

Summary of Current Instream Uses and Stream Diversions in the Huelo Region of East Maui

Item B-2
July 19, 2022

Ayron Strauch, Hydrologist
Stream Protection and Management Branch



159°40'0"W

159°20'0"W

156°40'0"W

156°20'0"W

156°0'0"W

22°0'0"N

21°0'0"N

157°10'0"W

157°0'0"W

156°50'0"W

20°40'0"N

20°0'0"N

21°10'0"N

21°40'0"N

19°30'0"N

21°20'0"N

19°0'0"N

156°0'0"W

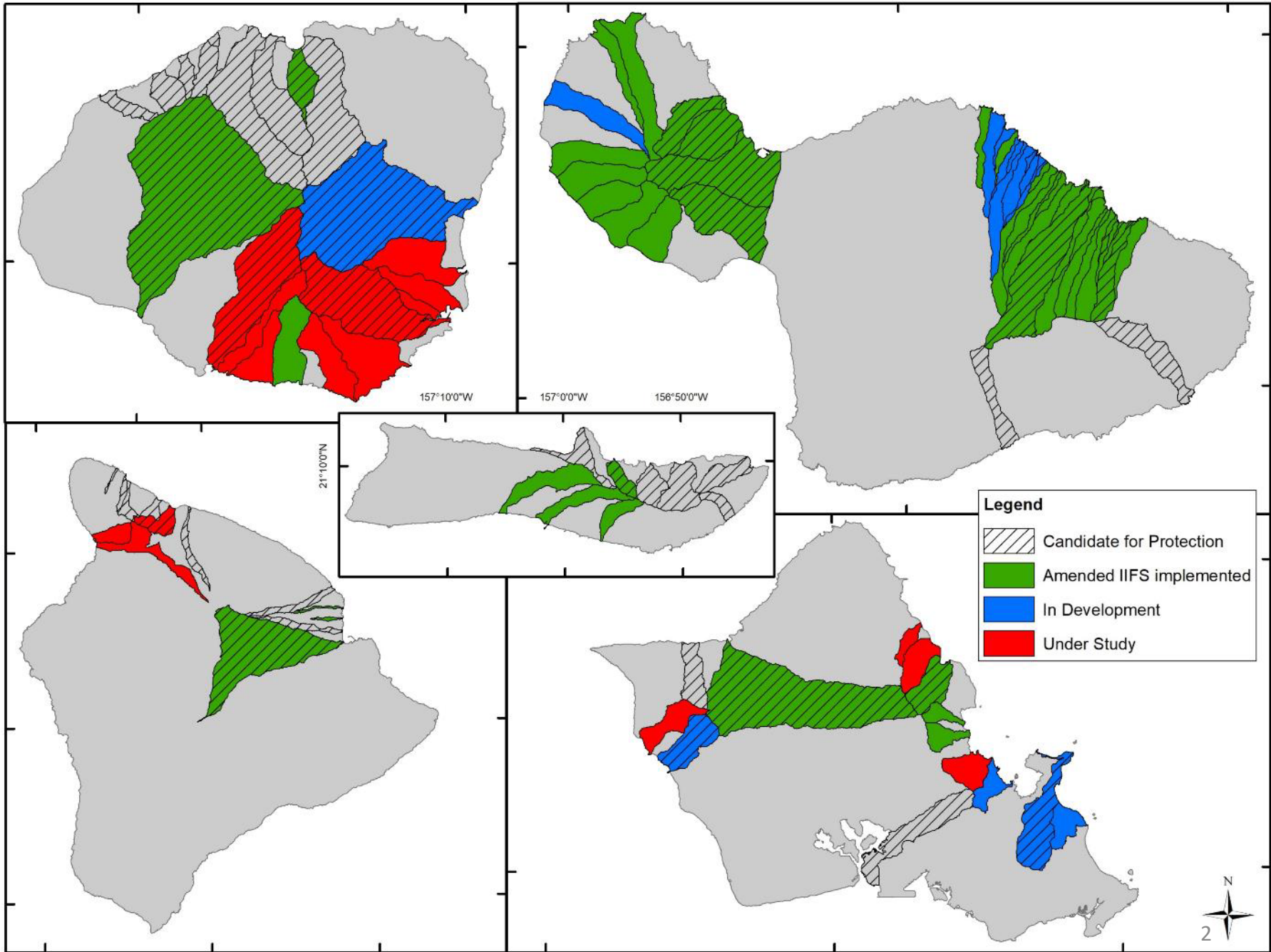
155°30'0"W

155°0'0"W

158°20'0"W

158°0'0"W

157°40'0"W



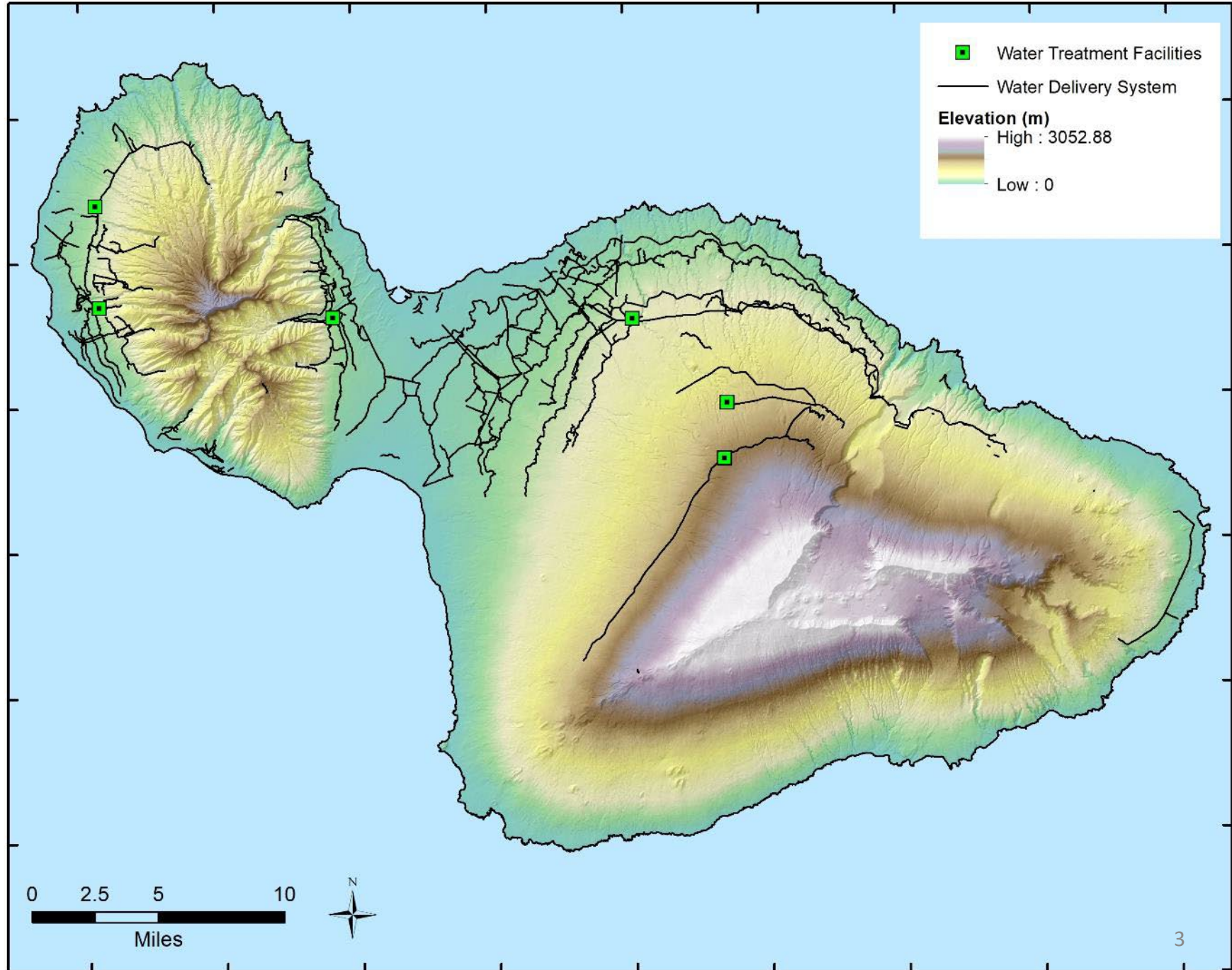
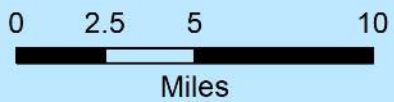
156°40'0"W 156°35'0"W 156°30'0"W 156°25'0"W 156°20'0"W 156°15'0"W 156°10'0"W 156°5'0"W 156°0'0"W

21°0'0"N
20°55'0"N
20°50'0"N
20°45'0"N
20°40'0"N
20°35'0"N

■ Water Treatment Facilities

— Water Delivery System

Elevation (m)
High : 3052.88
Low : 0



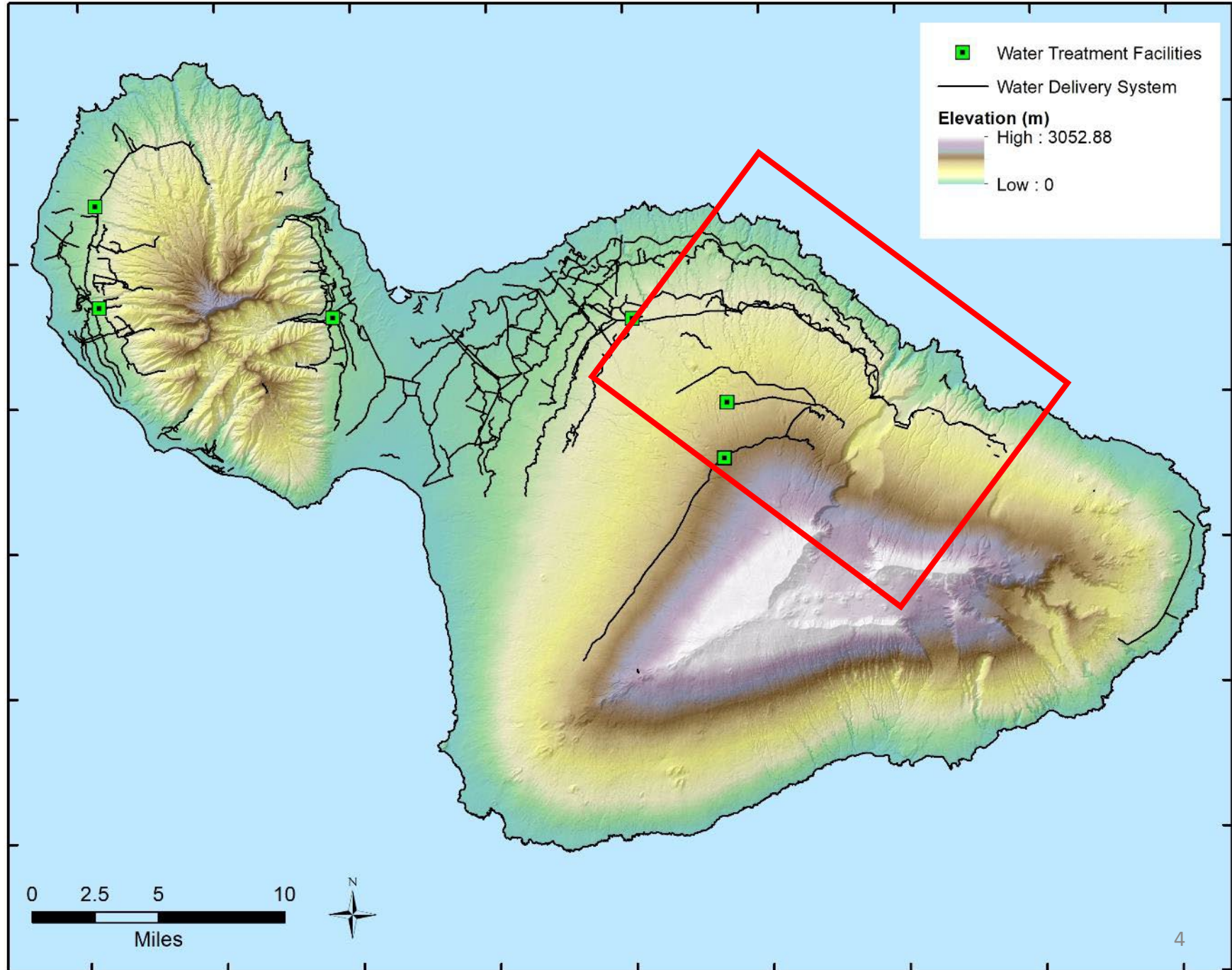
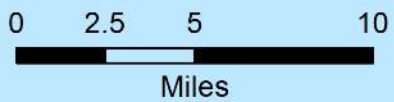
156°40'0"W 156°35'0"W 156°30'0"W 156°25'0"W 156°20'0"W 156°15'0"W 156°10'0"W 156°5'0"W 156°0'0"W

21°0'0"N
20°55'0"N
20°50'0"N
20°45'0"N
20°40'0"N
20°35'0"N

■ Water Treatment Facilities

— Water Delivery System

Elevation (m)
High : 3052.88
Low : 0



Assessment of Instream and Non-Instream Uses



Assessment of Instream and Non-Instream Uses



Hydrology

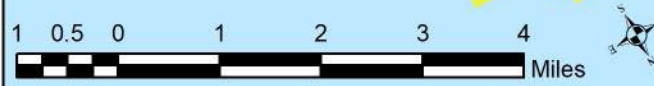
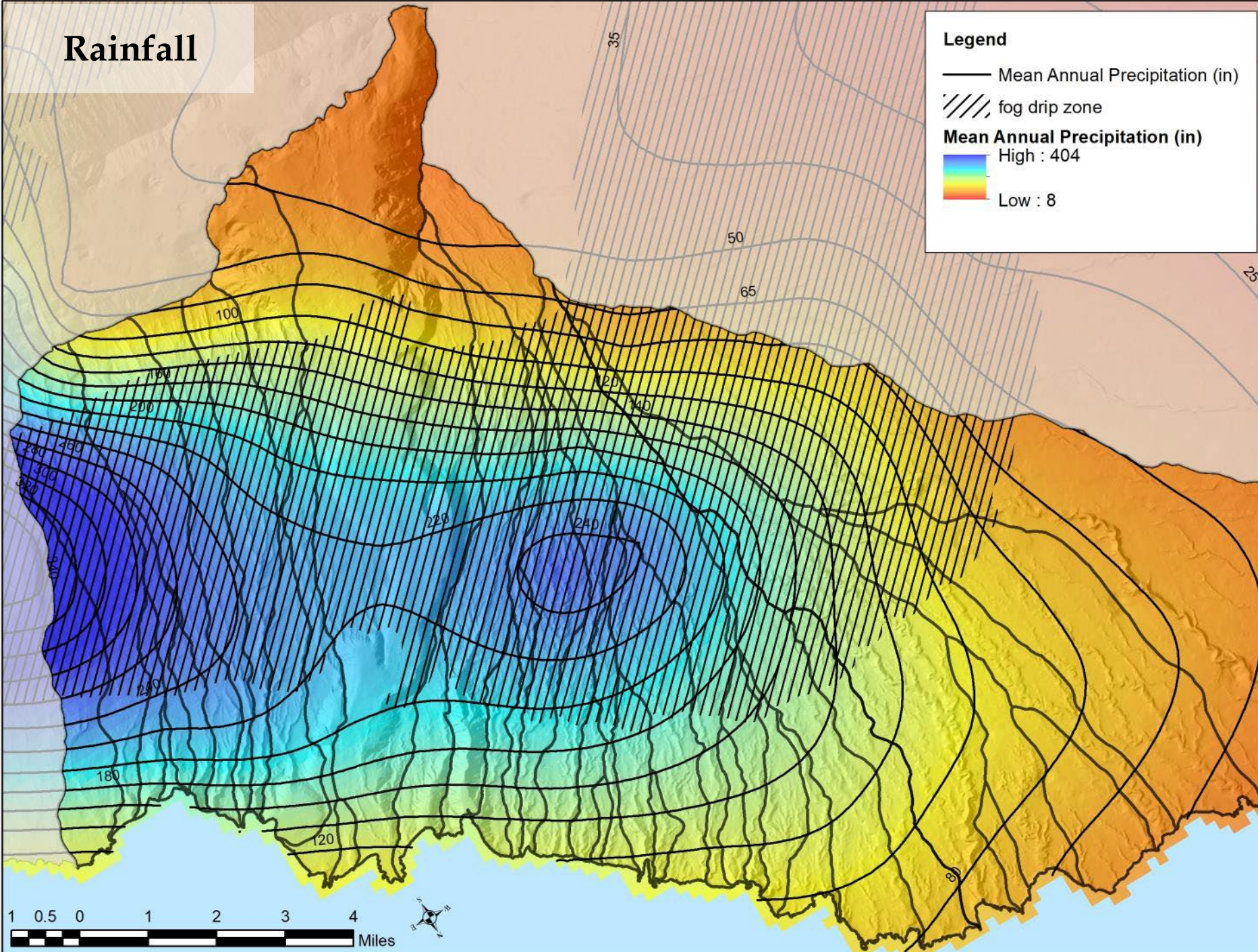
- Median Flow
- Base Flow
- Pre-Diversion Flow Estimate
- Groundwater Interaction
- Surface-Water Use
- Ground-Water Use
- Other



Rainfall

Legend

- Mean Annual Precipitation (in)
- //// fog drip zone
- Mean Annual Precipitation (in)**
 - High : 404
 - Low : 8



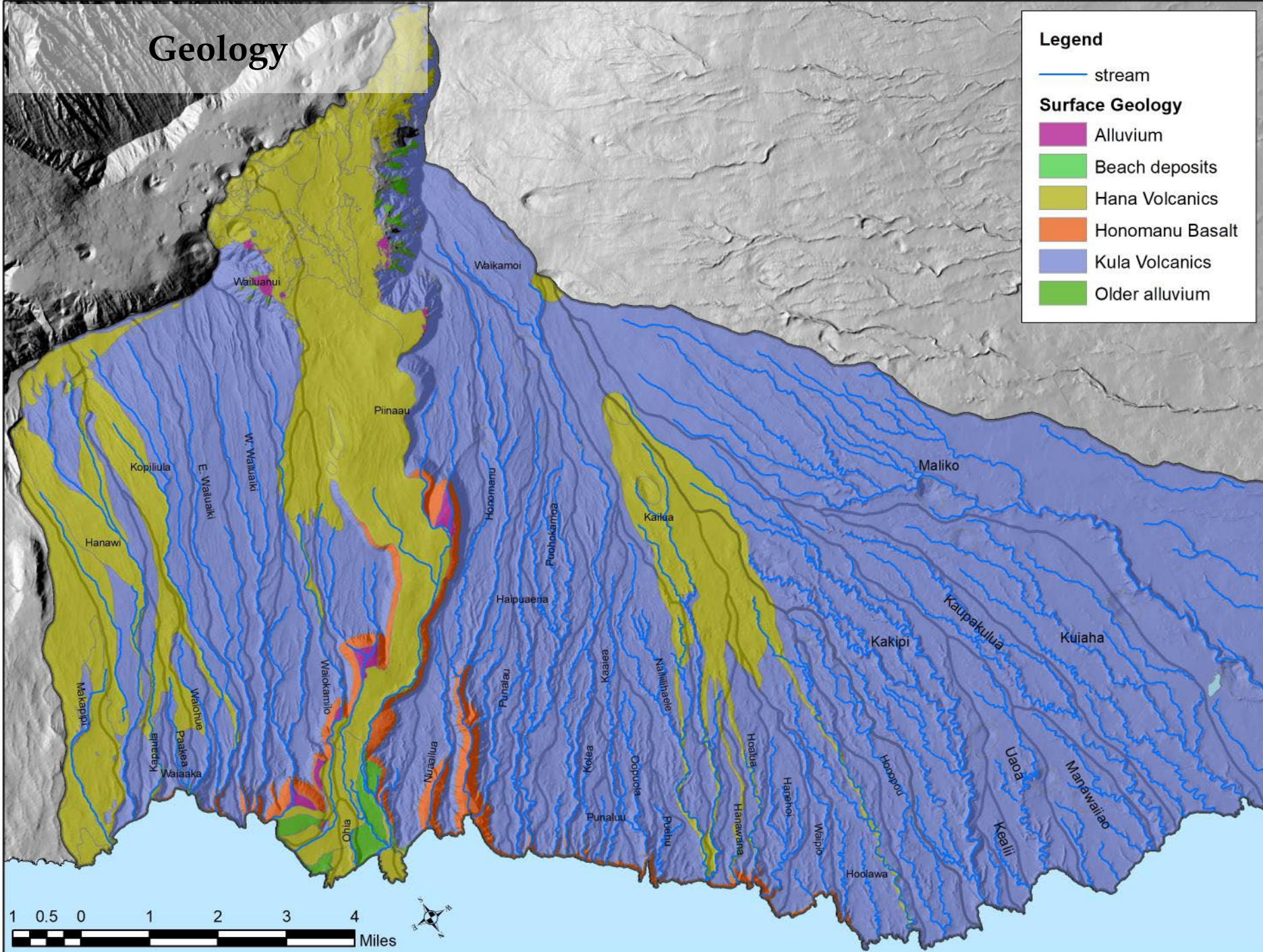
Geology

Legend

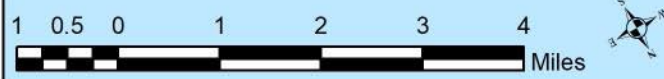
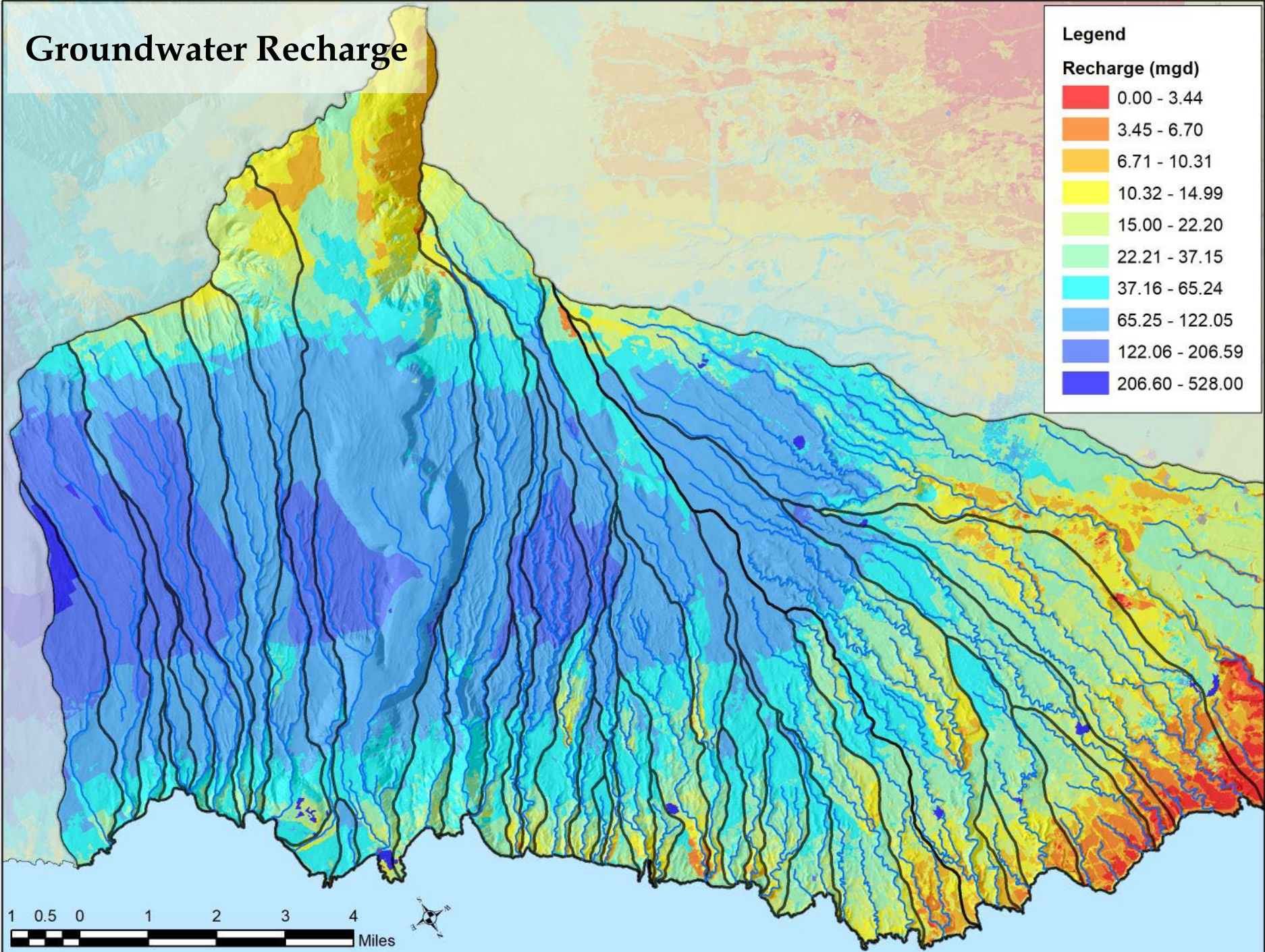
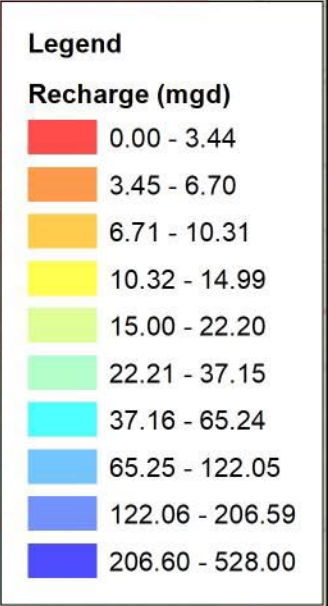
— stream

Surface Geology

- Alluvium
- Beach deposits
- Hana Volcanics
- Honomanu Basalt
- Kula Volcanics
- Older alluvium



Groundwater Recharge



Hydrologic Units Associated with the 2001 Petition to Amend Instream Flow Standards for East Maui Streams

Legend

 2001 petition to CWRM

27 streams in
21 Hydrologic Units

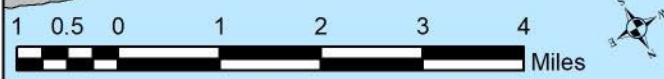
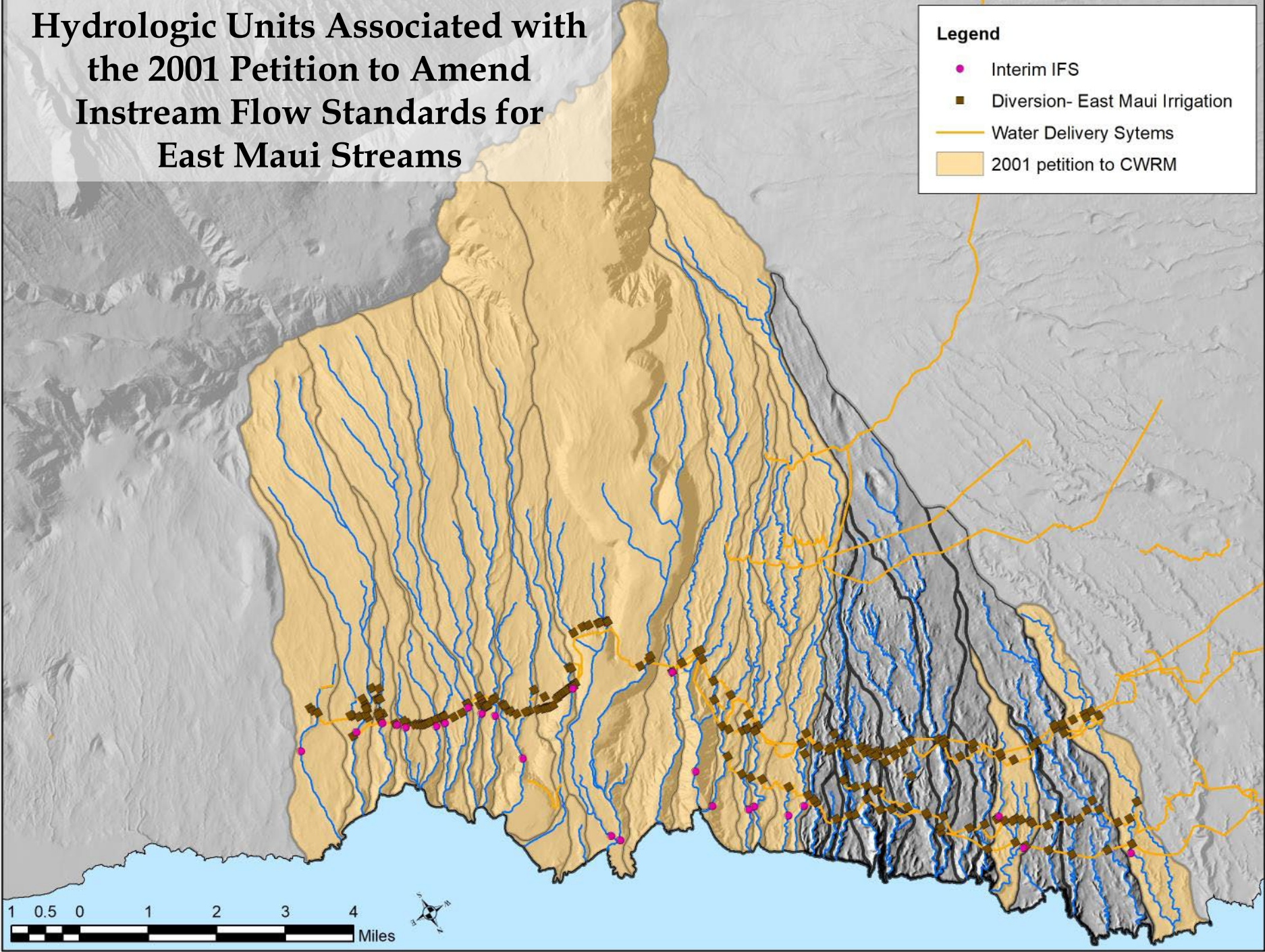
1 0.5 0 1 2 3 4 Miles



