The Historical Progression of Transportation in Mākaha

From Railways to Highways

HISTORIC HAWAI'I FOUNDATION

U.S. Department of Transportation
Federal Highway Administration

Presenters

Kiersten Faulkner, Executive Director, Historic Hawai‘i Foundation

Ms. Faulkner was been executive director of Historic Hawai‘i Foundation since 2006. Prior to joining HHF, Ms. Faulkner was a Senior City Planner for the City & County of Denver. She holds a Master of Arts in Urban and Environmental Policy and is a member of the American Institute of Certified Planners (AICP).

Presenters

Meesa Otani, Environmental Engineer, Federal Highway Administration, Hawai‘i Division

Ms. Otani is an Environmental Engineer for the Federal Highway Administration in the Hawai‘i Division office, where she provides oversight of the environmental process for all projects receiving Federal-aid highway funds in the State of Hawai‘i. Prior to joining the Hawai‘i Division, Ms. Otani was an Environmental Coordinator in the Arizona Division, and a participant in the Federal Highway Administration Professional Development Program. Ms. Otani holds a Bachelor of Science in Civil Engineering degree from the University of Portland.

Presenters

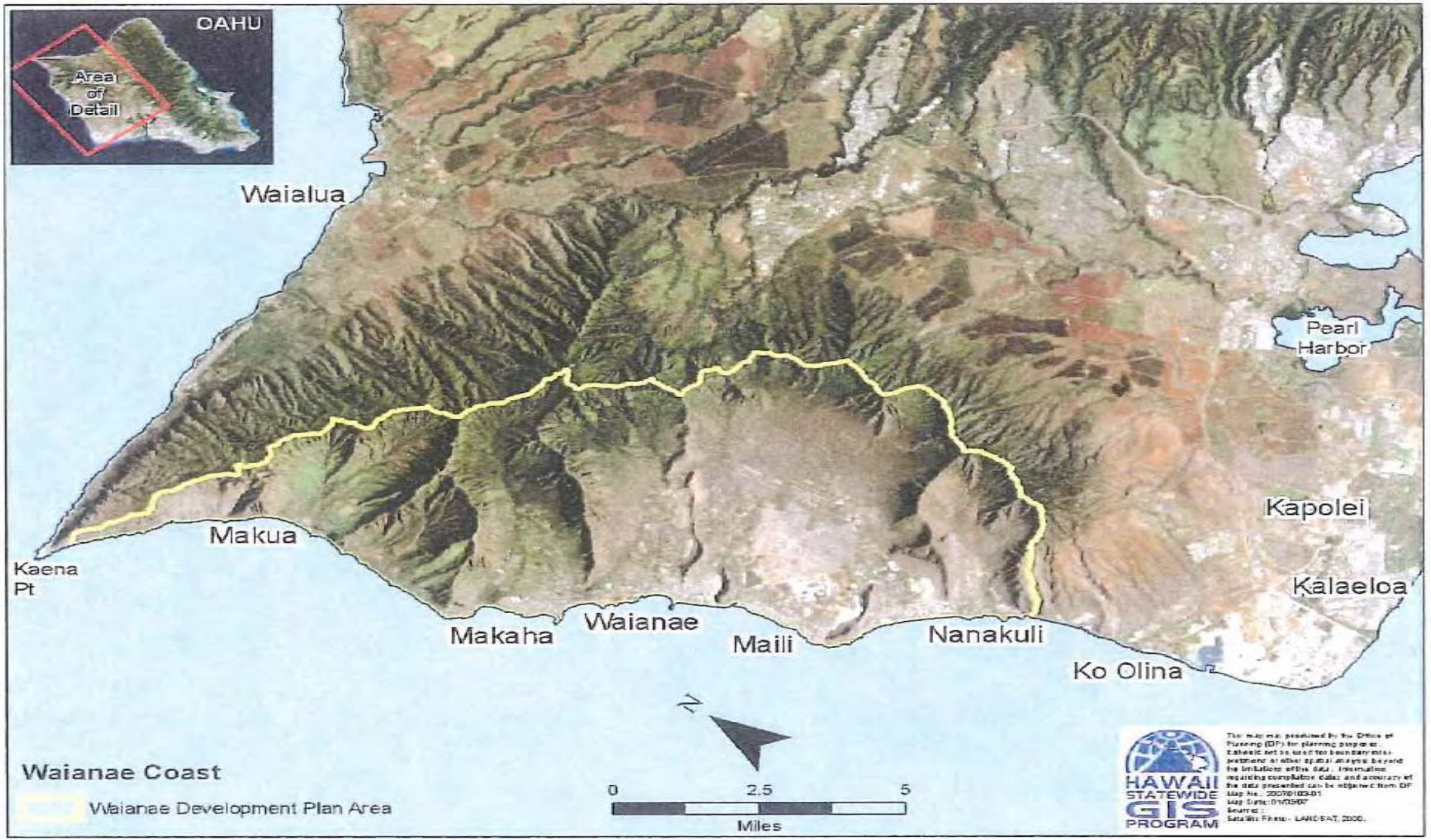
Henry Kennedy, Project Manager, Hawai‘i State Department of Transportation

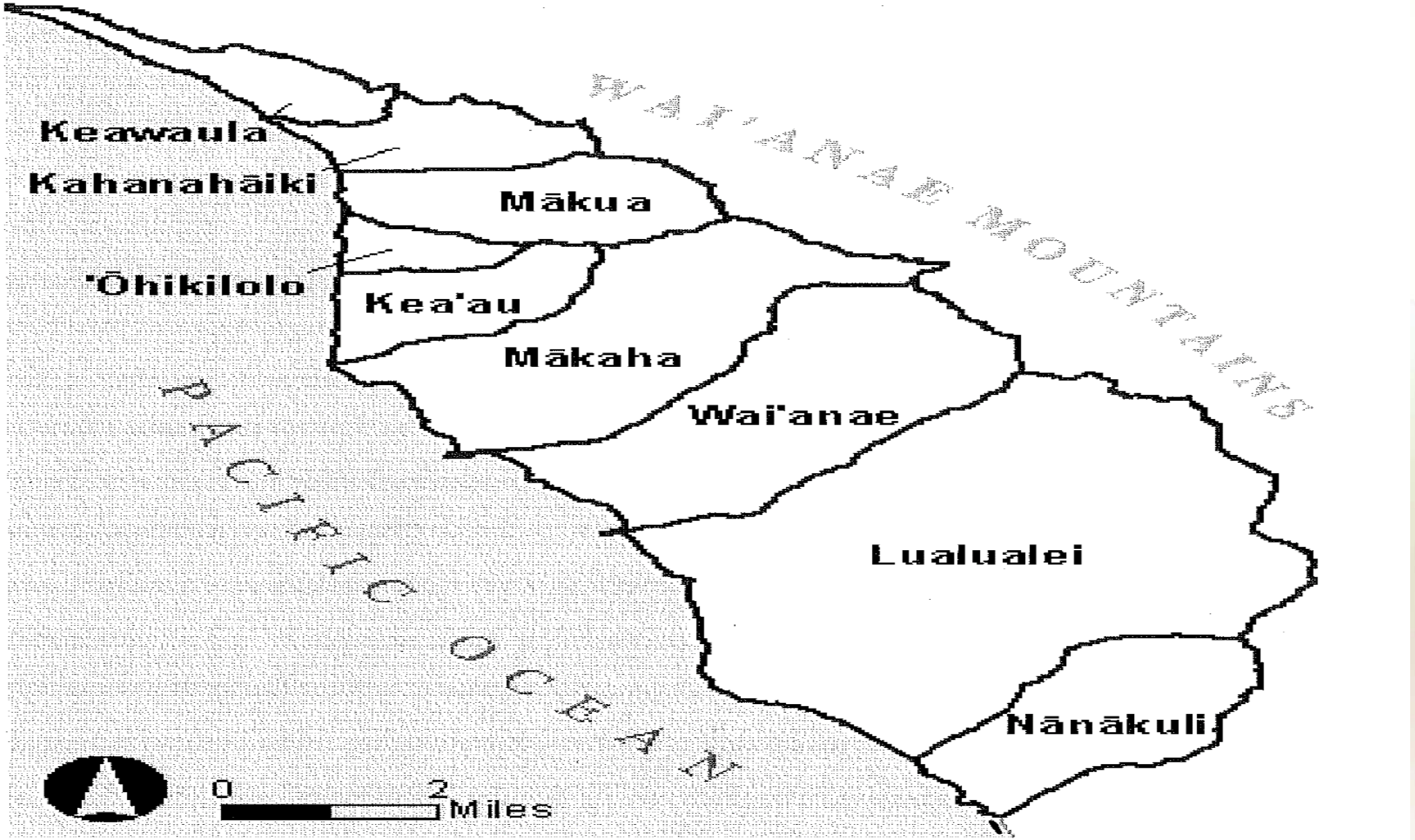
Mr. Kennedy is a Project Manager in the State’s Highways Division, Design Branch and oversees various consultant-designed highways and bridge projects throughout the State. He holds a Bachelors of Science degree in Civil Engineering from the University of Hawai‘i at Mānoa .

