



*Waikale Canal Bridge, 2012
David Franzen, Hawai'i State Archives*

HONOLULU AUTHORITY FOR RAPID TRANSIT
EDUCATIONAL FIELD GUIDE
HISTORIC RESOURCES :
**EARLY TRANSPORTATION &
BRIDGES**

INDEX

MAP AND INTRODUCTION

KE 'AWA LAU O PU'ULOA

EARLY TRANSPORTATION

LATE 19TH AND EARLY 20TH CENTURY TRANSPORTATION

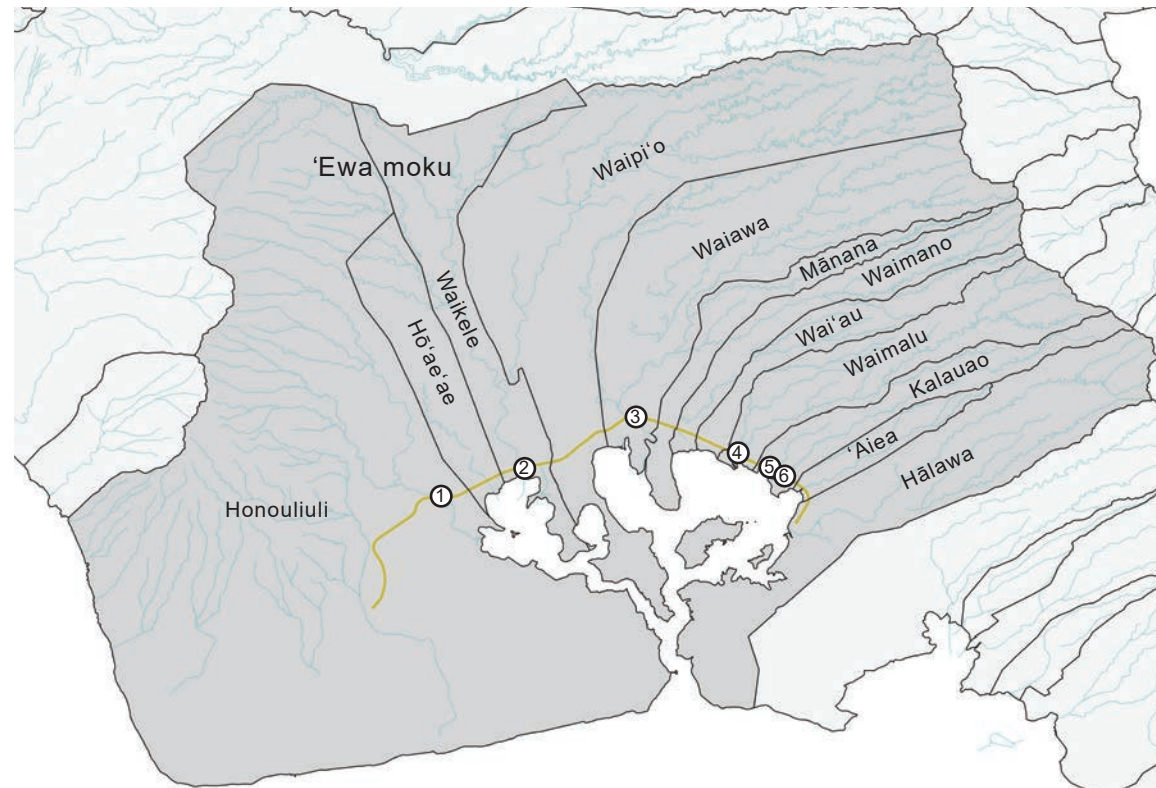
TERRITORIAL AND POST STATEHOOD TRANSPORTATION

BRIDGE DESIGN

BRIDGE TERMINOLOGY

BRIDGE SUMMARIES:

- ① *Honouliuli Stream Bridge*
- ② *Waikele Canal Bridge and OR&L Bridge*
- ③ *Waiawa Bridge*
- ④ *Waimalu Stream Bridge*
- ⑤ *Kalauao Springs Bridge*
- ⑥ *Kalauao Stream Bridge*



This map shows the numbered location of the bridges in this field guide along Phase A of the Skyline route. The route travels through the ahupua'a of the 'Ewa moku on the leeward side of O'ahu.

INTRODUCTION

This Educational Field Guide (Field Guide) was developed for the City and County of Honolulu Department of Transportation Services (DTS) in partial fulfillment of mitigation requirements stipulated within the *Programmatic Agreement (PA) among the U.S. Department of Transportation, Federal Transit Authority, the Hawai'i State Historic Preservation Officer, the United States Navy and the Advisory Council on Historic Preservation Regarding the Honolulu High-Capacity Transit Corridor Project in the City and County of Honolulu, Hawai'i* (2011) and PA Amendment 2 (2023). Agreements made within the PA were established to mitigate the effects of the rail on historic properties identified along its route.

The intent of the Field Guide is to share information with the public about the historic resources found along Skyline's path, which runs from East Kapolei to Aloha Stadium (Phase A). This first Field Guide focuses on historic transportation and infrastructure along the route, which extends from East Kapolei to Aloha Stadium. It provides a brief historical overview of Hawai'i's modes of transportation and information on each bridge. The six bridges are Honouliuli Stream Bridge, Waikele Canal Bridge, Waiawa Bridge, Waimalu Stream Bridge, Kalauao Springs Bridge, and Kalauao Stream Bridge. All six bridges were built in the 1930s under roadway improvement projects. They span streams that channel waters from either the southeastern end of the Waianae mountain range or the Koolau mountain range into Ke Awa Lau o Pu'uloa, "the many harbored seas of Pu'uloa," known commonly today as Pearl Harbor.

Additional Field Guides will be developed to document other historic resources along the full route, which includes Phase B: Aloha Stadium to Middle Street - Kalihi Transit Center, and Phase C: Middle Street - Kalihi Transit Center to Civic Center. See back cover for the sources of information used in the development of this Field Guide.



Aerial of a portion of Pearl Harbor's East Loch, 1949. Loko i'a Pa'iau can be seen at far right. National Archives



Waimano Falls, 2014
Sam Cox

KE 'AWA LAU O PU'ULOLOA "MANY HARBORED SEAS OF PU'ULOLOA"

The historic bridges documented in this field guide span various waterways located within the Skyline's Phase A segment. The Phase A segment traverses twelve individual ahupua'a from west to east; Honouliuli, Hō'ae'ae, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Wai'au, Waimalu, Kalauao, 'Aiea, and Hālawa.

Ca. 1480 A.D., High Chief Ma'ilikūhāhi of O'ahu was the first to survey and divide his chieftom into districts with clear palena (boundaries). This established the land division system known today in which each island is divided into moku, moku into ahupua'a, and ahupua'a into 'ili. The organizing principle used in the establishment of ahupua'a was the presence of wai (fresh water). This meant that the boundaries of each ahupua'a typically followed ridgelines in response to the path of a stream as it flowed from the mountains to the sea. As such, many ahupua'a have a narrow point in the uplands and broad near the shore. This arrangement ensured that each community had sufficient access to natural resources and could practice upland farming, cultivate lo'i kalo (irrigated taro terraces) in the lowlands, and tend to loko i'a (fishponds) along the shore.

Historically, Ke 'Awa Lau o Pu'uloa was rich in natural resources, nourished by the healthy nutrient runoff from a total of twelve ahupua'a. It was characterized by an abundance of estuaries, perennial fresh water springs, and shallow aquifers. Hawaiians established and tended lo'i kalo and loko i'a as well as salt works here for sustenance. Pu'uloa was also traditionally referred to as Wai Momi (Waters of Pearl), for its abundance of pearl oysters. Comparatively today such traditional practices in the region are rare, and such healthy natural resources are few. Of the over twenty loko i'a that once rimmed the harbor's shoreline, only three remain. Loko i'a Pā'aiau, in the Kalauao ahupua'a, is the last remaining intact royal fishpond in Pu'uloa, the subject of careful restoration by the community. Loko i'a Oki'oki'o Lepe in the Pu'uloa 'ili and Loko i'a Lauaunui on Lauaunui Island are the other two remaining loko i'a in Pu'uloa.



Portion of a historic map of O'ahu showing Ke 'Awa Lau o Pu'uloa. The approximate locations of the last three remaining loko i'a are marked. 1. Loko i'a Lauaunui 2. Loko i'a Oki'oki'o Lepe 3. Loko i'a Pā'aiau. Library of Congress

EARLY TRANSPORTATION: WA'A AND ALA HELE

In ancient Hawai'i, travel occurred by wa'a (canoe) or by foot. Polynesian voyagers arrived in Hawai'i by way of sailing canoe. Once settled permanently in the islands, Hawaiians continued to use wa'a for transportation in daily life and to fish, move between coastal settlements, travel between islands, and fight battles in times of war. Wa'a types varied, depending on the distance to be traveled, number of passengers (paddlers) and amount and type of cargo.

Pu'uloa was widely traveled by wa'a and a few of its early landings sites are known. For example, Kapua'ikāula was a landing that marked the narrowest point in the channel between Hālawā and Pu'uloa, for the entry to the harbor. Kupahu, in the Waikele ahupua'a, was a wa'a landing on the northeastern side of Halaulani. However, after the Mahele, when land ownership was opened to foreigners, canoes were restricted from traveling on the 'bay of Mānana,' in 1868. Traditional Hawaiians considered the estuary a "native path, regularly traveled from ancient time," and pleaded for help to maintain their rights to this path under the new laws of the land.

The ala hele (native trail system) served not only to provide travelers with access to resources within a given ahupua'a but through entire districts and around the island. The traditional trail system included many kinds of trails and employed a variety of methods of travel with which were adapted to the natural environment and needs of the travelers. Among the traditional terms and descriptions of types of trails found in early writings are:

- Ala hula'ana: Trails or routes which ended at points on the ocean or at streams that travelers swam to cross to the other side;
- Ala 'ūlili: Marked trails on the steep cliffs;
- Ala hakalewa or ala kaula: Trails along sheer cliffs from which one would at times dangle from roof ladders;
- Ala pi'i uka or ala pi'i mauna: trails which ascend to the uplands or mountain; now generally called mauka-makai trails;
- Ala kai: ocean trails on which wa'a were used to travel from place on one island, or between the various Hawaiian Islands.

Because ancient trails were established to provide travelers with standardized and relatively safe access to a variety of resources, the trails were (and remain) important features of the cultural landscape. The ala hele were the link between individual residences, the resource collection sites, agricultural field systems, and larger communities.

The trails themselves exhibit a variety of construction methods which range from worn paths along stone surfaces, trails across sandy shores and dry rocky soils, forest trails, trails worn in the soil, curbstone and coral cobble lined trails, or cobble stepping stone pavements, to historic curbstone lined roads with elevated stone filled "bridges" that level out the contour of the roadway.

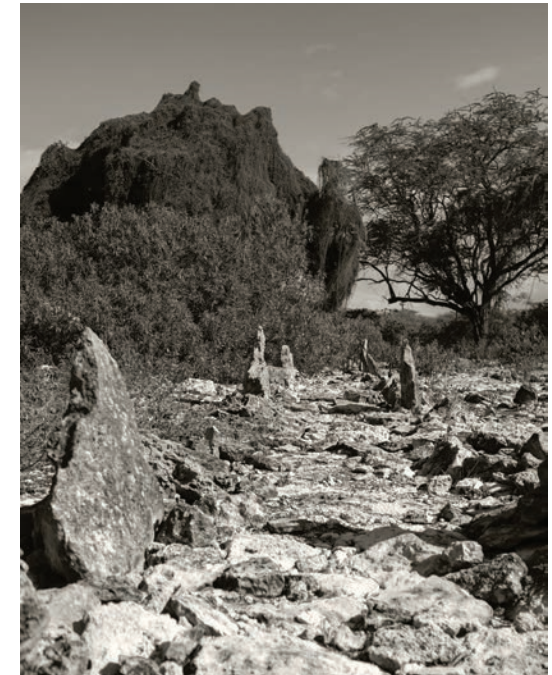
In a few cases, ala hele pathways are reflected in the alignment of modern transportation corridors. However, much of the native trail system has been fundamentally altered. Most notably, the mauka-makai accessways that were intrinsic to each ahupua'a for subsistence gathering are no longer feasible due to roughly a century and a half of urban development.

