 at age 70, Architect and Engineer noted he had served the city well.

While his retirement years found Leonard generally removed from an active design role, he remained active in an advocacy role, continuing to pursue and support code and inspection improvements and improved interdisciplinary relations. In 1928, he had become involved in a movement to establish a California Uniform Building Code. This was undertaken by the California Development Association (later the California Chamber of Commerce).The aim was to standardize materials and construction and to foster sound building statewide, and to eliminate the plethora of divergent municipal laws. When the draft was ready in mid-1933, Leonard had become Vice-Chairman of the Executive Committee on Building Code Revision. The following year he was appointed Chairman of the Building Code Committee of the Structural Engineers Association of Northern California, a group he had helped to found in 1930 to establish high standards for the profession and to seek professional licensing for engineers in California. He continued to hold the Association's post until the Code was ready for adoption in 1937.

Finally, Leonard's last known work was in 1942 when, probably due to a wartime shortage of engineers, he designed buildings for United Engineering Company in Alameda.

John Buck Leonard died in San Francisco on February 16, 1945 at 81 years of age. His legacy includes 47 known bridges designed throughout California (and Nevada), all but three of which were of reinforced concrete, as well as more than a score of reinforced concrete buildings. His aesthetic precepts, set forth in The Concrete Bridge and in his other writings, had influenced State bridge design, while his test highway work had formed the basis for the development of the state highway system. His was a legacy also of improved building codes and regulations, design principles and interdisciplinary cooperation. He had helped lead California from the traditional building practices and casual regulations of the 19th century into the innovative technology and codified practices of the 20th century.

Resource Name or # Mountain Quarries Railroad Bridge

***Recorded by** ______ *Date ______ ☐ Continuation ☐ Update

Historic Context: Mountain Quarries Mine and Railroad

The Mountain Quarries Company was incorporated in the State of California on August 8, 1910, with the main purpose of quarrying limestone on the south side of the Middle Fork of the American River, in El Dorado County. The company constructed a railroad that connected its limestone quarry operation in El Dorado County two miles north of Cool, to Auburn in Placer County, along the Middle and North Forks of the American River. In July 1912, after the completion of construction, the Pacific Portland Cement Company purchased the Mountain Quarries Company.
The western terminus of the railroad was at Flint Station alongside the Southern Pacific main line. The railroad is approximately 7 miles long. There were 17 trestles on the railroad, one of which was nearly a 100 feet high. The railroad had an average 4 % grade with a 1,100 feet elevation change. The upper portion of the railroad was as steep as 5% and required the use of powerful locomotives. It took about 30 minutes for the empty train to go from Auburn to the quarry and longer fully loaded to come back out. The railroad tracks were removed in 1942 during World War II to be recycled for use in the war effort.

Historic Account and Description:

The limestone deposit at Mountain Quarries was a large lens of gray limestone of which a substantial part had been eroded by the Middle Fork American River in forming its canyon. In 1910, the newly formed Mountain Quarries Company of San Francisco, later a subsidiary of Pacific Portland Cement Company, began the "glory-hole" method of mining at Mountain Quarries where limestone was blasted off the steep sides of the quarry and dropped down through a chute or glory hole to a tunnel that ran beneath the quarry. The limestone was loaded into ore cars inside and brought outside to the crushing plant.

The Mountain Quarries Company's quarry and plant was located in El Dorado County, five miles east of Auburn, Placer County, California. Transportation of the crushed limestone to the kilns at Cement, California, in Solano County, was accomplished by use of the Mountain Quarries private railroad to Auburn and then via the main line of the Southern Pacific. The construction of this railroad was notable because it was necessary to build one of the largest privately owned reinforced concrete railroad bridges in the United States in order to cross the American River.

In 1912, the reinforced concrete Mountain Quarries Railroad Bridge across the American River was completed. John B. Leonard, an architect and engineer in the use of reinforced concrete, designed the bridge. The bridge was designed to be strong enough to carry the largest locomotives of the day as well as cars laden with limestone. Leonard convinced Mountain Quarries Company to use reinforced concrete in the design of the Mountain Quarries Railroad Bridge versus other conventional steel or wood bridge applications. Leonard was an early advocate of reinforced concrete as a building material in bridges and buildings, which was considered experimental because its relatively rare use up to that point. Due to the engineering difficulties inherent in the restricted canyon site, the bridge had to be skewed rather than crossing the river at the preferred right angle. Leonard met the requirement with a bridge that proved to be 20% cheaper than a steel structure designed for the same site.