Past – The History

The Wai‘anae Coast Today

Photo credit: Dennis Oda, Honolulu Star Advertiser


OAHU
Area of Detail
Waialua
Pearl Harbor
Kapolei
Makua
Kaena Pt
Kalaeloa
Makaha
Waianae
Maili
Nanakuli
Ko Olina
N
Waianae Coast
Waianae Development Plan Area
0
2.5
5
Miles
HAWAII STATEWIDE GIS PROGRAM


Keawaula
Kahanahāiki
Mākua
'Ōhikilolo
Kea'au
Mākaha
Wai'anae
Lualualei
Nānākuli
PACIFIC OCEAN
0
2
Miles

Transportation in Early Mākaha

Pre-Contact Era

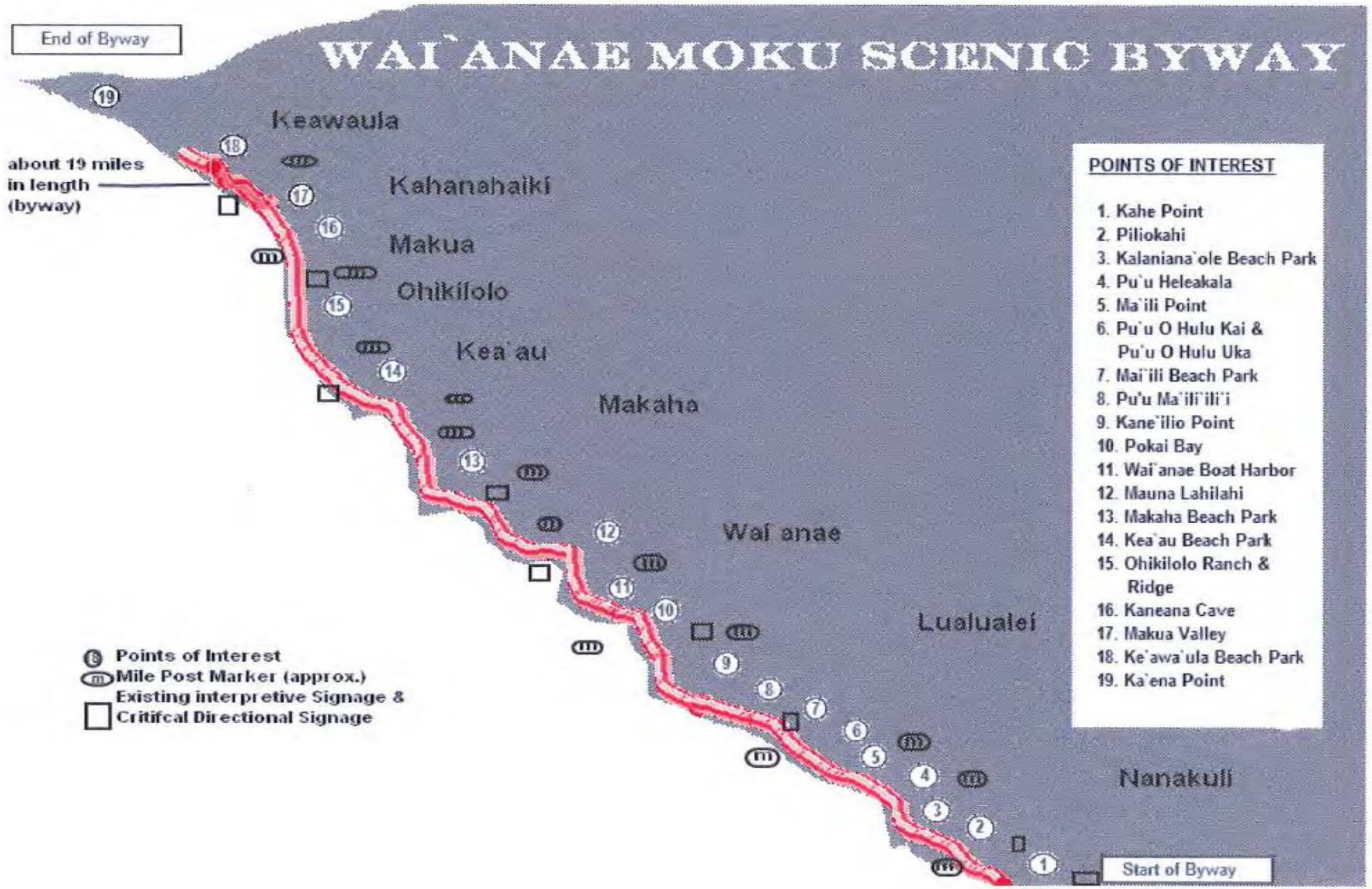
Mākaha was traditionally known for its abundance of marine resources, kalo loʻi and fishpond at the mouth of Mākaha Stream.

Transportation:

- Trails that both followed the coastline and connected mauka and makai
- Waʻa

Painting by Herb Kāne

Pre-contact Mauka – Makai trail in Kalealoa Cultural Heritage Park


WAI`ANAE MOKU SCENIC BYWAY
End of Byway
about 19 miles in length (byway)
Keawaula
Kahanahaiki
Makua
Ohikilolo
Kea`au
Makaha
Wai`anae
Lualualei
Nanakuli
Start of Byway
POINTS OF INTEREST
1. Kahe Point
2. Piliokahi
3. Kalaniana`ole Beach Park
4. Pu`u Heleakala
5. Ma`ili Point
6. Pu`u O Hulu Kai & Pu`u O Hulu Uka
7. Mai`ili Beach Park
8. Pu'u Ma`ili`ili`i
9. Kane`ilio Point
10. Pokai Bay
11. Wai`anae Boat Harbor
12. Mauna Lahilahi
13. Makaha Beach Park
14. Kea`au Beach Park
15. Ohikilolo Ranch & Ridge
16. Kaneana Cave
17. Makua Valley
18. Ke`awa`ula Beach Park
19. Ka`ena Point
Points of Interest
Mile Post Marker (approx.)
Existing interpretive Signage & Critifcal Directional Signage

Transportation in Mākaha

<u>Early 1800's</u>
Residents left farming and agriculture to harvest and trade sandalwood to western sailors

Great Māhele in 1845-1846 divided the land
1850: Pākī awarded 5000 acres
1855: Sold to James Robinson & Co.
Owen James Holt bought out shares
1887 – 1899: Holt Ranch

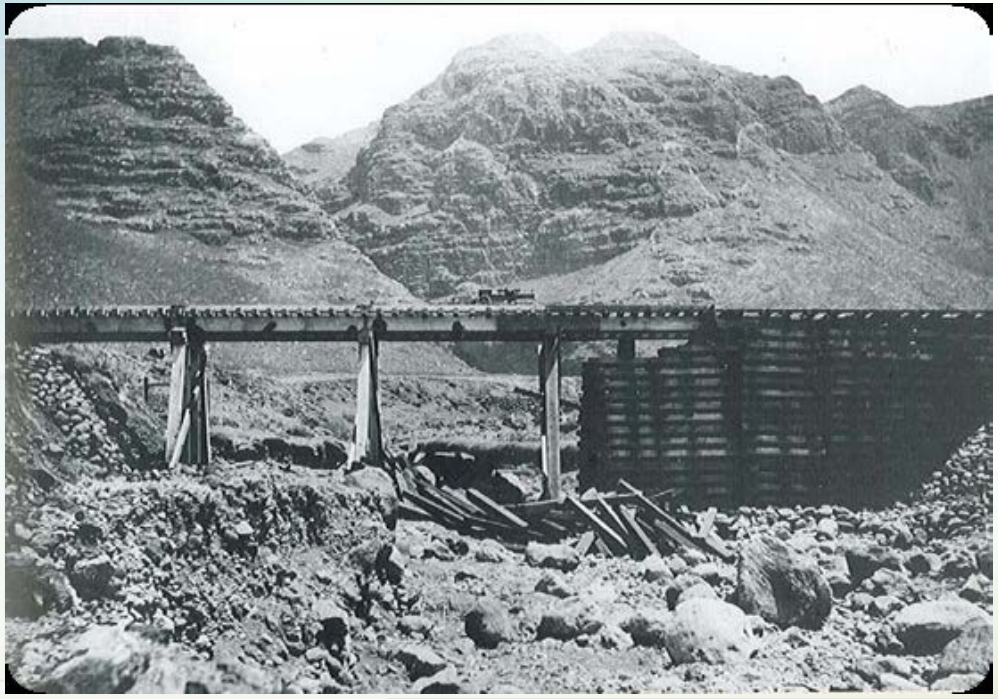
Transportation:
- Trails widened to roads to support horses and wagons
- Sailing Ships

High Chief Abner Pākī. Hawai'i State Archives

Transportation in Mākaha

Late 1800's
Waiʻanae Plantation Railroad
Oʻahu Rail & Land Company (OR&L)
Chartered by King Kalākaua in 1888; opened on the King's birthday in 1890

Benjamin Franklin Dillingham built the railway, which supported sugar plantation development and passenger service



Construction of the OR&L Railway

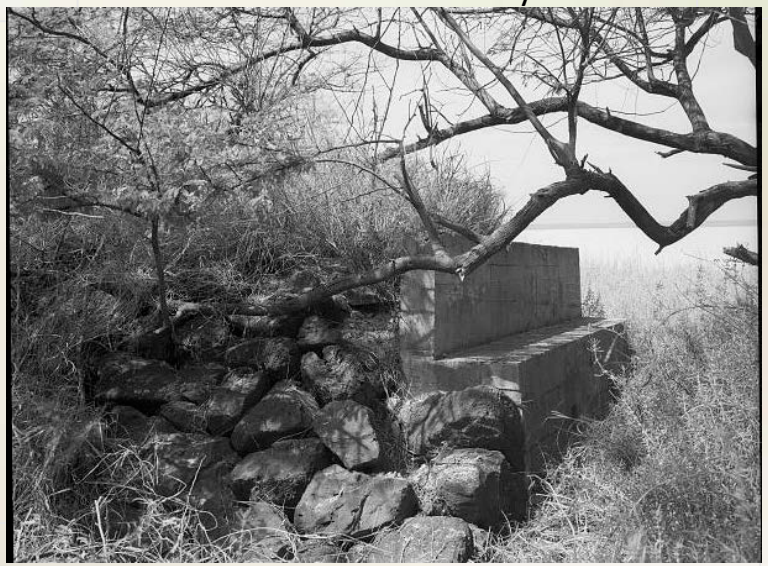
OR&L

Transportation in Mākaha

Early 20th Century

1890: Railway extended to Pearl City
1895: Tracks extended to Waiʻanae
1899: Rail goes to Kahuku
1915: ~1,000,000 passengers per year
1926: Ridership falls due to affordable automobiles and highway improvements
1940-1945: Railway used by Navy for wartime transportation of ammunition, supplies and equipment
1946: Tsunami damages the tracks, most not repaired
1947: Train reduced to urban Honolulu
1972: Train operations ceased
Today: Hawaiian Railway Society operates on ~26 mile of OR&L tracks from ʻEwa to Nānākuli