Hydrologic Units Associated with the 2001 Petition to Amend Instream Flow Standards for East Maui Streams


Legend

- Interim IFS
- Diversion- East Maui Irrigation
- Water Delivery Systems
- 2001 petition to CWRM



Hydrologic Units Associated with the 2021 Petition to Amend Instream Flow Standards for East Maui Streams

Legend

 Other hydrologic units

15 streams in
11 Hydrologic Units

1 0.5 0 1 2 3 4 Miles



USGS Reports in East Maui

U.S. Department of the Interior

Ground Water and Surface Water in the Haiku Area, East Maui, Hawaii

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 98-4142

Rec'd
2/10/00

U.S. Department of the Interior

Ground-Water Occurrence and Contribution to Streamflow, Northeast Maui, Hawaii

U.S. GEOLOGICAL SURVEY
Water-Resources Investigations Report 99-4090



Prepared in cooperation with the
State of Hawai'i Commission on Water Resource Management

Measurements of Seepage Losses and Gains, East Maui Irrigation Hawai'i



Prepared in cooperation with the State of Hawai'i Commission on Water Resource Management,
State of Hawai'i Department of Hawaiian Home Lands, and Office of Hawaiian Affairs

Low-Flow Characteristics for Streams on the Islands of Kaua'i, O'ahu, Molokai, Maui, and Hawai'i, State of Hawai'i

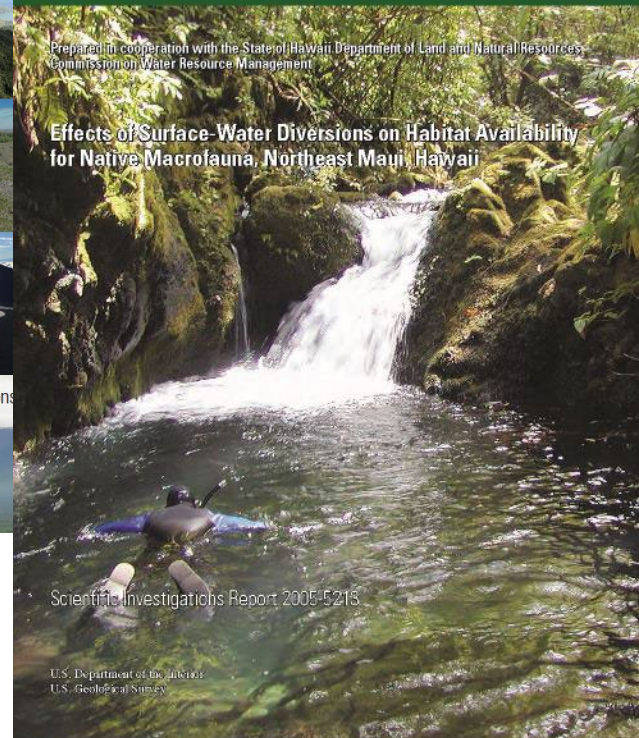


115



Prepared in cooperation with the State of Hawai'i Department of Land and Natural Resources
Commission on Water Resource Management

Effects of Surface-Water Diversions on Habitat Availability for Native Macrofauna, Northeast Maui, Hawaii



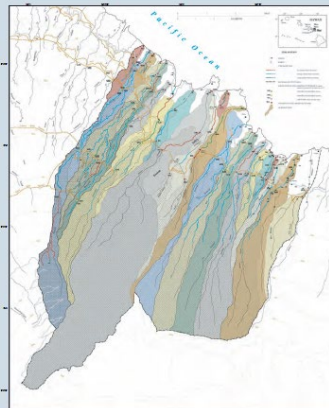
Scientific Investigations Report 2005-5215

U.S. Department of the Interior
U.S. Geological Survey



Prepared in cooperation with the
State of Hawaii Commission on Water Resource Management

Median and Low-Flow Characteristics for Streams under Natural and Diverted Conditions, Northeast Maui, Hawaii



Scientific Investigations Report 2004-5262

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
COUNTY OF MAUI DEPARTMENT OF WATER
STATE OF HAWAII COMMISSION ON WATER RESOURCE MANAGEMENT




Prepared in cooperation with the
COUNTY OF MAUI DEPARTMENT OF WATER
STATE OF HAWAII COMMISSION ON WATER RESOURCE MANAGEMENT



2018 Decision & Order based on streamflow metrics using the 1942-2001 base period

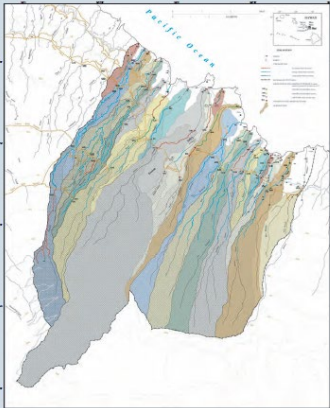
New reports with streamflow metrics updated for 1984-2013 base period



science for a changing world


Prepared in cooperation with the
State of Hawaii Commission on Water Resource Management

Median and Low-Flow Characteristics for Streams under Natural and Diverted Conditions, Northeast Maui, Hawaii



Scientific Investigations Report 2004-5262

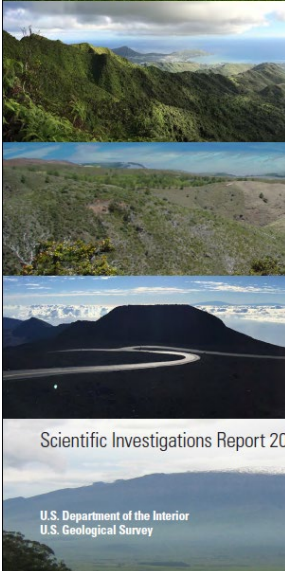
U.S. Department of the Interior
U.S. Geological Survey



science for a changing world

Prepared in Cooperation with the State of Hawai'i Commission on Water Resource Management,
State of Hawai'i Department of Hawaiian Home Lands, and Office of Hawaiian Affairs

Low-Flow Characteristics for Streams on the Islands of Kaua'i, O'ahu, Moloka'i, Maui, and Hawai'i, State of Hawai'i


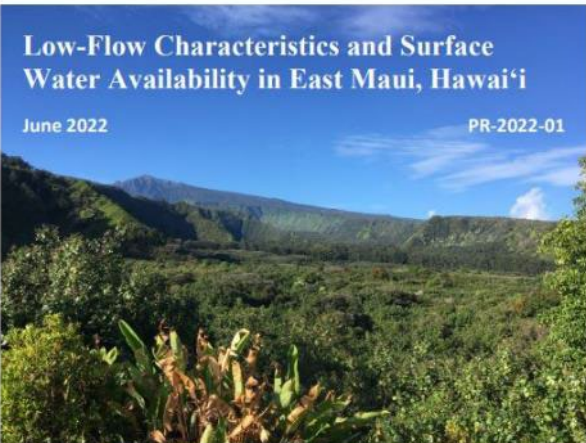


Scientific Investigations Report 2004-5262


U.S. Department of the Interior
U.S. Geological Survey

Low-Flow Characteristics and Surface Water Availability in East Maui, Hawai'i

June 2022 PR-2022-01

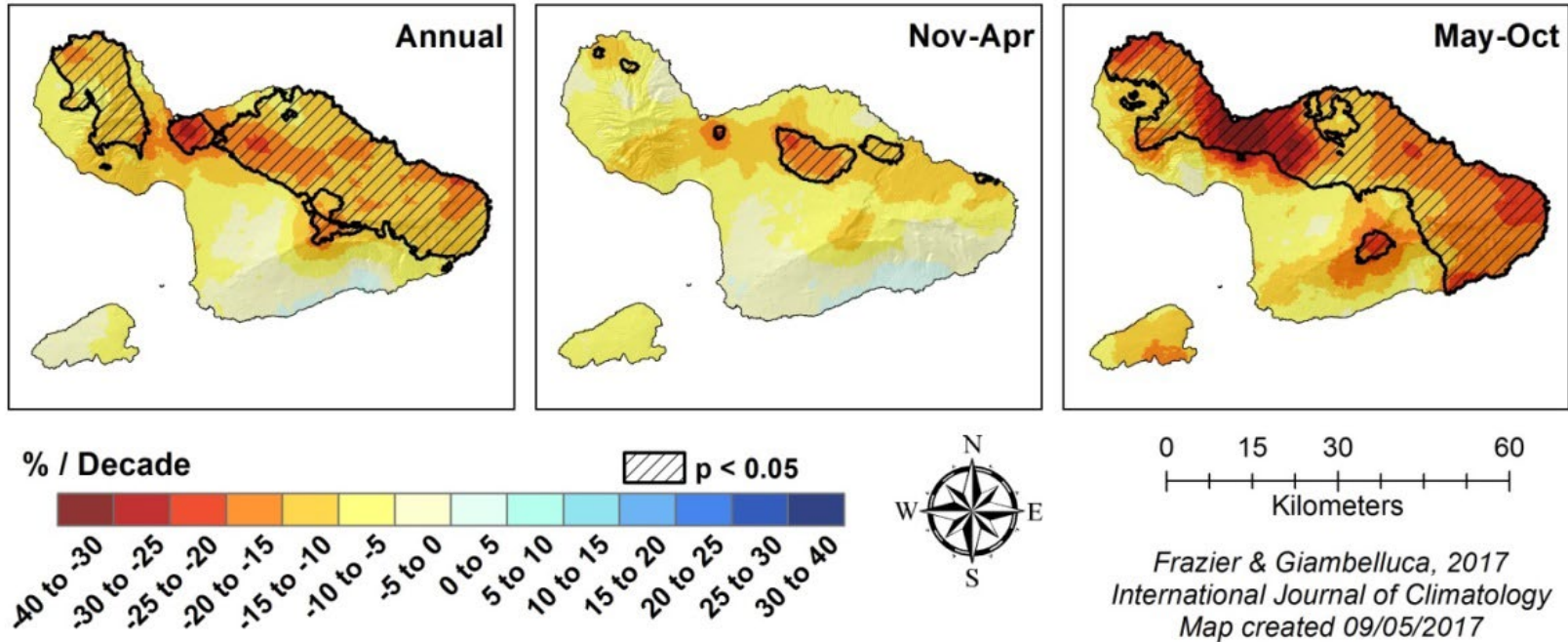


State of Hawaii
Department of Land and Natural Resources
Commission on Water Resource Management



Why Do We Need Updated Statistics?

Maui & Kaho'olawe Rainfall Trends: 1983-2012



Statistic	West Wailuaiki USGS 16518000			Hanawi USGS 16508000		
	1942-2001	1984-2013	% change	1942-2001	1984-2013	% change
Total Flow Q ₅₀	10	8.9	-11%	7.1	6.2	-13%
Total Flow Q ₉₅	2.5	2.2	-12%	4.6	2.2	-52%

All values in cubic feet per second

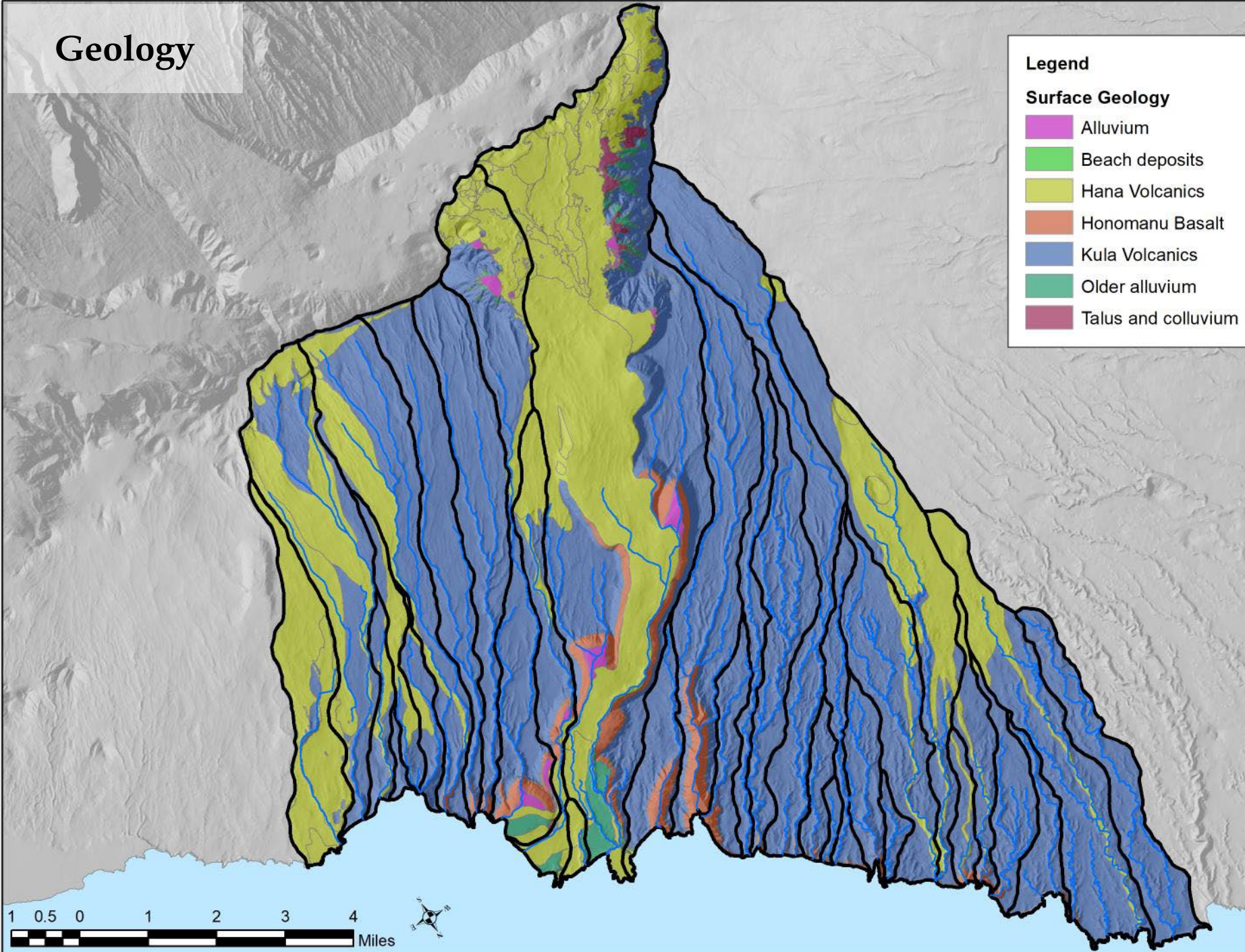


Geology

Legend

Surface Geology

- Alluvium
- Beach deposits
- Hana Volcanics
- Honomanu Basalt
- Kula Volcanics
- Older alluvium
- Talus and colluvium

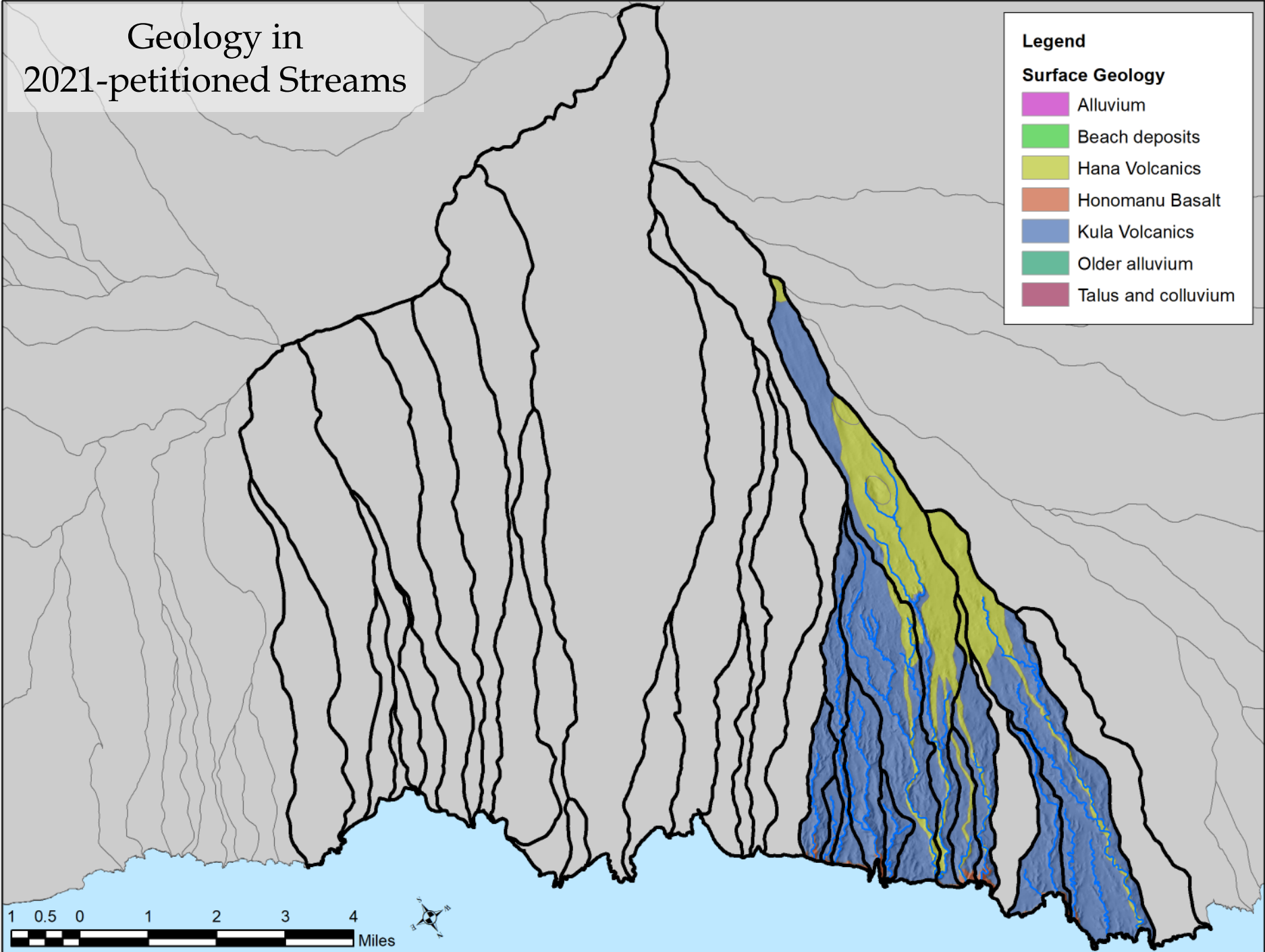


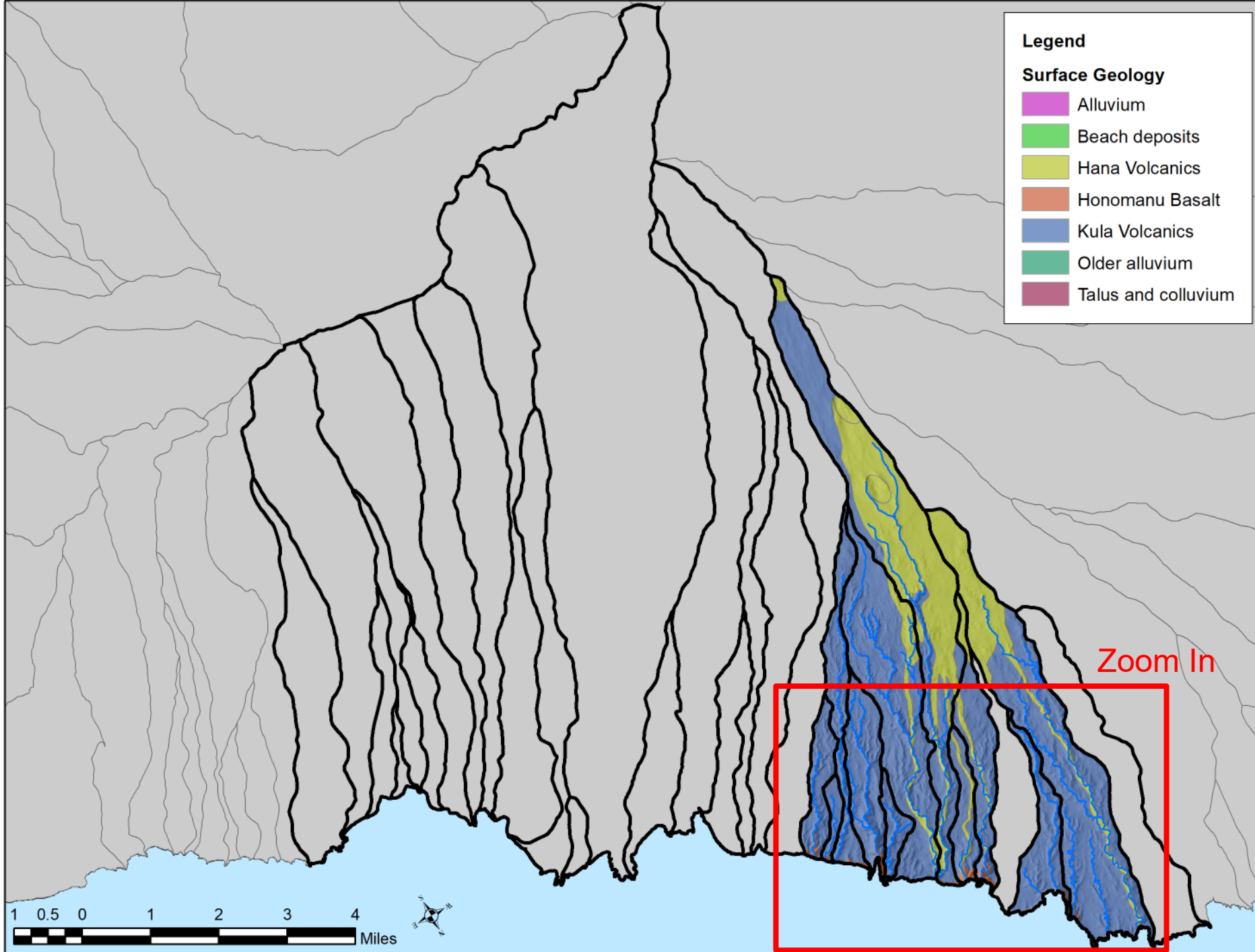
Geology in 2021-petitioned Streams

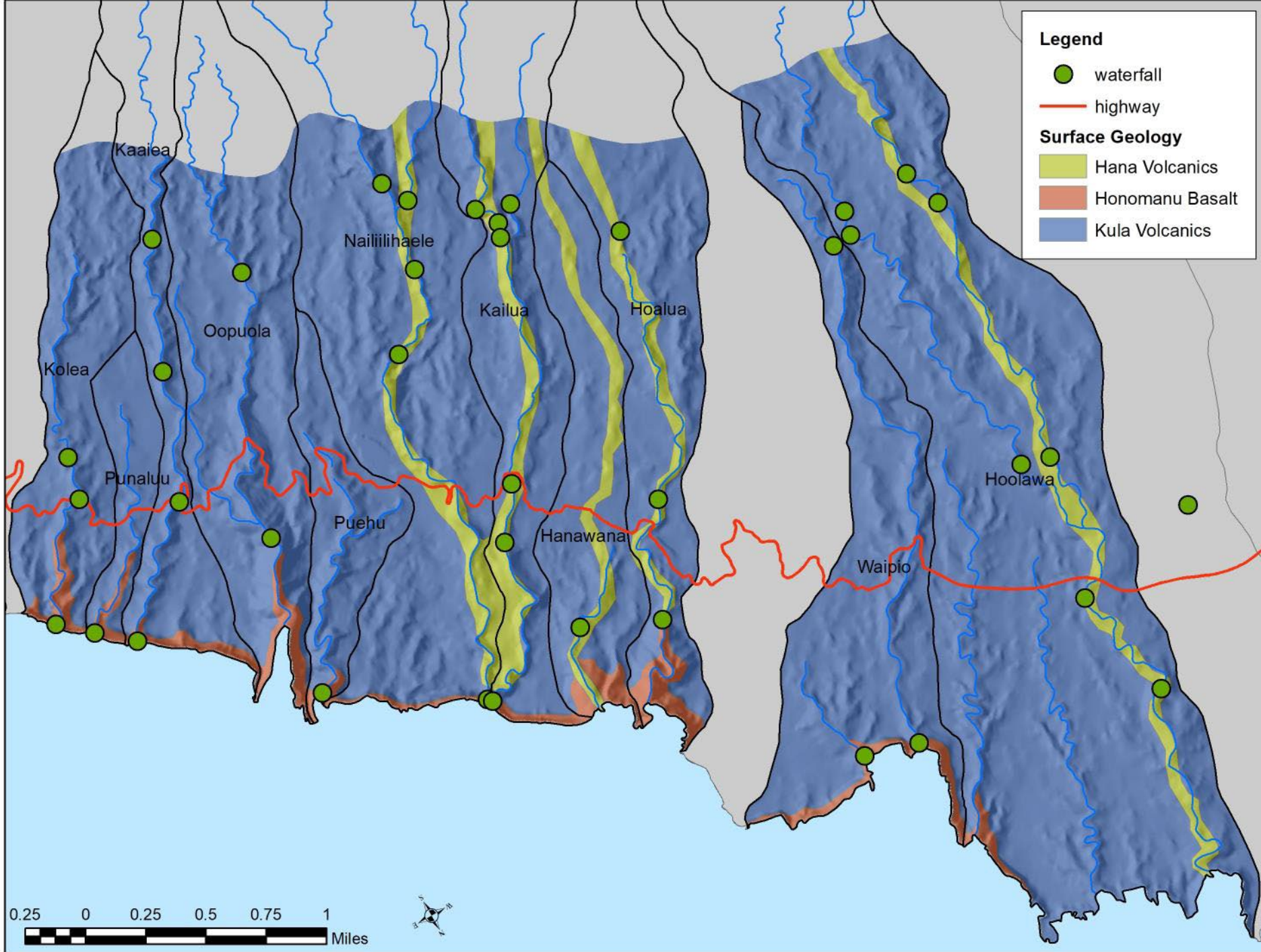
Legend

Surface Geology

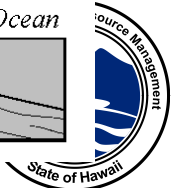
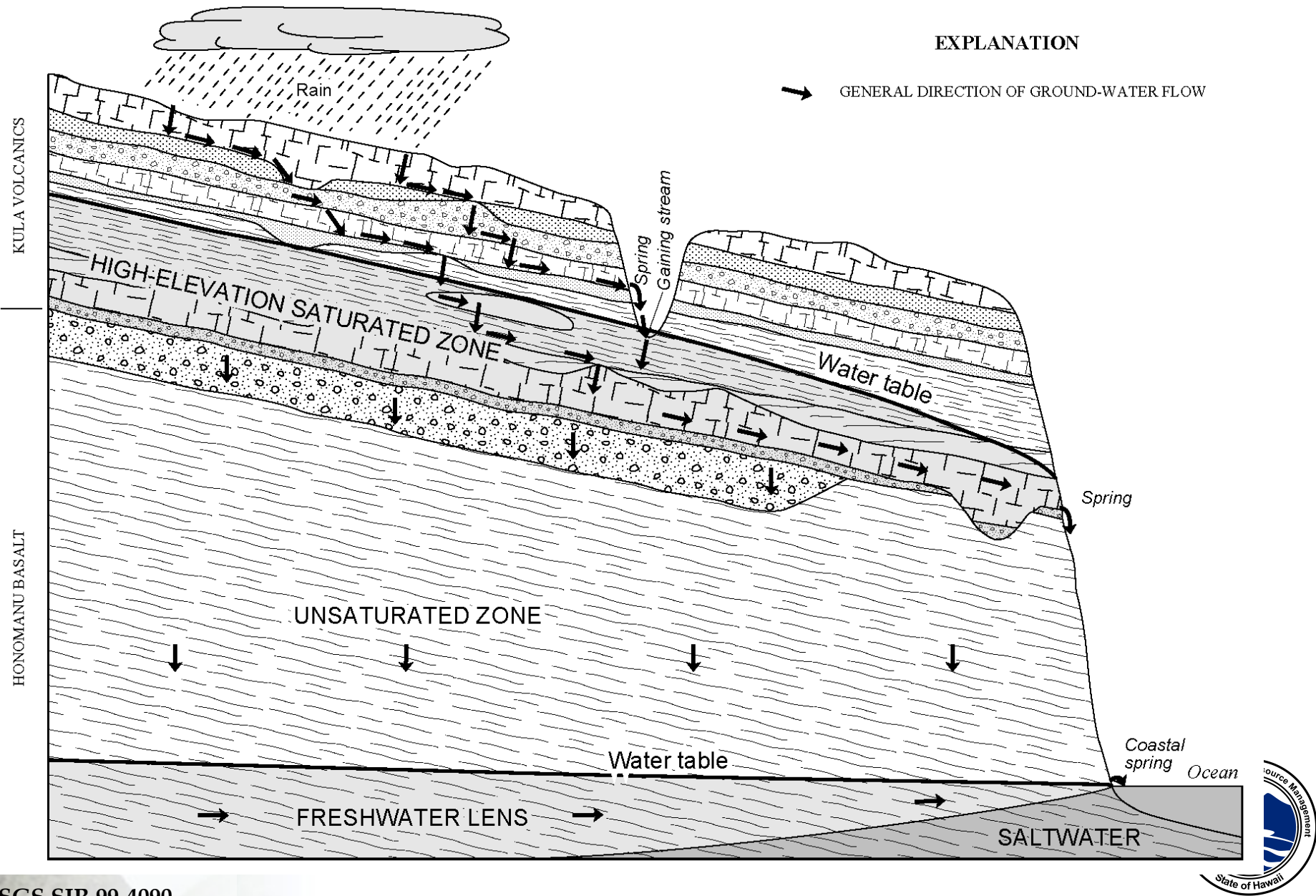
- Alluvium
- Beach deposits
- Hana Volcanics
- Honomanu Basalt
- Kula Volcanics
- Older alluvium
- Talus and colluvium