The historical significance of the Mountain Quarries Bridge is documented and currently listed on the register of the American Society of Civil Engineers' Historic Civil Engineering Landmarks of Sacramento and Northeastern California. In addition, on February 11, 2004, the Mountain Quarries Bridge was listed on the National Register of Historic Places (National Register #04000014). Both registers recognize John Leonard's engineering landmark accomplishments in the use of reinforced concrete in bridge building.

In May 1911, the Mountain Quarries Company contracted with the Palmer, McBride & Quail Company to construct a standard gauge railroad from the quarry in El Dorado County to Flint Station one mile south of Auburn. The railroad was a single-track design, standard gauge rail and able to carry a heavy Mallet compound engine weighing over 230,000 pounds and 60-ton limestone loaded cars used by the company. Up to 1,000 men, at a cost of $1,000,000 (about $25 million in 2014 dollars), were used to complete the railroad, bridge and preparation of the quarry and plant in less than one year from May 1911 to March 1912.

From 1912 to 1941, the Mountain Quarries Company operated the railroad from the limestone quarry. Trains operated between the quarry and the Southern Pacific main line in Auburn, California. At the Highway 49/Georgetown Road crossing, the Mountain Quarries Railroad was one of the few railroads that actually had to yield to automobile traffic, instead of the other way around. The only major modern day crossing is State Highway 49 about a mile west of the quarry.

On July 5, 1941, the press announced the official closing of the quarry plant and that 150 to 200 men would be without jobs. Starting in late 1941, the locomotives and some of the machinery were removed and sold. In 1942, the tracks were taken up for the WWII metal recovery effort.

Mining Operation:

Glory Hole Method of Mining:
•Mountain Quarries Mine was a rare example in the United States of large-scale mining of limestone by the "glory hole" method (Mountain Quarries Railroad 100 Year Anniversary 1912-2012, Special Anniversary History Publication, Placer County Historical Foundation, March 2012).
•Mountain Quarries Mine is the only remaining example of the use of the "glory hole" method of large-scale mining of limestone in California. Quarrying Limestone by Glory Holes, Engineering and Mining Journal-Press, July 4, 1925.)

The Mountain Quarries Company began full-scale "glory hole" type of mining in 1912. This operation included extensive tunneling, a crushing plant, repair shops and eventually three glory hole quarry pits.
The glory hole method of mining is where limestone was blasted off the steep sides of the quarry pit and dropped down through a funnel chute or glory hole underground to an adit tunnel running beneath the quarry.
The glory hole method of mining limestone is very rare in the United States. An extensive U.S. Department of Commerce report in 1926, Underground Limestone Mining, found that 95% of all limestone production came from open pit mines and 5% from underground mines, including glory hole mines. The report also identified that there were only three glory hole limestone mines in the US. Of these three, only two used locomotives in their operation. The third operation was probably very small scale as it used hand hauling. This report would indicate that the Mountain Quarries mine was one of only two large-scale limestone glory hole mining operations in the U.S. before 1926 and as such, it may well have been the first such limestone mine to use the glory hole method. Unfortunately, the name and startup date of the other large-scale glory hole mining operation was not identified in the report, so it was not possible to determine which mine held the distinction of being the first limestone glory hole mine in the nation.

The Mountain Quarries operation eventually had three glory holes that connected underground with a 1,800-foot south-extending adit tunnel. The adit entered the hillside at a point about 70 feet above the river. The glory holes had nearly vertical sides and were worked to a depth of about 600 feet. Limestone was quarried to within a few feet of the edge of the lens. This practice prevented the walls from caving, as the limestone is much more rigid and tenacious than the surrounding volcanic rock. The quarry pits cut directly into and across a high steep ridge. In later years, the surface overburden was removed by steam shovels and the material was removed utilizing several two-ton dump cars pulled by a six-ton Milwaukee L-30 locomotive on a 24" gauge track about a half-mile long. Stone was blasted from the quarry faces, dumped down the raises to chutes and then to six-ton cars in the adit. The cars then moved out the adit by attaching to a continuous steel cable to the crushing and sizing plant. The surface overburden was removed by a Marion No. 36 steam shovel (1 ¾ cubic year bucket) mounted on caterpillar tractors. This shovel was also used in cutting out the top of the deposit in preparation for the glory hole work.