Remnants of OR&L Railway Foundations

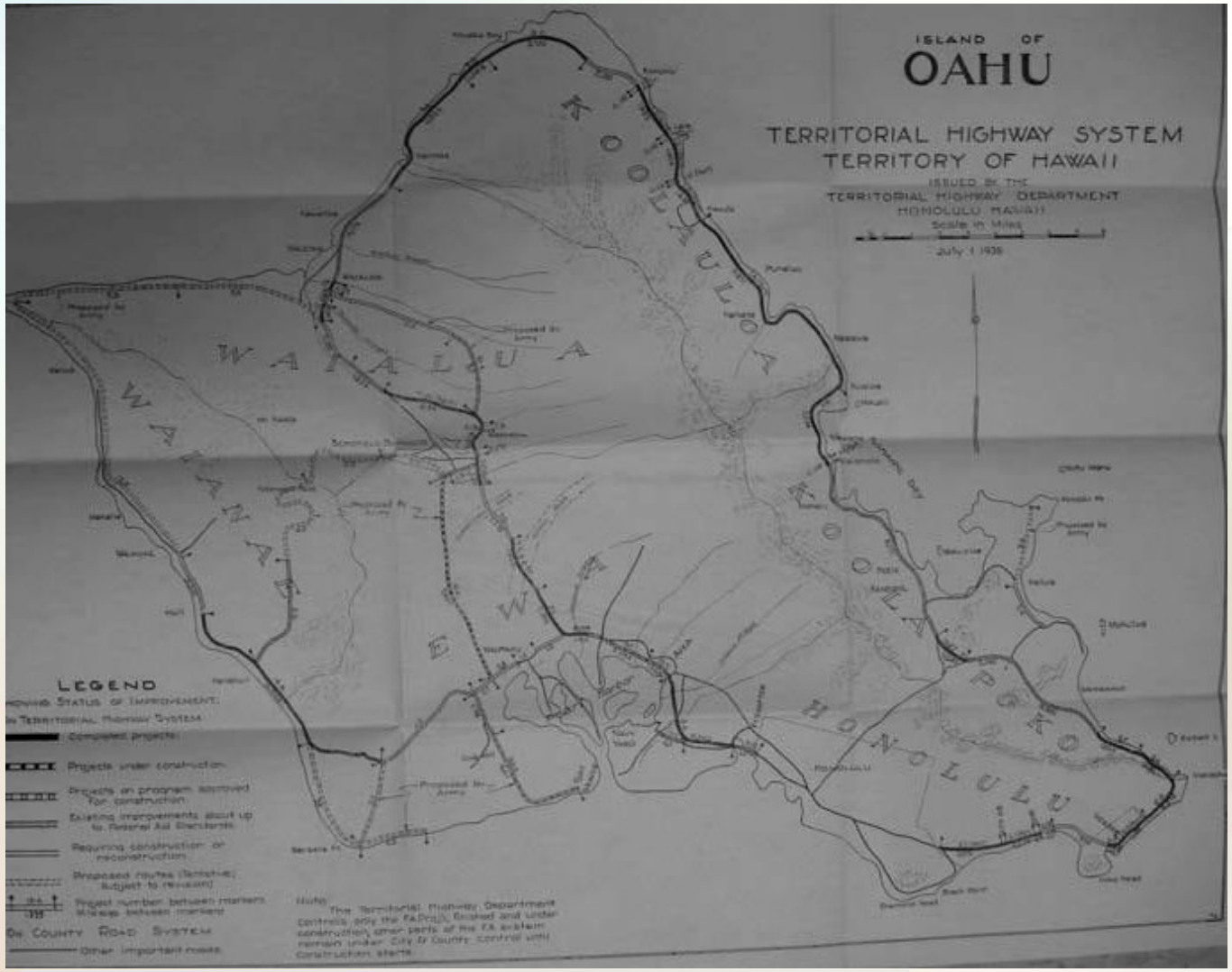


From Railroads to Highways

1899: First automobile in Honolulu; owned by Henry P. Baldwin

1930's: Roadway infrastructure built and highway system established

First car in Honolulu with H. Baldwin. Hawai'i State Archives



Territorial Highway System, O'ahu, July 1935

Bridge and Road Construction

Republic of Hawai‘i (1893 – 1894)

- Day labor
- Prisoners
- Contracts for Hawai‘i Belt Road

Bridge and Road Construction

Early Territorial Period (1898 – 1924)

- Office of the Superintendent of Public Works, used territorial funds for road and bridge work
- County system established 1903, given power to tax and expend funds
- Used federal, territorial and county funds
- Loans and bonds
- Private business, especially irrigation companies and plantations

Bridge and Road Construction

Federal Aid Program (1925 - 1941)

- Interstate and Defense Highways
- Federal Aid Primary System
- Federal Aid Secondary System

As a territory, Hawai‘i was excluded from receiving the funds, even though residents paid federal taxes

In 1923, Hawai‘i Legislature passed a Bill of Rights, demanding equal benefits; signed into law by President Calvin Coolidge in 1924

Bridge and Road Construction

Federal Aid Program (1925 - 1941)

- First federal highway funds in 1925, with back-pay to 1917

Depression Era Federal Work Programs in Hawaii (1933 – 1938)

- Works Progress Administration (WPA)
- Civil Works Administration (CWA)
- Civilian Conservation Corps (CCC)
- Federal Emergency Relief Act (FERA)

Mākaha Bridges 3 and 3A

1937: Kaʻena Point Road Projects, funded by WPA

Kaupuni to Mākua

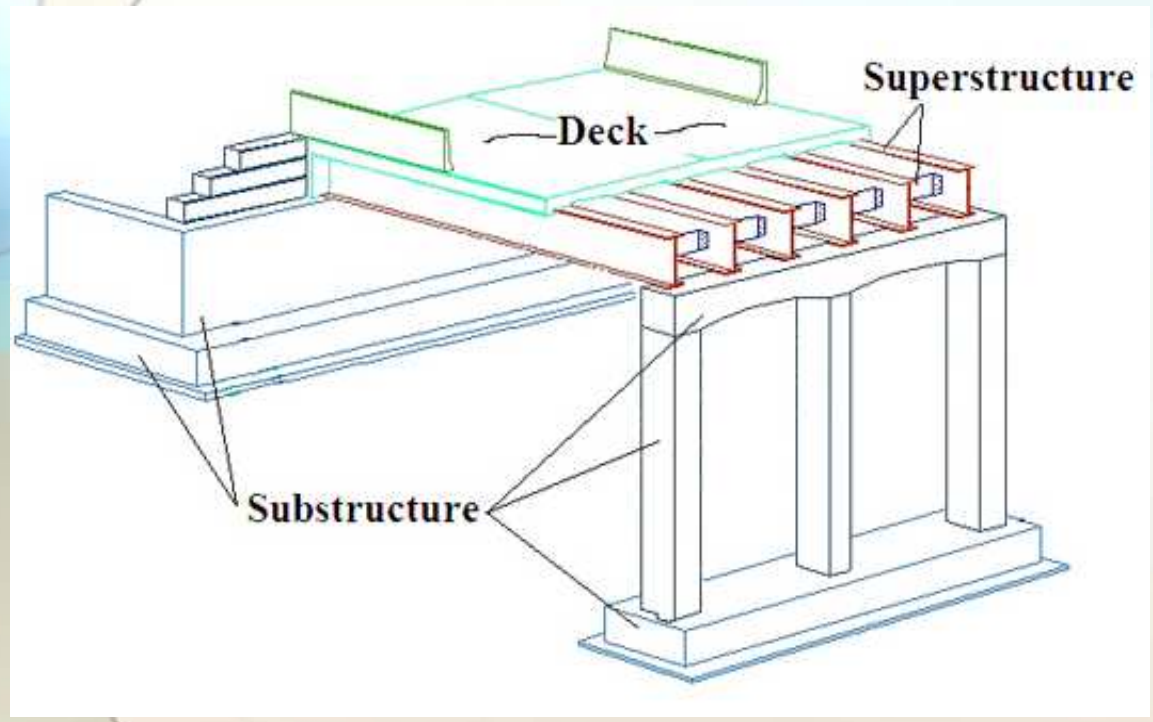
Parallel and mauka of OR&L Tracks

9 timber-framed bridge crossings

Goal: to provide “all weather access to the westernmost portion of Oʻahu, hitherto inaccessible in rainy weather”

Construction crew of 124 men

The Bridges



Bridge Structural Elements Diagram

Deck: The portion of the bridge that directly carries traffic.

Superstructure: The portion of the bridge that supports the deck and connects one substructure element to another.

Substructure: The portion of the bridge that supports the superstructure and distributes all bridge loads to below-ground bridge footings.