While Pu'uloa is no longer a common ala kai for travel by wa'a, the harbor has been used by canoe clubs for practices, and was honored by the presence of the Hōkūle'a voyaging canoe. Hōkūle'a made a week long visit in 2018, to draw attention to Pu'uloa's traditional cultural importance and support the restoration of loko i'a Pa'aiu.

Top:
Remnants of the ancient Kualakai trail which runs through part of the the 'Ewa moku. Upright stones are set in pairs along its borders.
MASON, 2024

Middle:
Portion of a map showing ancient trails in the 'Ewa moku, 1825.
State of Hawai'i

Bottom:
Paddlers in Pearl City, 'Ewa moku, O'ahu. n.d.
Bishop Museum



LATE 19TH TO EARLY 20TH CENTURY TRANSPORTATION



*Train rounding Pu'uloa near Waipio Peninsula. n.d.
Bishop Museum*



*Government Road looking northwesterly, 1935.
National Archives*

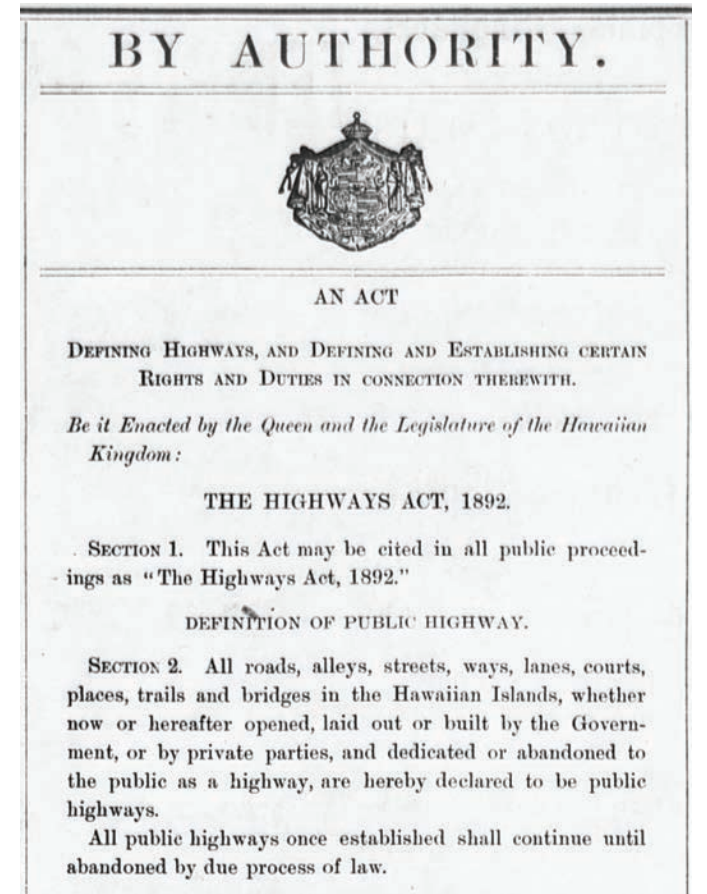
Western contact brought about changes in the methods of travel when horses and other hoofed animals were introduced. By the mid-nineteenth century, wheeled carts were being used on some of the trails. In some cases the old ala hele-ala loa were realigned (straightened out), widened, and smoothed over, and others were simply abandoned for newer more direct routes. In establishing modified trails and early road-systems, portions of the routes were moved far enough inland to straighten the route, thus, taking travel away from the shoreline. Masonry arch bridges were constructed in Hawai'i from approximately 1840. This was also the year the Kingdom of Hawaii established a constitutional monarchy. By the late 1840s, the modified alignments became a part of a system of "roads" called the "Ala Nui Aupuni" or Government Roads. Work on the roads was funded in part by government appropriations and through the labor or financial contributions of area residents and prisoners working off penalties.

In 1848, King Kamehameha III abolished the land tenure system that was intrinsic to the ahupua'a's communal subsistence economy, and divided land to independent title. This agreement was known as the Māhele ("To divide or portion") and allowed foreigners to own land.

In October 1892, Queen Lili'uokalani signed into law the Highways Act, placing not only all Alanui Aupuni (Government Roads), but all existing trails at the time "or hereafter opened, laid out or built by the Government, or by private parties as public highways." The Act also stated that "All public highways once established shall continue until abandoned by due process of law." Kingdom Survey maps produced up to the signing of the law are now used to identify primary routes for public access.

In 1893, a group of local businessmen and politicians (non-native Hawaiian Kingdom subjects along with American, British, and German nationals) illegally overthrew the monarchy, driven by economic interest amidst plans for eventual American annexation. After roughly six years governed under a provisional government and later as a Republic, Hawai'i was annexed as a Territory of the United States in 1898. The indigenous Hawaiian people never relinquished their claims to their inherent sovereignty.

Roadways of the present day are a mix of ancient and historic routes.



Sections 1 and 2 of the Highways Act, 1892. The Daily Bulletin, October 25, 1892.

TERRITORIAL AND POST STATEHOOD TRANSPORTATION

The rapid economic and population growth of Hawai'i once it became a territory in 1900 would spur a period of major infrastructure growth through the onset of World War II. Electric streetcars were first introduced on O'ahu at the turn of the twentieth-century. As the automobile grew in popularity and became more accessible to the population, streetcars fell out of popularity and ceased operation on the island.

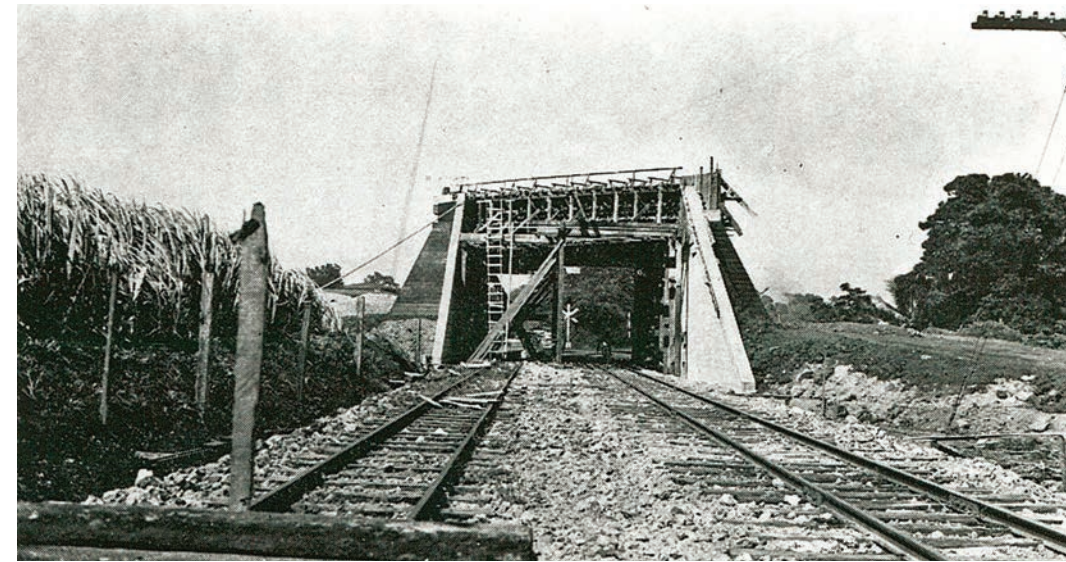
In the early territorial period, counties in Hawai'i relied on legislative appropriations to supplement county funds. This impaired road and bridge-building efforts and most counties could not keep up with infrastructure needs. Since Hawai'i was not a state, it was excluded from the Federal-aid Highway Program, despite the fact that its citizens paid U.S. taxes; this further contributed to the slow pace of improvements. In 1924, Congress passed the Hawai'i Bill of Rights, granting equal benefits to Hawai'i with the nation's states. The bill was signed into law by President Calvin Coolidge in 1924 and in 1925, Hawai'i received its first federal funds. That year Congress voted to give Hawai'i the funds it had missed since the Federal-aid funding for the upgrade of roads, highways, and bridges went into place in 1917.

Hawai'i sought to replace its narrow and hazardous roads and bridges. With sufficient funds, Hawai'i began to build bridges across valleys and straighten belt roads. The Territory built the first concrete bridge over Honouliuli stream in 1927. Reinforced concrete tee-beam bridges became the dominant bridge form in this period. Some of its elements, such as their parapets' Greek-cross voids were standardized, making the federally-funded bridges of this period easily recognizable.

In the build up to World War II, Hawai'i saw a significant increase in road construction for military use. Many of the existing corridors between military reservations were indirect, so newer, more efficient routes and bridges were constructed under the Federal Aid Primary highway system (F.A.P) 4-C highway realignment. The outbreak of war in December of 1941 spurred more road construction and as the War Department designated O'ahu's principle highways as part of the "strategic network of highways," as they were of particular military importance. During the war, civilian construction halted, and virtually all construction that took place was military related. Highway and bridge construction was restricted to projects which aided the National Defense System.

In 1959, Hawai'i became the 50th State, once again shifting the policy and procedure for the construction of highways and bridges. The Hawai'i Statehood Transition Bill that same year gave the state access to millions of federal dollars for highway improvement and development. The Hawai'i Department of Transportation (HDOT) was established on January 20, 1960 under the Government Reorganization Act of 1959, which took effect at Statehood in August 1959, replacing the Territorial Highway Department.

Hawai'i continued to receive federal funds for highways and bridges, including funding for a set of Interstate Highways in 1960 and under the Highway Beautification Act of 1965. The corridor connecting Barbers Point to Diamond head was designated as H-1 Freeway and extended beginning in 1963. New bridges were constructed during this time, and others were improved. Bridges of this period are recognizable by their post-war style railing which is composed of reinforced concrete balustrades with rectilinear horizontal voids and concrete rails as seen in the bridges in this field guide. Metal guard rails also made their first appearance during this period. While some historic bridges were modified with such changes, many were demolished and replaced.