The glory hole pit was opened out by rows of holes drilled concentrically about the raise. These holes were 20 feet in depth, 6 feet back from the face, and spaced 5 to 6 feet apart. They were drilled vertically and blasted in groups of four or five at one time. The holes were generally charged to within 3 feet from the top and, 14-foot electric exploders were used. In solid ground, the primer was placed approximately 6 feet from the bottom of a 20-foot hole and proportionally in holes of lesser depth. In broken ground, two primers were used separated a few feet for safety. A 120-volt current was used from a line for exploding the blasts. Only powder men handled the powder, and group blasts were shot by the powder foreman.

The rock hauled out by the six-ton cars from the bottom of the glory hole went to the crusher, where it passed through a No. 9 crusher into a 60-inch x 10-foot screen; then into bins, and from there it was drawn through two No. 6 crushers, distributed into the conveyor belts and carried a distance of 425 feet to bunkers. Three sizes; 2½ inch, plus 2½ inch minus 4 inch, and plus 4, minus 8-inch were produced. The capacity of the crusher plant was 1,500 tons per day.

After crushing, the limestone was then loaded on railroad cars for transportation. The 2½ inch rock was shipped to the Pacific Portland Cement Company cement plant in Solano County while the coarser sizes were shipped to sugar refineries and smelters.

Limestone Production:
•Mountain Quarries Mine was the largest limestone quarry in Northern California (California Journal of Mines & Geology, July 1947.)
•From 1912 through 1930, the Mountain Quarries Mine quarry was one of the chief sources of limestone for cement, sugar, and steel industries in northern California. (California Journal of Mines and Geology, July-October, 1954.)

The primary use of limestone from the Mountain Quarries was to manufacture cement. Cement, sand and gravel are the main ingredients for producing concrete. One of the other main uses of limestone from the Mountain Quarries involves the manufacturing of sugar. The refining process to extract pure sugar from beet or cane juice uses milk of lime, made from the purest quality of limestone like that from the Mountain Quarries. Unwanted minerals and other impurities bond with the milk of lime, forming a precipitate that deposits out and then is removed from the sugar syrup before it is crystallized. Limestone is also used in iron and steel processing to remove impurities.

Peak limestone production at the Mountain Quarries varied from 1,200 to 1,500 tons on average per day. At its height, from 140-200 men were employed by the Mountain Quarries Company.
The Mountain Quarries produced a great quantity of limestone, especially in the period between 1912 to1930. Based on a U.S. Department of Commerce 1926 report Underground Limestone Mining, the Mountain Quarries would have been one of the largest, if not the largest, underground limestone mining operation in the nation at the time.

The following is the production reported during representative years;

Year	Tons per year	Average tons per day	Total lbs./year
1914	330,000	1,200	660 million
1925	550,000	1,500	1.1 billion
1934	125,000	360	250 million
1939	180,000	500	360 million

Using these reported numbers as an average for each year in the same decade, the Mountain Quarries during its 39 years of operation produced an estimated 9.1 million tons or 18.2 billion pounds of limestone. The estimated production cost per ton for limestone mining during the 1920's was $.60-$1.00 per ton or about $7.75-$13.00 per ton in 2012 dollars. This would indicate up to $9 million total production costs at the time or up to $115 million in 2012 dollars. Assuming the retail value of the limestone was at least double the production costs, the profit may have been a similar amount say $115 million or nearly $3 million a year in 2012 dollars. The significant operations of the Mountain Quarries had an important monetary and fiscal impact to the local, regional and state economies.

All-Electric Operation:
•The Mountain Quarries Mine was an early example of an all-electric limestone mining operation with power supplied by Pacific, Gas and Electric Company (PG&E.). (Pacific Gas and Electric Company bulletin Vol. III, November 1911.)

Electrical power was supplied by Pacific, Gas and Electric (PG&E) Company to the Mountain Quarries mine via a connected load of over 800 horsepower. 325 horsepower was for compressors, 300 horsepower for crushes. The remaining total went for electricity for hoists, blowers, pumps, and small motors. A 60 KV sub-station, with three 125 KW Stanley transformers and a fourth 125 KW transformer for spare, was located close by the plant, and was fed by a regular “high” line. The line was so high that the wires at the center of some of the half-mile spans could hardly be seen from the ground. This line taped PG&E's Alta Sacramento line at the Auburn sub-station.

The Mountain Quarries all-electric mining operation was touted by PG&E, who published a five-page article about the Mountain Quarries in the February 1922 edition of their Pacific Service Magazine.

Resource Name or # Mountain Quarries Railroad Bridge

***Recorded by** ____________ *Date ____________ ☐ Continuation ☐ Update

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