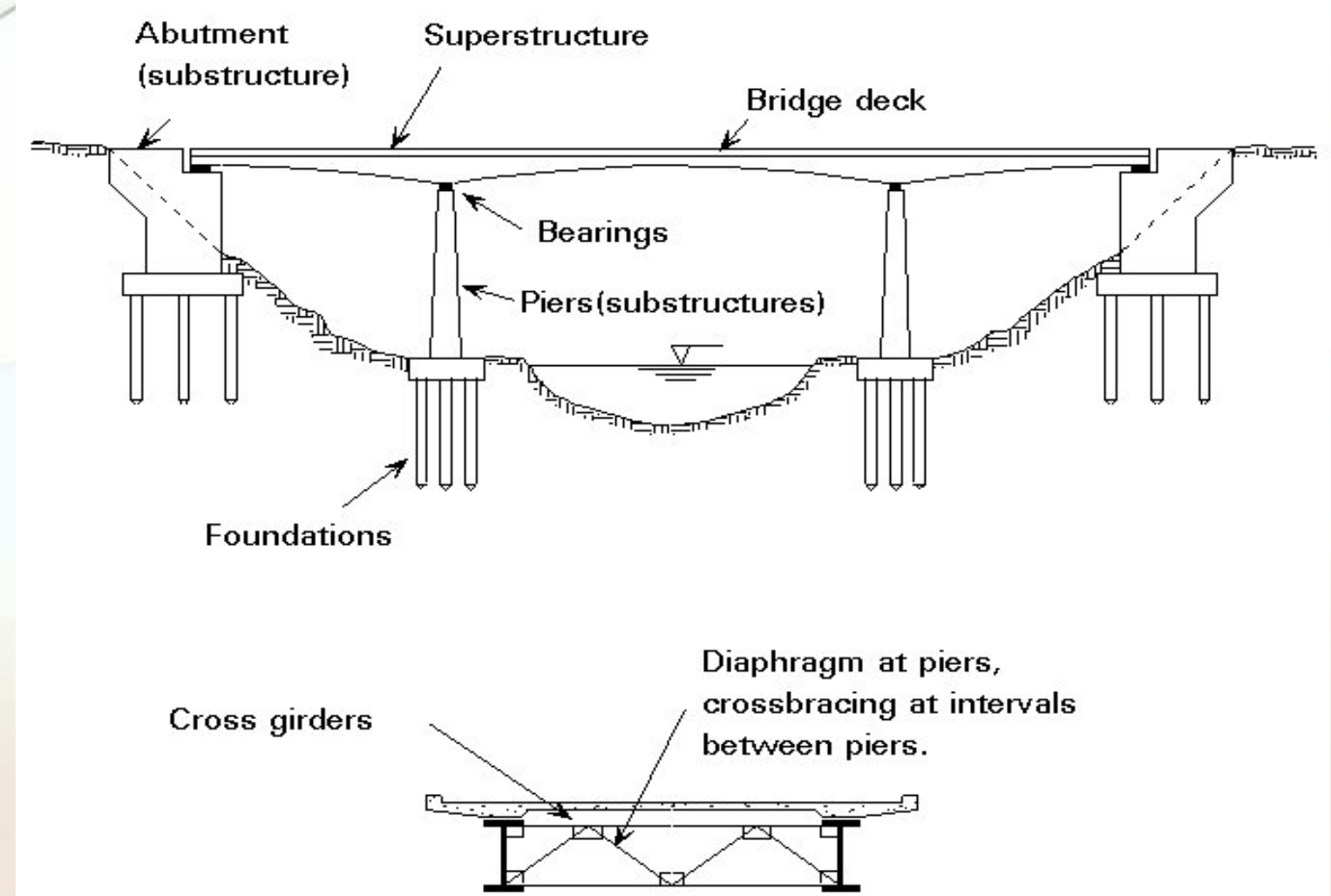
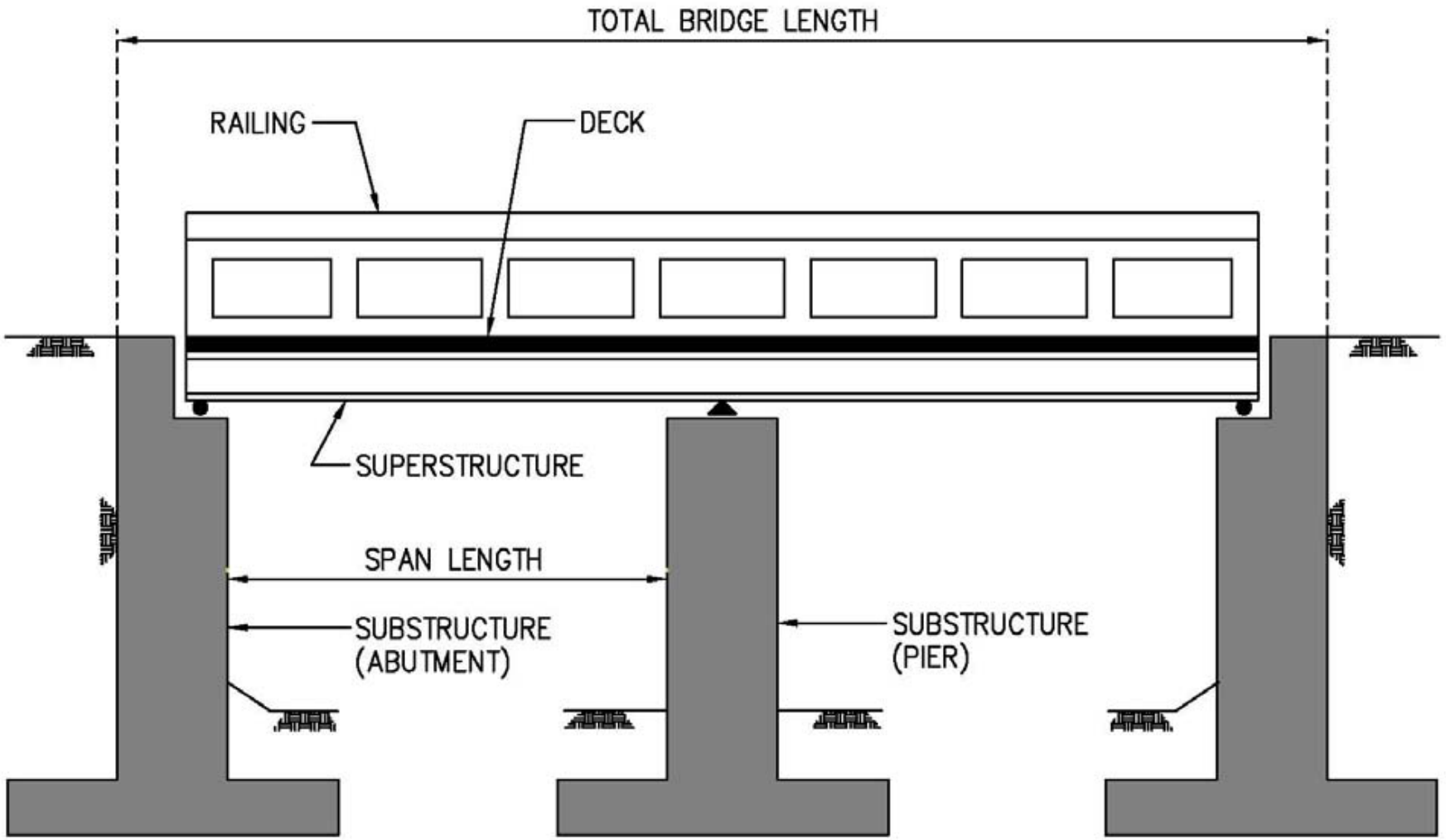


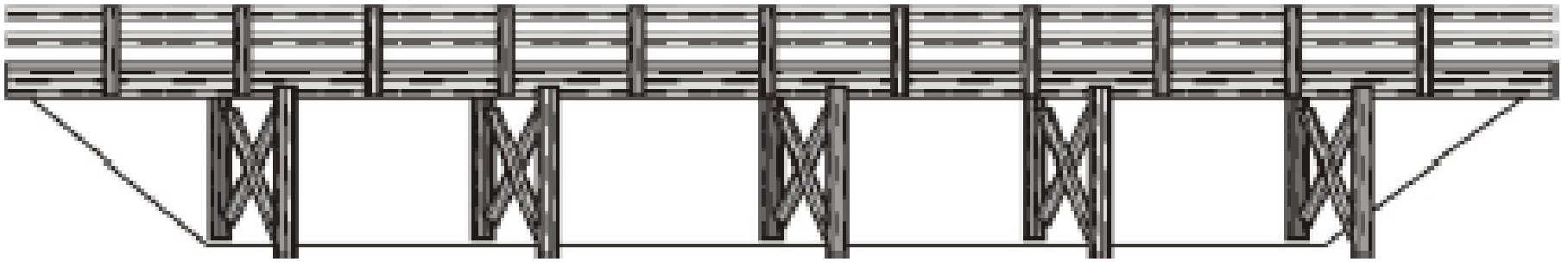
Figure 1 Basic components of a bridge


TOTAL BRIDGE LENGTH
RAILING
DECK
SUPERSTRUCTURE
SPAN LENGTH
SUBSTRUCTURE
(ABUTMENT)
SUBSTRUCTURE
(PIER)

	1890s	1900s	1910s	1920s	1930s	1940s
BRIDGE STYLES	MASONRY (LAVA ROCK) ARCH 1896 – 1897 STEEL & WROUGHT IRON TRUSS 1884 – 1904		METAL TRUSS & STEEL STRINGER 1912 – 1957 STEEL TRESTLE RAILROAD 1911 SOLID SPANDREL CONCRETE ARCH Early 1904 – 1916; Late 1916 - 1929 OPEN SPANDREL CONCRETE ARCH 1911 - 1936 RAINBOW "MARSH" CONCRETE ARCH 1921 - 1938 CONCRETE FLAT SLAB 1908 – 1960s CONCRETE RIGID FRAME 1936 - 1941 CONCRETE DECK GIRDER 1911 - 1935 CONCRETE TEE-BEAM 1911 – 1912; Territorial Highway Department after 1925 TIMBER STRINGER 1924 - 1949		
HAWAII EVENTS	**1893** Overthrow of Hawaiian monarchy **1894 – 1898** Republic of Hawaii **1898** United States annexed Hawaii	**1900** Organic Act abolished Department of Interior and replaced it with Office of Superintendent of Public Works • Loan commission appointed to oversee fund expenditures **1904** Territorial Gov't advocated durable concrete bridges **1905** Territorial legislature established • County gov't established on islands		**1920s** Bridges were financed through loan fund and legislative appropriation **1925** Federal Aid Program initiated	**1930s** Bridges were financed through loan fund and legislative appropriation **1932 – 1952** William R. Bartels tenure as chief designer with Territorial Highways Department marked shift to large deck girder and rigid frame bridges **1937** Territory no longer matched incoming federal funds	**1941** Hawaii enters WWII **1944** Federal Aid Highway Act
BRIDGE DETAILS	**1899** Rubble masonry (lava rock) parapet		**1911** Loan fund commission road width requirement of 18' but 16' was common in rural areas **1910s** • Bridges on belt roads designed by County Engineers Office until 1925 • Notable people: J. H. Moragne (Kauai), En Leong Wung, and William Hoy Chun (Hamakua Coast, Hawaii)	**1920s** Road width requirement changed to 20'	**1936** Most significant timber stringer bridges were designed by Bartels in 1936 **1930s** • Block-like end piers • Sidewalks added on one side of bridge **Late 1930s** Concrete and steel shortage due to military construction for WWII • Lava rock masonry footings and abutments	**1940s** • Sidewalks added on both sides of many bridges
BIDGE PHOTOGRAPH EXAMPLES	 **1896 STEEL TRUSS** OPAEKAA (KAUAI COUNTY)	 **1904 SOLID CONC ARCH** PUKIHAI (HAWAII COUNTY)	 **1911 CONC TEE-BEAM** HANAPEPE (KAUAI COUNTY)	 **1921 RAINBOW "MARSH"** ANAHULU (OAHU COUNTY)	 **1936 CONC RIGID FRAME** KAAHUMANU (MAUI COUNTY)	 **1940 TIMBER STRINGER** NINOLE (HAWAII STATE)