*Waialeale Canal Bridge, ca. 1940
Both photos from the Report to the Governor, Territory of Hawai'i,
by the Superintendent of Public Works
Year ending June 30, 1940*

BRIDGE DESIGN

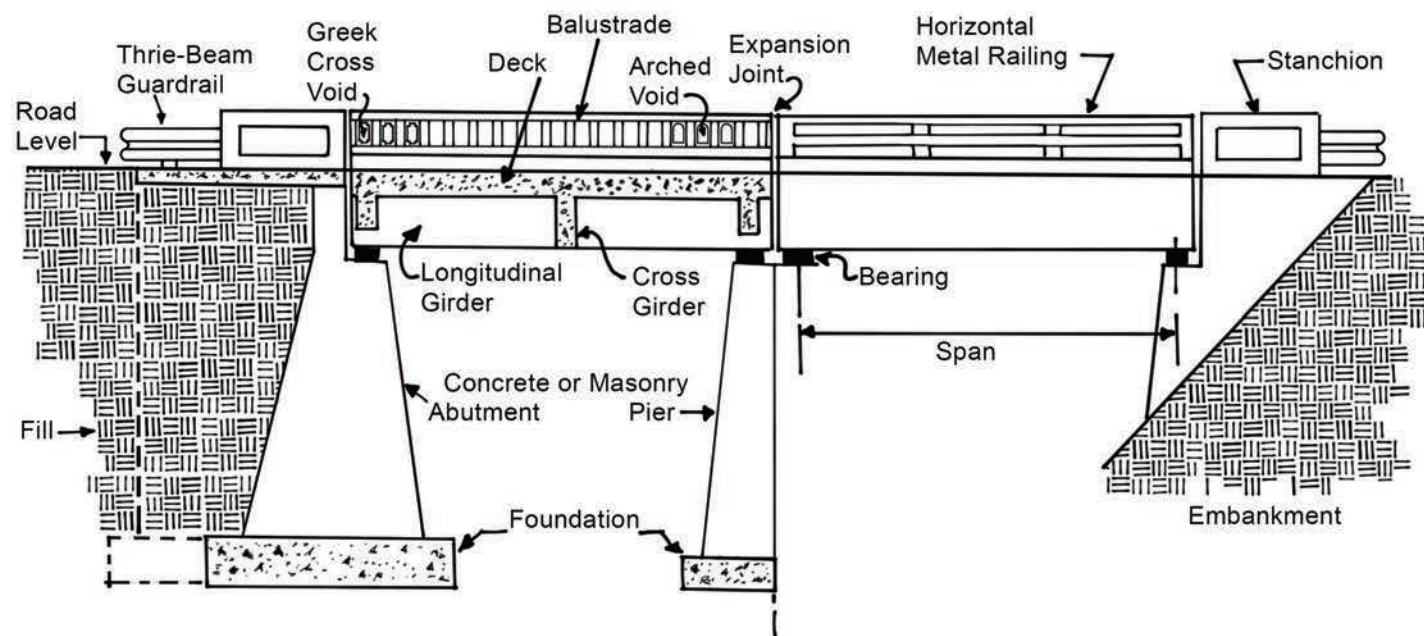
Bridges are structures that “span... horizontally between supports, whose function it is to carry vertical loads” with a total span greater than 20’ (less than 20’ is a culvert). They are typically constructed in seven primary forms: beam, girder, truss, arch, suspension, cantilever, and cable-stay. Beam bridges are the most common. They can be constructed with multiple spans and with materials such as wood, steel, or concrete.

Concrete girder and tee-beam bridges are the most common types of remaining pre-World War II bridges in Hawai‘i, characterized by their monolithic deck and girder systems. They are a part of the evolution of reinforced concrete deck bridge technology in Hawai‘i that began with the first flat slab bridges around 1908 and progressed rapidly during the first decades of the 20th century. Many of the earliest concrete bridges were arched similar to the Hawaiian kingdom’s lava-rock bridges. Concrete became the most practical construction material for bridges in Hawai‘i due to the salt air from the Pacific Ocean, which corroded steel, and insects such as termites, which damaged wood. Often County engineer-designed early slab bridges consisted of concrete decks replacing older superstructures on their original abutments, which were often lava rock or wood. The strength of concrete girder and tee-beam types and their lower cost led to their use in locations with short spans rather than use of concrete arches.

The earliest tee-beam bridges in Hawai‘i date from about 1912. After about 1925, the tee-beam bridge became the preferred choice for bridge construction by the Territorial Highway Department over the concrete girder bridge. Girder bridges were best suited to short spans from 15 to 40 feet and were not economical for wide roadways of more than 24 feet. The pattern of reinforcing steel within the tee-beam girders structurally joined the two together so that they can efficiently carry a greater load and create longer spans. This relatively small change over standard girder construction provided an increased carrying capacity and was more economical. The tee-beam quickly became widely used, with many examples constructed into the 1950s.

Early twentieth-century flat slab bridges in Hawai‘i were reinforced-concrete structures built as an alternative to timber or metal stringer bridges. They were constructed with simple concrete decks often built over original nineteenth-century stone abutments. Formwork and concrete casting for the bridges were done on site. The railings were a variety of styles from open balustrades to solid parapets.

Girder and tee-beam bridges in Hawai‘i generally had parapets with a pattern of voids below a reinforced concrete rail cap. The Territorial Highway Department relied on a few standard rail patterns: ‘Greek-cross,’ arched, or simple rectangular voids. Earlier masonry (lava rock or concrete) bridges typically had solid parapets. Bridges of this type and period were built with solid concrete end stanchions usually inscribed with the bridge name and year built.



Sketch of composite bridge components
*not all elements are found together

BRIDGE TERMINOLOGY

Abutment – Part of a substructure which supports the end of a span or accepts the thrust of an arch; often supports and retains the approach embankment.

Arch – A curved structure which supports a vertical load.

Balustrade – A decorative railing, especially one constructed of concrete or stone, including the top and bottom rail and the vertical supports called balusters. May also include larger vertical supports called stanchions.

Beam – A linear structural member designed to span from one support to another.

Bearing – A support element at the ends of beams which is placed on top of a pier or abutment. The ends of a beam rest on bearings.

Bent – Intermediate substructure support between bridge spans.

Board-formed Concrete – Method of concrete construction that involves pouring concrete into wood board formwork or moulds, leaving a wood grain texture on the face of the concrete. No longer used in contemporary construction.

Column – A vertical structural member used to support compressive loads.

Deck – The roadway surface of a bridge which carries the traffic.

Embankment – Angled grading of the ground at the bridge ends.

Expansion Joint – A connection designed to allow for movement of the parts due to thermal or moisture factors. Commonly visible on a bridge deck.

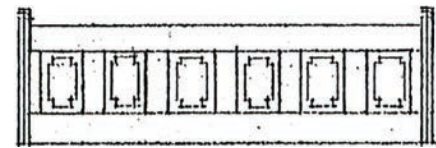
Fill – Earth, stone or other material used to raise the ground level, form an embankment, or fill the inside of an abutment or pier.

Girder – A large beam that provides primary support for the deck.

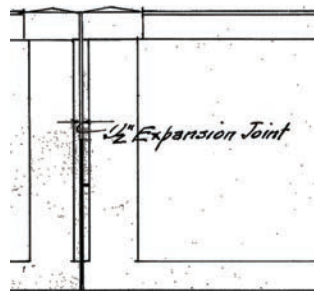
Guardrail – A safety feature at the side of a road intended to redirect an errant vehicle.

Parapet – A low solid, often decorative, wall or barrier at the edge of a bridge.

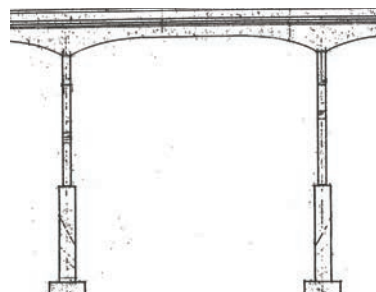
Pier – A vertical structure which supports the ends of a multi-span superstructure between abutments.



balustrade



expansion joint



Pier

Pile – A vertical shaft driven into the ground that carries loads through weak layers of soil to those capable of supporting such loads.

Pipe Hangar Insert – Hanging system used to suspend pipe on bridges.

Railings – A barrier composed of one or more horizontal rails supported by widely spaced uprights; also see balustrade.

Reinforced Concrete – Concrete with steel bars or mesh embedded in it for increased strength and durability.

Socket Piles – A technique that is used to embed a pile into solid rock.

Span – The horizontal distance between structural supports.

Spandrel – The roughly triangular area between the arch and deck.

Stanchion – One of the larger vertical posts supporting a railing.

Stirrups – Steel elements that support and stabilize reinforced concrete beams and columns in bridges.

Substructure – The portion of a bridge structure including abutments and piers which supports the superstructure (or deck).

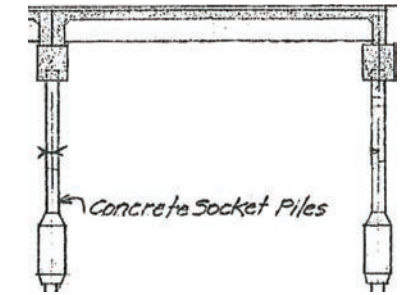
Superstructure – The portion of a bridge structure which carries traffic.

Tee-Beam Bridge – A reinforced concrete bridge consisting of a monolithic floor slab with contiguously-reinforced supporting beams so that a cross section resembles "T".

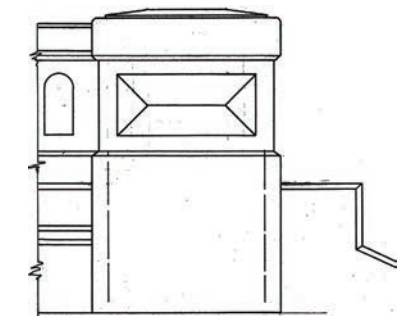
Truss – A jointed structure comprised of metal members usually arranged in a triangular pattern to support longer spans.

Voids - Openings between rails and balusters. For example, Arched or Greek Cross.

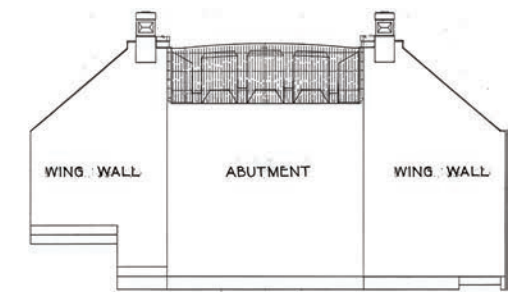
Wing Walls – Extensions of a retaining wall as part of an abutment; used to contain the fill of an approach embankment



socket piles



stanchion



wing walls



Honouliuli Bridge, 2012
David Franzen, Hawai'i State Archives



Honouliuli Bridge, ca. 1940s.
National Archives, ID 169139912

HONOULIULI STREAM BRIDGE

Location: Farrington Highway and Honouliuli Stream, 'Ewa Beach Vicinity, Honouliuli ahupua'a, 'Ewa moku

Date of Construction: 1939

Engineer: William R. Bartels, Territorial Highway Engineer

Builder/Contractor: E.E. Black, Contractor

Style: Single-span, reinforced concrete tee-beam

Hawai'i State Register of Historic Places: Listed 2014

National Register of Historic Places: Not listed

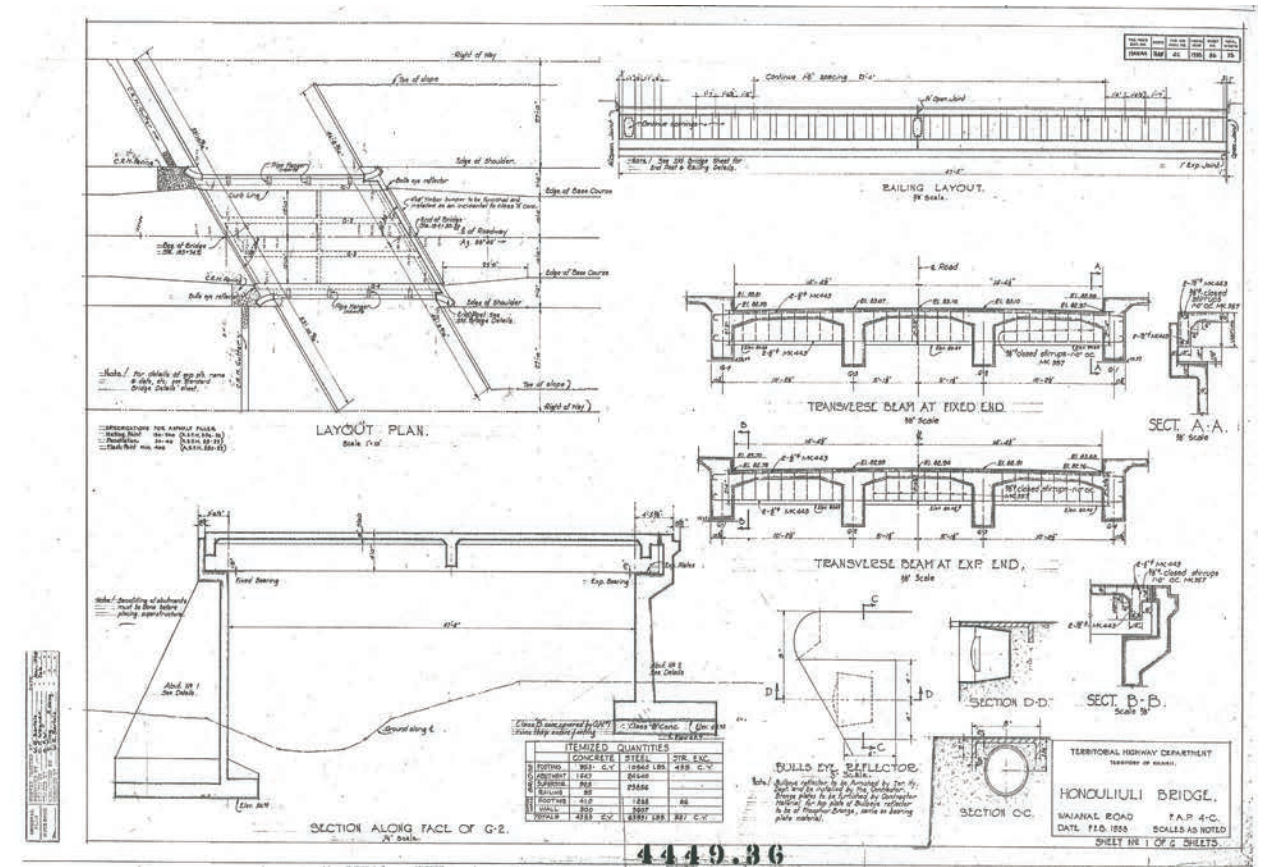
National Bridge Inventory Structure No.: 003922001100001

State Inventory of Historic Places No.: 50-80-12-07745

HAER HI-99

The Honouliuli Bridge was constructed as part of the Territorial Highway Department's extension of Waianae Road in 1938-1939 under Federal Aid Project (F.A.P.) No. 4-C., subtitled "Waipahu Cutoff." The bridge was completed in 1939.