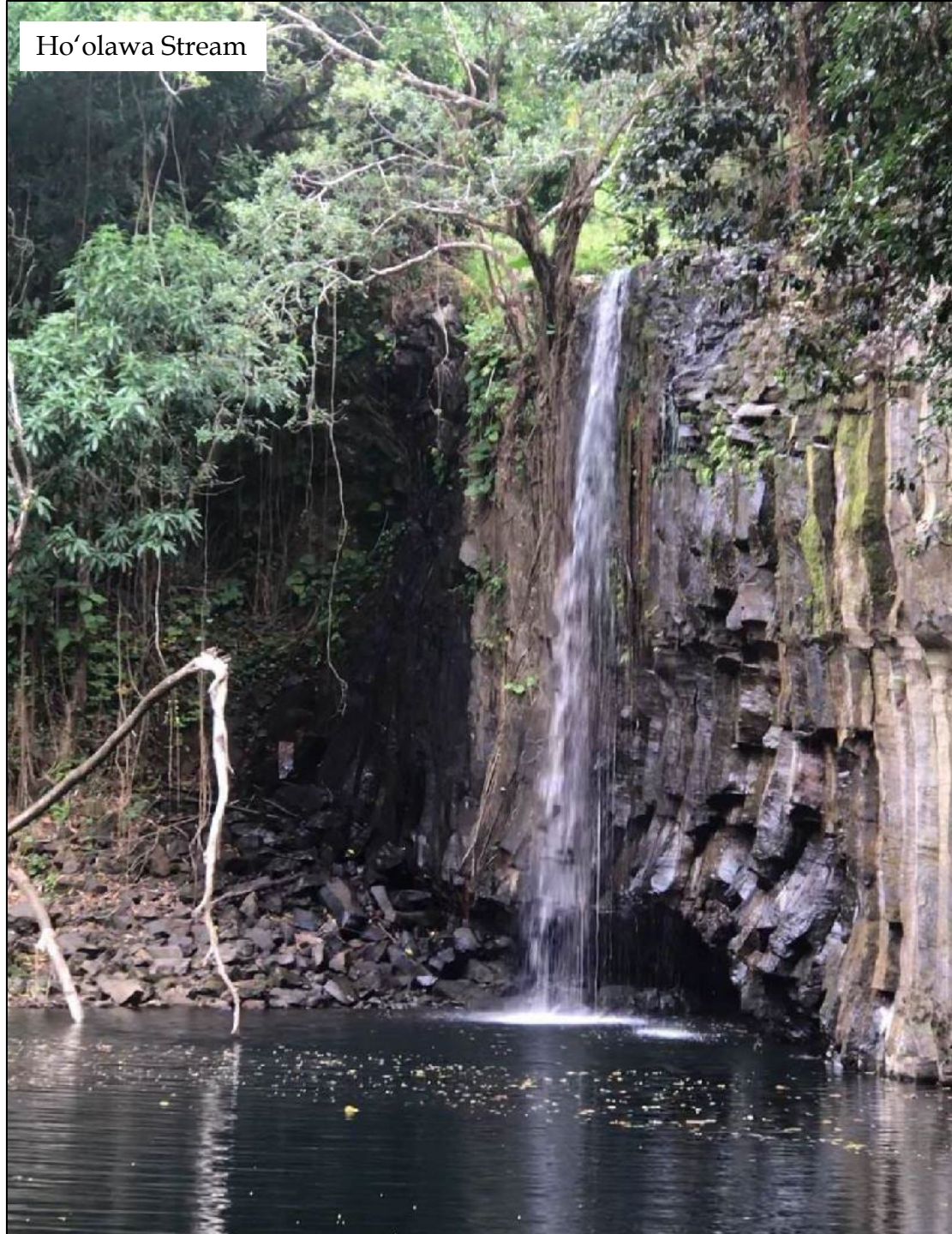




Geology: Variably Saturated Groundwater System West of Keanae Valley



Ho'olawa Stream



Kailua Stream

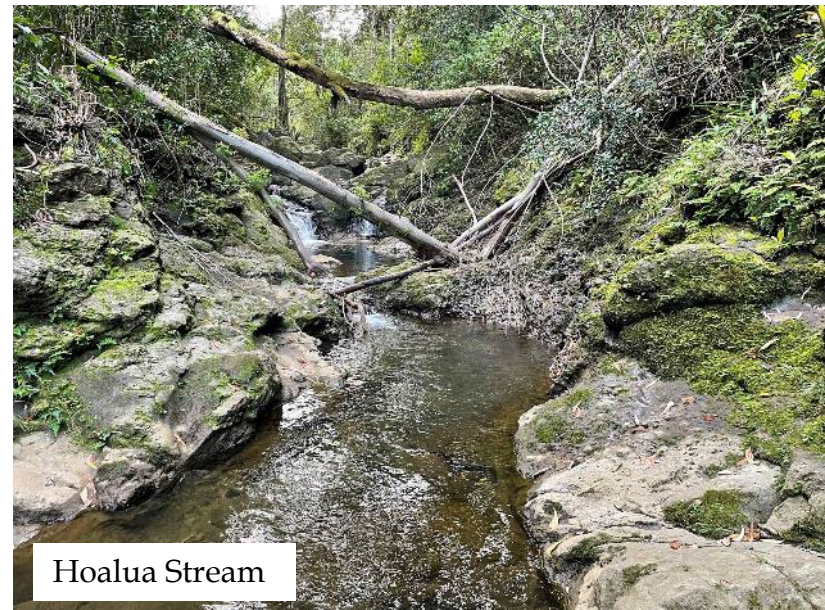


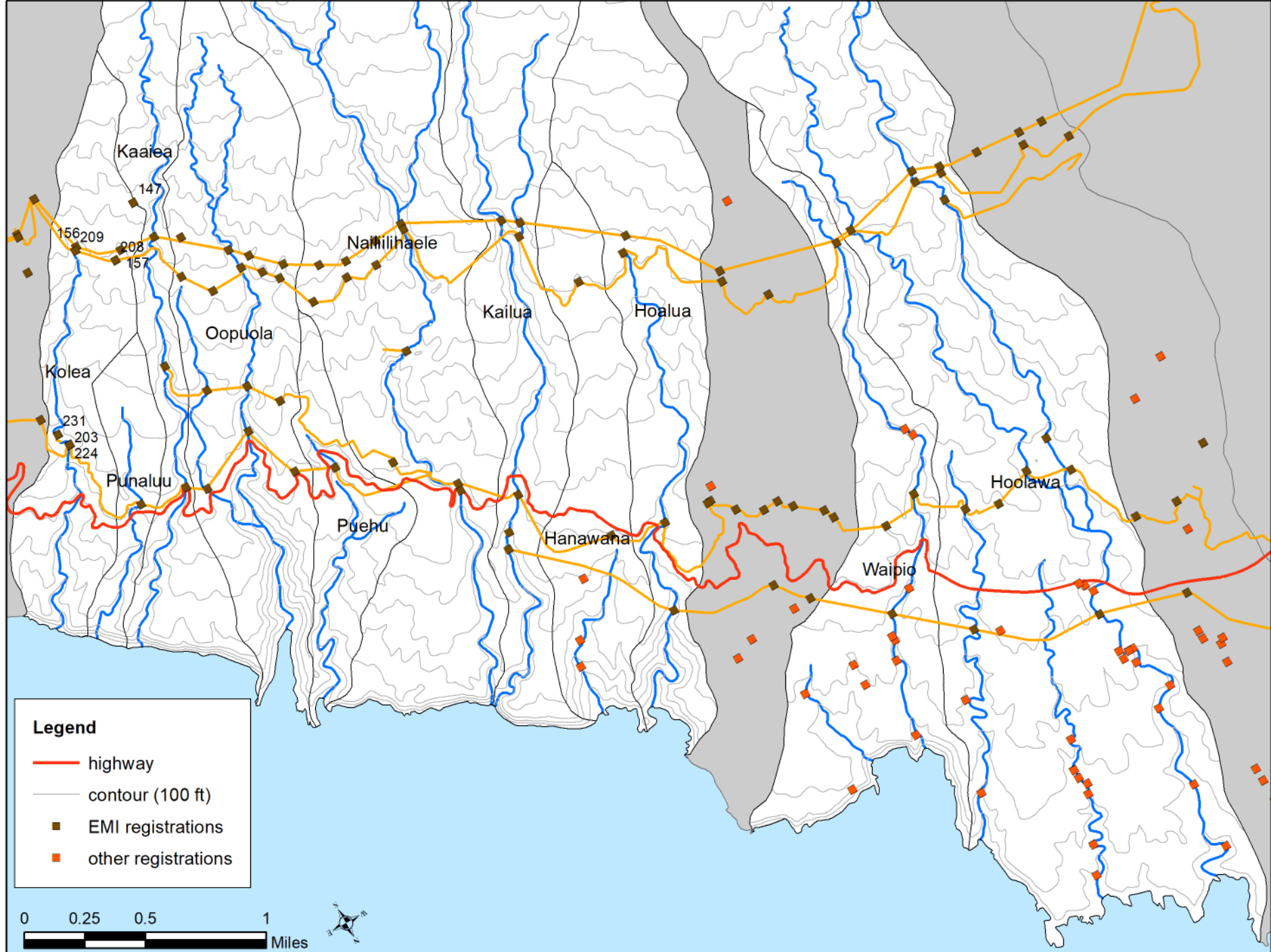
Nailiilihale Stream



Surface Geology

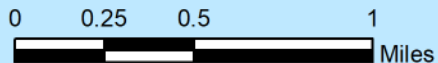
Stream	Hāna Volcanics (50-140 kya)	Percent of Unit	Kula Volcanics (140-780/950 kya)	Percent of Unit	Honomanū Basalt (950-1,300 kya)	Percent of Unit
Ho‘olawa	1.358	28.2	3.433	71.4	0.018	0.3
Waipi‘o	0.0	0.0	0.969	95.3	0.048	4.7
Hoalua	0.263	21.5	0.907	74.0	0.055	4.5
Hānawana	0.125	19.4	0.485	75.1	0.035	5.4
Kailua	3.073	59.1	2.107	40.5	0.017	0.3
Nailiilihaele	0.465	13.2	3.052	86.4	0.015	0.4
Puehu	0.0	0.0	0.342	96.6	0.012	3.4
Oopuola	0.0	0.0	1.180	96.2	0.044	3.6
Kaaiea	0.0	0.0	1.113	97.5	0.029	2.5
Punalu‘u	0.0	0.0	0.199	90.1	0.020	9.9
Kōlea	0.0	0.0	0.665	95.0	0.035	5.0





Legend

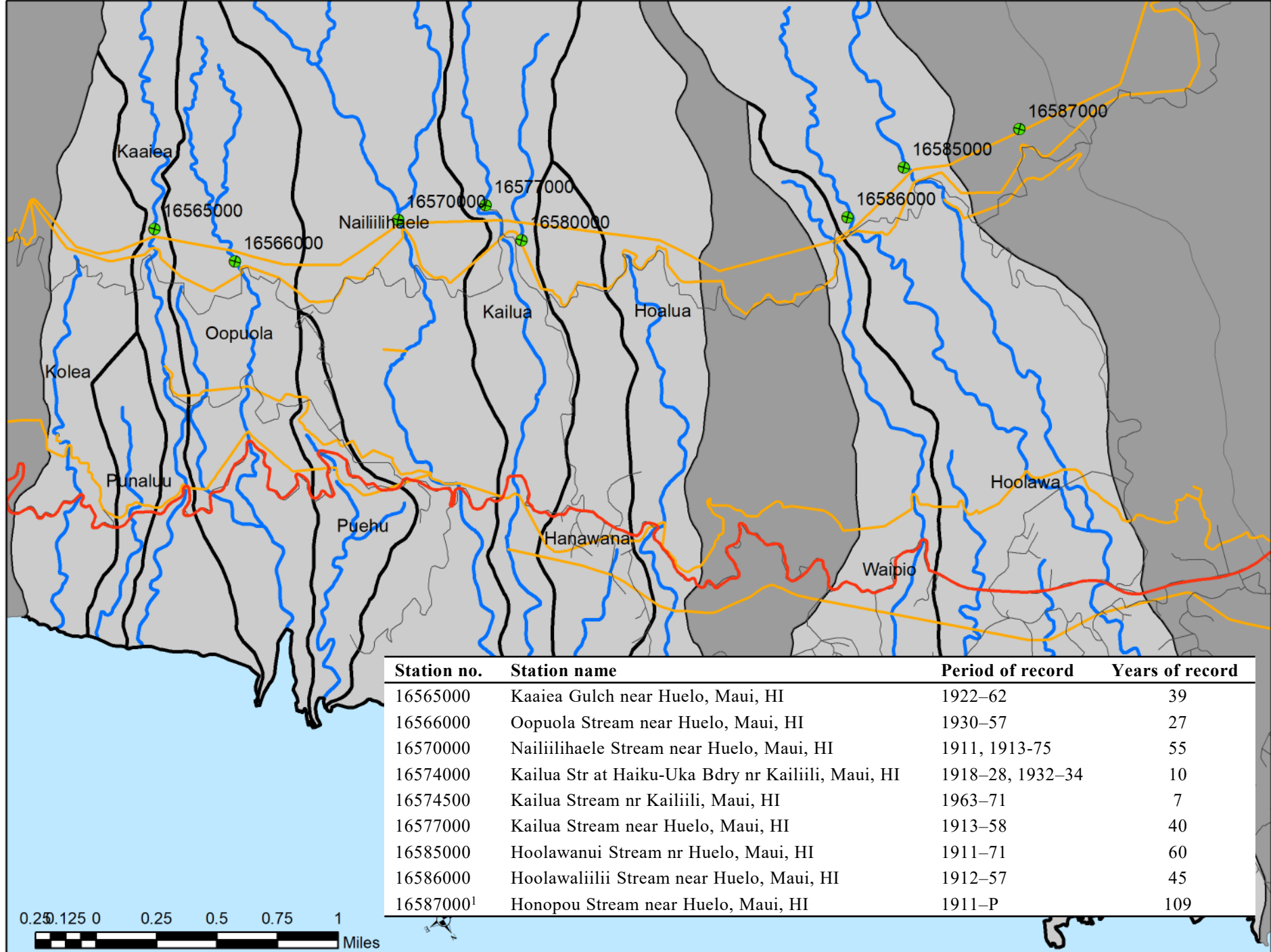
- highway
- contour (100 ft)
- EMI registrations
- other registrations



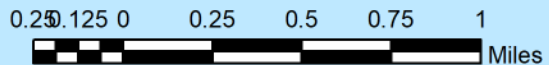
Types of Hydrologic Data

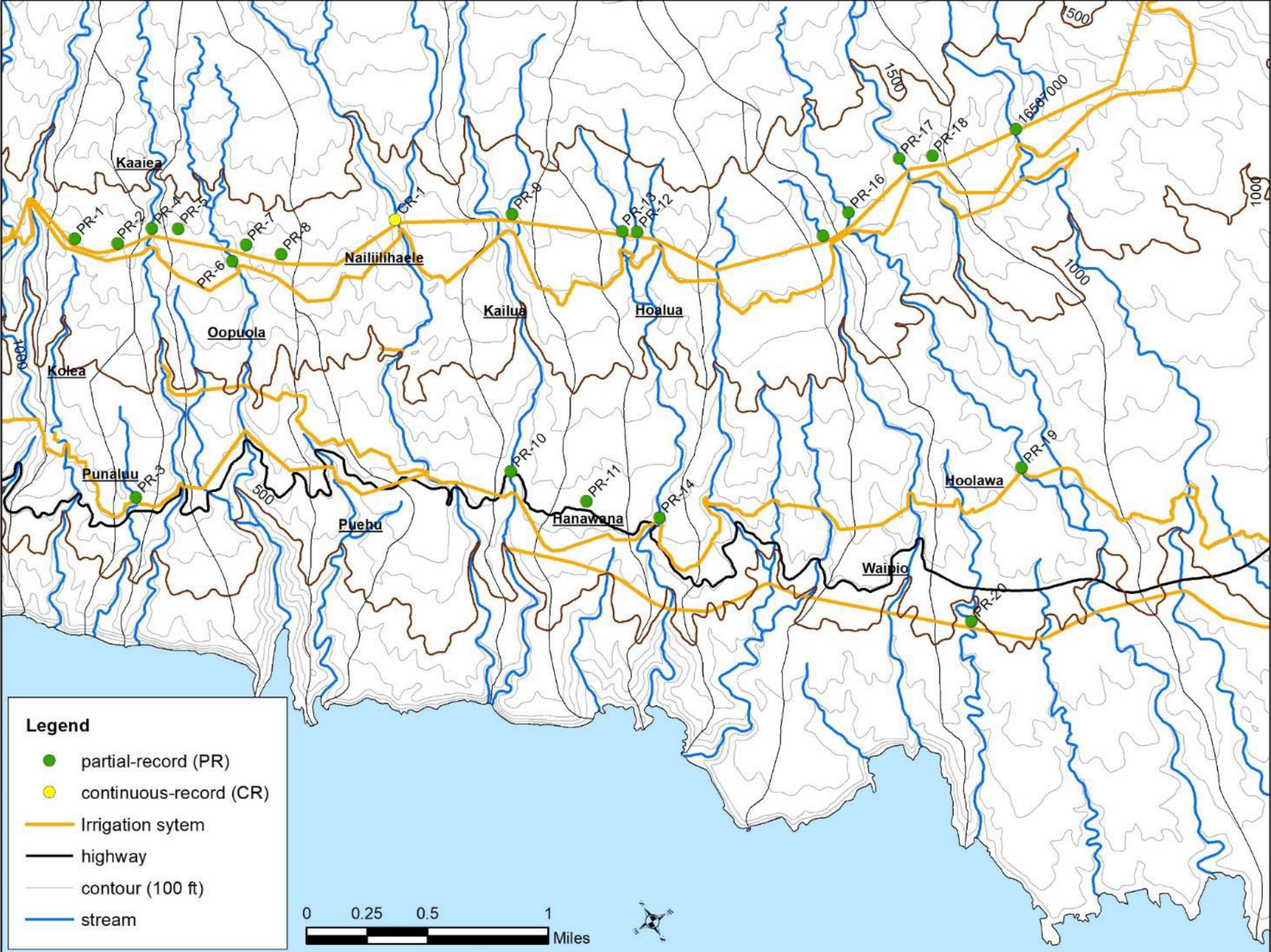
- **Historic continuous-record streamflow data**
- **Record-augmentation techniques with historic continuous record data**
- **Partial-record gaging stations (low-flow measurements) with statistical modeling**
- **Watershed modeling**
- **Seepage runs (synoptic measurements under stable conditions)**





Station no.	Station name	Period of record	Years of record
16565000	Kaaiea Gulch near Huelo, Maui, HI	1922–62	39
16566000	Oopuola Stream near Huelo, Maui, HI	1930–57	27
16570000	Nailiilihaele Stream near Huelo, Maui, HI	1911, 1913-75	55
16574000	Kailua Str at Haiku-Uka Bdry nr Kailiili, Maui, HI	1918–28, 1932–34	10
16574500	Kailua Stream nr Kailiili, Maui, HI	1963–71	7
16577000	Kailua Stream near Huelo, Maui, HI	1913–58	40
16585000	Hoolawanui Stream nr Huelo, Maui, HI	1911–71	60
16586000	Hoolawaliilii Stream near Huelo, Maui, HI	1912–57	45
16587000 ¹	Honopou Stream near Huelo, Maui, HI	1911–P	109





Legend

- partial-record (PR)
- continuous-record (CR)
- Irrigation system
- highway
- contour (100 ft)
- stream



Kōlea Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 0.6 mi²

Maximum elevation: 1864 ft

Land Use: 26.1% agriculture; 73.9% conservation

Total Stream Length: 1.8 mi

Terminal Order: 1

Terminal Reach: Waterfall

Watershed Rating:

Landcover: 9/10

Shallow Waters Rating: 0/10

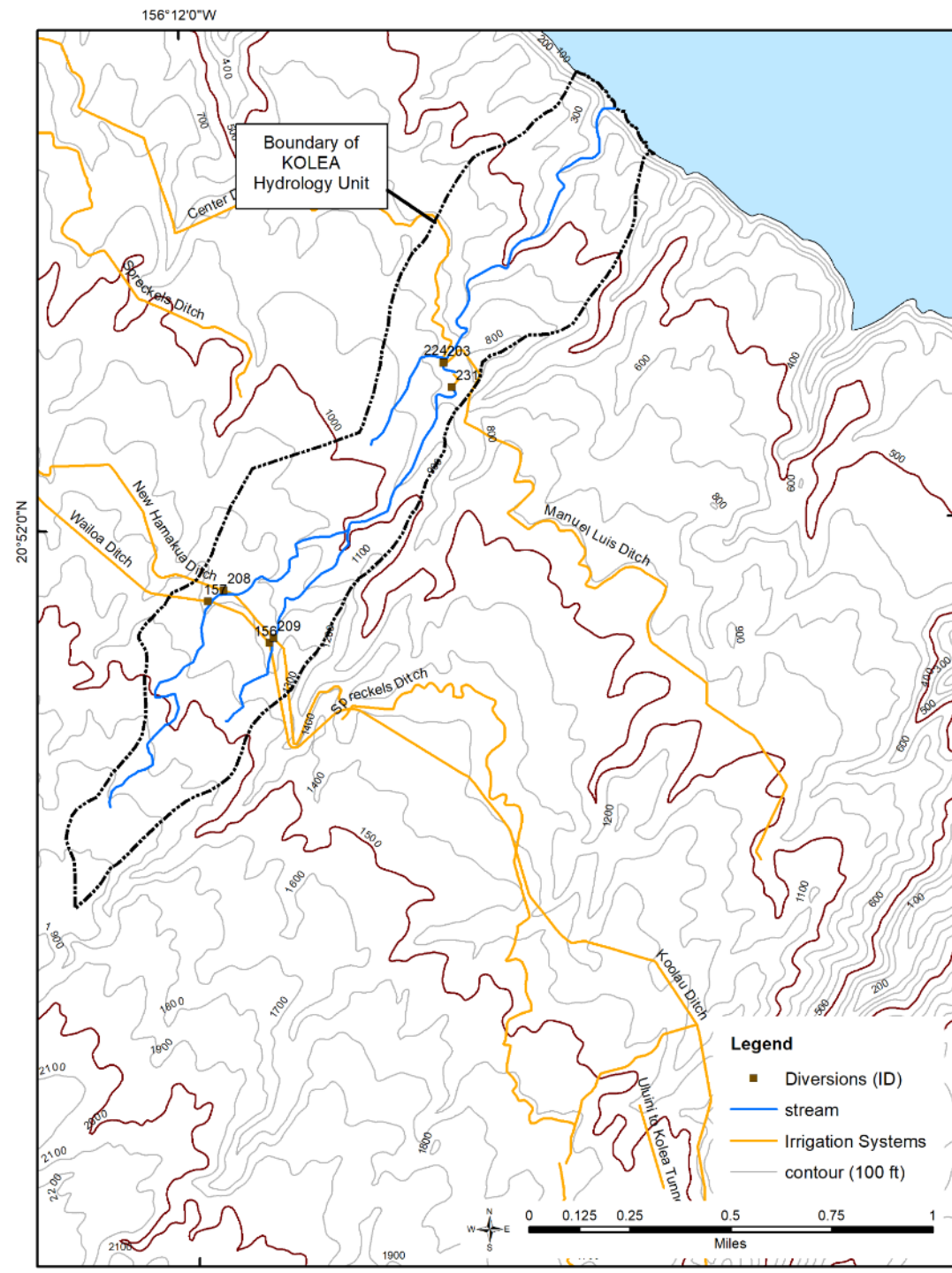
Stewardship Rating: 4/10

Size Rating: 1/10

Wetness Rating: 6/10

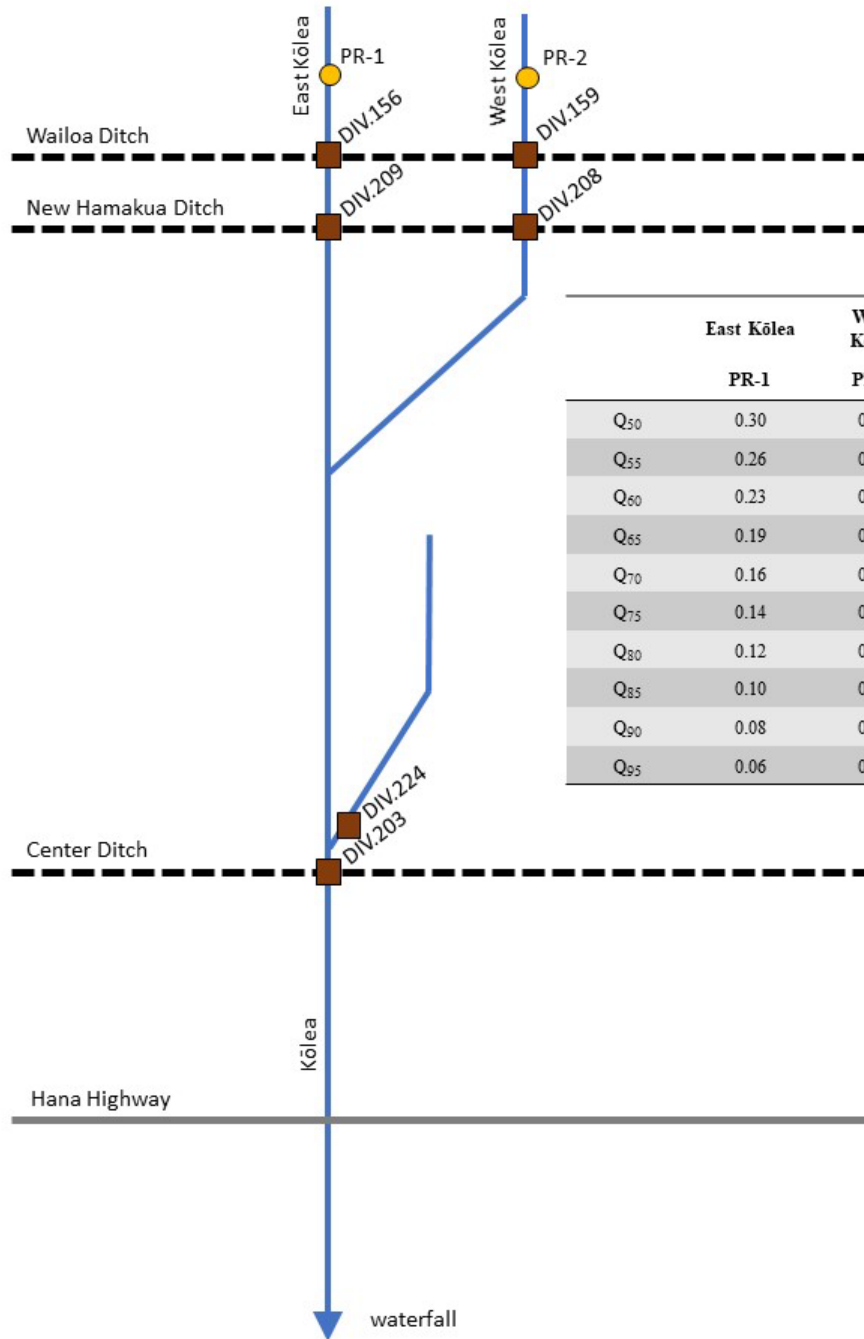
Reach Diversity Rating: 2/10

Total Watershed Rating: 5/10



Kōlea Hydrologic Unit (6046)

mauka



	East Kōlea	West Kōlea
	PR-1	PR-2
Q ₅₀	0.30	0.65
Q ₅₅	0.26	0.56
Q ₆₀	0.23	0.48
Q ₆₅	0.19	0.41
Q ₇₀	0.16	0.35
Q ₇₅	0.14	0.29
Q ₈₀	0.12	0.25
Q ₈₅	0.10	0.21
Q ₉₀	0.08	0.17
Q ₉₅	0.06	0.13