	1950s	1960s
BRIDGE STYLES	METAL TRUSS & STEEL STRINGER 1912 – 1957 STEEL TRESTLE RAILROAD 1911 – 1953 CONCRETE FLAT SLAB 1908 – 1960s CONCRETE DECK GIRDER 1945+ CONCRETE TEE-BEAM 1911 – 1912; Territorial Highway Department after 1925	
HAWAII EVENTS	**1950 – 1953** Korean War **1952** Nimitz Highway opened **1956** Federal Aid Highway Act & Highway Revenue Act **1959** Hawaii admitted as 50th state of the United States	**1960** State Department of Transportation established • Interstate Highway System extended to State of Hawaii thus allowing Federal Interstate Highway Fund to be applied to Hawaii highway and bridge constructions • Construction of bridges and roads linked to needs of National Defense & military establishment in the Pacific • Interstates H1, H2, and H3 were proposed to connect military bases on Oahu
BRIDGE DETAILS		
BIDGE PHOTOGRAPH EXAMPLES	 **1953 CONC FLAT SLAB** MANOA (OAHU COUNTY)	 **1961 CONC GIRDER** MALIKO (MAUI STATE)

HDOT Typical Bridge, early 21st Century (Līhu‘e, Kaua‘i)

Timber Stringer[39]	

First type of bridge in Hawai‘i
Constructed 1840 – 1949

Design features:

- timber girders
- masonry/basalt footings and abutments
- wood trestles
- open horizontal wood board railings

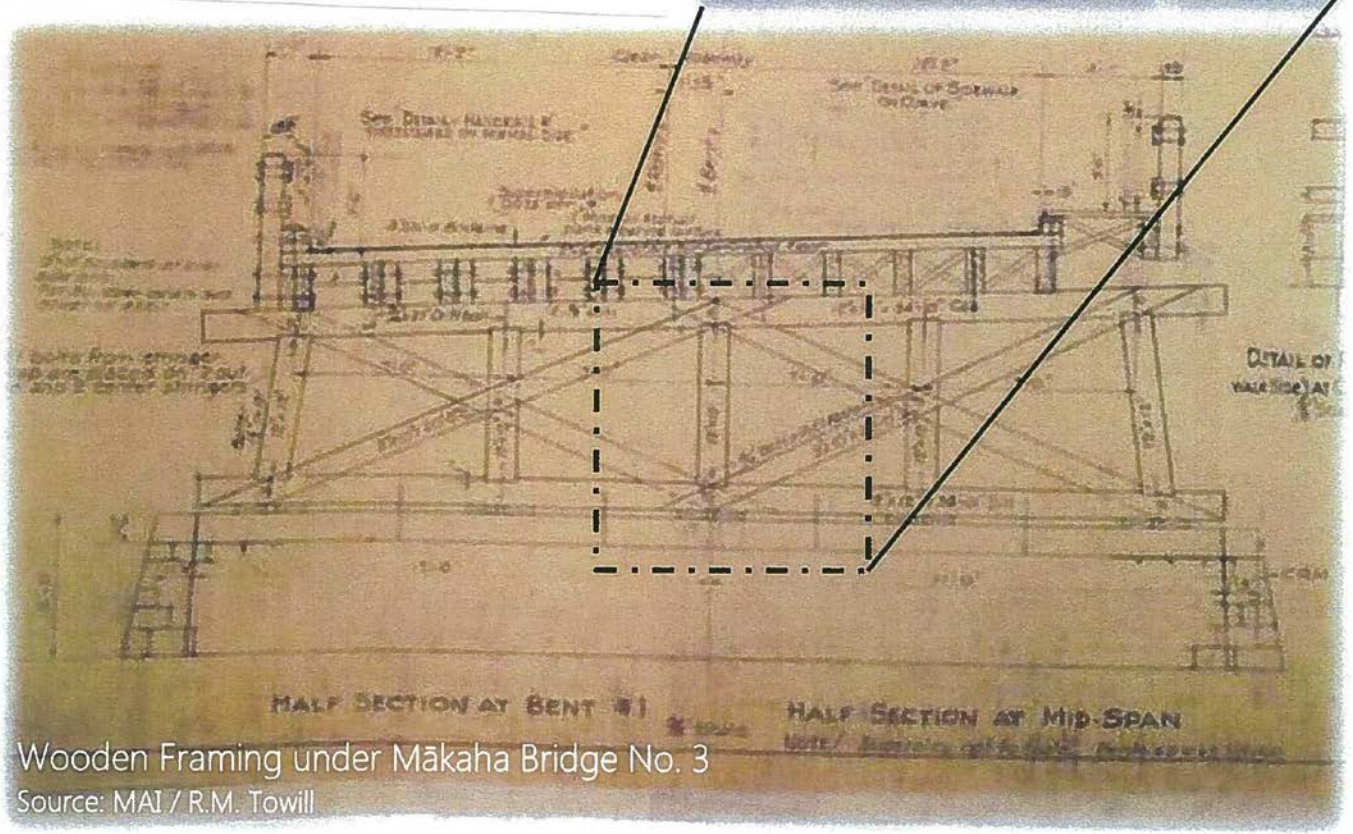
MAKAHA BRIDGE NO. 3

- Over Mākaha Stream
- 60 feet long and 36.1 feet wide
- Three spans, maximum 19 feet
- Timber soaked in creosote
- 60 foot long girder and floor beam structure
- 4-foot high lava rock foundations with tapered ends
- 12-inch concrete cap
- Foundations are 36-feet six-inches long
- 12-inch thick lava rock and mortar walls
- Plank deck, covered in asphalt

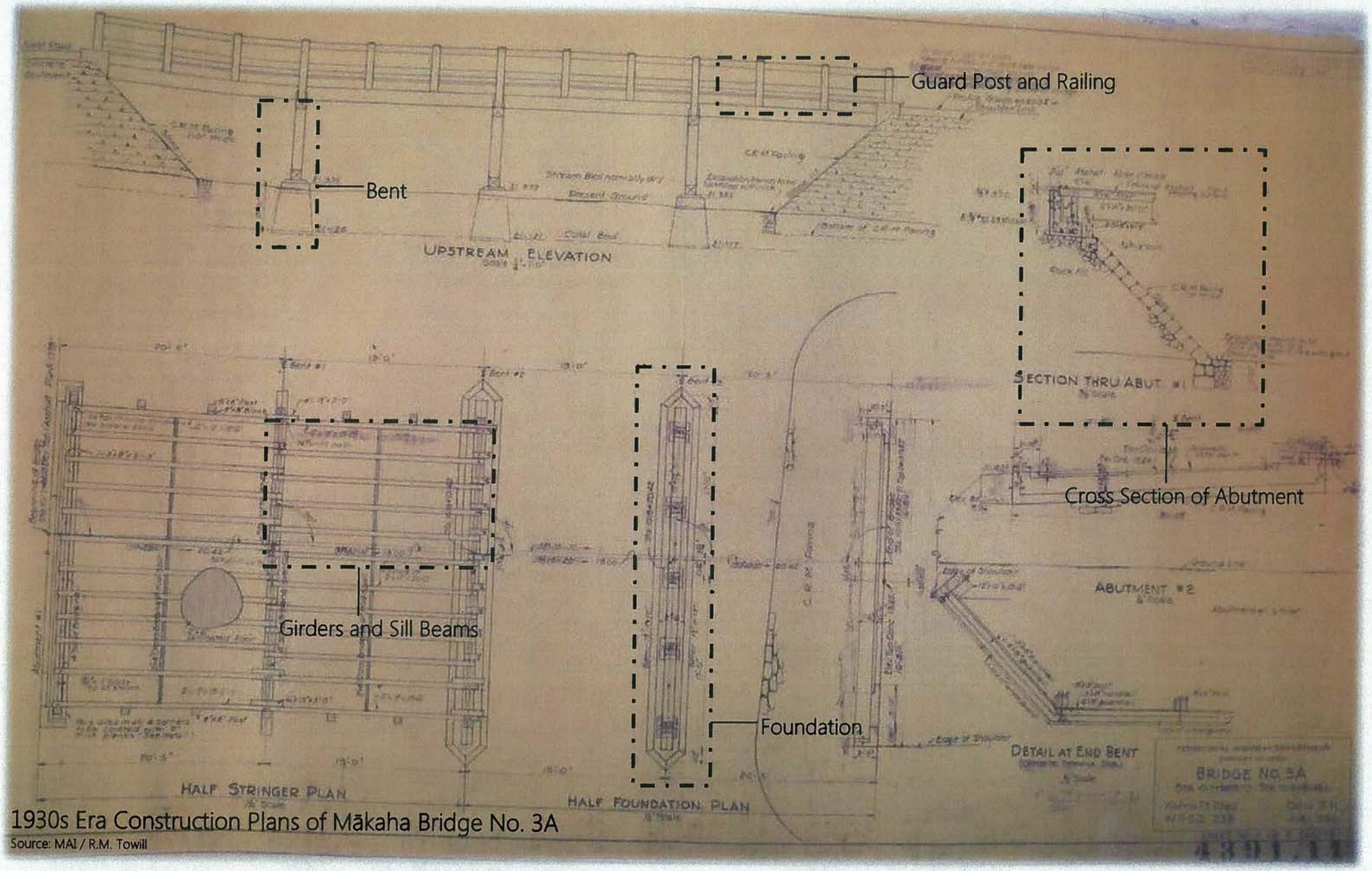
MAKAHA BRIDGE NO. 3A

- Over West Mākaha Stream
- 78.1 feet long and 36.1 feet wide
- Four spans
- Timber soaked in creosote
- 60 foot long girder and floor beam structure
- 4-foot high lava rock foundations with tapered ends
- 12-inch concrete cap
- Foundations are 36-feet six-inches long
- 12-inch thick lava rock and mortar walls
- Plank deck, covered in asphalt

Wood framing under Bridge No. 3



Wooden Framing under Mākaha Bridge No. 3
Source: MAI / R.M. Towill



1930s Era Construction Plans of Mākaha Bridge No. 3A

Source: MAI / R.M. Towill

Present – The Project

What is the project?