Before this project the only connecting road between 'Ewa Junction in the east and Waianae Road to the west was Waipahu Road. This roadway, originally simply called "Government Road," linked Waianae Road with Kamehameha Highway (the main belt road) at 'Ewa Junction. Waipahu Road (now Waipahu Street) is a winding road through the former O'ahu Sugar Co. village, running generally east-west. Before 1938, its western end had a section that ran north-south. The 1939 construction of the Honouliuli Bridge along Farrington Highway eliminated a looping portion of the former road that connected Honolulu with 'Ewa and the leeward Wai'anae coast significantly increasing transportation efficiency.



Construction drawings for the Honouliuli Bridge
State of Hawai'i, Department of Transportation
June 9, 1938

The above drawing shows elements of the bridge design including the transverse beams at the fixed and expansion ends. Sections drawings are a vertical cut through of an area of a building or structure. The drawing also indicates the deck layout plan (top left) and railing and balustrade layout (top right).



The photo above shows the underside of the Honouliuli Bridge. The **board-formed concrete** soffit and abutment is visible above and at the rear. The longitudinal and transverse **beams** are seen on the underside of the **deck** outlined in yellow.

The end **stanchions** seen in the photo to the left and outlined in yellow, are a common feature seen on many bridges built in Hawai'i in the 1930s and 1940s. The substantial concrete **stanchions** feature stepped edges and a curved shape. The name and date inscriptions typically present on bridges of this type and era have been obscured on the Honouliuli Bridge **stanchions** by the addition of concrete wedges which are used to attach modern steel thrie-beam **guardrails**.

*Honouliuli Bridge, 2012
David Franzen, Hawai'i State Archives*

HONOULIULI STREAM BRIDGE (cont.)

The Honouliuli Bridge is significant at the local level for its association with O'ahu's road transportation system and its contribution to the development of the Farrington Highway segment, which was an important connector in O'ahu's belt road system. The construction of the Honouliuli Bridge facilitated travel along the highway across the areas of Honouliuli and Waipahu, providing better links to the 'Ewa and Wai'anae areas to Honolulu. The bridge is located along a rural section of Farrington Highway approximately ½ mile west of the commercial area of Waipahu.

The Honouliuli Bridge is a single-span, reinforced-concrete tee-beam bridge that carries two lanes of traffic over the Honouliuli Stream. The bridge has concrete balustrades and end stanchions that were typical in Hawai'i in the period of the 1930s and 1940s. The balustrades are 2'-10" tall and measure 47'-7" long between the end stanchions with narrow expansion joints between the balustrades and stanchions. The parapets are built of thick concrete, with Greek cross-shaped voids between the balusters. The end stanchions are curved (arc) in plan measuring 3'-3" high, 1'-9" thick, and approximately 5' long. They are inscribed with the name of the bridge and date of construction. Later added concrete wedges with attached guardrails obscure the inscriptions for the Honouliuli Bridge.

Due to the angle at which Farrington Highway crosses Honouliuli Stream, the bridge's footprint is skewed, which is most evident from below. The underside is board-formed concrete and consists of four longitudinal beams, each approximately 3' high and 1'-4" wide across the 47'-6" span. They are joined near the mid-span by a single transverse beam which crosses the longitudinal beams at a 90-degree angle.

The abutments of the bridge are constructed of board-formed concrete with integral wing walls. The west abutment is 12' high from its top edge to the grade of the stream, while the east abutment is approximately 20' high.

ALTERATIONS

- Steel guardrails were added to the end stanchions at an unknown date.
- Wedge of concrete added to the outer (road facing) surface that anchors the steel guardrails.



Detail of a **balustrade** on the Honouliuli Bridge is seen to the left. The **balustrade** features **reinforced-concrete** construction with thick top railings and evenly spaced vertical balusters containing **Greek-Cross voids**, both outlined in yellow. These voids are typical of concrete bridge design in Hawai'i during this period.

WAIKELE CANAL BRIDGE and OR&L BRIDGE

Location: Farrington Highway Waikele Stream, Waipahu, Waikele ahupua'a, 'Ewa moku

Date of Construction: 1939

Engineer: William R. Bartels, Territorial Bridge Engineer

Builder/Contractor: E.E. Black, Contractor

Style: Three-span and single span, reinforced concrete tee-beam

Hawai'i State Register of Historic Places: Listed 2014

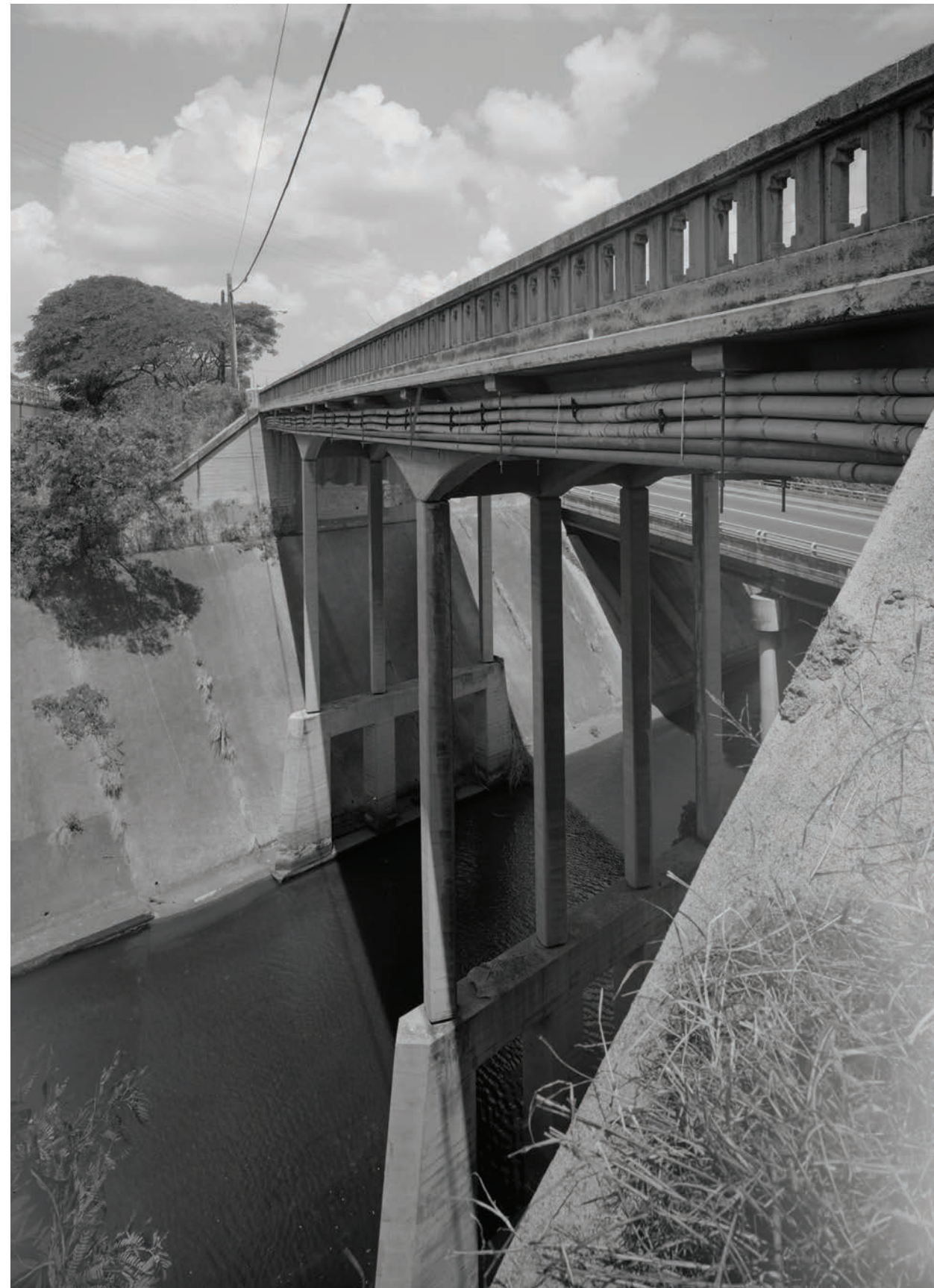
National Register of Historic Places: Not listed

National Bridge Inventory Structure No.:
Waikele, 003090001400108
OR&L, 003090001400114

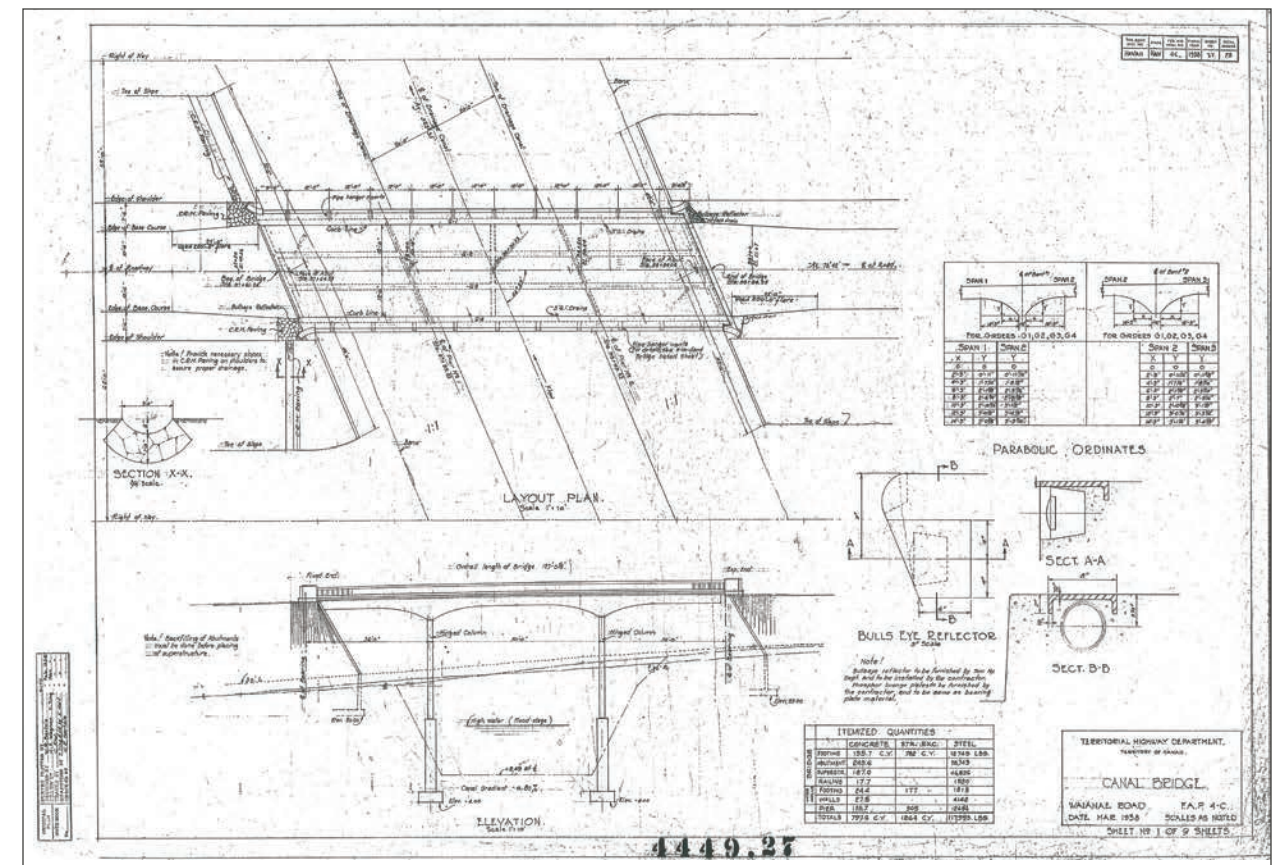
State Inventory of Historic Places No.:
50-80-09-07746