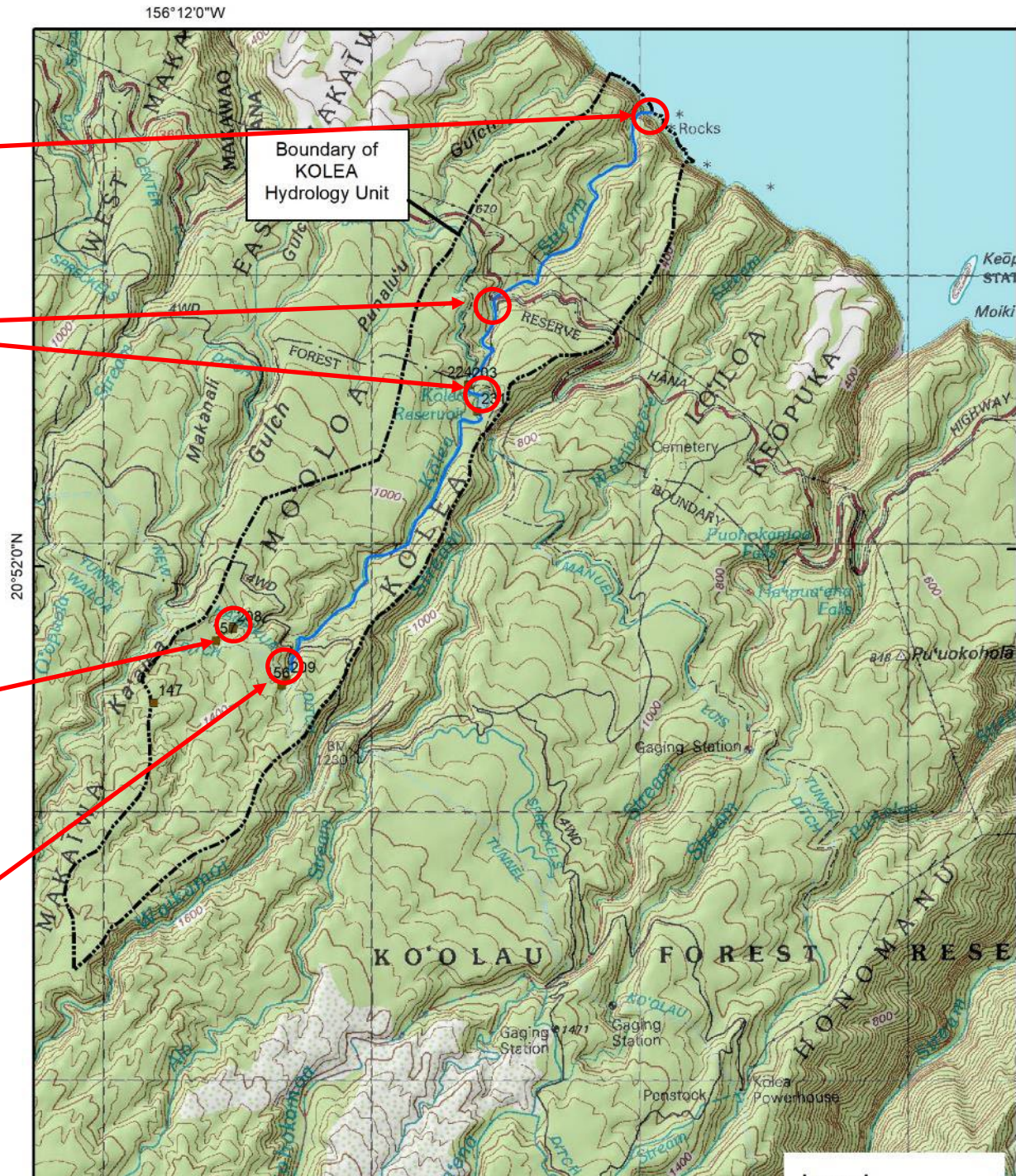
Kōlea Hydrologic Unit

Kōlea mouth

Kōlea 800-900 ft asl

West Kōlea

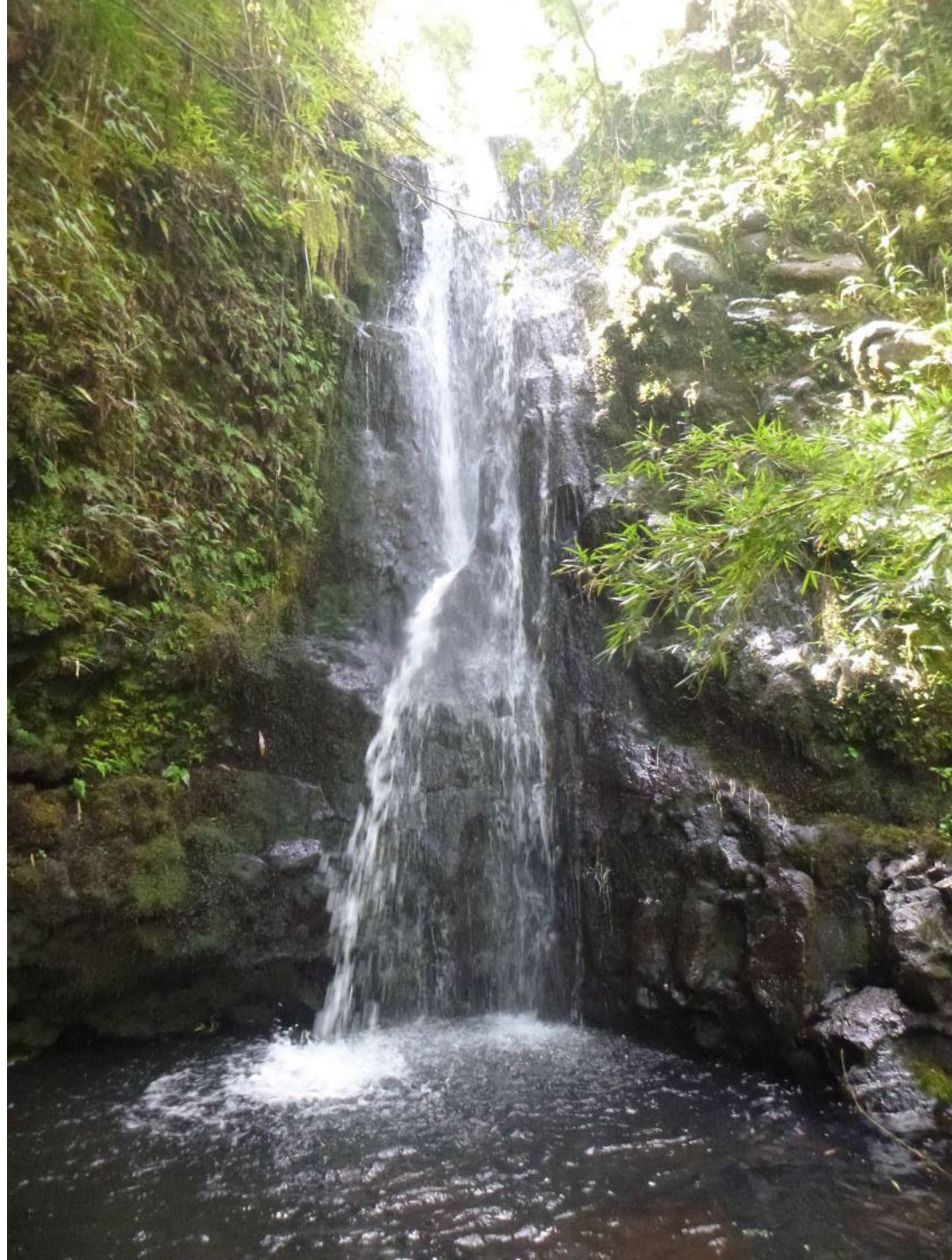
East Kōlea



Kōlea Hydrologic Unit: Mouth



Kōlea Hydrologic Unit:
at 800-900 ft



Kōlea Hydrologic Unit: at Center Ditch



East Kōlea at Wailoa Ditch

East Kōlea at New Hāmākua Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-1	East Kōlea abv Wailoa Ditch	1984-2013	0.30	0.26	0.23	0.19	0.16	0.14	0.12	0.10	0.08	0.06



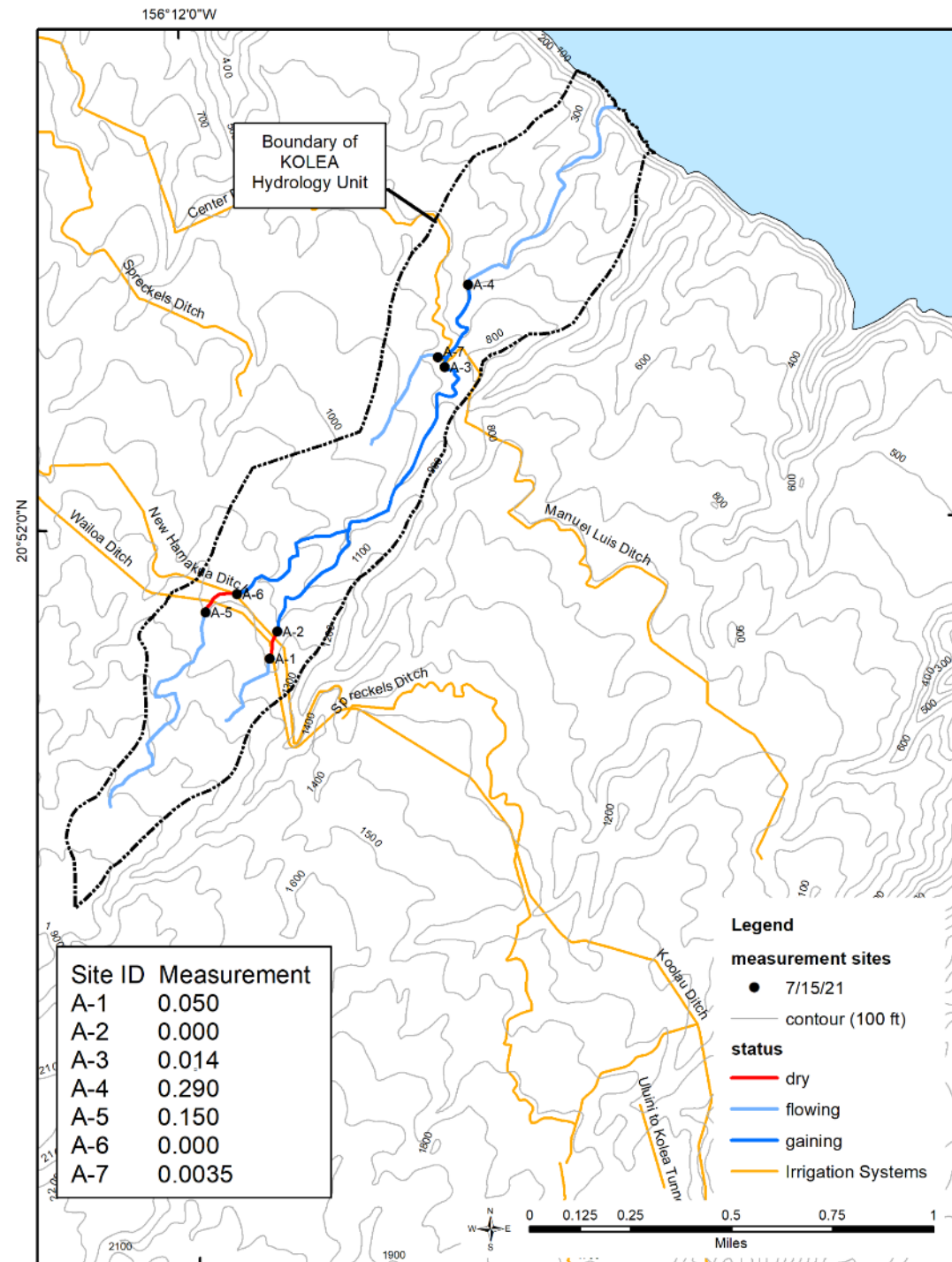
West Kōlea at Wailoa Ditch

West Kōlea at New Hāmākua Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-2	West Kōlea abv Wailoa Ditch	1984-2013	0.65	0.56	0.48	0.41	0.35	0.29	0.25	0.21	0.17	0.13



Kōlea Hydrologic Unit: Seepage Run



Kōlea Hydrologic Unit: Instream Uses

kalo not grown in watershed

No recognized trails

Biotic Information:

Terminal reach waterfall limits recruitment of
amphidromous species

Small stream limits habitat availability

No native species observed in 16 site visits

20 point-quadrant biota surveys (1 reach) conducted at 710ft
with flow restored past Center Ditch since 2016; no native
species observed; many non-native (*Poecilia mexicana*)
Megalagrion pacificum (endangered) observed in East
Kōlea above Wailoa Ditch (~1300ft)

Hawaii Stream Assessment:

HSA aquatic resources: not ranked

HSA riparian resources: detrimental animals (pigs);

0% native forest

HSA cultural resources: not surveyed

HSA recreational resources: ranked limited



Poecilia mexicana; Mexican molly/guppy
→commonly found in Kōlea Stream



Punalu'u Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 0.20 mi²

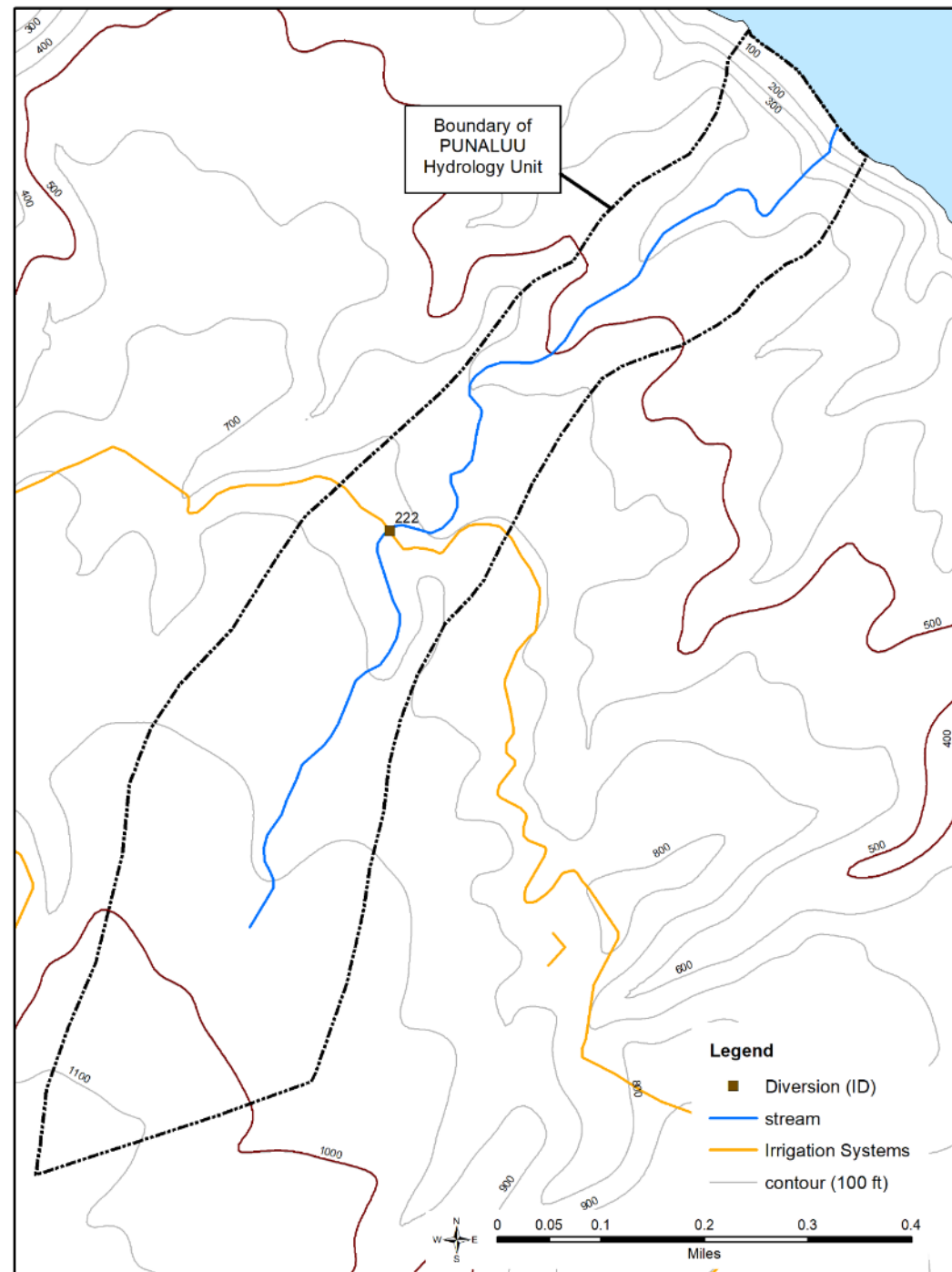
Maximum elevation: 1190 ft

Land Use: 68.5% conservation, 31.5% agriculture

Total Stream Length: 1.62 mi

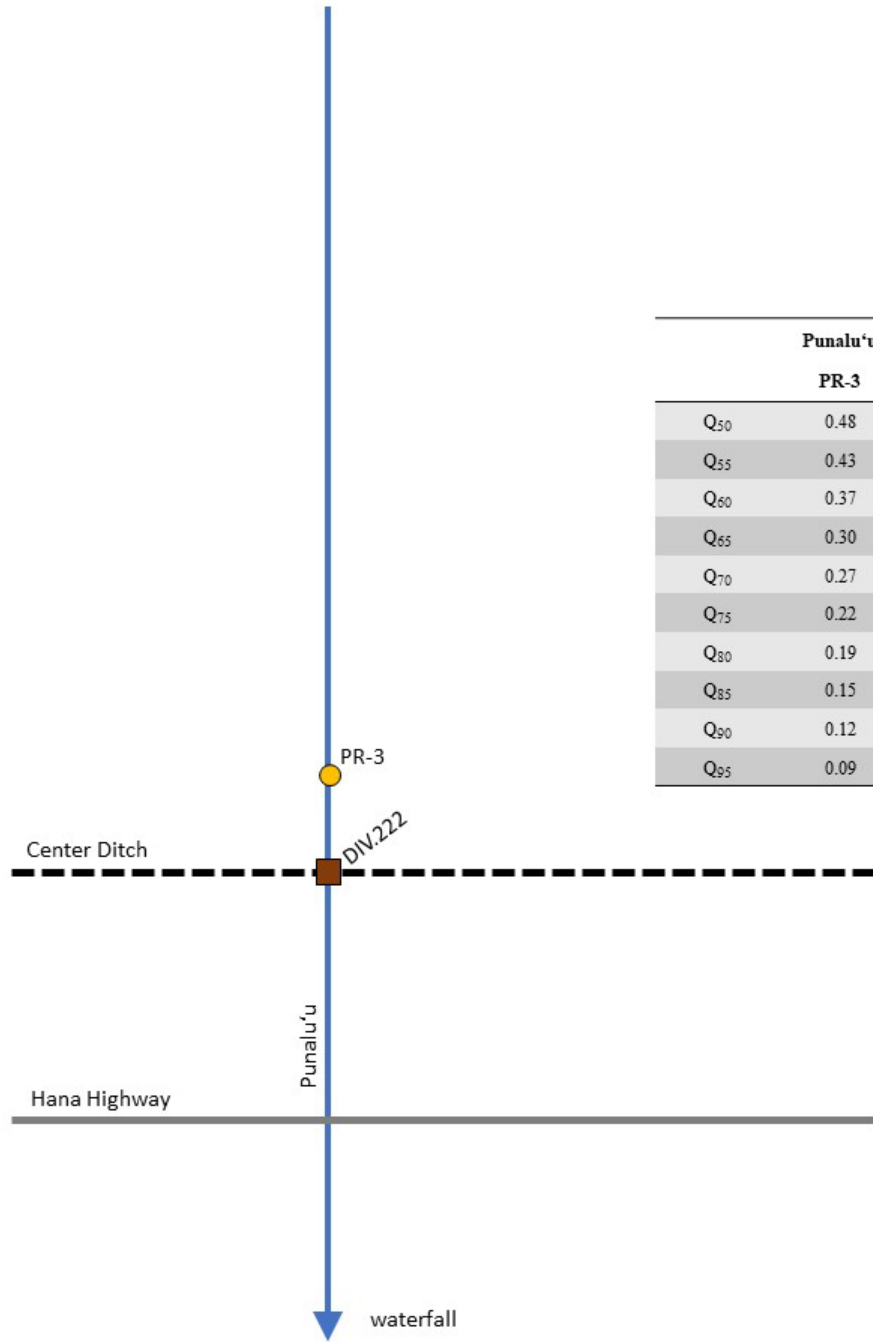
Terminal Order: 1

Terminal Reach: Waterfall



Punalu'u Hydrologic Unit (6045)

mauka



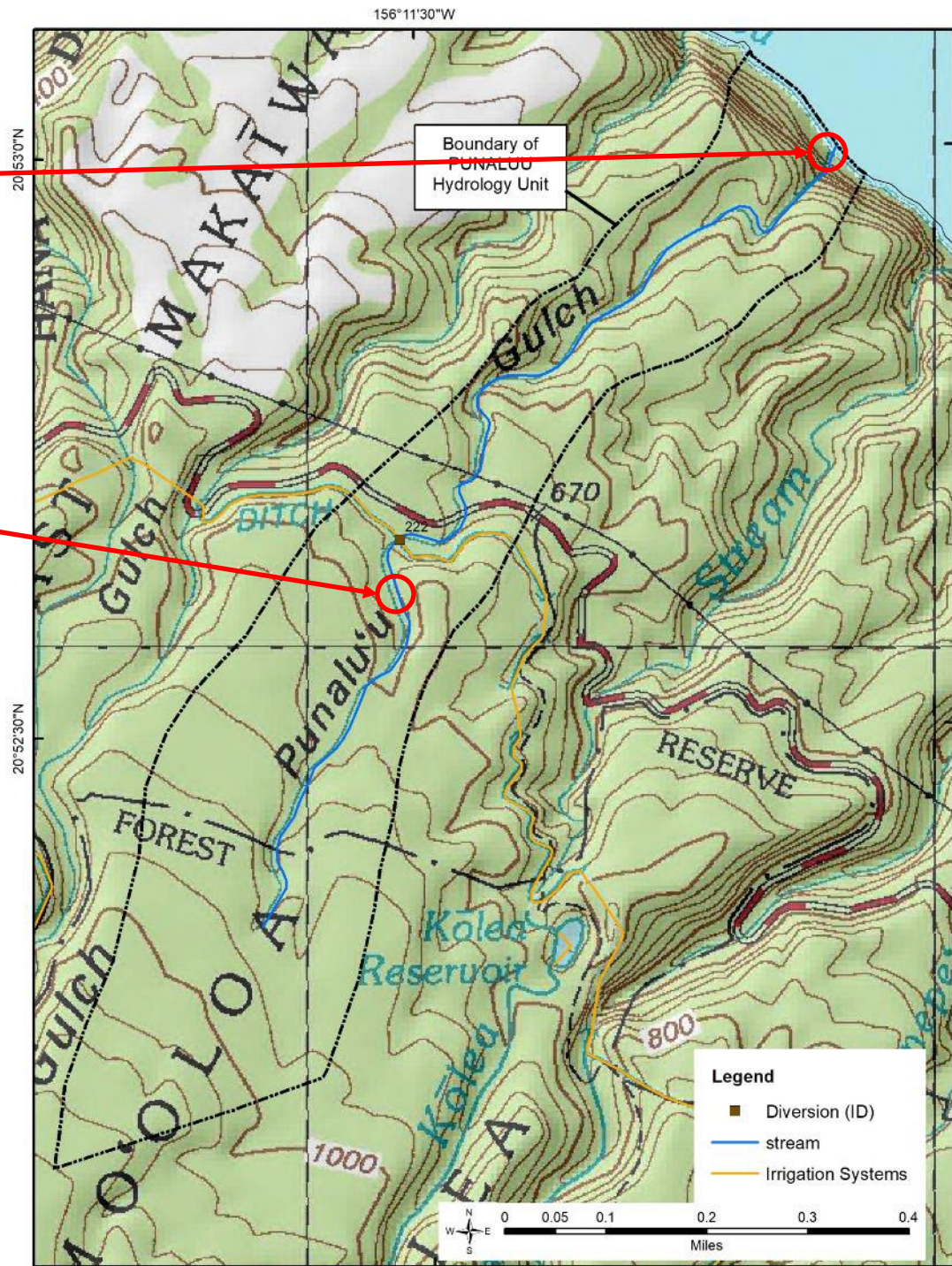
Punalu'u	
PR-3	
Q ₅₀	0.48
Q ₅₅	0.43
Q ₆₀	0.37
Q ₆₅	0.30
Q ₇₀	0.27
Q ₇₅	0.22
Q ₈₀	0.19
Q ₈₅	0.15
Q ₉₀	0.12
Q ₉₅	0.09



Punalu'u Hydrologic Unit

Punalu'u mouth

Punalu'u 800-900 ft asl



Punalu'u Hydrologic Unit:
Mouth



Punalu'u Hydrologic Unit: 800-900 ft



Punalu'u above Center Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-3	Punalu'u Stream abv Center Ditch	1984-2013	0.48	0.43	0.37	0.30	0.27	0.22	0.19	0.15	0.12	0.09



Punalu'u Hydrologic Unit: Instream Uses

kalo not grown in watershed

No recognized trails

Biotic Information:

Terminal reach waterfall limits recruitment of amphidromous species

Small stream limits habitat availability

No native species observed in 15 site visits

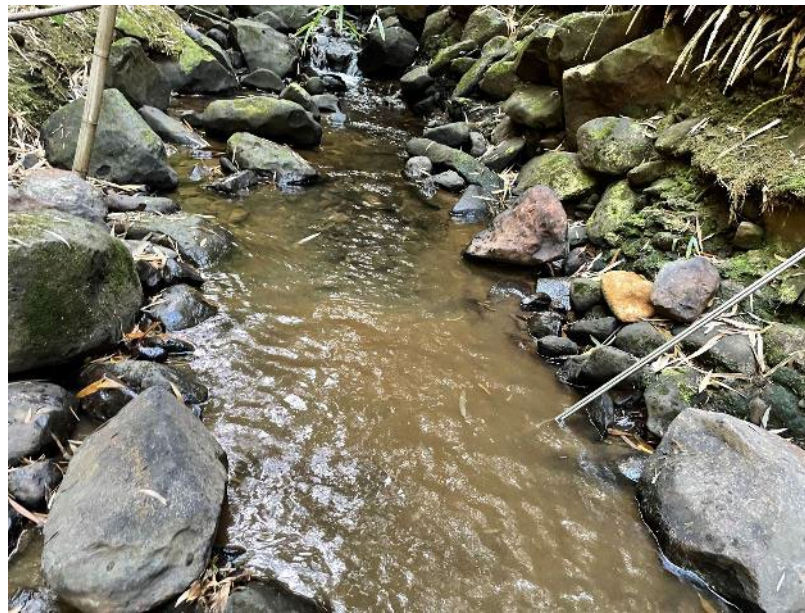
Hawaii Stream Assessment:

HSA aquatic resources: not ranked

HSA riparian resources: not surveyed

HSA cultural resources: not surveyed

HSA recreational resources: not surveyed



Ka'aiea Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 1.1 mi²

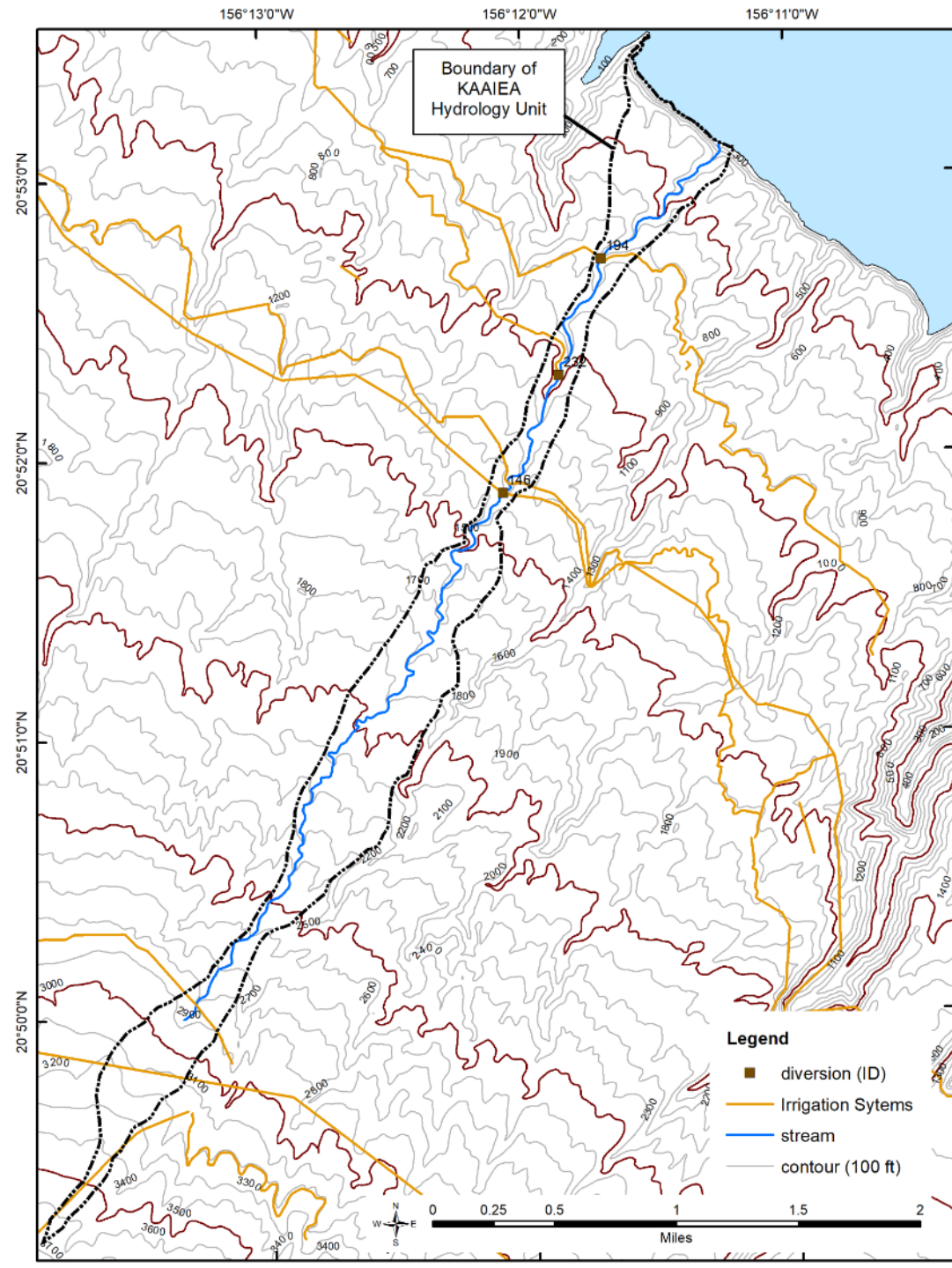
Maximum elevation: 2717 ft

Land Use: 19.9% agriculture; 80.1% conservation

Total Stream Length: 5.3 mi

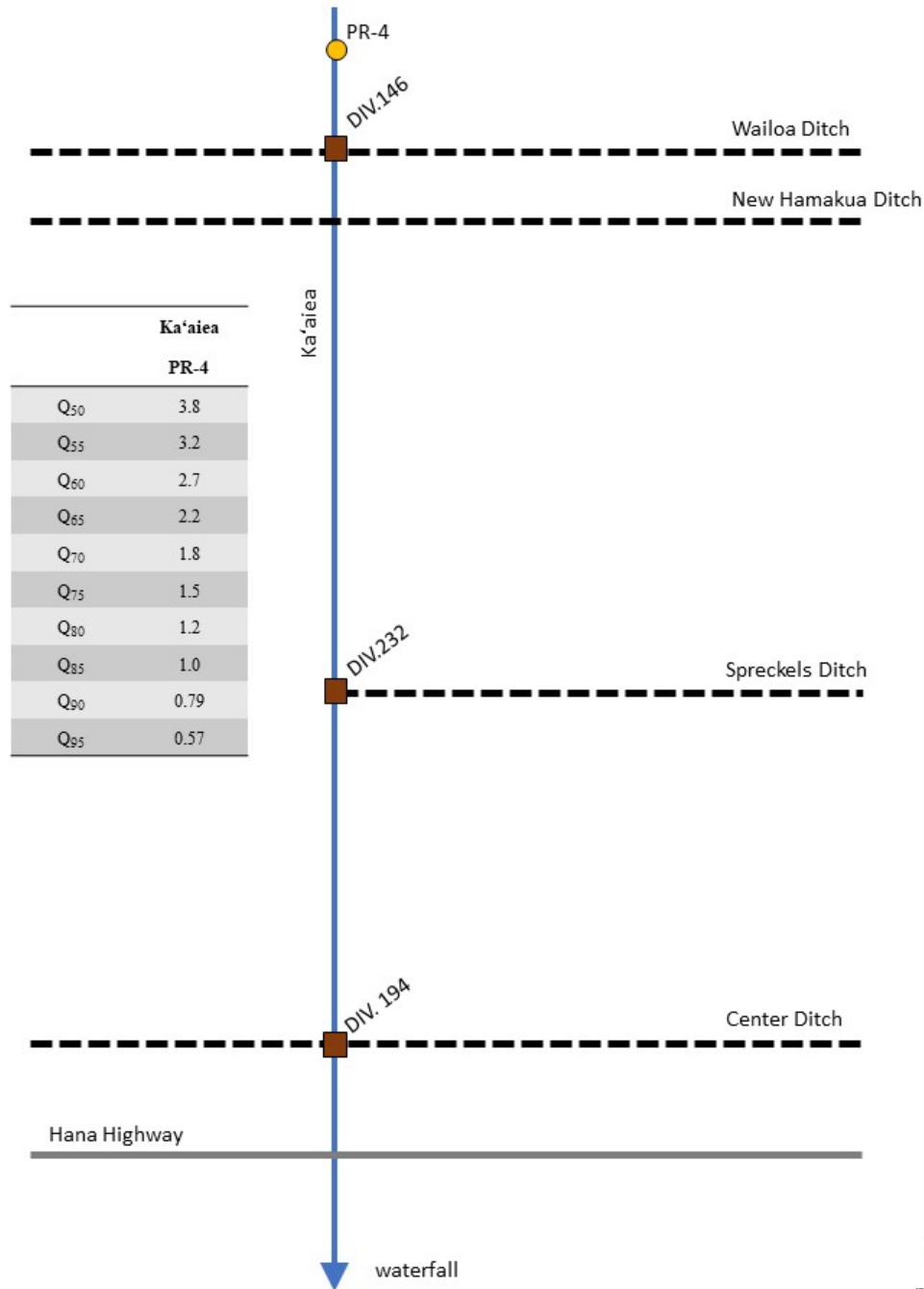
Terminal Order: 1

Terminal Reach: Waterfall



Ka'aiea Hydrologic Unit (6044)