- Replacement of Makaha Bridges No. 3 and No. 3A

Google 2018

Why is this project needed?

- Existing timber bridges built in 1937.
- In 1997, the State of Hawaii Department of Transportation (HDOT) determined that both bridges needed to be replaced.
- Replacement of the Bridges is being funded through both the HDOT and the Federal Highway Administration (FHWA).

Project Development

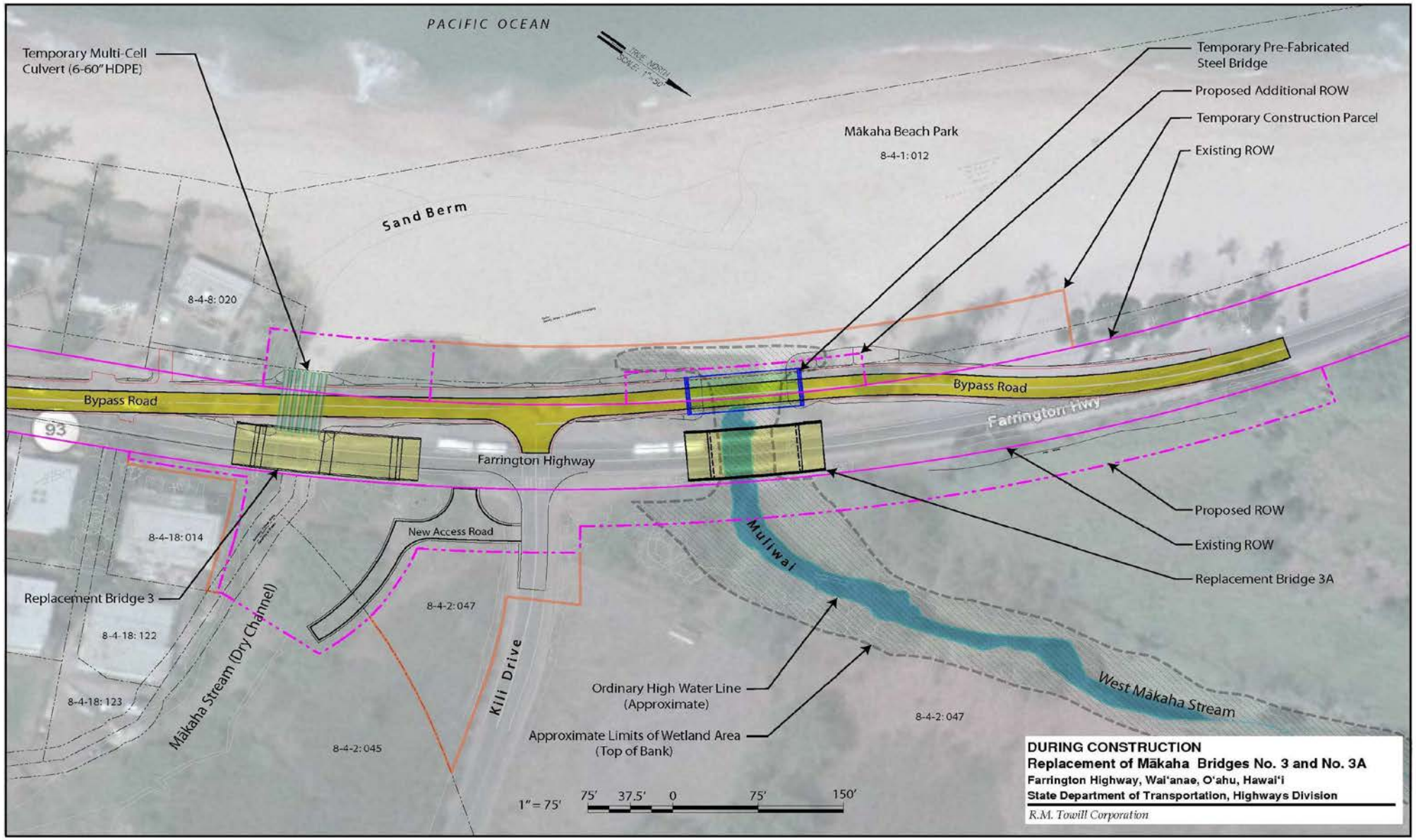
- Projects that receive Federal funds are required to follow the National Environmental Policy Act, and associated environmental regulations, including the National Historic Preservation Act.
- The National Historic Preservation Act requires the Federal agency to follow the Section 106 Consultation Process, which considers the effects of the project on properties on or eligible for the National Register of Historic Places (NRHP).
- The Mākaha Bridges No. 3 and No. 3A were determined eligible for the NRHP.

Section 106 of the National Historic Preservation Act

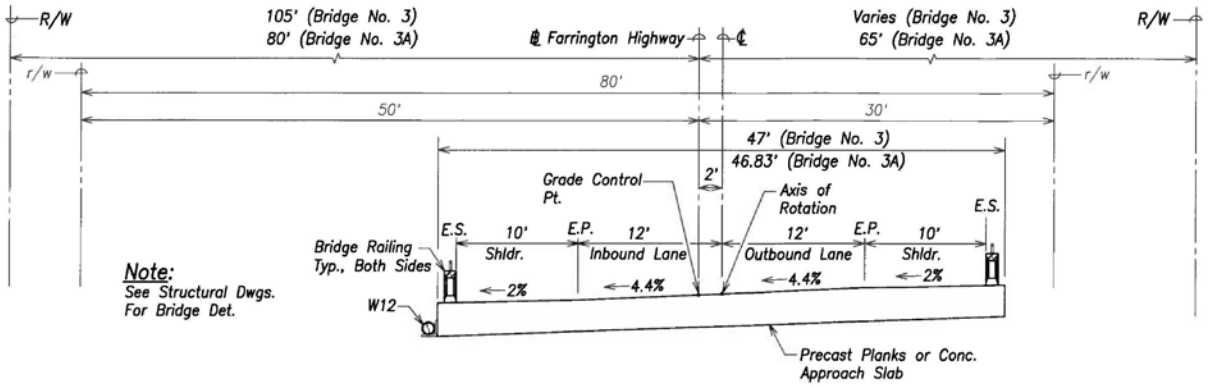
- Since the Mākaha Bridges No. 3 and No. 3A are being removed and replaced with new bridges, an adverse effect determination under Section 106 was made.
- A Memorandum of Agreement documenting the effects on historic properties was executed.
- One of the mitigations was the brochure.

Future – The Design

Figure 2. Project Site During Construction

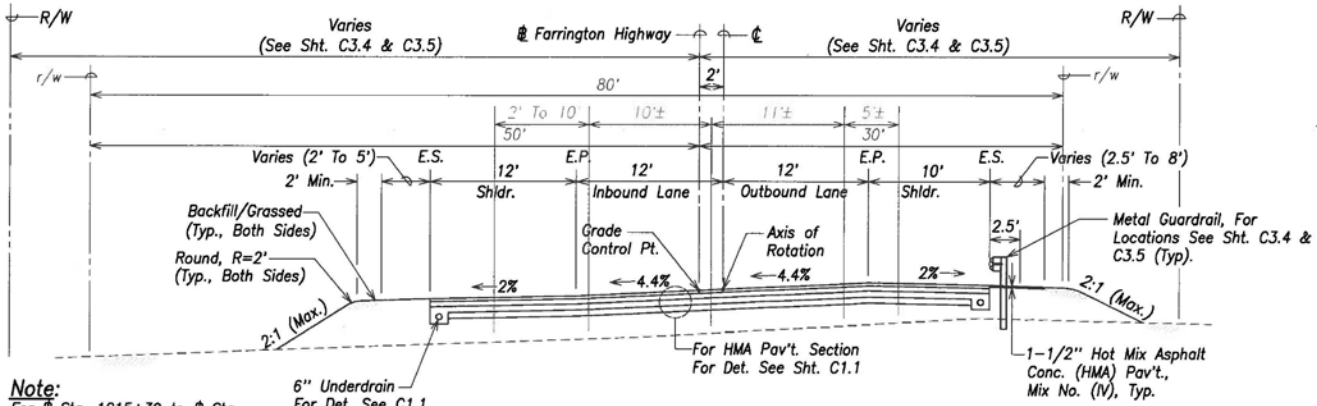


FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(20)	2011	17	172



Note:
See Structural Dwgs. For Bridge Det.

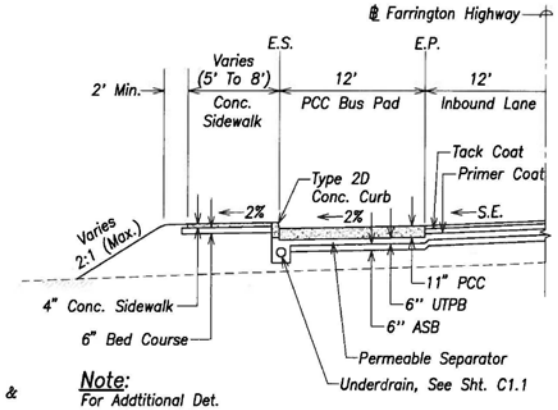
TYPICAL SECTION – BRIDGE NO. 3 & 3A
Scale: 1"=5'



Note:
For ℄ Sta. 1015+39 to ℄ Sta. 1016+18, See Typical Section – Farrington Highway PCC Bus Pad on this sheet.

TYPICAL SECTION – FARRINGTON HIGHWAY ℄ STA. 1014+85.61 TO ℄ STA. 1017+38.74
Scale: 1"=5'

Notes:
1. See Sht. C8.5 for Guardrail Installation Det.
2. Locations of existing facilities are approximate. Contractor shall verify existence & size of facilities.



Note:
For Addtional Det. See Sheet C8.3 and Std. Plan D-16

TYPICAL SECTION – FARRINGTON HIGHWAY PCC BUS PAD
Scale: 1"=5'

Subject To Change

Graphic Scale
1" = 5' 5' 0 5' 10'

MICHAEL H. OKAMOTO LICENSED PROFESSIONAL ENGINEER No. 8824-C HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION AND CONSTRUCTION OF THIS PROJECT WILL BE UNDER MY OBSERVATION.