HAER HI-100

Both the Waikele Canal Bridge and adjacent O'ahu Railway and Land Co. (OR&L) Bridge were constructed as part of the Territorial Highway Department's extension of Waianae Road in 1938-39 under Federal Aid Project (F.A.P.) No. 4-C, subtitled "Waipahu Cutoff." The Honolulu Stream Bridge was also part of this project. The bridges were built in conjunction with the construction of the Waikele Canal and completed in 1939. The Waikele Canal Bridge was constructed to go over the Waikele Canal, while the OR&L bridge was built to span the former OR&L right-of-way. The bridges facilitated passage along Farrington Highway and provided a shorter route to the nineteenth-century government road through the town of Waipahu. The bridges are located in an urban area, approximately 1/3 mile west of Waipahu Road. At the time of their construction the bridges were on the fringes of the Waipahu community which has expanded since their construction.



Waikele Canal Bridge, 2012
David Franzen, Hawai'i State Archives



Construction drawings for the Waikele Canal Bridge
State of Hawai'i, Department of Transportation
June 9, 1938

The above drawing depicts elements of the bridge design including an elevation showing the columns and an abutment. The drawing also shows the deck layout plan (top left) and girder span dimensions (box, top right).

WAIKELE CANAL BRIDGE and OR&L BRIDGE (cont.)

The Waikele Canal Bridge and OR&L Bridge are significant at the local level for their contribution to the development of an efficient road transportation system on O'ahu as part of the Farrington Highway segment on O'ahu's belt road system. The Waikele Stream Bridge is visually remarkable for its height above the stream supported on slender piers. Like the Honouliuli Bridge, which was part of the same system, they facilitated passage along the Farrington Highway by providing a shorter route to the nineteenth-century government road through Waipahu. The Waikele Stream Bridge is located 128' west of the OR&L Bridge.

The Waikele Stream Bridge is a three-span, reinforced-concrete, tee-beam bridge which carries two eastbound lanes of traffic over the Waikele Canal. The bridge is 122' long and its deck is approximately 50' above the concrete lined streambed. The bridge has concrete balustrades and end stanchions that were typical in Hawai'i when it was constructed. The balustrades have Greek-Cross shaped voids. The end stanchions are curved (arc) in plan with stepped edges. The underside of the Waikele Stream Bridge has four longitudinal beams with partial-arch closed spandrels where the bearings contact the top of the four supporting piers.

The OR&L Bridge is a single-span, reinforced-concrete bridge which carries two eastbound lanes of Farrington Highway over the former OR&L right-of-way. It is classified as a tee-beam bridge in the National Bridge Inventory Database; however, original drawings were not located to confirm the pattern of reinforcing steel within its girders which would distinguish a tee-beam from a concrete girder bridge. The bridge is 48'-9" long with a deck width of 32'-2". It features the same concrete balustrades with Greek-Cross shaped voids and curved end stanchions with stepped edges as the Waikele Stream Bridge. Unlike the Waikele Stream Bridge, this bridge does not have a partial closed arch spandrel form. The OR&L Bridge has four longitudinal beams supported by the flanking abutment walls.

ALTERATIONS

- Steel three-beam guardrails were added to the end stanchions of both bridge at an unknown date.
- Concrete paving stones added that slope up the bridge's walkways, covering the bullseye reflectors.



*Waikele Canal Bridge, 2012
David Franzen, Hawai'i State Archives*



*Waikele Canal Bridge, ca. 1940
National Archives, ID 169139914*



View of the north side of the OR&L bridge taken from the former OR&L right-of-way. The concrete **balustrade** with **Greek-Cross voids** is seen, as well as the **abutment** and **wing walls**, all outlined in yellow. The longitudinal **beams** are also visible.



View of the north side of the Waikele Canal Bridge. The slender supporting **piers** and **arched** closed **spandrel** is outlined in yellow. The **balustrade** with **Greek-Cross voids**, **abutments**, and longitudinal **beams** are also visible, as is the concrete-lined Waikele Canal.



Waiawa Bridge, 2012
David Franzen, Hawai'i State Archives

WAIAWA BRIDGE

Location: Kamehameha Highway Westbound and Pearl City Vicinity, Waiawa ahupua'a, 'Ewa Moku

Date of Construction: 1933

Engineer: Merritt A. Trease

Builder/Contractor: J.L. Young Engineering Co.

Style: Multi-span, reinforced concrete tee-beam

Hawai'i State Register of Historic Places: Listed 2014

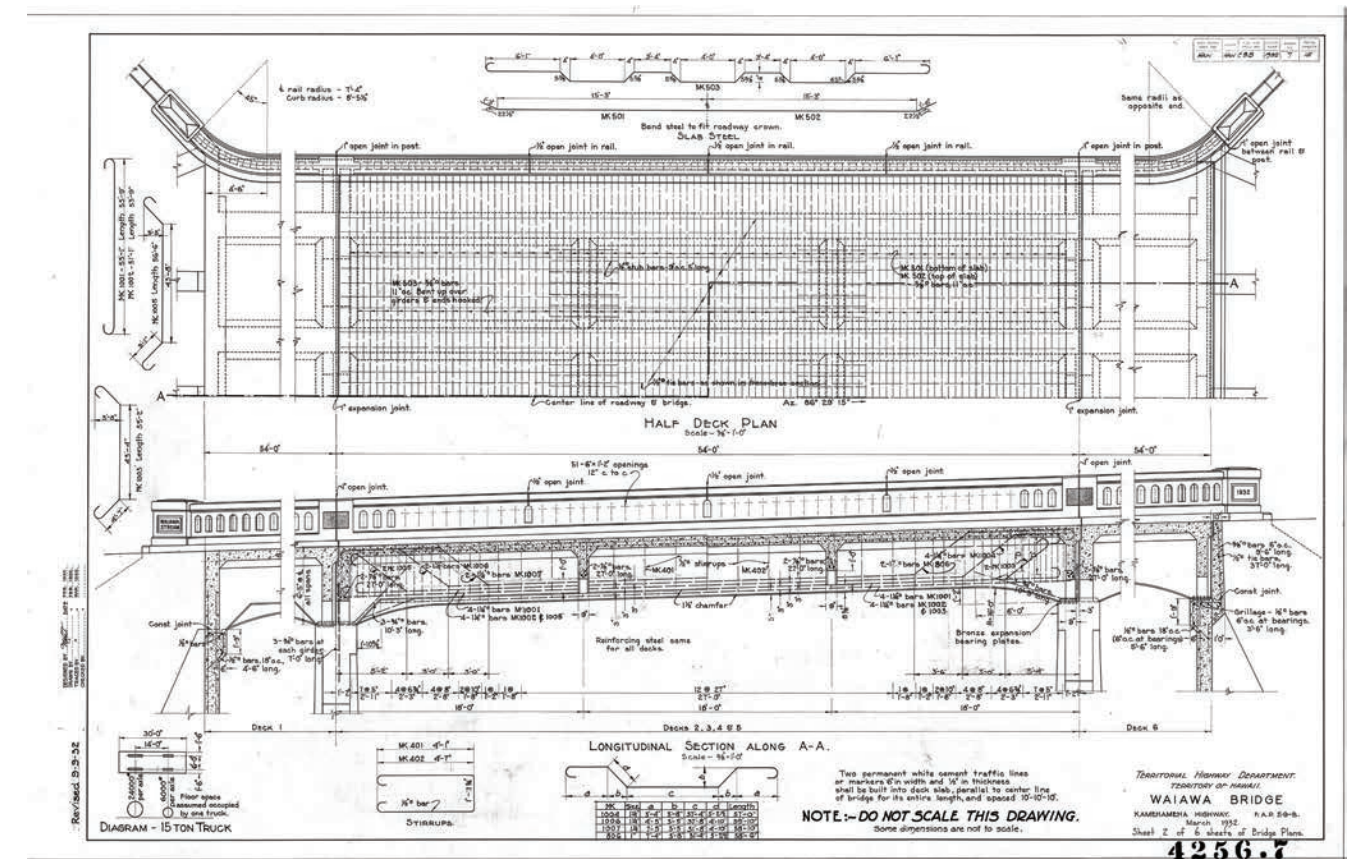
National Register of Historic Places: Not listed

National Bridge Inventory Structure No.: 003000990401802

State Inventory of Historic Places No.: 50-80-09-07744

HAER HI-101

The Waiawa Bridge was constructed with Federal "Emergency Funds" provided to the Territory of Hawaii in 1931. The bridge was designated Federal Aid Project (FAP) E-9-B, with the E denoting special funding. As stated by the Superintendent of Public Works in his report for 1933, for the "Federal Aid Emergency Projects, all funds...had to be expended within a certain period." The Waiawa Bridge and seven other road projects were accomplished within a year or two (deadline of June 30, 1933, to spend or obligate funds). This 1933 bridge was built on a section of road that re-routed Kamehameha Highway from its earlier alignment that followed a curving path down into and out of Waiawa gulch. The earlier highway alignment crossed Waiawa Stream on a short bridge located to the south of the current structure. In 1953, both lanes of the 1933 bridge were converted to westbound only traffic. A new bridge built in 1952 and section of highway built in 1953 opened south of the 1933 bridge to provide traffic flow in the easterly direction.



Construction drawings for the Waiawa Bridge
State of Hawai'i, Department of Transportation
June 9, 1938

The above drawing depicts elements of the bridge design including longitudinal sections (bottom) displaying the internal structure of the bridge including the reinforcing steel beams. The railing and balustrade layout indicating arched voids is seen in the section drawing, end stanchions are also visible. The deck layout plan (top) shows the pattern of reinforcing steel rods in the deck slab.



Clockwise from the top left: Two of the original end stanchions, the bridge deck, arched voids, a balustrade stanchion with expansion joint, and an original end stanchion. These elements are outlined in yellow.

Waiawa Bridge, 2012
David Franzen, Hawai'i State Archives

WAIAWA BRIDGE (cont.)

The Waiawa Bridge is significant at the local level for its contribution to the development of an effective road transportation system on O'ahu as part of the Kamehameha Highway section of O'ahu's belt road system. It is one of the earliest remaining bridges in the area formerly known as 'Ewa junction. Waiawa Bridge is also significant as one of Hawai'i's longest tee-beam bridges.