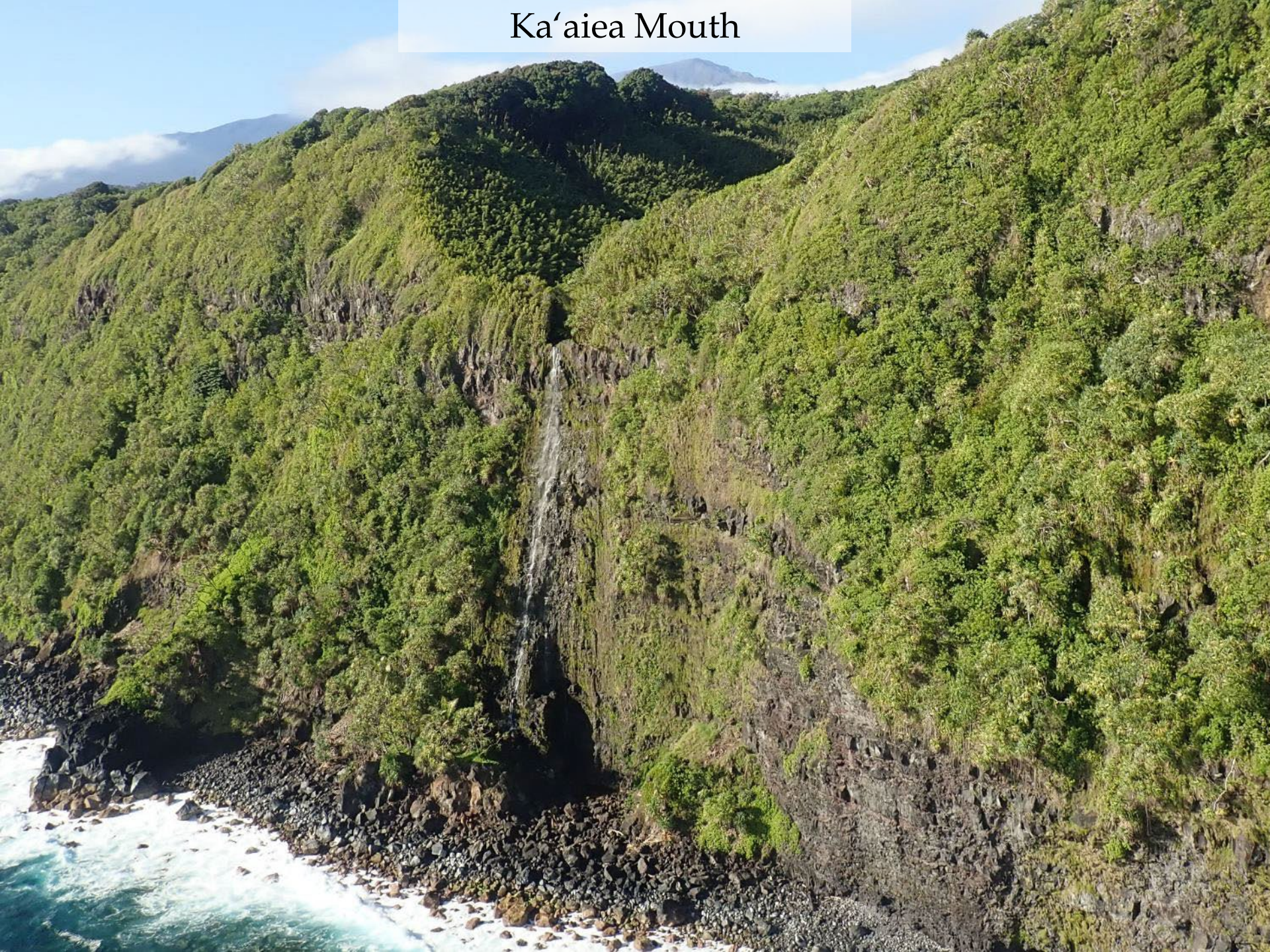
mauka



Ka'aiea	
PR-4	
Q ₅₀	3.8
Q ₅₅	3.2
Q ₆₀	2.7
Q ₆₅	2.2
Q ₇₀	1.8
Q ₇₅	1.5
Q ₈₀	1.2
Q ₈₅	1.0
Q ₉₀	0.79
Q ₉₅	0.57



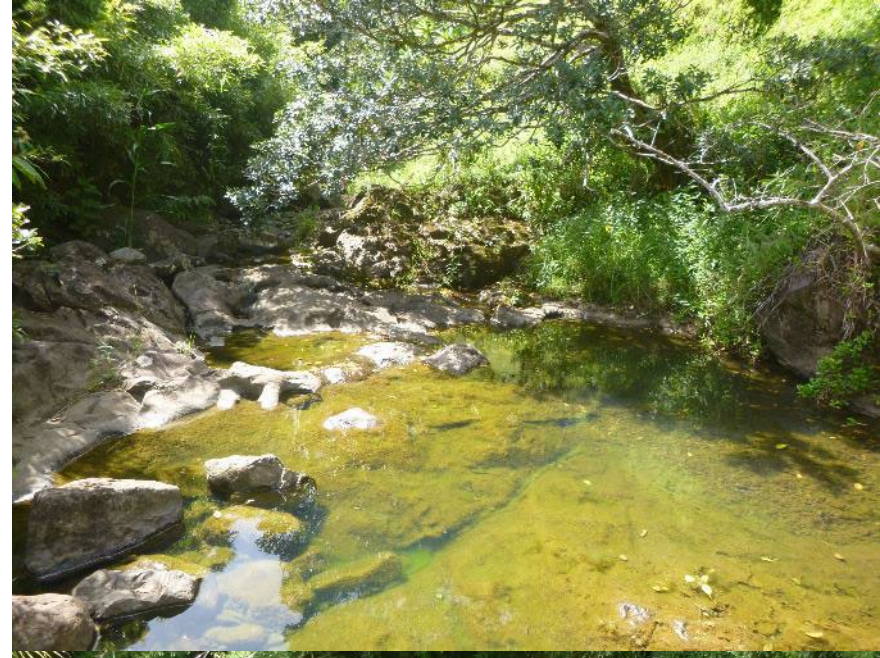
Ka'aiea Mouth



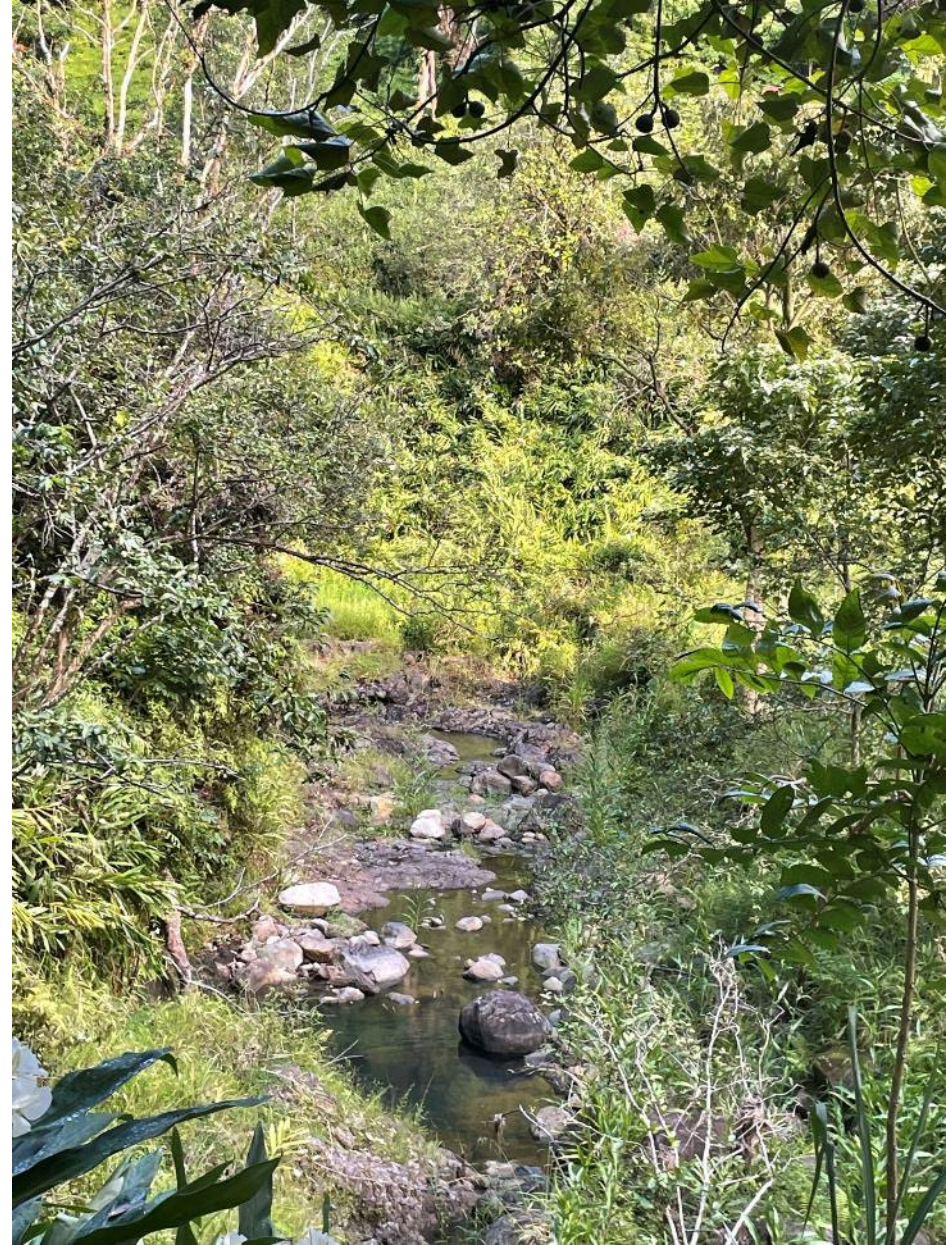
Ka'aiea Stream at 800 ft
(above Center Ditch)



Ka'aiea Stream at 700 ft
(below Center Ditch)



Ka'aiea Stream at 950 ft (Spreckels Ditch)

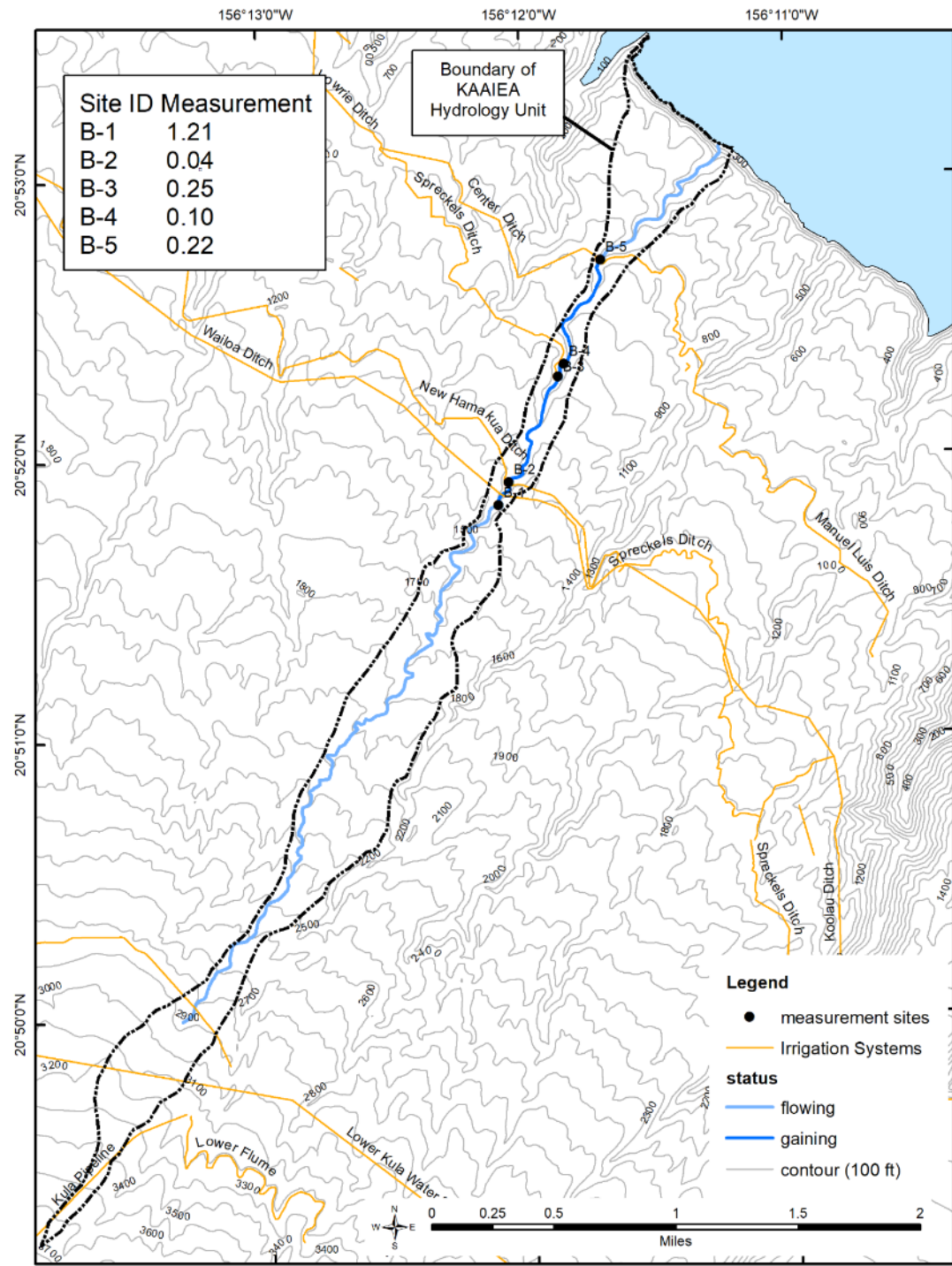


Ka'aiea Stream at Wailoa Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-4	Ka'aiea Stream abv Wailoa Ditch	1984-2013	3.8	3.2	2.7	2.2	1.8	1.5	1.2	1.0	0.79	0.57



Ka'aiea Hydrologic Unit: Seepage Run



Ka'aiea Hydrologic Unit: Instream Uses

kalo not grown in watershed

Biotic Information:

Terminal reach waterfall limits recruitment of amphidromous species
20 point-quadrant biota surveys (1 reach) conducted at 680ft; no native species observed.

‘ōpae observed at 1250ft above Wailoa Ditch

No other native species observed in 19 site visits

Hawaii Stream Assessment

HSA aquatic resources: not ranked

HSA riparian resources: detrimental plants (hau); detrimental animals (pigs); 10% native forest

HSA cultural resources: not surveyed

HSA recreational resources: hiking, swimming, scenic views;
ranked substantial by regional committee



'O'puola Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 1.0 mi²

Maximum elevation: 2057 ft

Land Use: 27.7% agriculture; 72.3% conservation

Total Stream Length: 4.4 mi

Terminal Order: 2

Terminal Reach: Estuary

Watershed Rating:

Landcover: 9/10

Shallow Waters Rating: 1/10

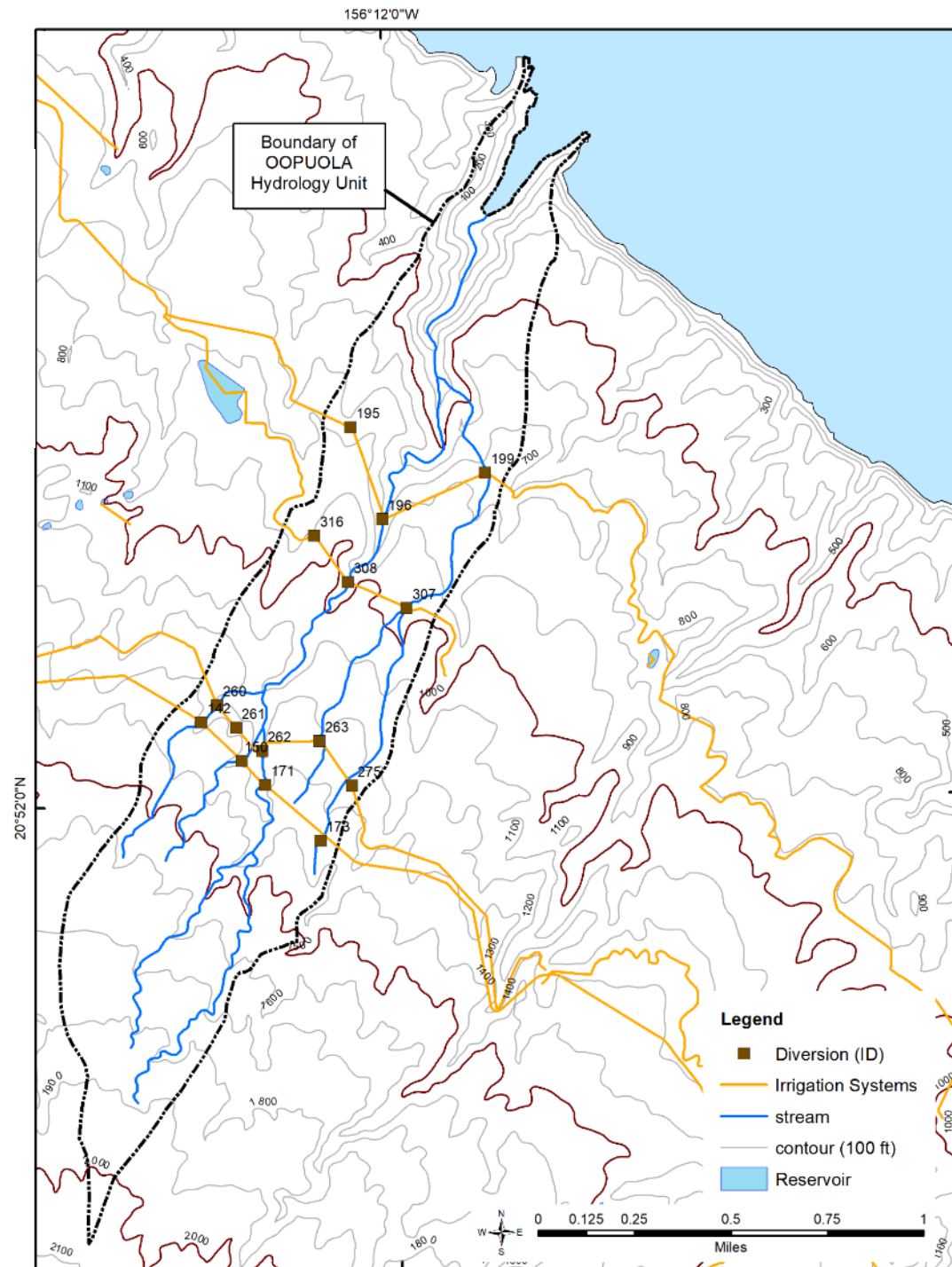
Stewardship Rating: 5/10

Size Rating: 2/10

Wetness Rating: 7/10

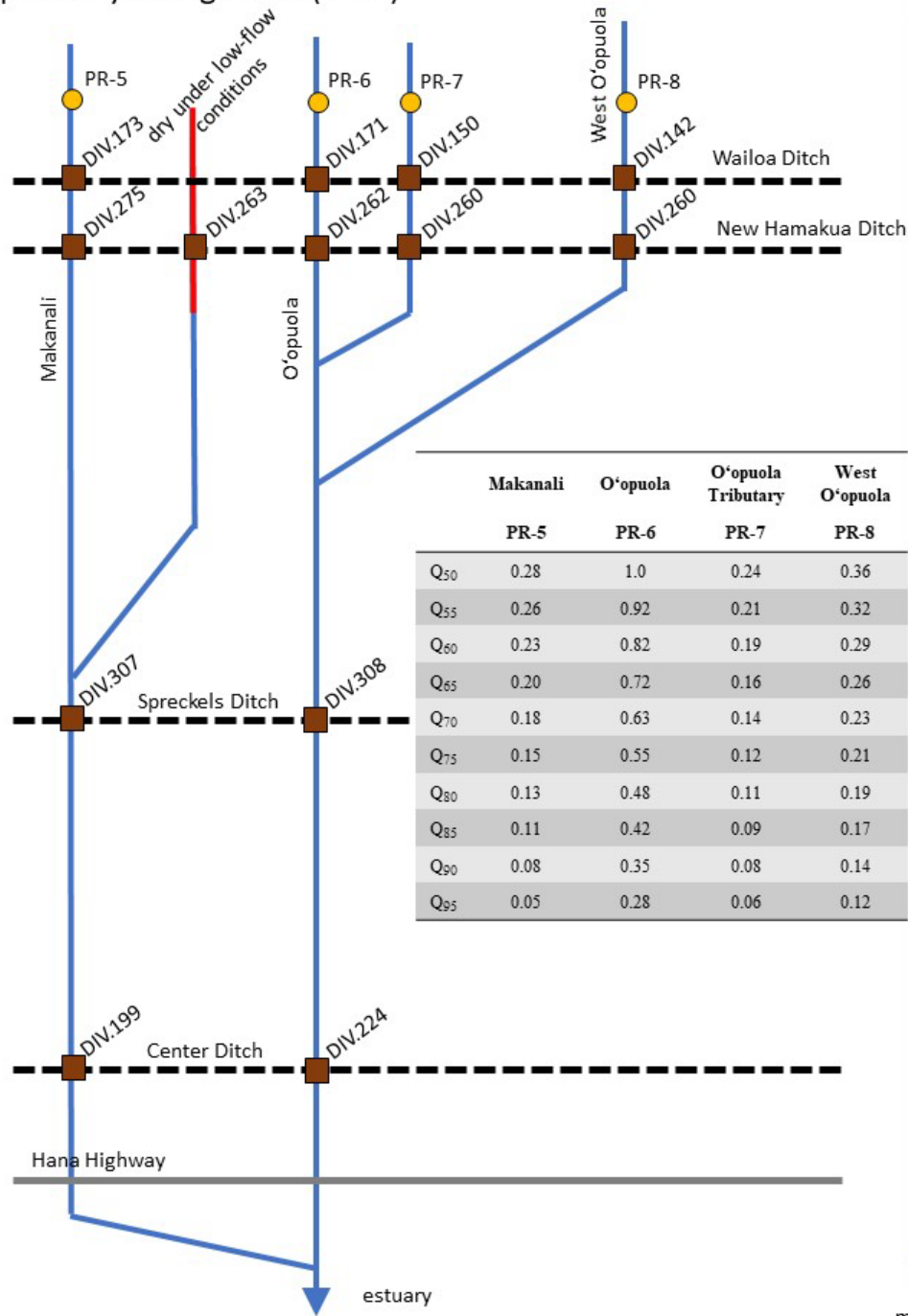
Reach Diversity Rating: 3/10

Total Watershed Rating: 7/10



O'opuola Hydrologic Unit (6043)

mauka



'O'opuola Hydrologic Unit:
Mouth



'O'opuola Hydrologic Unit:
800-900 ft



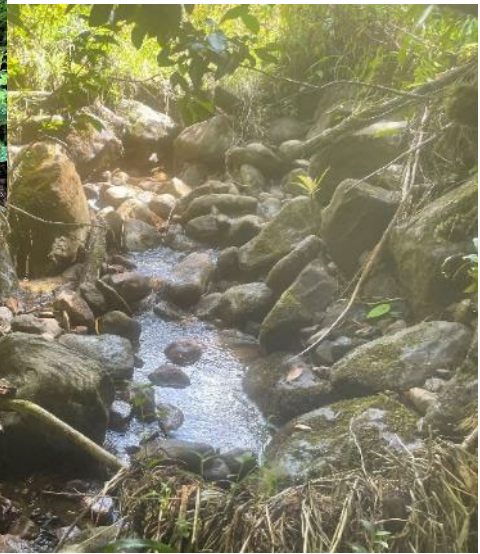
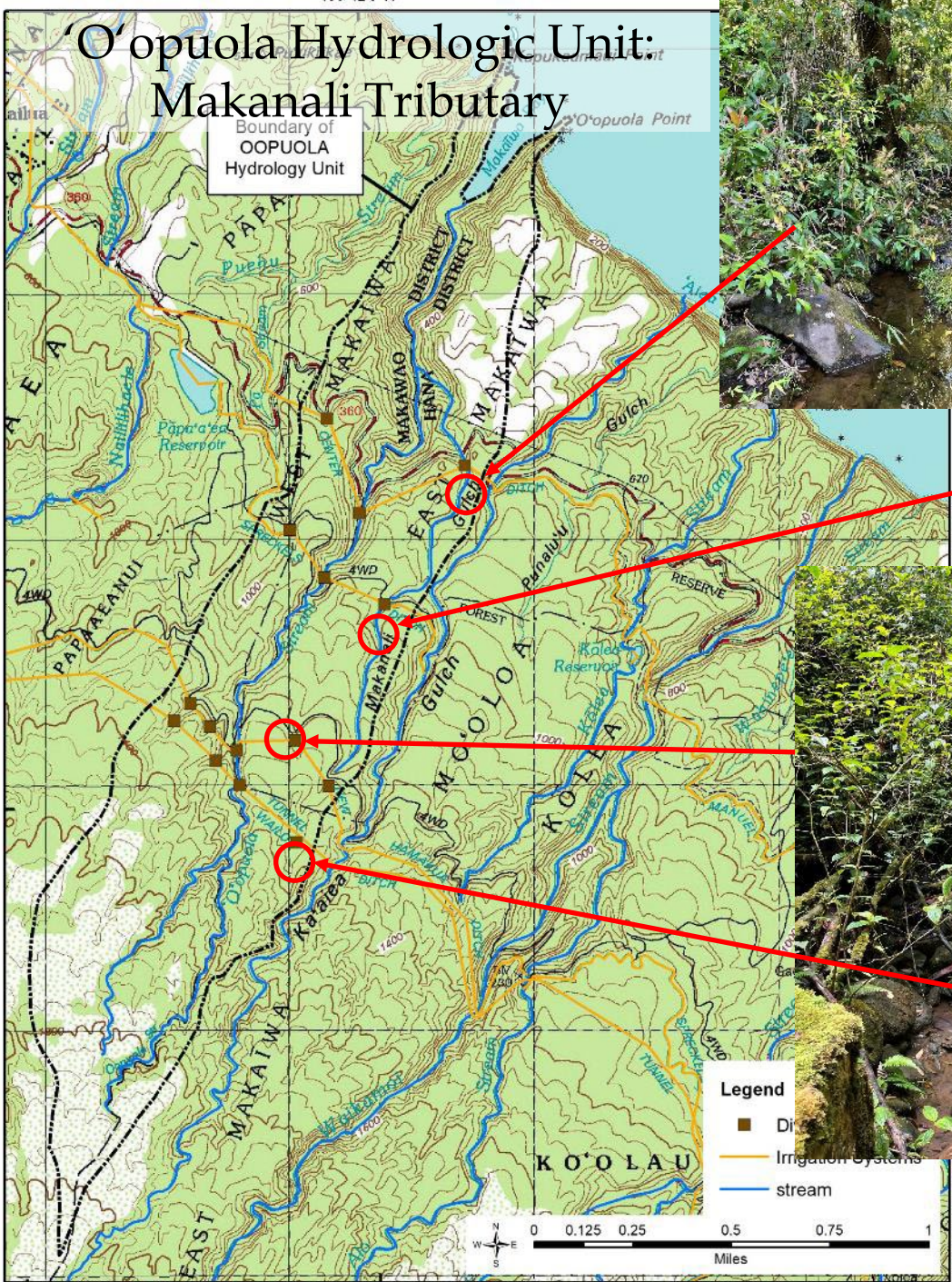
'O'opuola Hydrologic Unit: 1000 ft