April 30, 2012
SIGNATURE EXPIRATION DATE OF THE LICENSE

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

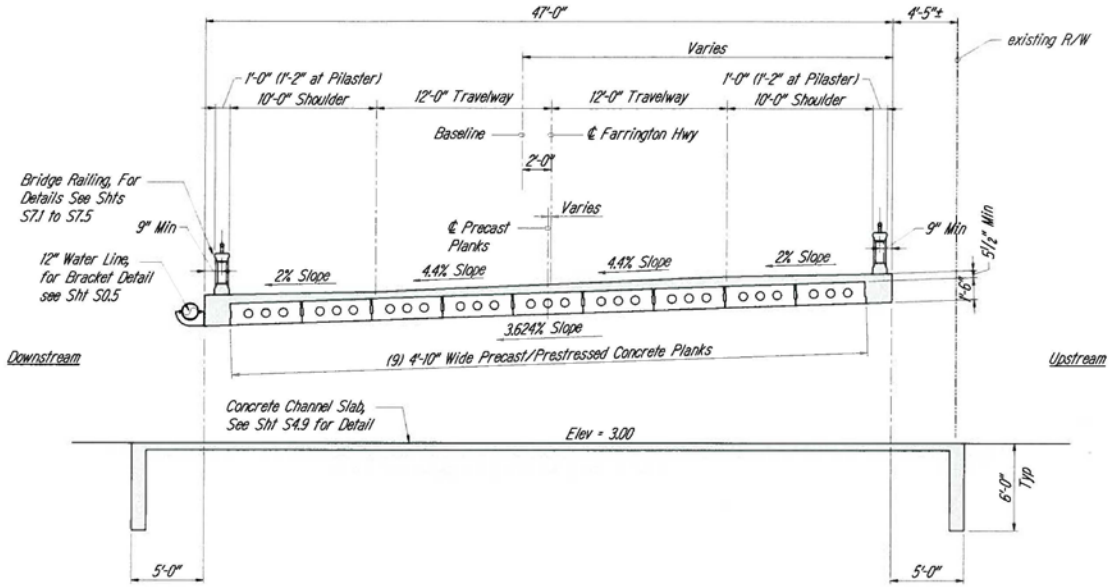
TYPICAL SECTIONS – 2

FARRINGTON HIGHWAY
Replacement of Makaha Bridge No. 3 and Makaha Bridge 3A
F. A. Project No. BR-093-1(20)

Scale: 1" = 5' Date: May 2010

SHEET No. C1.2 OF 172 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
HAWAII	HAW.	BR-093-1(20)	2010	89	159



Subject To Change

BRIDGE NO. 3 - TYPICAL CROSS SECTION

Scale : 1/8" = 1'-0"

1
S3.2 | S3.2

KEN KAZUO HAYASHIDA
LICENSED PROFESSIONAL ENGINEER
No. 6813-E
HAWAII, U.S.A.

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

BRIDGE NO. 3
TYPICAL CROSS SECTION

Farrington Hwy – Replacement of Makaha Bridge No.3 & Makaha Bridge No. 3A
Federal Aid Project No. BR-093-1(20)

Scale: AS NOTED Date: May 2010

SHEET No. S3.2 OF 159 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
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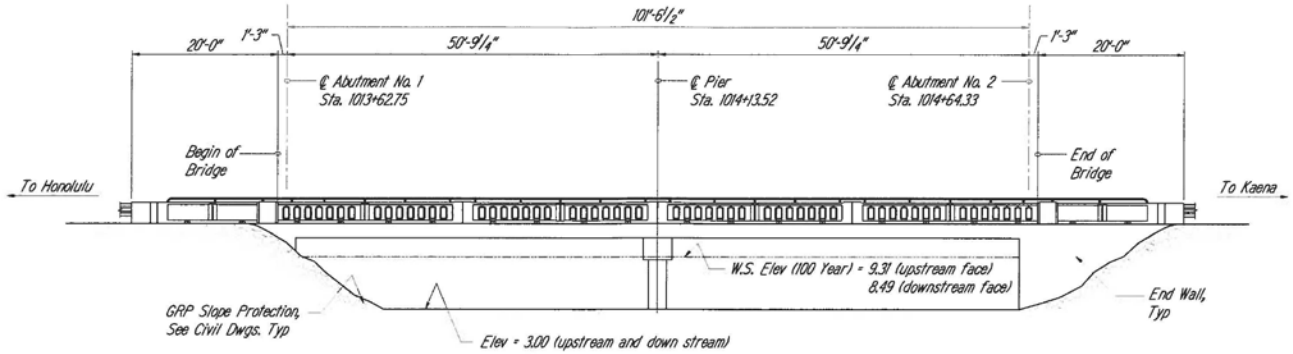
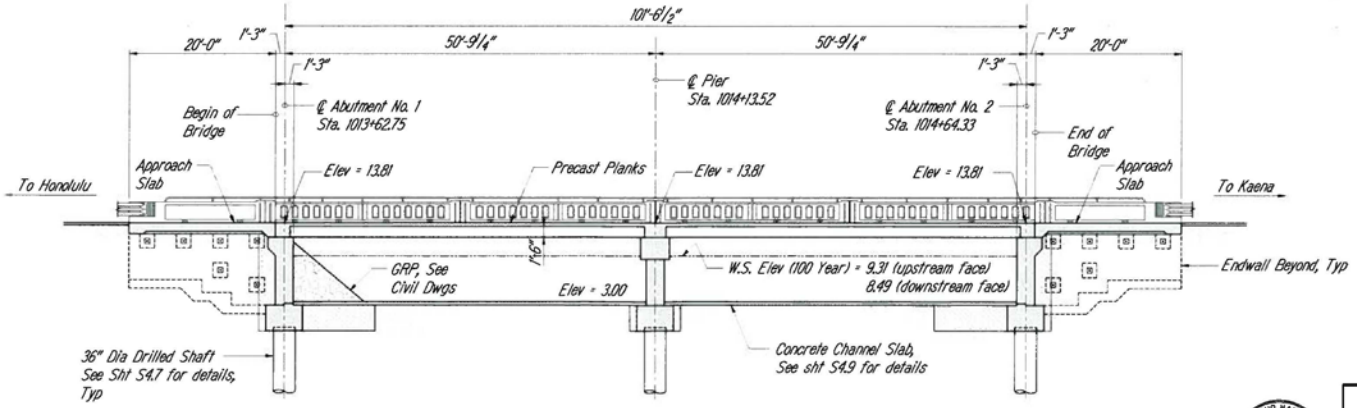


BRIDGE NO. 3 - LONGITUDINAL ELEVATION

Scale : 1/8" = 1'-0"

1 S3.1 | S3.1

Subject To Change



BRIDGE NO. 3 - LONGITUDINAL SECTION ALONG BASELINE

Scale : 1/8" = 1'-0"

2 S3.1 | S3.1

REN KAZUO HAYASHIDA LICENSED PROFESSIONAL ENGINEER No. 6010-S HAWAII, U.S.A.

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

BRIDGE NO. 3 - LONGITUDINAL ELEVATION AND SECTION

Farrington Hwy – Replacement of Makaha Bridge No.3 & Makaha Bridge No. 3A
Federal Aid Project No. BR-093-1(20)

Scale: AS NOTED Date: May 2010

SHEET No. S3.1 OF 159 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
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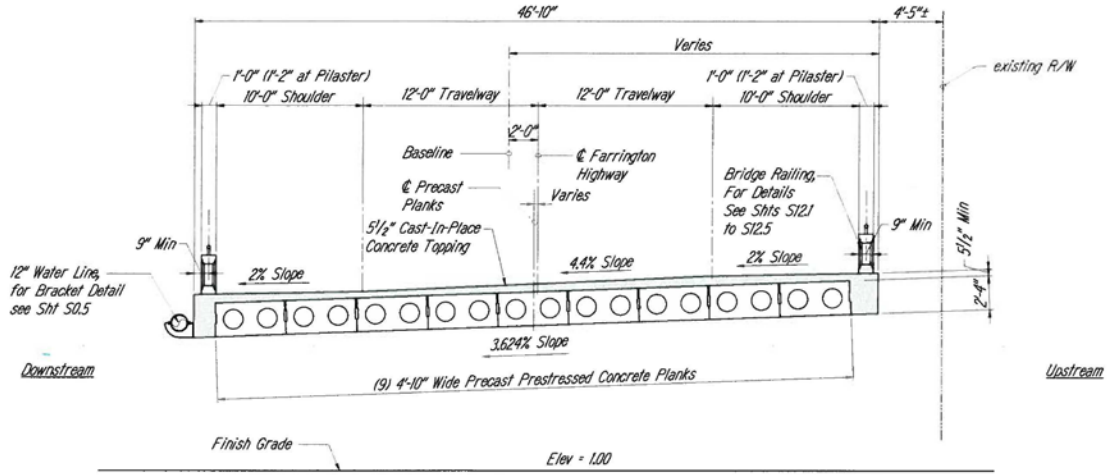

Subject To Change

BRIDGE NO. 3A - TYPICAL CROSS SECTION

Scale : 1/4" = 1'-0"

1
S8.3 | S8.3

BEN KAZUO HAYASHIDA
LICENSED PROFESSIONAL ENGINEER
No. 6818-S
HAWAII, U.S.A.