The Waiawa Bridge is a six-span, reinforced concrete, tee-beam bridge that carries two lanes of westbound Kamehameha Highway traffic over the gulch formed by the Waiawa Stream. The Waiawa Bridge's total span is 324', divided into six equally spaced spans measuring 54' long each.

The Waiawa Bridge has concrete balustrades perforated with narrow arched voids. Along the length of the balustrades are intermediate stanchions that are the height of the balustrade. They have a plain inset panel and a narrow expansion joint that vertically bisects each stanchion. The balustrades curve away from the edge of the roadway before meeting the end stanchions.

The bridge has three remaining original end stanchions. The end stanchions are concrete, rectangular in plan, with inset panels on the sides. They have a base, a top cap, and inset panels on three sides. The front panel of the northwest end stanchion is inscribed "WAIAWA," the southwest stanchion is inscribed "1932," and the northeast is inscribed "1933." The end stanchion and balustrade end of the bridge at the southeast corner appears to have been replaced and is different from the others. The parapet end does not curve away from the roadway like the other three and has a plain vertical face with no inscription. A steel thrie-beam guardrail is attached to the northeast end stanchion.

The underside of the Waiawa Bridge is board-formed concrete, with four longitudinal girders supported by rectangular, reinforced-concrete bents. The two legs of each bent are cross-shaped in plan (rabbeted corners). The bridge abutments are board-formed concrete with angled wing walls of varying lengths.

ALTERATIONS

- Steel thrie-beam guardrails were added to each side of the eastern approach to the bridge. At the northeast corner the guardrail is attached to the balustrade, on the southeast corner it is attached to the southeast stanchion.
- The unadorned southeast stanchion appears to be a replacement as it does not match the design of the other three.

Below: Underside of the Waiawa Bridge. Visible are the longitudinal **beams** and the rectangular **reinforced concrete bents**. The **bent** in the foreground is outlined in yellow.



Waiawa Bridge, 2012
David Franzen, Hawai'i State Archives



Waimalu Stream Bridge, 2012
David Franzen, Hawai'i State Archives

WAIMALU STREAM BRIDGE

Location: Kamehameha Highway Waimalu Stream, Waimalu ahupua'a, 'Ewa moku

Date of Construction: 1936, 1945, 1966

Engineer: William R. Bartels, C.R.Y / R.K. (sic.)

Builder/Contractor: Chester R. Clarke, E.E. Black

Style: Multi-span, reinforced concrete tee-beam

Hawai'i State Register of Historic Places: Not listed. Determined eligible in the 2013 Statewide Bridge inventory.

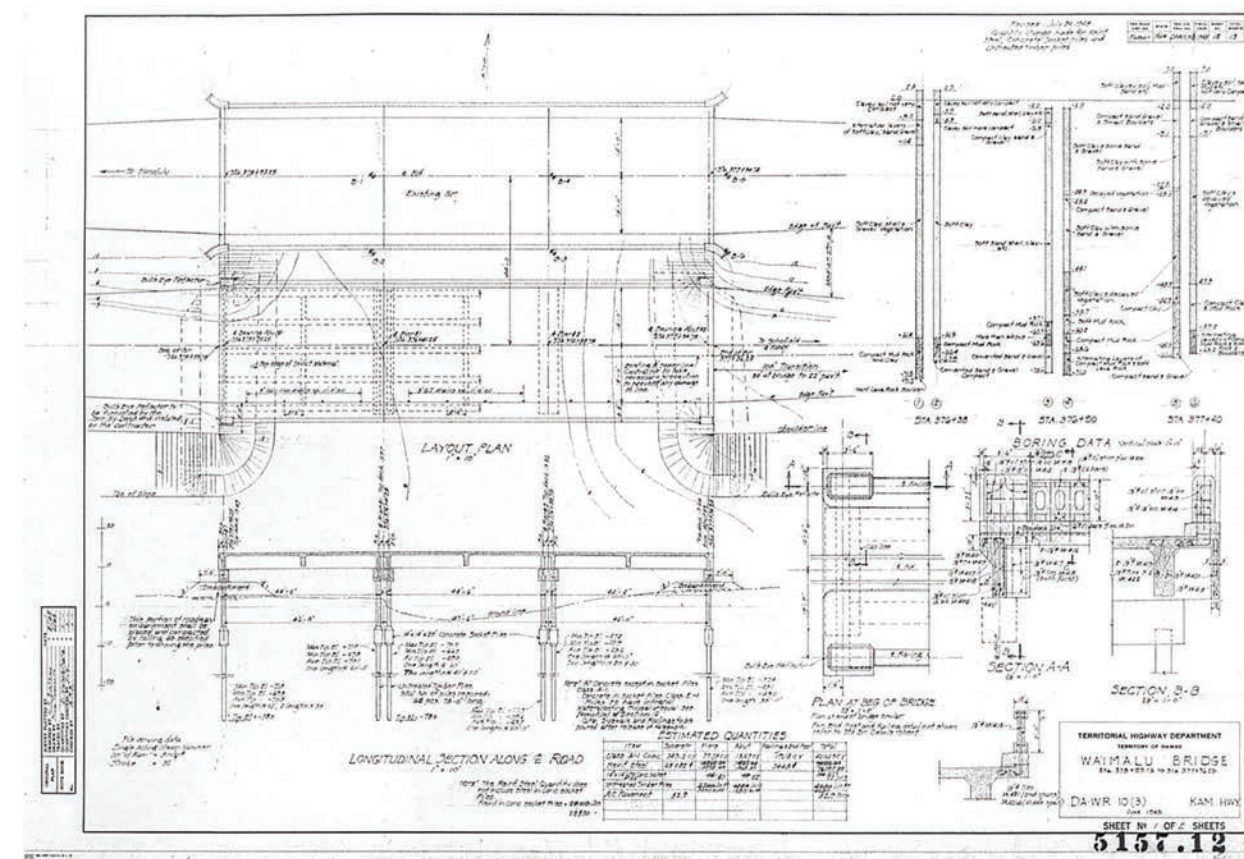
National Register of Historic Places: Not listed

National Bridge Inventory Structure No.:
Eastbound: 003000990401986
Westbound: 003000990401987

State Inventory of Historic Places No.:
Eastbound: 50-80-09-08108
Westbound: 50-80-09-08109

HAER HI-115

The Waimalu Stream Bridge was built as part of the Federal Aid Project (FAP) No. 9-F. Two other bridges in this guide, Kalauao Springs Bridge and Kalauao Stream Bridge, were also built under the same series of project numbers. This original 1936 bridge had two lanes, one for each travel direction. In 1945, under Hawaii Project No. DA-WR 10 an additional two-lane bridge was built parallel to the original one on the mauka side. Initially these bridges each carried traffic going east and westbound before being converted so the 1936 bridge carried the westbound lanes, and the 1945 bridge carried eastbound. The 1966 Kamehameha Highway widening, FAP No. U 090 I (9), included an additional lane on the outboard sides of both bridges. The widening of both bridges required demolition of the outboard walkways and parapets of each bridge. The bridges facilitate passage of the Kamehameha Highway across Waimalu Stream.



Construction drawings for the Waimalu Stream Bridge
State of Hawai'i, Department of Transportation
June 1945

The above drawing displays elements of the 1945 bridge design including a longitudinal section (bottom left) showing the transverse **beams** and **concrete socket piles**. The drawing also shows the **deck layout plan** with road transitions (top left) and a detail of the **railing and balustrade layout and stanchion** (bottom right).

WAIMALU STREAM BRIDGE (cont.)

The Waimalu Stream Bridges are significant resources within O'ahu's road transportation system, significant for their association with the development of the Kamehameha Highway and adjacent 'Aiea town and Pearl City, which grew into suburbs from their initial establishment as a sugarcane plantation and train stop "city."

Both the 1936 westbound bridge and the 1945 eastbound bridge are three-span, reinforced concrete girder bridges. They are 143' long with approximately 40' wide roadways.

EASTBOUND (1936/1966)

The eastbound bridge has concrete balustrades and stanchions on the mauka side of the bridge. The 1936 balustrade spans the length of the bridge. The balustrade features concrete balusters with Greek-cross shaped voids. At the ends of this balustrade are concrete stanchions which are curved in plan, arching away from the roadway, with stepped corners. The west stanchion has an added wedge of concrete on its road facing surface that anchors a steel guardrail. The stanchions have date and name inscriptions; however, the concrete wedge on the west stanchion covers the name inscription. The east stanchion has the date "1936" inscribed on its road facing surface.

The 1966 balustrade and end stanchions are on the makai side of the bridge. The horizontal steel and concrete balustrade is typical of its period. The lower portion has three concrete sections with a horizontal line incised across each panel 9" from the bottom. The upper section is a metal railing composed of two horizontal tubes supported by slightly curved rail posts. The concrete end stanchions are rectangular with horizontal lines incised around the circumference at 9" and 1'-6" from the bottom. The west stanchion is inscribed with "Waimalu Stream Bridge 1966." A steel guardrail runs along the mauka side of the walkway.

The underside of the eastbound bridge reveals the structural design of both the original 1936 bridge and the added 1966 traffic lane and sidewalk. The 1936 portion is board-formed concrete and has four longitudinal girders and two supporting frames in an inverted U-shape with two reinforced concrete legs. The 1966 portion consists of two longitudinal girders supported in line with the 1936 frames, by three octagonal-cross section concrete piles capped by a concrete beam.

WESTBOUND (1945/1966)

The westbound bridge has concrete balustrades and stanchions on the *makai* side of the bridge. The 1945 balustrade is almost identical to the 1936 eastbound bridge balustrade, except it does not have a sidewalk only a concrete curb, and its end stanchions are rectangular, not curved. Each stanchion has stepped corners and squarely abuts the balustrade. The east end stanchion has an added steel thrie-beam guardrail that is through-bolted to the stanchion, partially concealing the name inscription, only the letters "ALU" are visible. The west stanchion is inscribed with "1945."

The 1966 balustrade of the westbound bridge was constructed identical to the 1966 balustrade of the eastbound bridge. Unlike the eastbound bridge, no guardrail runs between the sidewalk and traffic lanes.

The underside of the westbound bridge shows the structural design of both the 1945 bridge and the added 1966 traffic lane and walkway. The 1945 portion is board-formed concrete with five longitudinal girders and two supporting frames or piers. Each frame consists of ten pairs of square-cross-section concrete piles topped by a concrete pile cap, or beam, which carries the girders. The 1966 portion is supported, in line with the 1945 frames, by four octagonal, cross-section piles like those on the 1945 portion. The 1945 abutments are board formed concrete. The 1966 abutments are supported by a pile foundation.

ALTERATIONS

- Both bridges were widened in 1966, creating a third lane and removing original balustrades and stanchions on the outer edges and adding new balustrades and stanchions.
- Steel thrie-beam guardrails added to both bridges at an unknown date.

Waimalu Bridge looking west n.d.
National Archives, ID 169139886



Waimalu Stream Bridge, 2012
David Franzen, Hawai'i State Archives



Above: A **stanchion** of the 1936 bridge is seen outlined in yellow on the right; a 1945 **stanchion** is on the left. The westbound 1966 **balustrade** is on the left outlined in yellow. The added steel **guardrail** between the road and walkway of the eastbound bridge is on the right outlined in yellow. A small portion of the supporting **columns** is visible between the two bridges, outlined in yellow. A more detailed view is on page 28.



Kalauao Springs Bridge, 2012
David Franzen, Hawai'i State Archives

KALAUAO SPRINGS BRIDGES

Location: Kamehameha Highway and Kalauao Springs, 'Aiea, Kalauao ahupua'a, 'Ewa moku

Date of Construction: 1936, 1945, 1966

Engineer: William R. Bartels, C.R.Y / R.K. (sic.)