156°12'0"W

O'opuola Hydrologic Unit: Makanali Tributary

Boundary of
OOPUOLA
Hydrology Unit



Makanali at Wailoa Ditch

Makanali at New Hāmākua Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-5	Makanali Stream abv Wailoa Ditch	1984-2013	0.28	0.26	0.23	0.20	0.18	0.15	0.13	0.11	0.08	0.05



'O'opuola at Wailoa Ditch

'O'opuola at New Hāmākua Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-6	O'opuola Stream abv Wailoa Ditch	1984-2013	1.0	0.92	0.82	0.72	0.63	0.55	0.48	0.42	0.35	0.28



'O'opuola Tributary at Wailoa Ditch

'O'opuola Tributary at New Hāmākua Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-8	West O'opuola Stream abv Wailoa Ditch	1984-2013	0.36	0.32	0.29	0.26	0.23	0.21	0.19	0.17	0.14	0.12



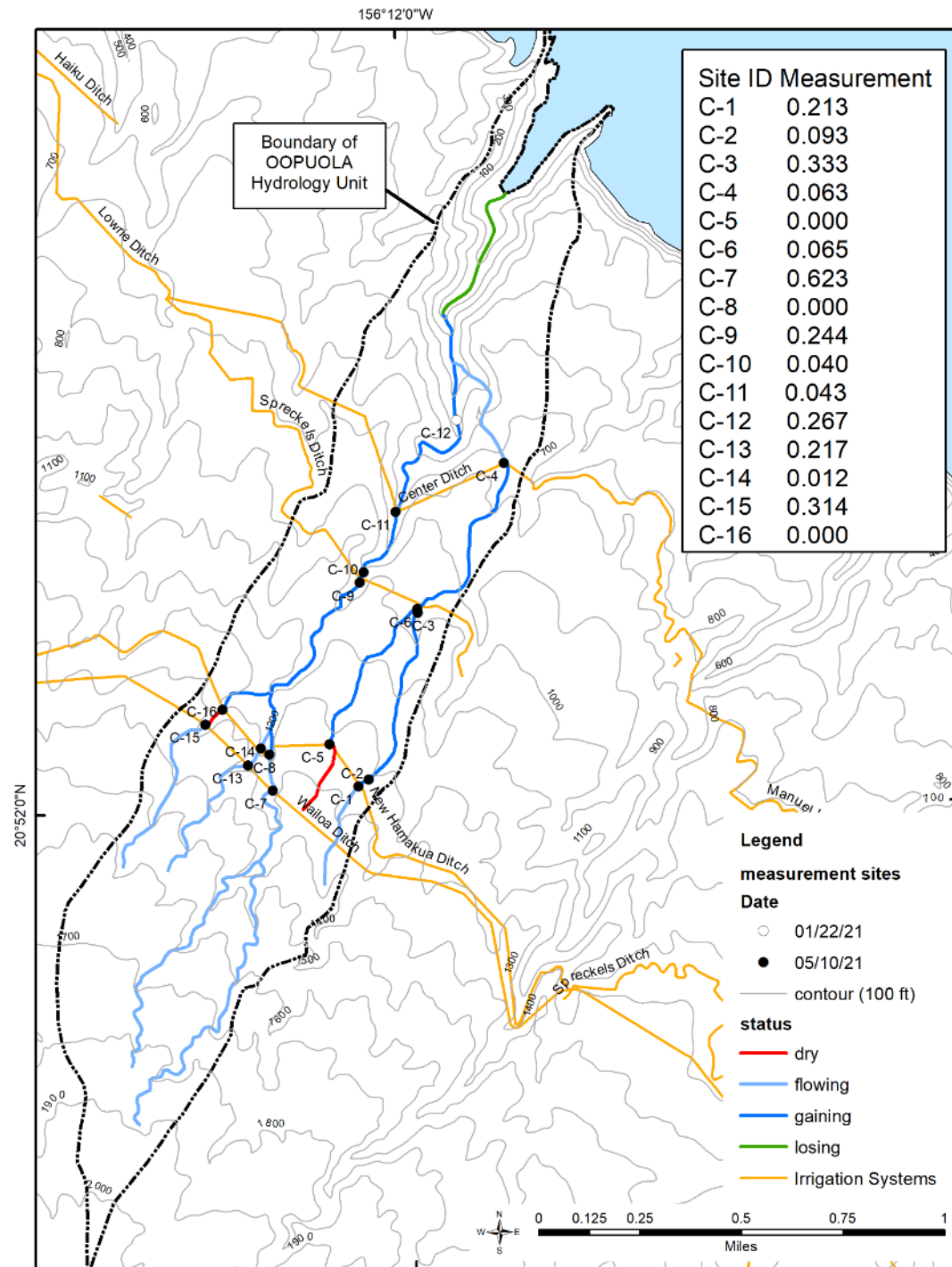
West 'O'opuola at Wailoa Ditch

West 'O'opuola at New Hamākua Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-8	West O'opuola Stream abv Wailoa Ditch	1984-2013	0.36	0.32	0.29	0.26	0.23	0.21	0.19	0.17	0.14	0.12



'O'opuola Hydrologic Unit: Seepage Run



'O'opuola Hydrologic Unit: Instream Uses

kalo not grown in watershed

Potential for 'o'opu in mid and lower elevations

Biotic Information:

Terminal reach estuary increases recruitment potential of amphidromous species

2008 DAR point quadrat survey

20 point-quadrant biota surveys (1 reach) conducted at 600ft with flow restored past Center Ditch since 2016; o'opu alamo'o observed

Hawaii Stream Assessment:

HSA aquatic resources: not ranked

HSA riparian resources: Detrimental plants (hau);

Detrimental animals (pigs); 0% native forest;

HSA cultural resources: not surveyed

HSA recreational resources: hiking, hunting, scenic views; 2 high quality experiences; ranked substantial by regional committee



Puehu Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 0.354 mi²

Maximum elevation: 1680 ft

Land Use:

Total Stream Length: 2.94 mi

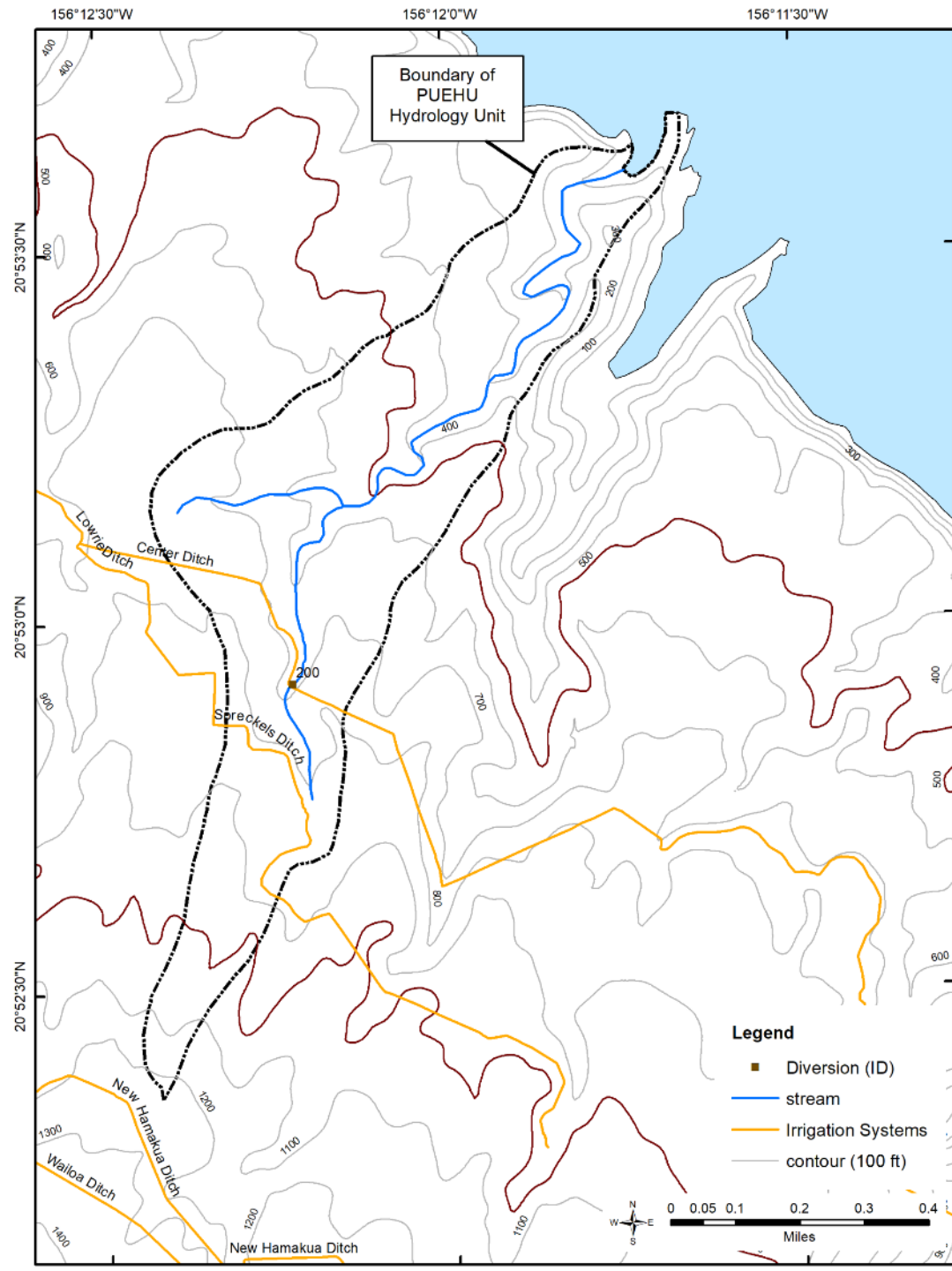
Terminal Order: 1

Biotic Information:

Terminal reach waterfall limits recruitment of
amphidromous species

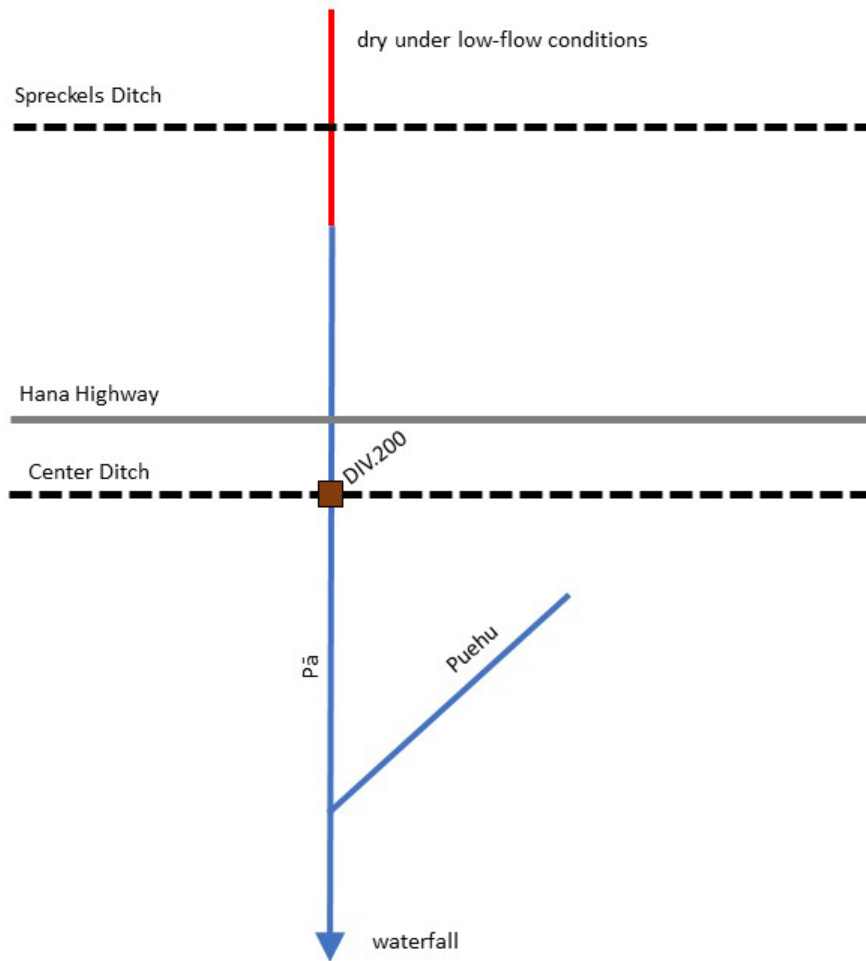
Small stream limits habitat availability

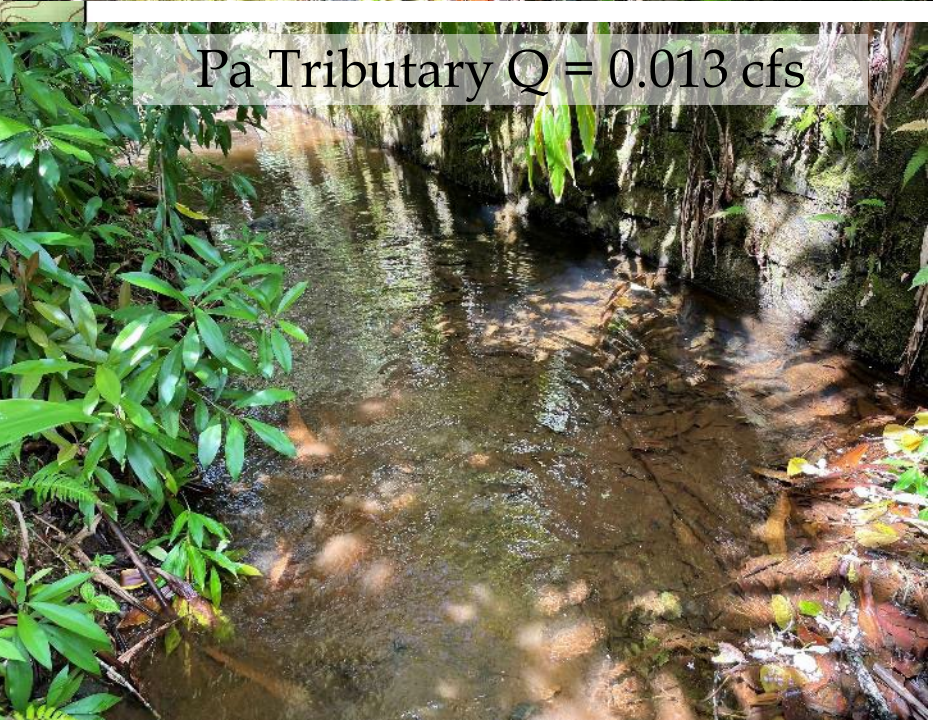
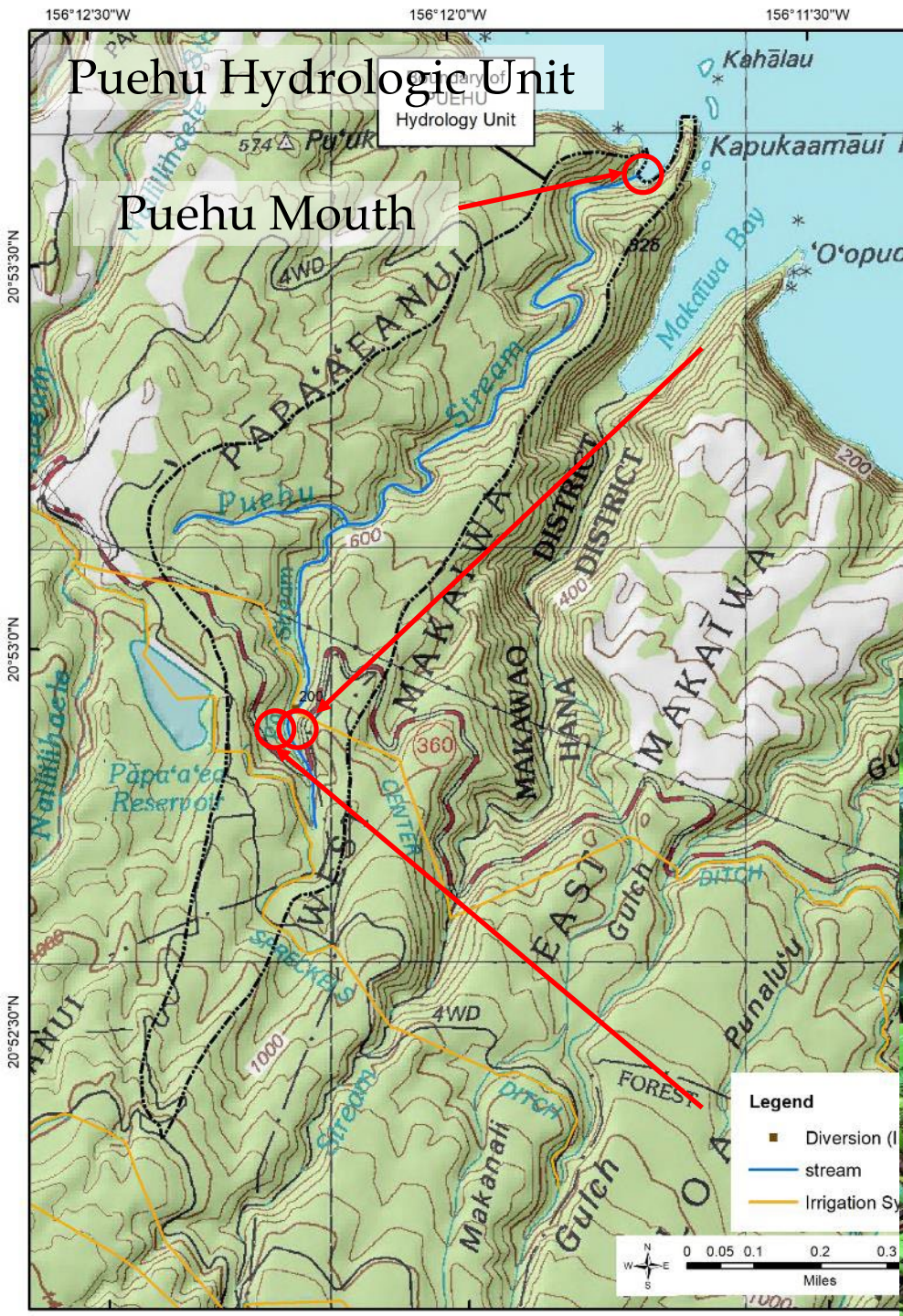
No native species observed in 7 site visits



Puehu Hydrologic Unit (6042)

mauka





Puehu Mouth



Nailiilihaele Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 3.53 mi²

Maximum elevation: 5210 ft

Land Use: 8.2% agriculture; 91.8% conservation

Total Stream Length: 11.9 mi

Terminal Order: 3

Terminal Reach: multi-step waterfall

Watershed Rating:

Landcover: 10/10

Shallow Waters Rating: 0/10

Stewardship Rating: 6/10

Size Rating: 3/10

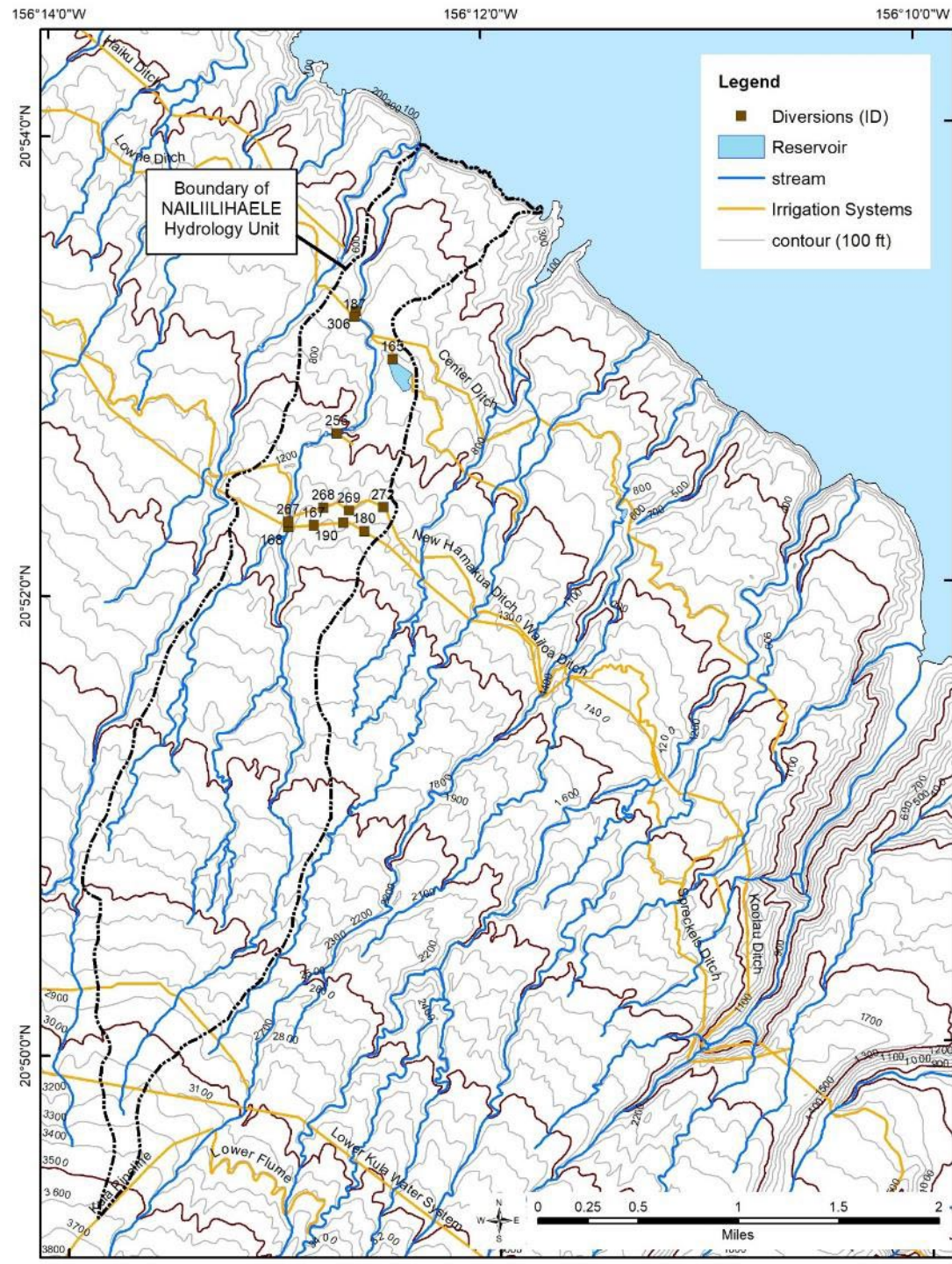
Wetness Rating: 8/10

Reach Diversity Rating: 5/10

Total Watershed Rating: 8/10

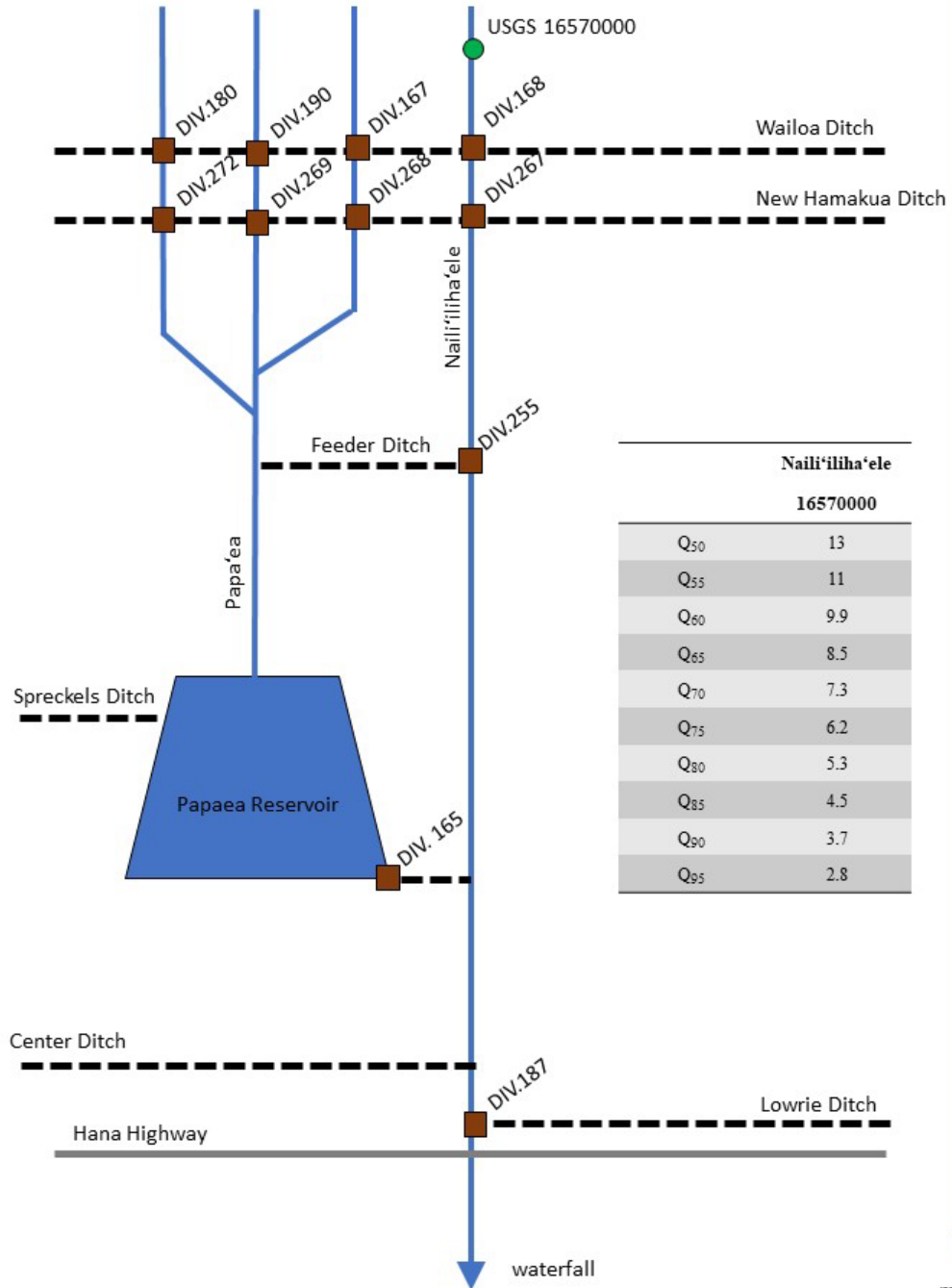
Hau bush encroachment above mouth

Watershed invaded with bamboo between 400
and 800 ft elevation



Naili'iliha'ele Hydrologic Unit (6041)

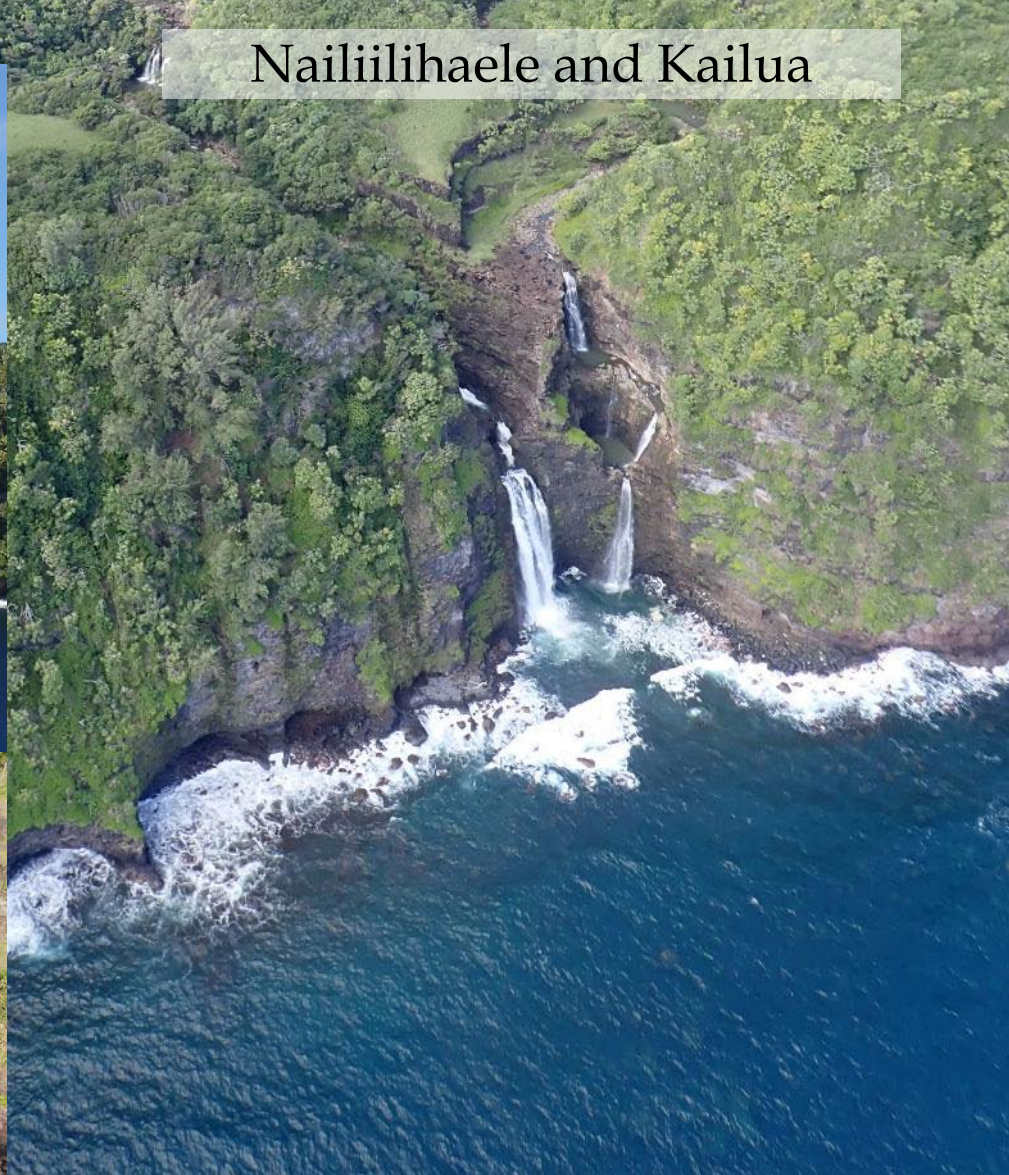
mauka



Naili'iliha'ele 16570000	
Q ₅₀	13
Q ₅₅	11
Q ₆₀	9.9
Q ₆₅	8.5
Q ₇₀	7.3
Q ₇₅	6.2
Q ₈₀	5.3
Q ₈₅	4.5
Q ₉₀	3.7
Q ₉₅	2.8