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STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

BRIDGE NO. 3A
TYPICAL CROSS SECTION
Farrington Hwy – Replacement of Makaha Bridge No.3 & Makaha Bridge No. 3A
Federal Aid Project No. BR-093-1(20)

Scale: AS NOTED Date: May 2010

SHEET No. S8.3 OF 159 SHEETS

FED. ROAD DIST. NO.	STATE	FED. AID PROJ. NO.	FISCAL YEAR	SHEET NO.	TOTAL SHEETS
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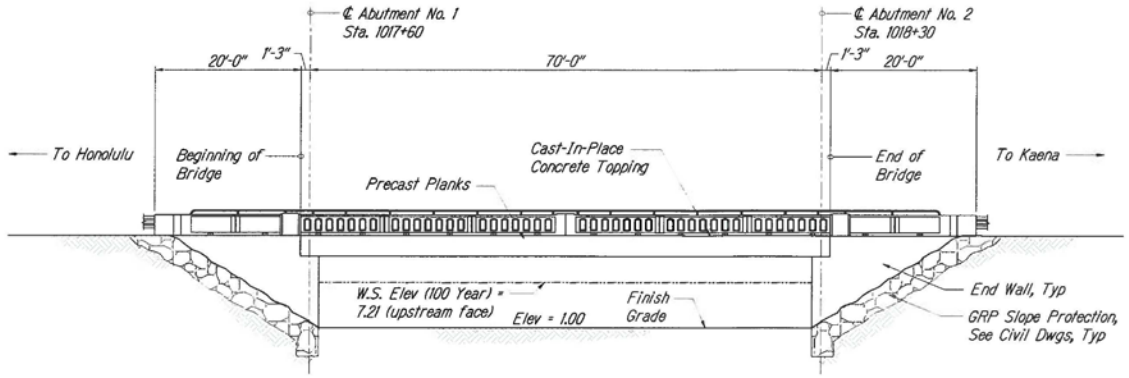
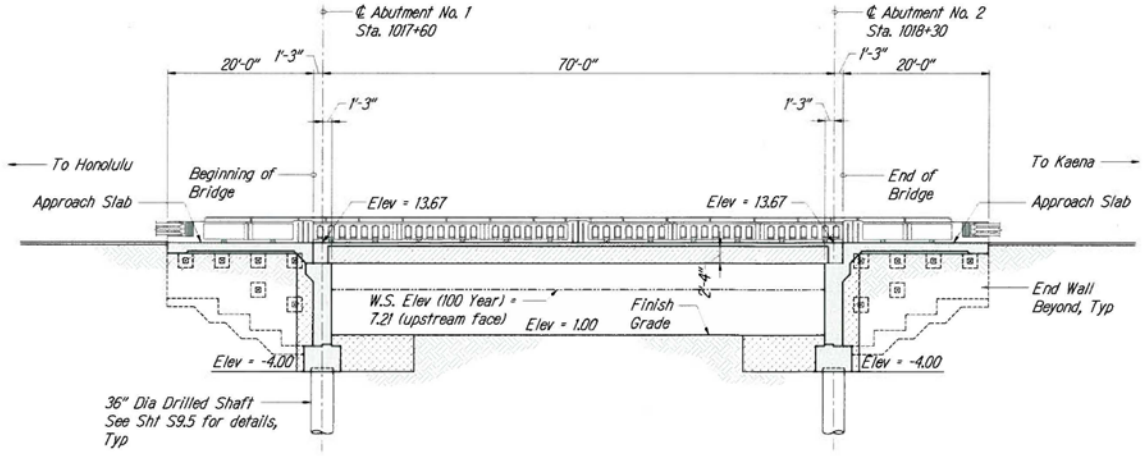


BRIDGE NO. 3A - LONGITUDINAL ELEVATION (2 / S8.2 | S8.2)

Scale : 1/8" = 1'-0"



BRIDGE NO. 3A - LONGITUDINAL SECTION ALONG BASELINE (1 / S8.2 | S8.2)

Scale : 1/8" = 1'-0"

Subject To Change

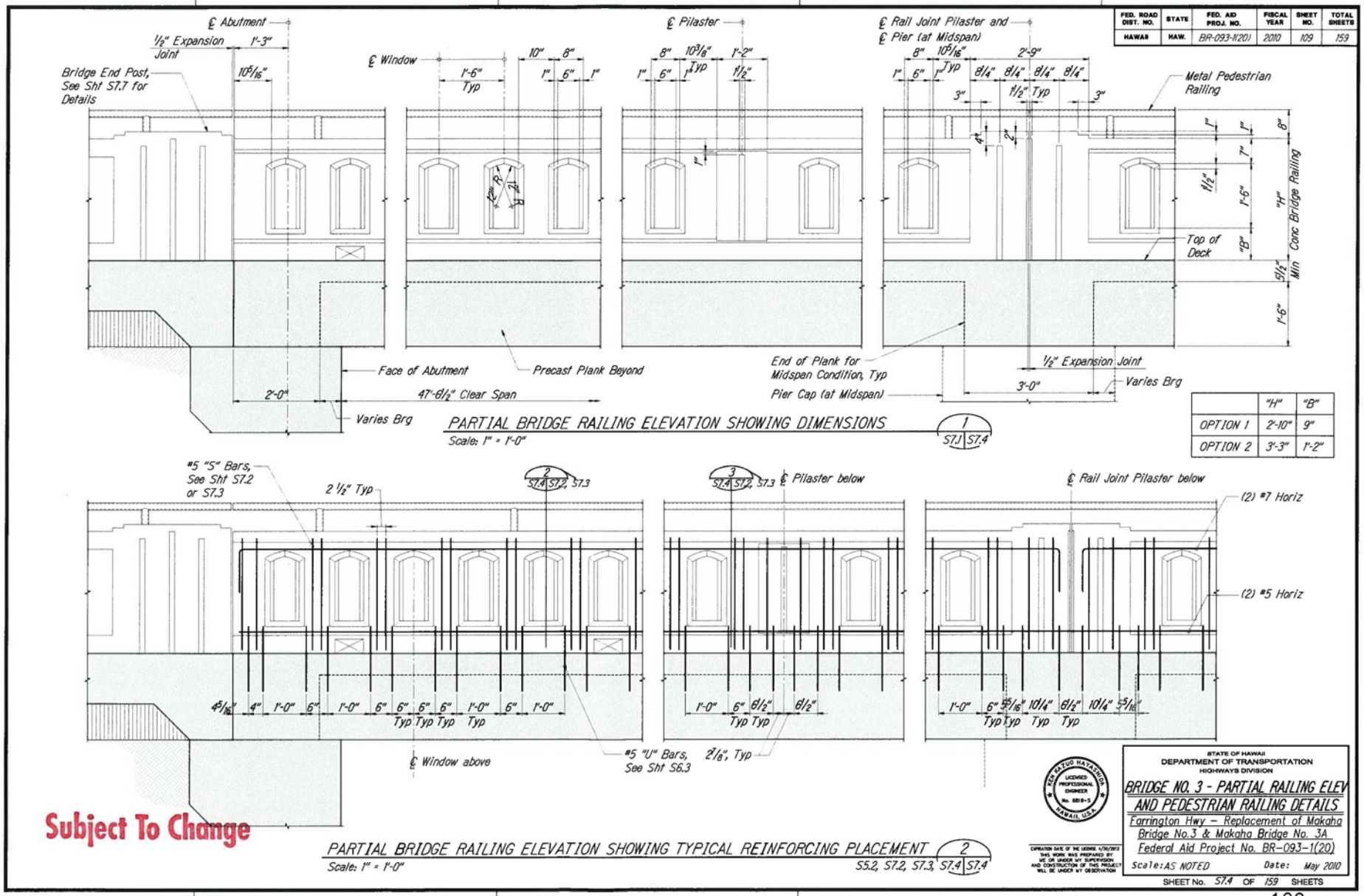
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION

BRIDGE NO. 3A - LONGITUDINAL ELEVATION AND SECTION

Farrington Hwy – Replacement of Makaha Bridge No.3 & Makaha Bridge No. 3A
Federal Aid Project No. BR-093-1(20)

Scale: AS NOTED Date: May 2010

SHEET No. S8.2 OF 159 SHEETS


℄ Abutment
½" Expansion Joint
1'-3"
Bridge End Post, See Sht S7.7 for Details
10⅜16"
℄ Window
1'-6" Typ
10"
8"
1"
6"
1"
℄ Pilaster
8"
10⅜16" Typ
1'-2"
1"
6"
1"
1½"
℄ Rail Joint Pilaster and ℄ Pier (at Midspan)
8"
10⅜16" Typ
2'-9"
1"
6"
1"
8¼"
8¼"
8¼"
8¼"
3"
1½" Typ
3"
Metal Pedestrian Railing
4"
2"
1"
1"
8"
7"
1½"
1'-6"
"B"
"H"
Conc Bridge Railing
5½" Min
1'-6"
Top of Deck
Face of Abutment
Precast Plank Beyond
47'-6½" Clear Span
2'-0"
Varies Brg
End of Plank for Midspan Condition, Typ
Pier Cap (at Midspan)
½" Expansion Joint
3'-0"
Varies Brg
PARTIAL BRIDGE RAILING ELEVATION SHOWING DIMENSIONS
Scale: 1" = 1'-0"
1
S7.1 S7.4
"H" "B"
OPTION 1 2'-10" 9"
OPTION 2 3'-3" 1'-2"
#5 "S" Bars, See Sht S7.2 or S7.3
2 ½" Typ
2
S7.4 S7.2, S7.3
3
S7.4 S7.2, S7.3
℄ Pilaster below
℄ Rail Joint Pilaster below
(2) #7 Horiz
(2) #5 Horiz
4⅝16" 4" 1'-0" 6" 1'-0" 6" 6" 6" 6" 1'-0" 6" 1'-0"
Typ Typ Typ Typ
1'-0" 6" 6½" 6½"
Typ Typ
1'-0" 6" 5⅝16" 10¼" 6½" 10¼" 5⅝16"
Typ Typ Typ Typ
℄ Window above
#5 "U" Bars, See Sht S6.3
2⅛", Typ
Subject To Change
PARTIAL BRIDGE RAILING ELEVATION SHOWING TYPICAL REINFORCING PLACEMENT
Scale: 1" = 1'-0"
2
S5.2, S7.2, S7.3, S7.4 S7.4
FED. ROAD DIST. NO. STATE FED. AID PROJ. NO. FISCAL YEAR SHEET NO. TOTAL SHEETS
HAWAII HAW. BR-093-1(20) 2010 109 159
STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
HIGHWAYS DIVISION
BRIDGE NO. 3 - PARTIAL RAILING ELEV AND PEDESTRIAN RAILING DETAILS
Farrington Hwy – Replacement of Makaha Bridge No.3 & Makaha Bridge No. 3A
Federal Aid Project No. BR-093-1(20)
Scale: AS NOTED Date: May 2010
SHEET No. S7.4 OF 159 SHEETS

Mahalo!