Builder/Contractor: Chester R. Clarke, E.E. Black

Style: Eastbound, single-span, Westbound, two-span, reinforced concrete girder

Hawai'i State Register of Historic Places: Not listed. Determined eligible in 2013 Statewide Bridge Inventory

National Register of Historic Places: Not listed

National Bridge Inventory Structure No.:

Eastbound: 003000990402053

Westbound: 003000990402054

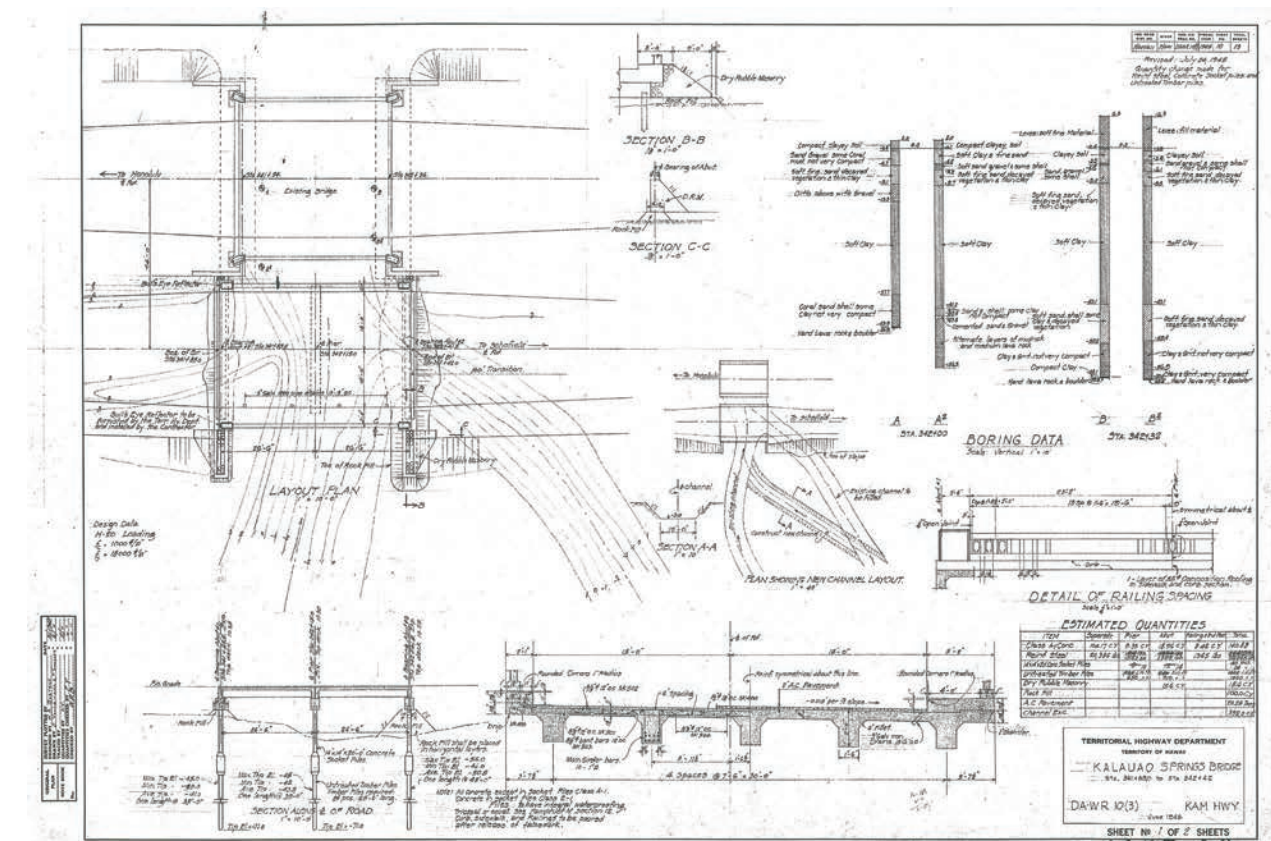
State Inventory of Historic Places No.:

Eastbound: 50-80-09-08063

Westbound: 50-80-09-08064

HAER HI-116

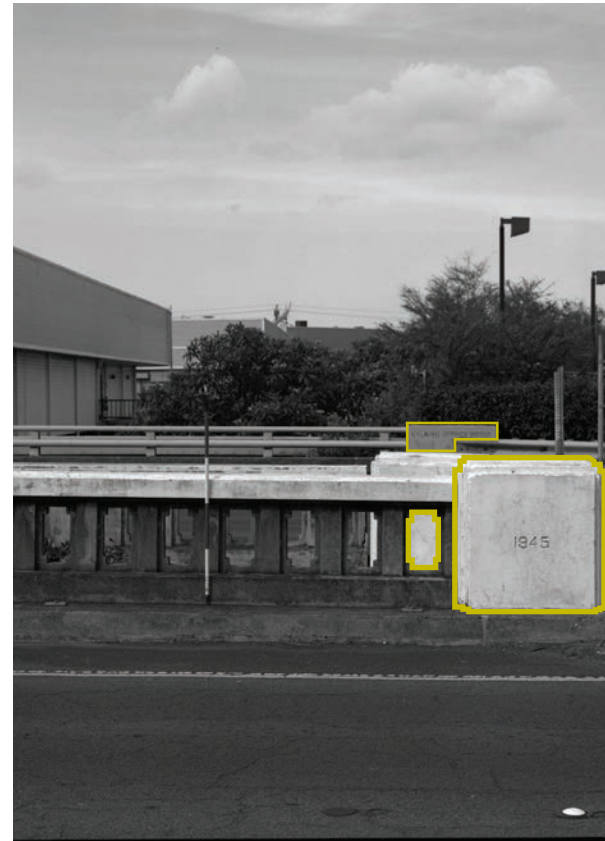
The original Kalauao Springs Bridge was built in 1936 as part of the National Recovery Highway (NRH) Project No. NRH-9-C to facilitate passage of Kamehameha Highway over the outflow of the Kalauao Springs. This bridge was constructed with two lanes, one for each direction of travel. Prior to World War II, the area was mostly rural and sugarcane fields were prevalent. Post-war development activities made the capacity of Kamehameha Highway and the Kalauao Springs single bridge inadequate. In 1945, under Hawai'i Project No. DA-WR (3), an additional two-lane bridge was built parallel to the original one carrying the westbound lanes. The original one was converted to carry only the eastbound lanes. The 1966 Kamehameha Highway widening, FAP No. U-090-I (9), included an additional two lanes on the outboard side of both of the bridges. The construction of the 1945 bridge and widening in 1966 accommodated or encouraged the Post-war development along this corridor.



Construction drawings for the Kalauao Springs Bridge
State of Hawai'i, Department of Transportation
June 1945

The above drawing displays elements of the 1945 bridge design including sections (bottom) showing the main **girder bars** and **concrete socket piles**. The drawing also shows the **deck layout plan** (top left) indicating the position of the existing 1936 bridge as well as a detail of the **railing** and **balustrade layout** (bottom right).

KALAUAO SPRINGS BRIDGES (cont.)



The Kalauao Springs Bridges are significant resources within O'ahu's road transportation system for their association with the development of this portion of the Kamehameha Highway and the adjacent 'Aiea and Pearl City settlements, which evolved from a sugarcane plantation and a train-stop "city," into suburbs.

Both the 1936 eastbound bridge and the 1945 westbound bridge are reinforced concrete girder bridges. The 1936 bridge has one span, while the 1945 bridge has two spans. The 1966 additions of both bridges used prestressed concrete.

EASTBOUND (1936/1966)

The 1936 eastbound bridge is approximately 45' in length and retains the original concrete balustrades and stanchions on the mauka side of the bridge. The balustrade features vertical concrete balusters with Greek-cross shaped voids. At the ends of this balustrade are concrete stanchions that are curved in shape, arching away from the roadway, with stepped corners. The west stanchion has an added wedge of concrete on its road facing surface that anchors a steel thrie-beam guardrail. Typically, concrete bridges of this type and period include the year built and name inscriptions on their end stanchions. However, the concrete wedge covers the name inscription on the west stanchion. The east end stanchion has the date inscription "1936."

The 1966 balustrade and end stanchions are on the makai side of the bridge. The horizontal steel and concrete balustrade is typical of its period. The lower portion has three concrete sections with a horizontal line incised across each panel 9" from the bottom. The upper section is a metal railing composed of two horizontal tubes supported by slightly curved rail posts. The concrete end stanchions are rectangular with horizontal lines incised around the circumference at 9" and 1'-6" from the bottom. The west stanchion is inscribed with "KALAUAO SPRINGS BRIDGE 1966." The added steel thrie-beam guardrails partially obscure this inscription.

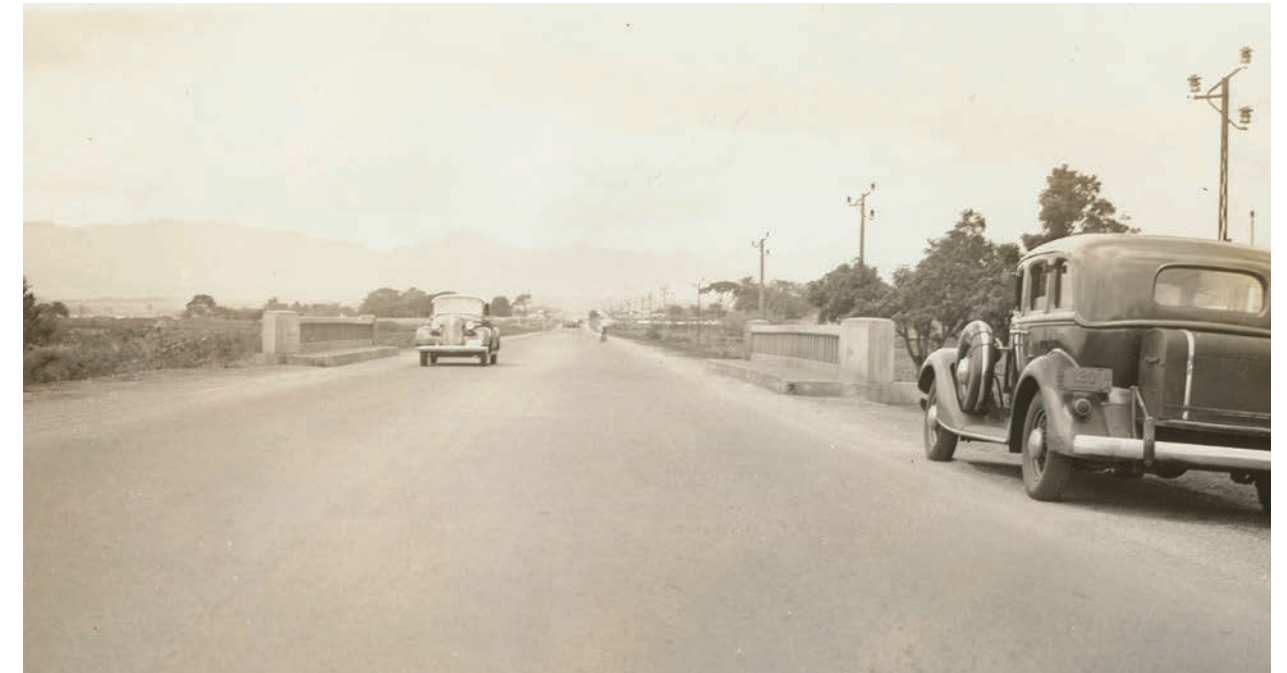
The bridge has concrete abutments are supported by piles.

Top left: **Stanchions** for the two bridges are outlined in yellow, as well as a Greek-Cross **void**.

Bottom Left: the 1966 **balustrade** is outlined in yellow.