Nailiilihaele and Kailua



Feeder Ditch Intake to Papaaea Reservoir



Papaaea Reservoir



Nailiilihaele at Wailoa Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
CR-1	Nailiilihaele Str nr Huelo	1984-2013	13	11	9.9	8.5	7.3	6.2	5.3	4.5	3.7	2.8



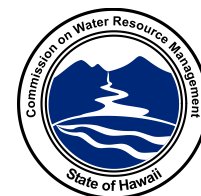
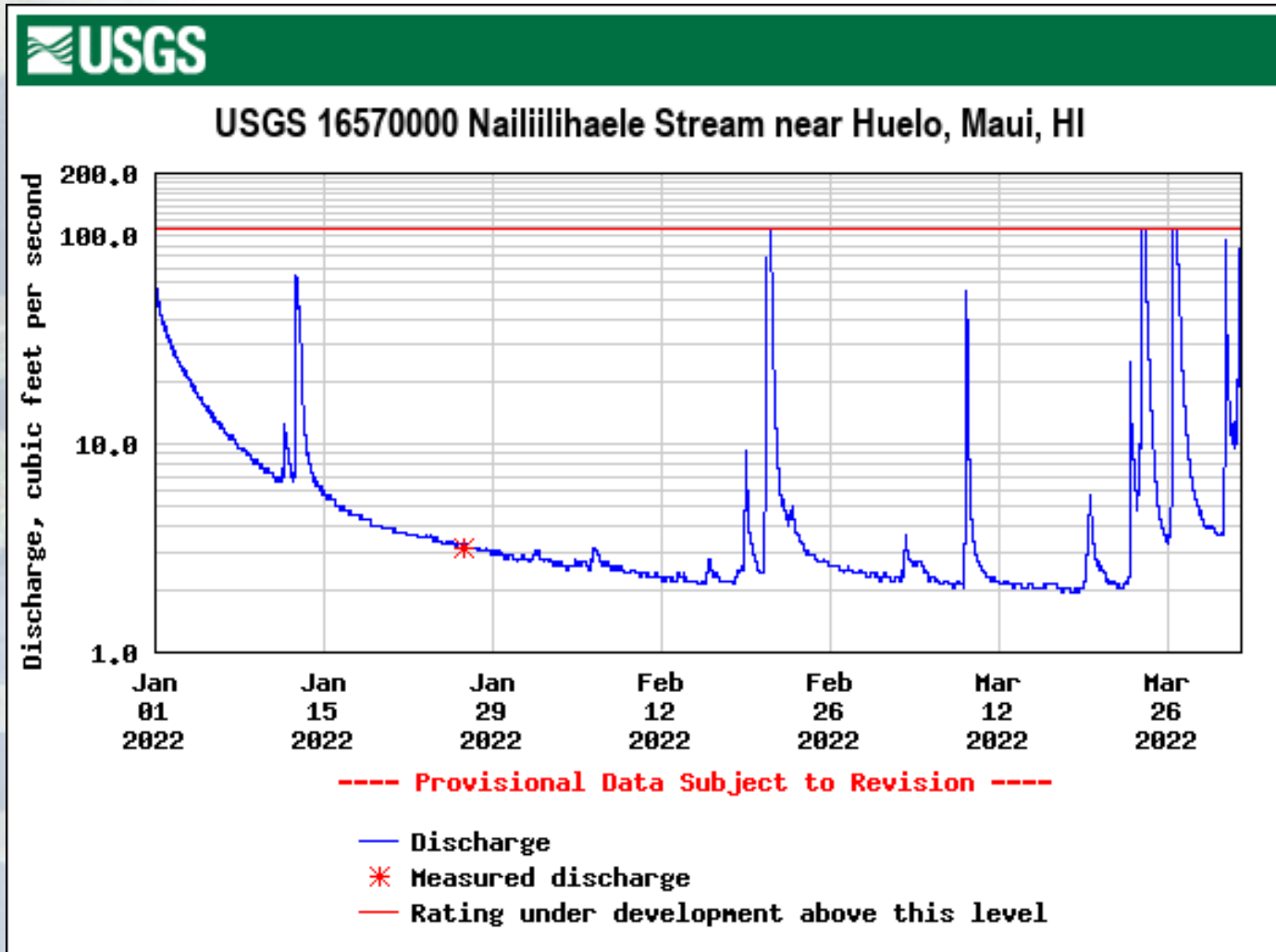
Nailiilihaele at New Hamākua Ditch



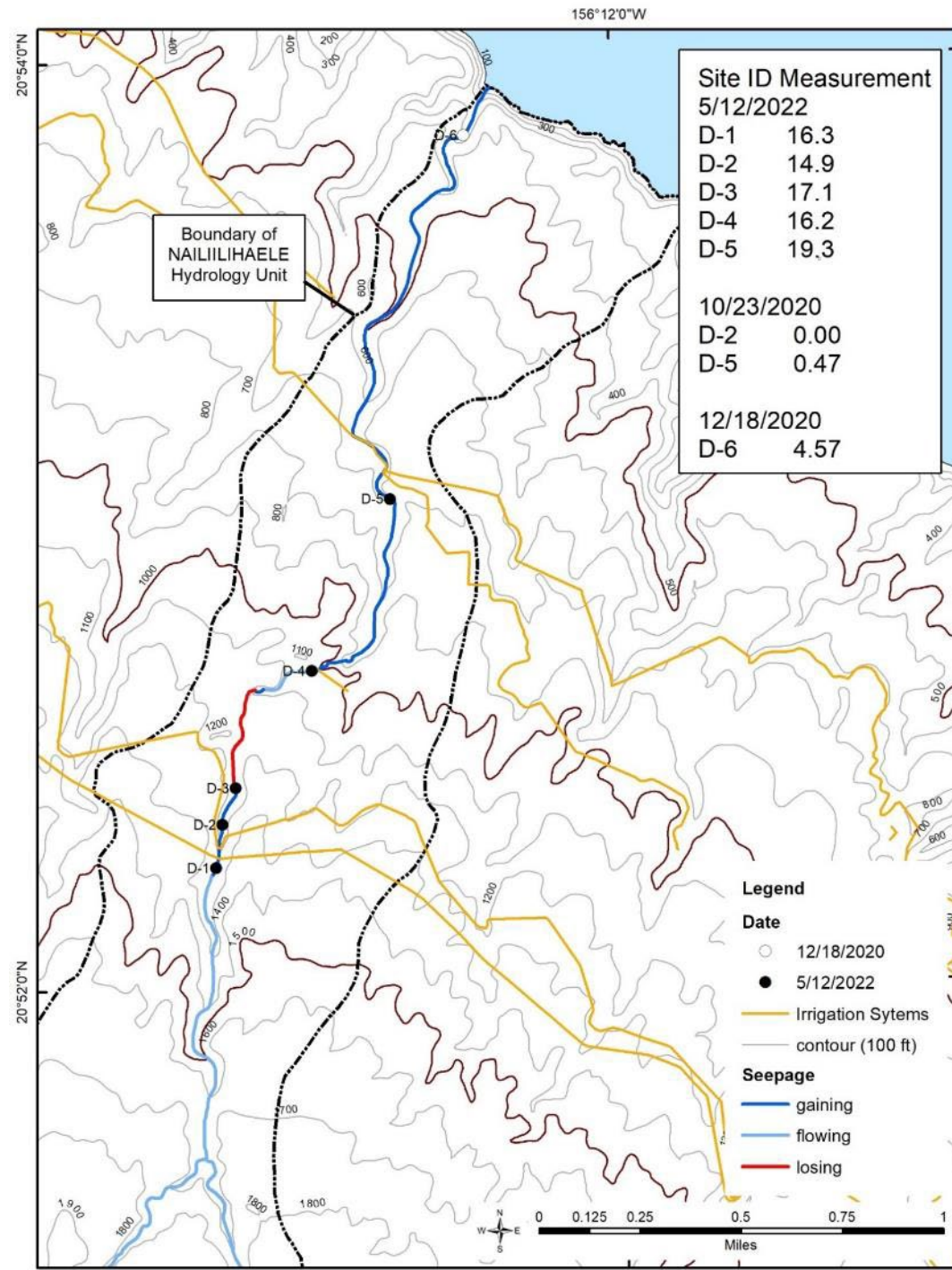
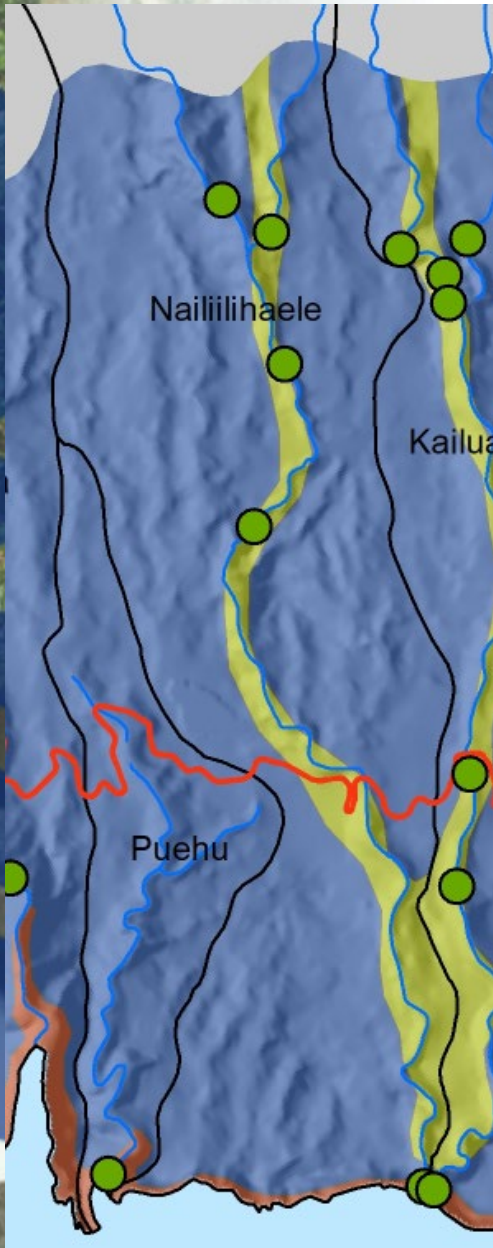
Re-establishment of USGS 16570000 Nailiilihaele Stream near Huelo



Re-establishment of USGS 16570000 Nailiilihaele Stream near Huelo



Nailiilihaele Hydrologic Unit: Seepage Run



Nailiilihaele Hydrologic Unit: Instream Uses

kalo not grown in watershed

Popular for swimming

unofficial trail crisscrosses stream on private land

Biotic Information:

-Terminal reach waterfall limits recruitment of amphidromous species

-1961 DAR point quadrat survey:

Atyoida bisulcata in middle and upper reaches

-20 point-quadrant biota surveys (1 reach) conducted at 100ft near mouth (no native species), at 750ft above Lowrie Ditch (no native species), and at 1260ft above Wailoa Ditch ('ōpae and 'o'opu alamo'o observed) with flow restored past feeder ditch intake and Lowrie Ditch intake since 2016.

Hawaii Stream Assessment

HSA aquatic resources: ranked limited (1 of 4)

HSA riparian resources: detrimental plants (hau); detrimental animals (pigs); 20% native forest; palustrine wetland

HSA cultural resources: not surveyed

HSA recreational resources: swimming, scenic views; ranked moderate (3 of 4) by regional committee



Kailua Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 4.9 mi²

Maximum elevation: 6549 ft

Land Use: 17.9% agriculture; 82.1% conservation

Total Stream Length: 10.7 mi

Terminal Order: 2

Terminal Reach: waterfall

Watershed Rating:

Landcover: 10/10

Shallow Waters Rating: 1/10

Stewardship Rating: 7/10

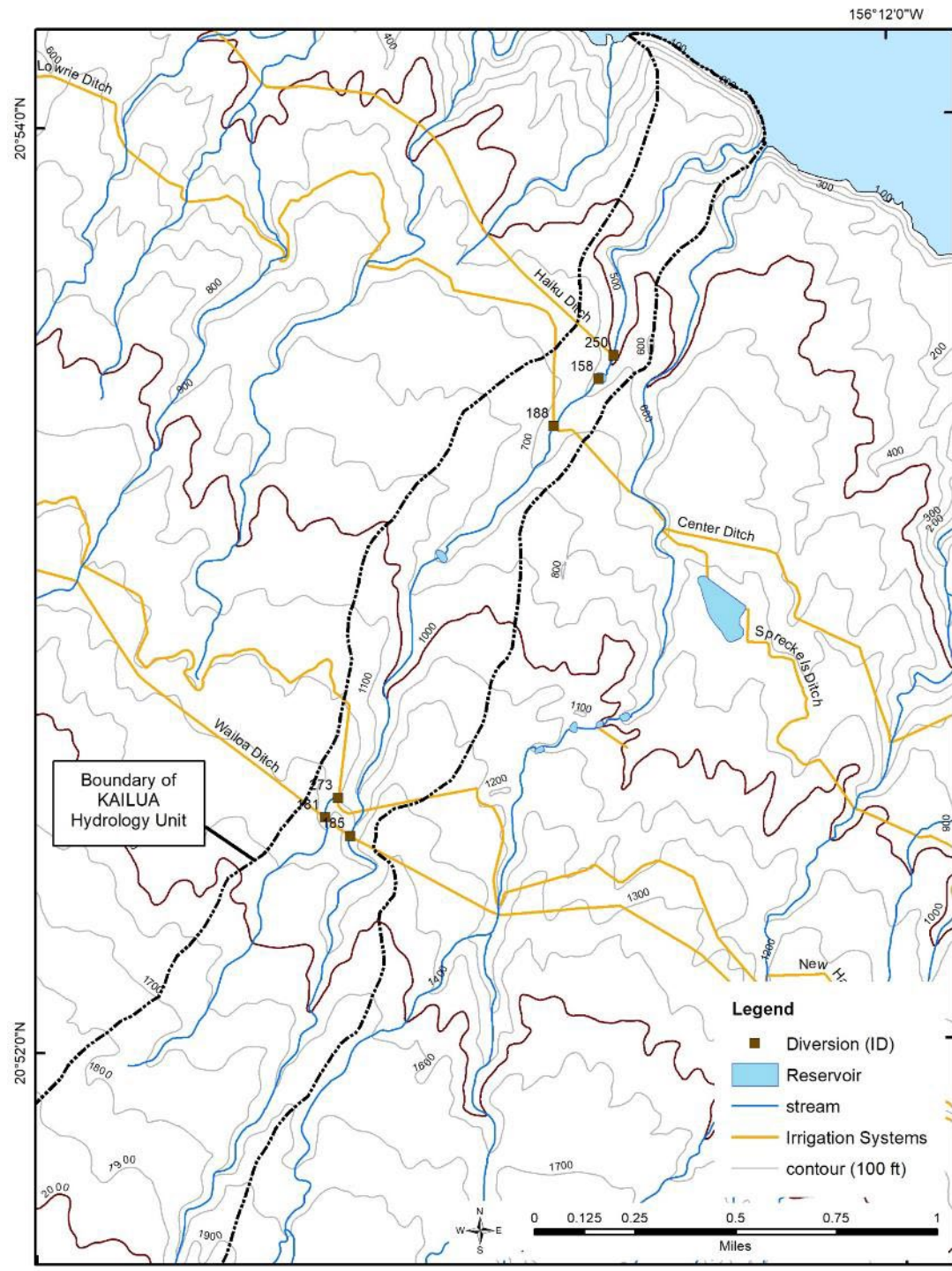
Size Rating: 2/10

Wetness Rating: 7/10

Reach Diversity Rating: 5/10

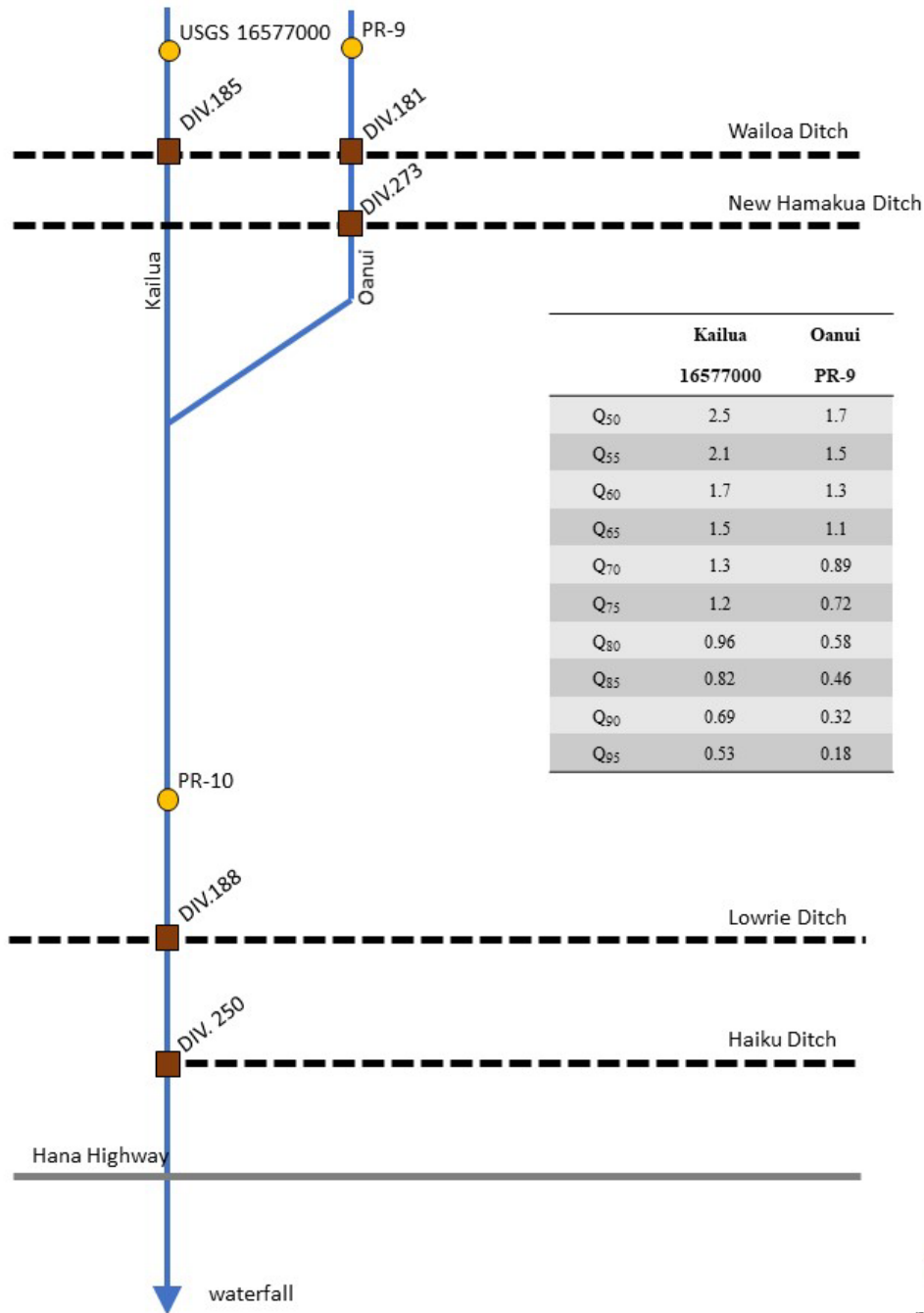
Total Watershed Rating: 7/10

Riparian issues: hau bush encroachment above mouth and above Lowrie ditch



Kailua Hydrologic Unit (6040)

mauka



Kailua Hydrologic Unit

156° 14' 0" W

156° 12' 0" W

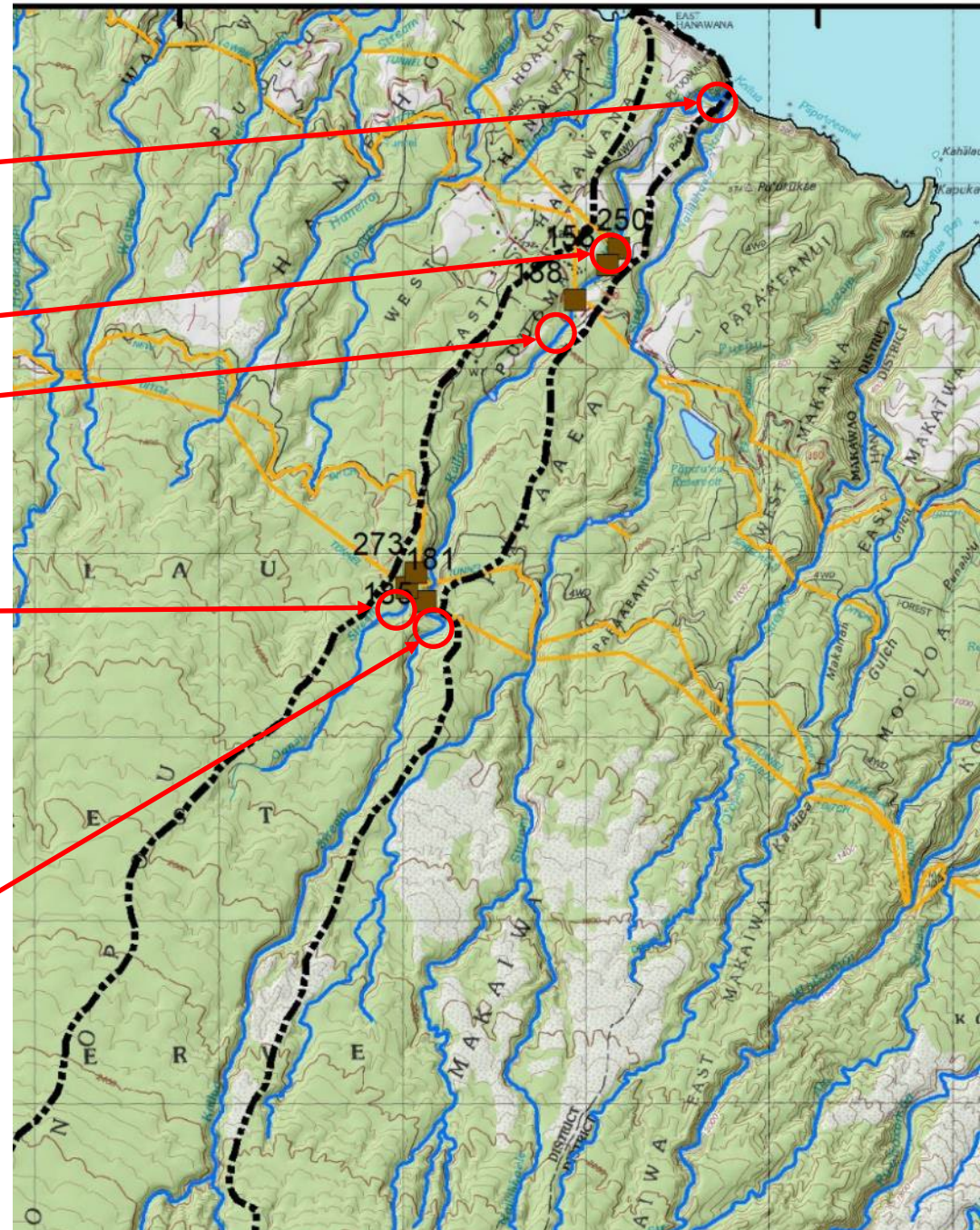
Kailua mouth

Kailua at 450 ft

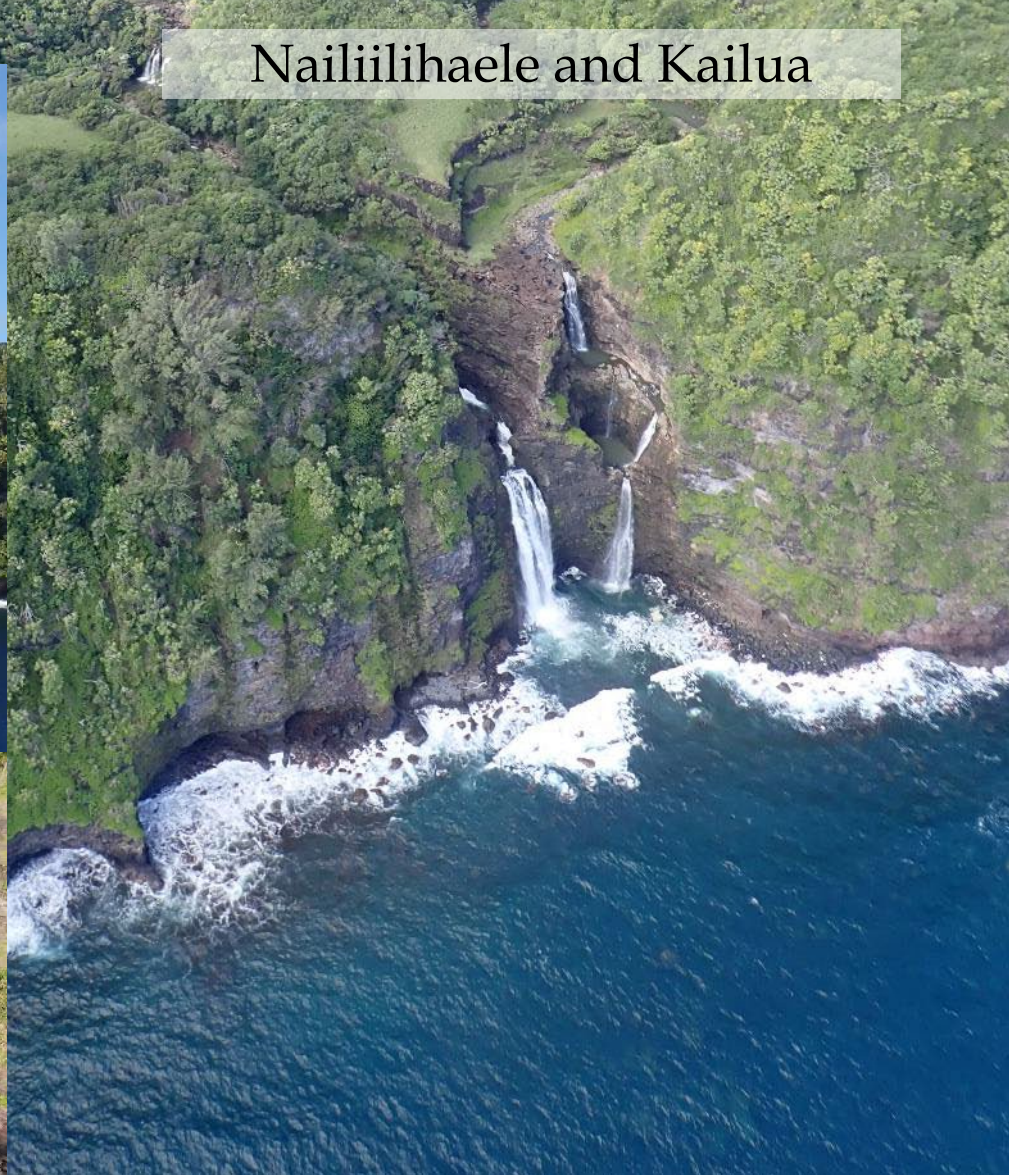
Kailua at 750 ft

Oanui at 1250 ft

Kailua at 1300 ft



Nailiilihaele and Kailua



Kailua at Lowrie Ditch



Kailua at Wailoa Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-10	Kailua Stream abv Lowrie Ditch	1984-2013	10	9.0	7.9	6.5	5.6	5.0	4.2	3.3	2.6	1.8