*Kalauao Springs Bridge, 2012
David Franzen, Hawai'i State Archives*



*View looking northwesterly
near Kalauao Springs Bridge, n.d.
National Archives ID 169139880*

WESTBOUND BRIDGE (1945/1966)

The 1945 westbound bridge is approximately 51' in length. The 1945 section has two-spans, while the 1966 addition is a single-span. The westbound bridge has concrete balustrades and stanchions on the makai side of the bridge. The 1945 balustrade is almost identical to the 1936 eastbound bridge balustrade, except it does not have a sidewalk, only a concrete curb and its end stanchions are rectangular, not curved. Each stanchion has stepped corners and squarely abuts the balustrade. The east end stanchion has an added steel thrie-beam guardrail that is through-bolted to the stanchion. The guardrail partially obscures the name, but "KALAUAO SPRINGS" remains visible beneath it. The west end stanchion has no added guardrail and "1945" is inscribed in the road facing surface.

The 1966 balustrade of this westbound bridge was constructed identical to the 1966 balustrade of the eastbound bridge (see description above).

The underside of the 1945/1966 westbound bridge is inaccessible for observation. From the bank of the waterway north of the bridge there is a view of the structural design – the original 1945 bridge and the 1966 traffic lane and sidewalk. The 1945 portion that carries the two makai lanes has two spans, with a central line of support consisting of square-cross section concrete piles topped by a transverse concrete beam or pile cap. The 1945 drawings show the piles are composites; the upper portions, labeled as concrete "Socket Piles," have wider bottom sections that fit over the lower "Untreated Timber Piles." The added 1966 portion carries the third lane and sidewalk on the mauka side of the bridge. Its two longitudinal prestressed concrete girders cross the waterway in a single span. The bridge abutments are board-formed concrete.

ALTERATIONS

- Both bridges were widened in 1966, creating a third lane and removing original balustrades and stanchions on the outer edges and adding new balustrades and stanchions.
- Steel thrie-beam guardrails were added to both bridges, attached to the end stanchions.



Kalauao Stream Bridge, 2012
David Franzen, Hawai'i State Archives



KALAUAO STREAM BRIDGES

Location: Kamehameha Highway and Kalauao Stream, 'Aiea, Kalauao ahupua'a, 'Ewa moku

Date of Construction: 1936, 1945, 1966

Engineer: William R. Bartels, C.R.Y / R.K. (sic.)

Builder/Contractor: Walker & Olund, Ltd, E.E. Black, Ltd.

Style: Multi-span, reinforced concrete girder

Hawai'i State Register of Historic Places: Not listed. Determined eligible in the 2013 Statewide Bridge Inventory

National Register of Historic Places: Not listed

National Bridge Inventory Structure No.:

Eastbound: 003000990402074

Westbound: 003000990402075

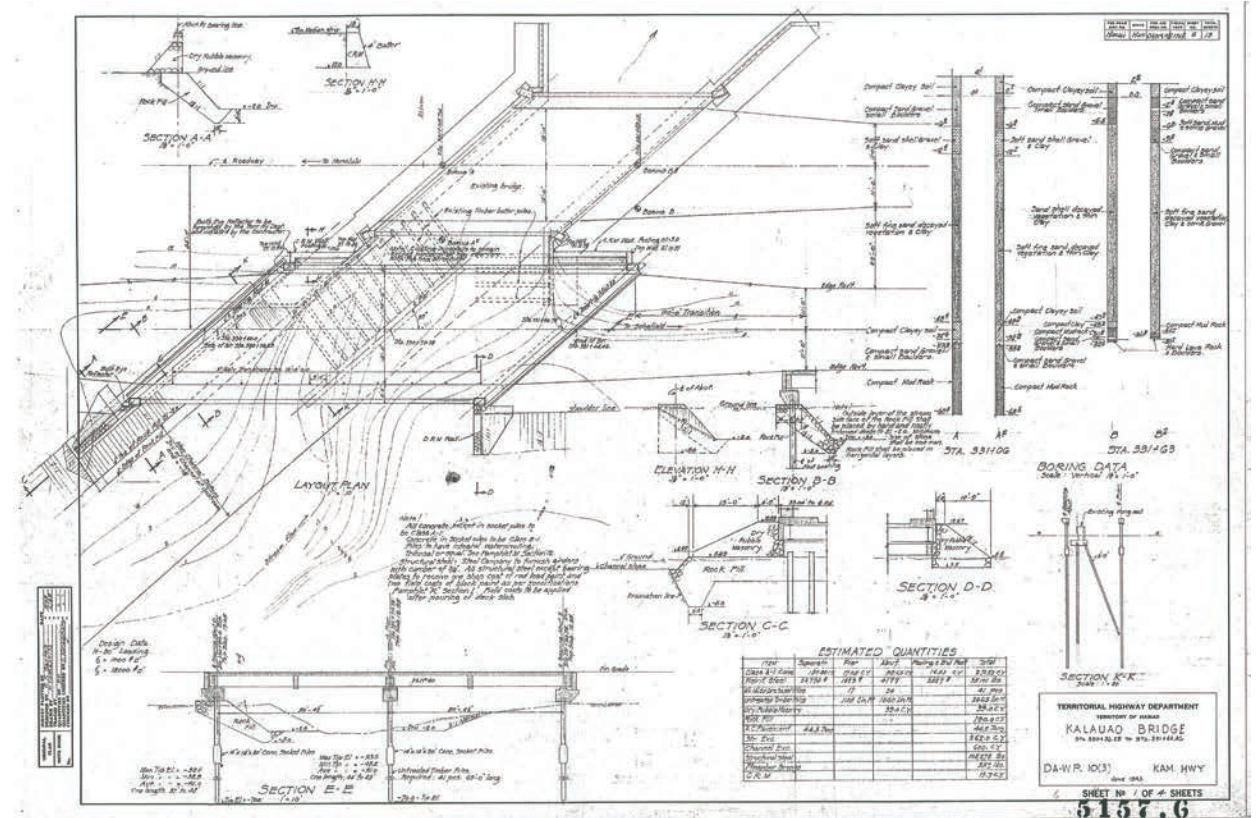
State Inventory of Historic Places No.:

Eastbound: 50-80-09-08065

Westbound: 50-80-09-08066

HAER HI-116

The original Kalauao Stream Bridge was built in 1936 as part of the National Recovery Highway (NRH) Project No. NRH-9-C to facilitate passage of Kamehameha Highway over the Kalauao Stream. This bridge was constructed with two lanes, one for each direction. Prior to World War II, the area was mostly rural and sugarcane fields were prevalent in the area. Post-war development made the capacity of Kamehameha Highway and the Kalauao Stream single bridge inadequate. In 1945, under Hawai'i Project No. DA-WR (3), an additional two-lane bridge was built parallel to the original one carrying the westbound lanes. The original lanes were converted to carry only the eastbound lanes. The 1966 Kamehameha Highway widening, FAP No. U-090-I (9), included an additional two lanes on the outboard side of both of the bridges. The construction of the 1945 bridge and widening in 1966 accommodated or encouraged the Post-war development along this corridor.



Construction drawings for the Kalauao Stream Bridge
State of Hawai'i, Department of Transportation
June 1945

The above drawing shows elements of the 1945 bridge design including sections showing the **concrete socket piles** (bottom left) and the **abutments** (bottom right) with dry rubble masonry infill. The drawing also shows the **deck** layout plan (top left) noting the positions of the existing **wing walls** and the existing 1936 bridge.

KALAUAO STREAM BRIDGES (cont.)

The Kalauao Springs Bridges are significant resources within O'ahu's road transportation system for their association with the development of this portion of the Kamehameha Highway and the adjacent 'Aiea and Pearl City settlements, which evolved from a sugarcane plantation and a train-stop "city," into suburbs.

The 1936 portion of the eastbound bridge is a reinforced concrete girder type with a single-span. The 1945 portion of the westbound bridge is a steel I-beam and has two spans. The 1966 additions of both bridges used prestressed concrete and has two spans.

EASTBOUND (1936/1966)

The 1936 portion of the eastbound bridge is approximately 54' in length and retains the original concrete balustrades and stanchions on the mauka side of the bridge. The balustrade features vertical concrete balusters with Greek-cross shaped voids. At the ends of this balustrade are concrete stanchions that are curved in shape, arching away from the roadway, with stepped corners. The west stanchion has an added wedge of concrete on its road facing surface that anchors a steel thrie-beam guardrail. The bridge includes the year built and name inscriptions on its end stanchions. A concrete wedge covers the name inscription on the west stanchion. The east end stanchion has the date inscription "1936."

The 1966 balustrade and end stanchions are on the makai side of the bridge. The horizontally steel and concrete balustrade is typical of its period. The lower portion has three concrete sections with a horizontal line incised across each panel 9" from the bottom. The upper section is a metal railing composed of two horizontal tubes supported by slightly curved rail posts. The concrete end stanchions are rectangular with horizontal lines incised around the circumference at 9" and 1'-6" from the bottom. The west stanchion is inscribed with "KALAUAO STREAM BRIDGE 1966."

The underside of the 1936 eastbound bridge is constructed with board-formed concrete with five longitudinal concrete beams. The 1966 portion is supported by two prestressed concrete girders. The bridge has concrete abutments supported by piles.



The yellow outlines in this photo highlight one of the 1936 **stanchions** and a **Greek-cross opening** in the **balustrade** of the eastbound bridge.

*Kalauao Stream Bridge, 2012
David Franzen,
Hawai'i State Archives*

WESTBOUND BRIDGE (1945/1966)

The 1945 portion of the westbound bridge is approximately 48' in length and retains the original concrete balustrades and stanchions on the makai side. The balustrade of this bridge is almost identical to the 1936 balustrade described above. The chief differences are this balustrade is longer, over 100' in length and does not have a sidewalk, while the 1936 has one on the mauka side. The concrete stanchions are rectangular, not curved. The stanchions on this portion of the bridge have stepped corners and squarely abut the balustrade. They each have an added steel thrie-beam guardrail, through-bolted to one stanchion. The guardrails obscure the name (Kalauao Stream) and year built (1945) inscriptions on the road facing surfaces.

The 1966 balustrade on the westbound bridge is about 107' long. The balustrade and end stanchions of this part of the westbound bridge are identical to the 1966 balustrade of the eastbound bridge.

The underside of the 1945 portion of the westbound bridge has six longitudinal girders that are steel I-beams. The westbound bridge has two spans of about 50' each. The I-beams are supported at the mid-point by seventeen square concrete piles topped by a concrete beam. The 1966 section of this bridge has two longitudinal girders of pre-stressed concrete supported at mid-span by a concrete beam with four octagonal concrete piles. The east abutment of the westbound bridge is of board-formed concrete, and the west abutment is of lava rock and cement mortar masonry.

ALTERATIONS:

- Both bridges were widened in 1966, creating a third lane and removing original balustrades and stanchions on the outer edges and adding new balustrades and stanchions.
- Steel thrie-beam guardrails were added to both bridges. They are attached to the westbound stanchions of the eastbound bridge and to both 1945 stanchions of the westbound bridge.



The yellow outlines in this photo highlight one of the 1966 **stanchions** and the more modern style of the **parapet** and **railings**.

*Kalauao Stream Bridge, 2012
David Franzen,
Hawai'i State Archives*

HART

HONOLULU AUTHORITY for RAPID TRANSPORTATION

M

A big mahalo to the archives, community groups, consulting parties to the programmatic agreement, historians, and individuals who supported the development of this Educational Field Guide. A special mahalo to:

Bishop Museum Archives

Hawai'i State Archives

Historic Hawai'i Foundation

Kalaeloa Heritage Park; www.kalaeloaheritagepark.org

Kehaulani Lum and the Ali'i Pauahi Hawaiian Civic Club; www.paaiau.org

State Historic Preservation Division

Previous research and documentation also prepared in partial fulfillment of mitigation required under the PA for Skyline served as the primary information source for the content presented in this Educational Field Guide. These included numerous Historic American Engineering Records (HAER) and National Register Nomination forms for the bridges, as well as a document titled He Mo'olelo Aina - Traditions and Storied Places in the District of 'Ewa and Moanalua (2012), along with the He Ala Mēheuheu a nā Hānauna, a Customary Path Traveled Over the Generations Draft Phase I Interpretive Plan and Stories Along Skyline brochure for the Honolulu Rail Transit Project.