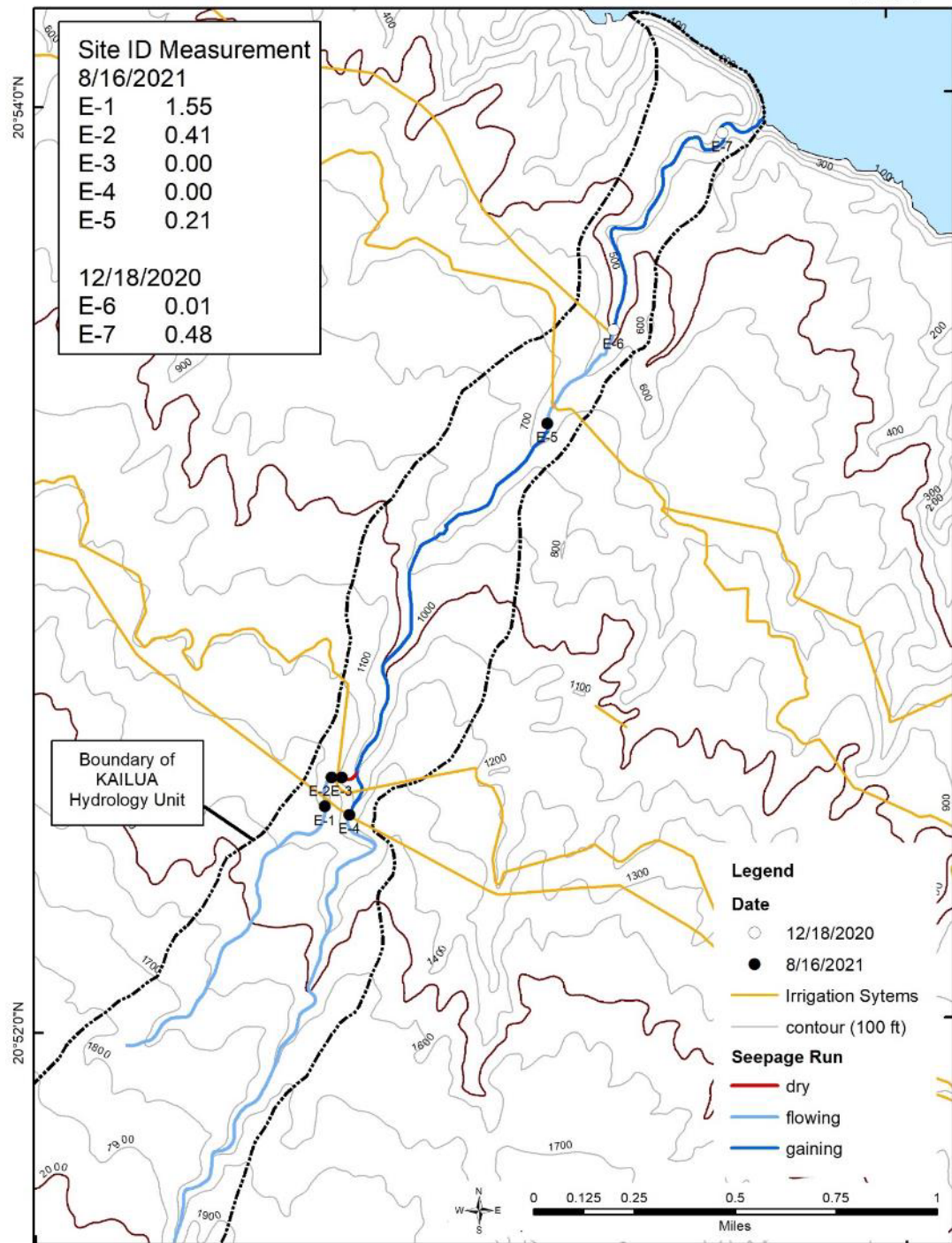


Oanui at Wailoa Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-9	Oanui Stream abv Wailoa Ditch	1984-2013	1.7	1.5	1.3	1.1	0.89	0.72	0.58	0.46	0.32	0.18



Kailua Hydrologic Unit: Seepage Run



Kailua Hydrologic Unit: Instream Uses

Kalo not grown in watershed

Popular for swimming

Biotic Information:

1961, 1962, 1988, 2003 surveys:

Atyoida bisulcata in middle and upper reaches

Sicyopterus stimpsoni in upper reaches

20 point-quadrant biota surveys (1 reach) conducted at 100 ft above mouth (no native species) and at 750 ft above Lowrie Ditch (no native species)

Hawaii Stream Assessment:

HSA aquatic resources: ranked moderate (1 high value species (nopili); 1 low value native species observed)

HSA riparian resources: not ranked

HSA cultural resources: very limited survey coverage; 2 archeological sites; very few sites; pre-contact/early contact, important information; moderately sensitive; no taro historically associated with stream

HSA recreational resources: swimming; ranked substantial by regional committee

Kailua

Oanui



Hanawana Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 0.7 mi²

Maximum elevation: 1535 ft

Land Use: 52.7% agriculture; 47.3% conservation

Total Stream Length: 0.8 mi

Terminal Order: 1

Watershed Rating:

Landcover: 9/10

Shallow Waters Rating: 0/10

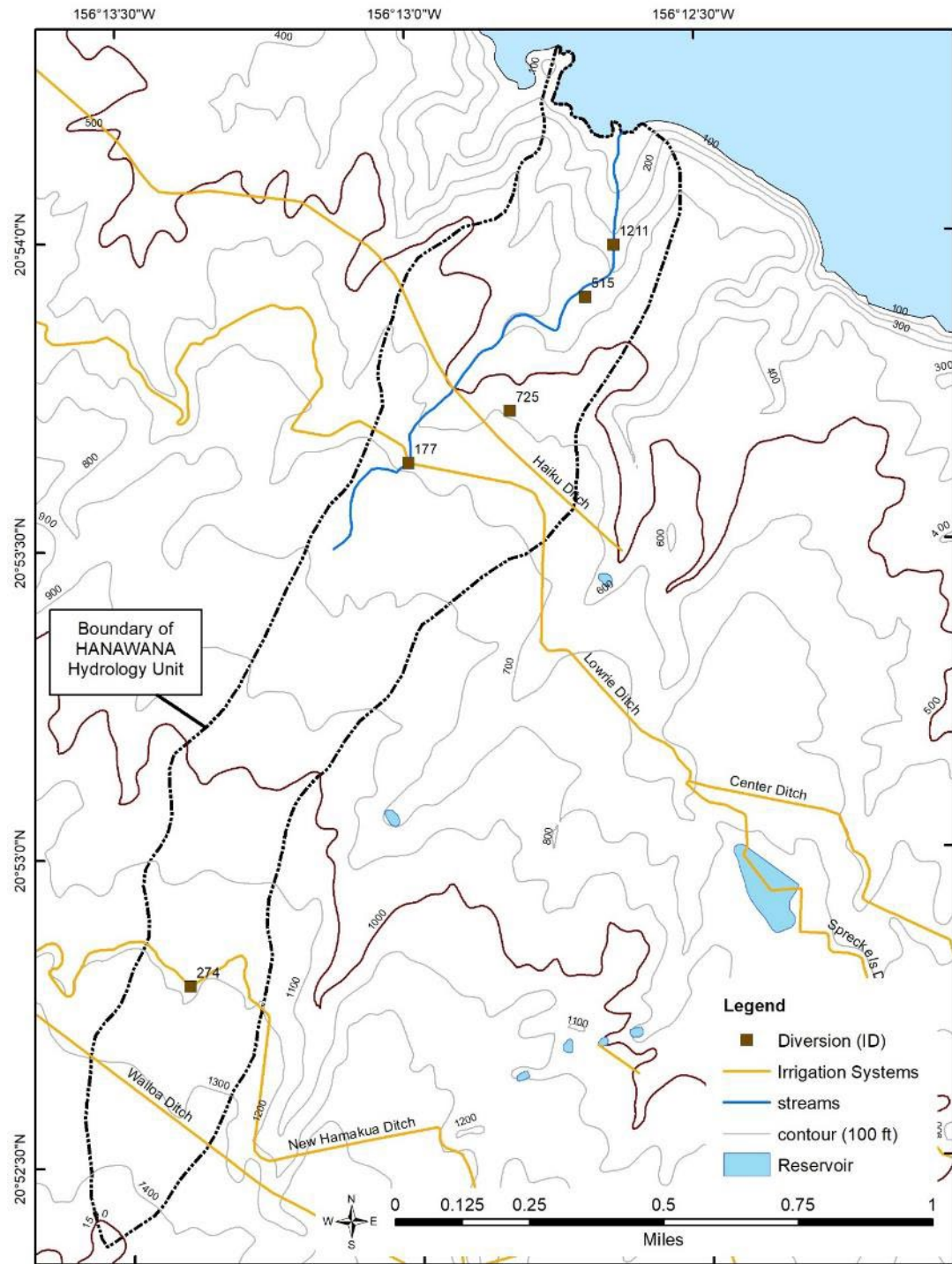
Stewardship Rating: 3/10

Size Rating: 1/10

Wetness Rating: 5/10

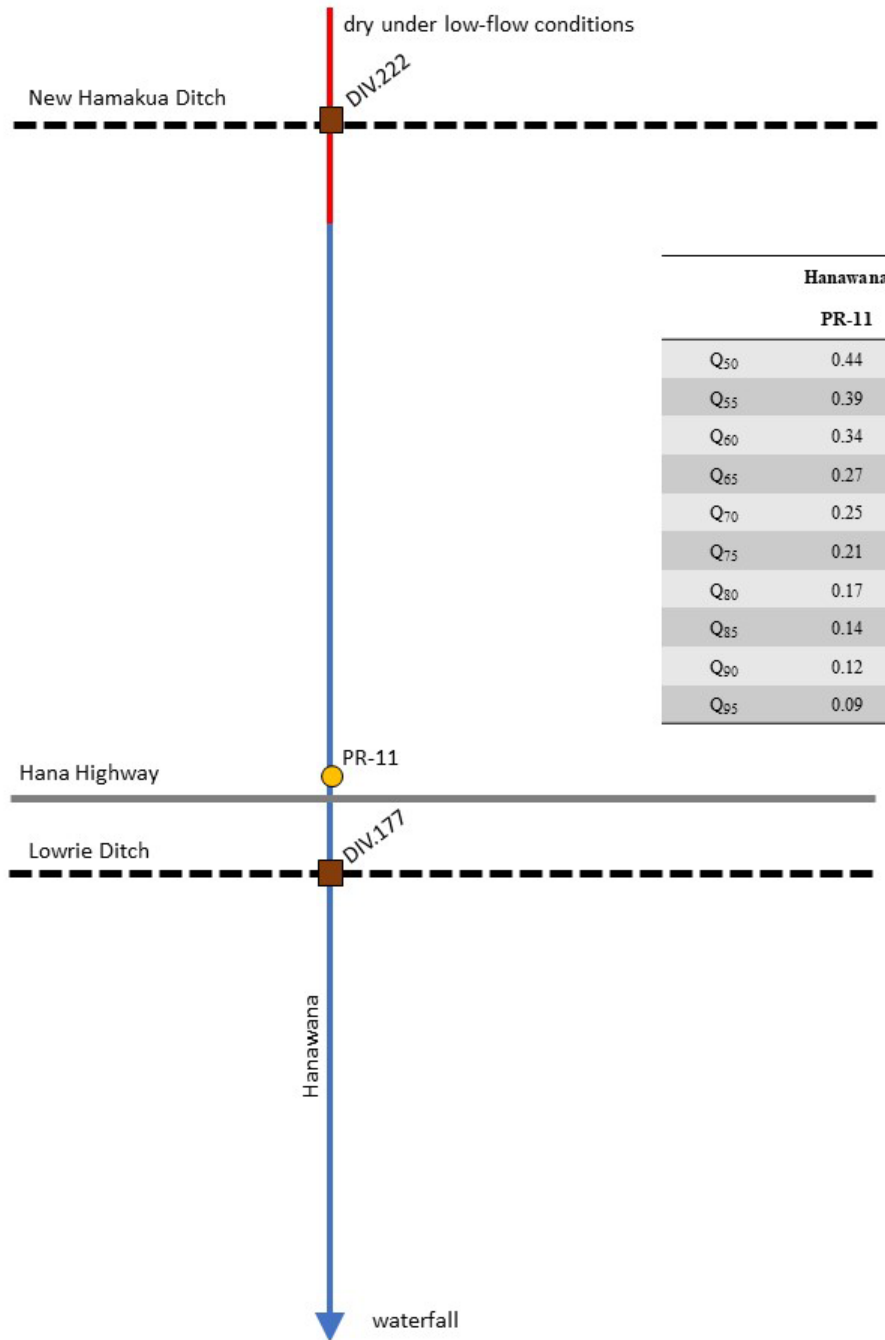
Reach Diversity Rating: 1/10

Total Watershed Rating: 4/10



Hanawana Hydrologic Unit (6039)

mauka



Hanawana	
PR-11	
Q ₅₀	0.44
Q ₅₅	0.39
Q ₆₀	0.34
Q ₆₅	0.27
Q ₇₀	0.25
Q ₇₅	0.21
Q ₈₀	0.17
Q ₈₅	0.14
Q ₉₀	0.12
Q ₉₅	0.09



Hanawana Hydrologic Unit

Legend

- Diversion (ID)
- stream
- Irrigation System

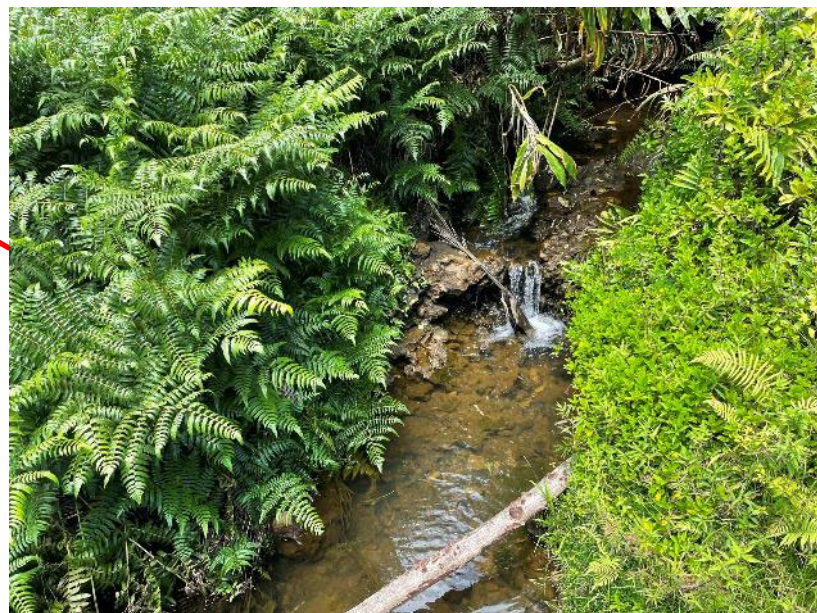
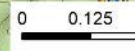
20°54'0"N

20°53'30"N

20°53'0"N

20°52'30"N

Boundary of HANAWANA Hydrology Unit



Hanawana mouth

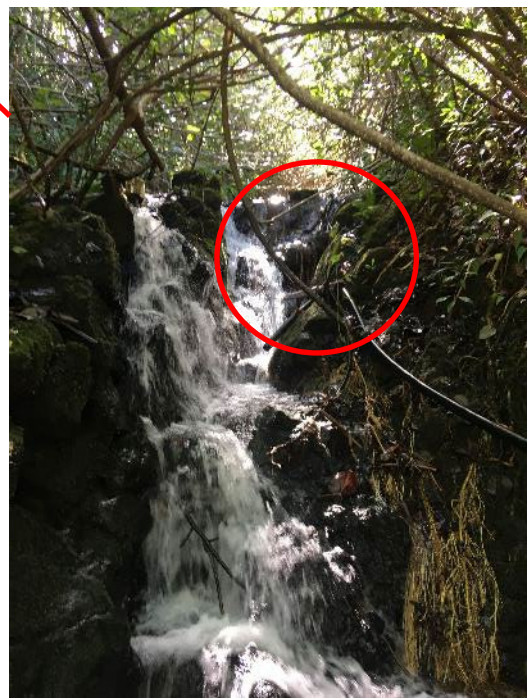
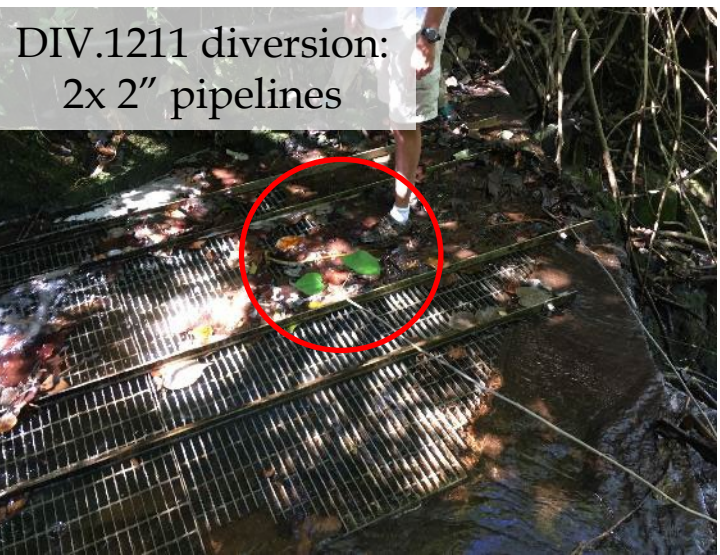
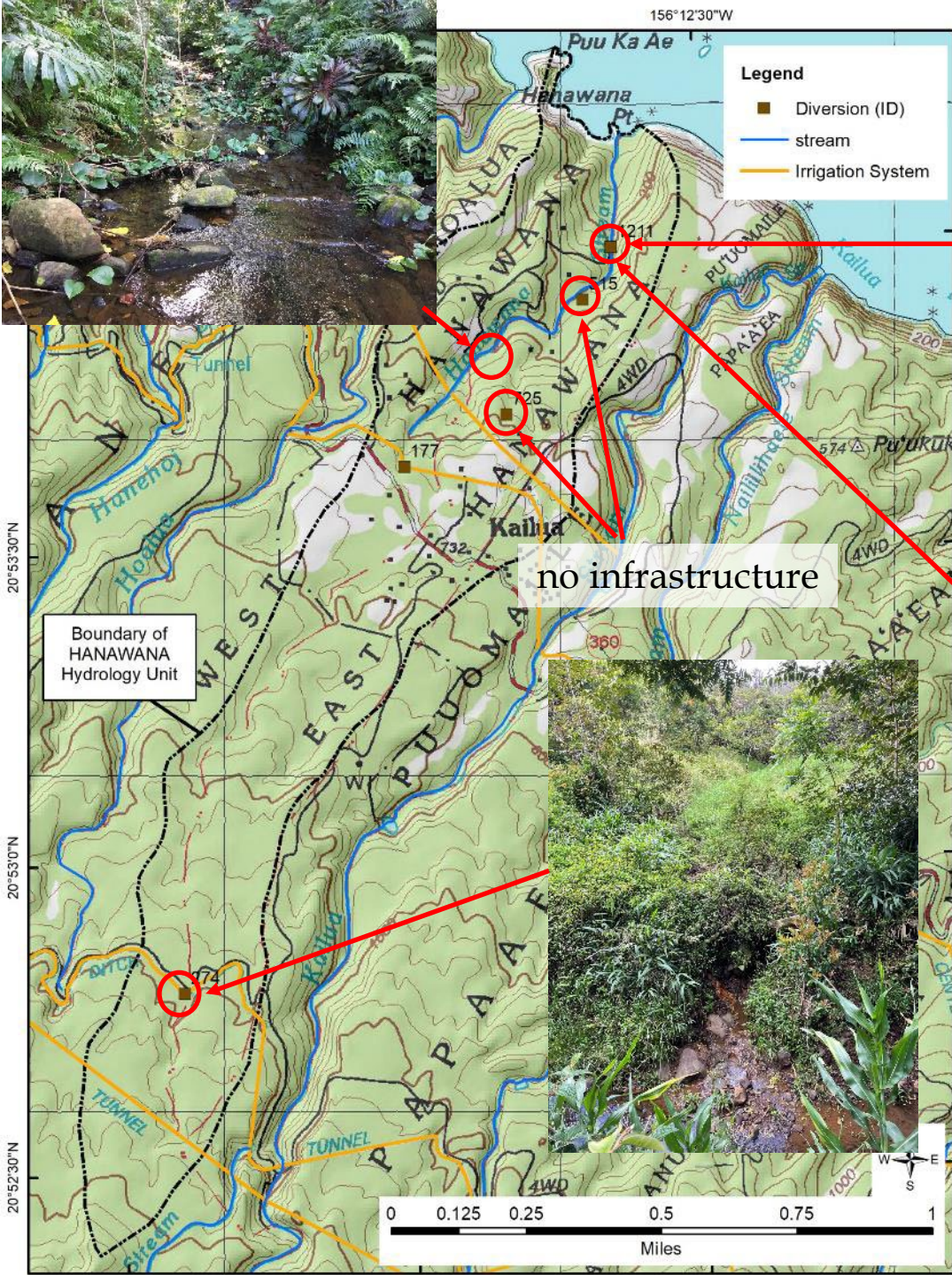


Hanawana Lowrie Ditch Bypass



Non-EMI Hanawana Intakes



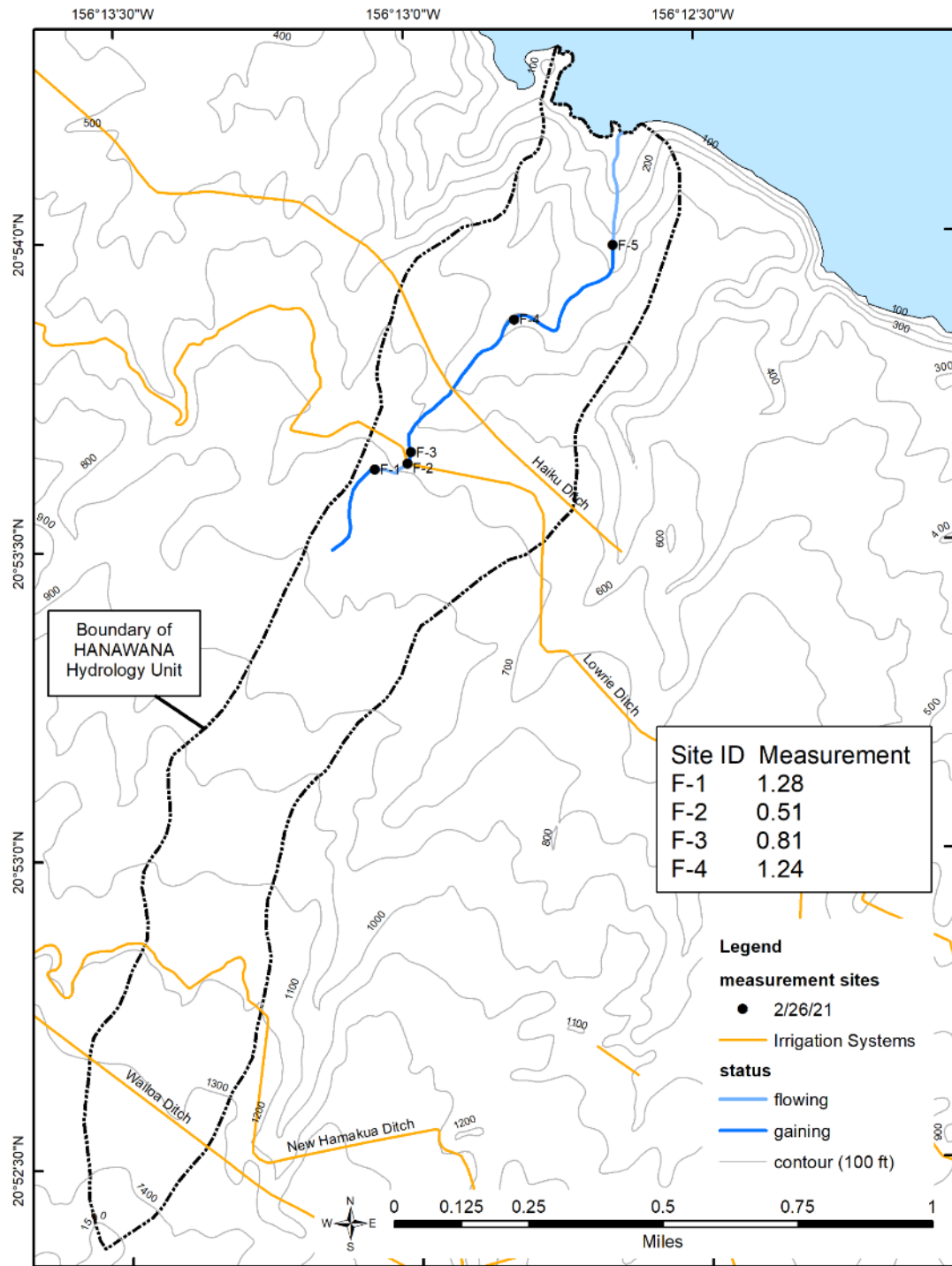


Hanawana above Lowrie Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-11	Hanawana Stream abv Lowrie Ditch	1984-2013	0.44	0.39	0.34	0.27	0.25	0.21	0.17	0.14	0.12	0.09



Hanawana Hydrologic Unit: Seepage Run



Hanawana Hydrologic Unit: Instream Uses

Some recreational uses

Kalo historically grown below Lowrie Ditch

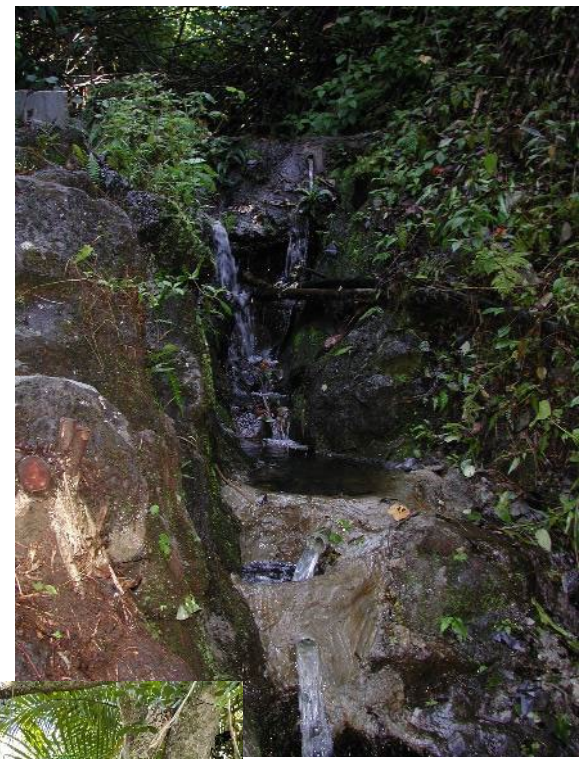
Downstream uses met with flow restored over Lowrie Ditch

→ Replace with flume that doesn't get plugged up with leaves

Biotic Information:

Small stream limits habitat availability

No native species observed in 20 site visits



Hoalua Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 1.3 mi²

Maximum elevation: 2887 ft

Land Use: 14.6% agriculture; 85.4% conservation

Total Stream Length: 2.4 mi

Terminal Order: 1

Watershed Rating:

Landcover: 10/10

Shallow Waters Rating: 0/10

Stewardship Rating: 6/10

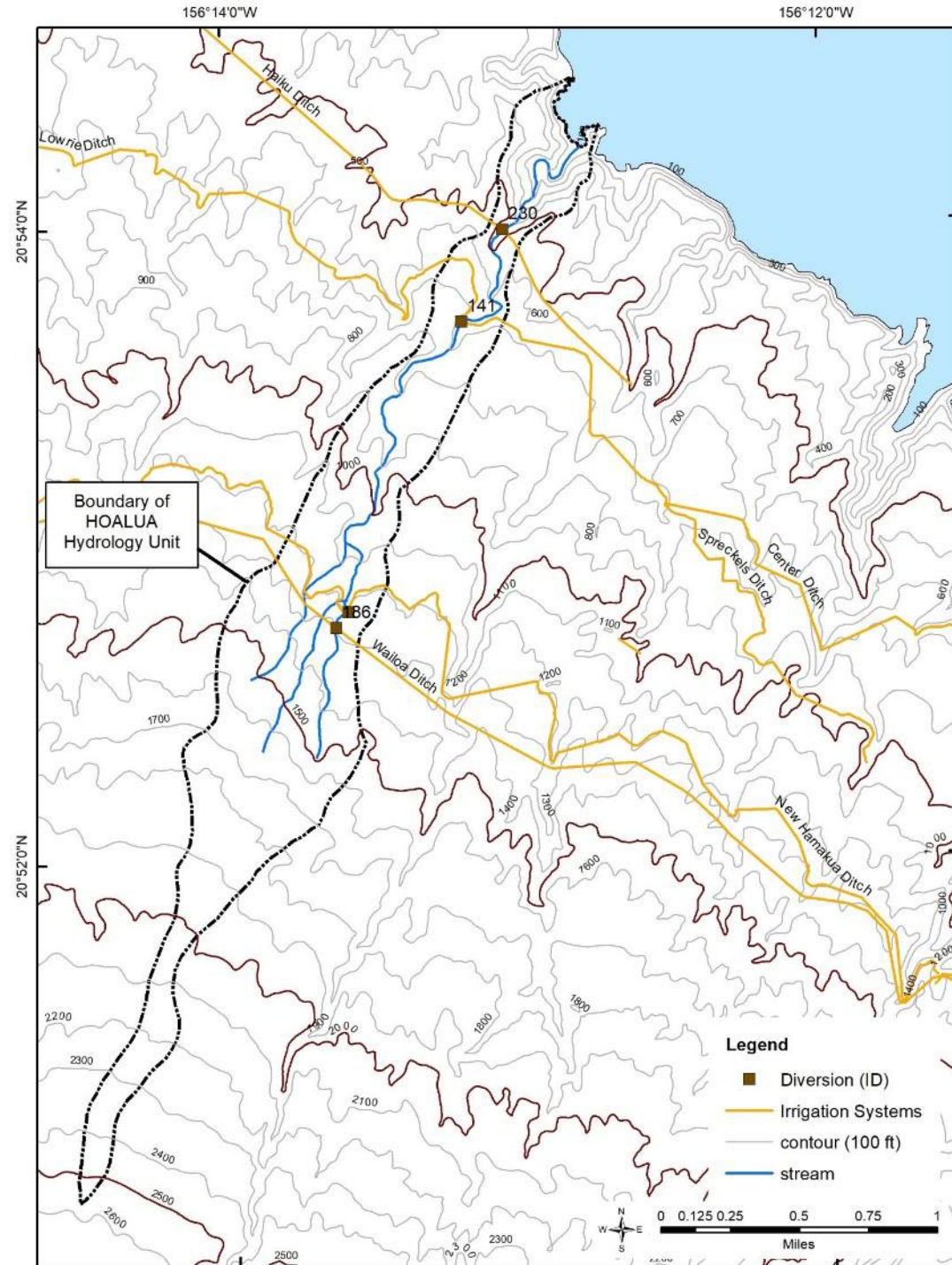
Size Rating: 1/10

Wetness Rating: 7/10

Reach Diversity Rating: 3/10

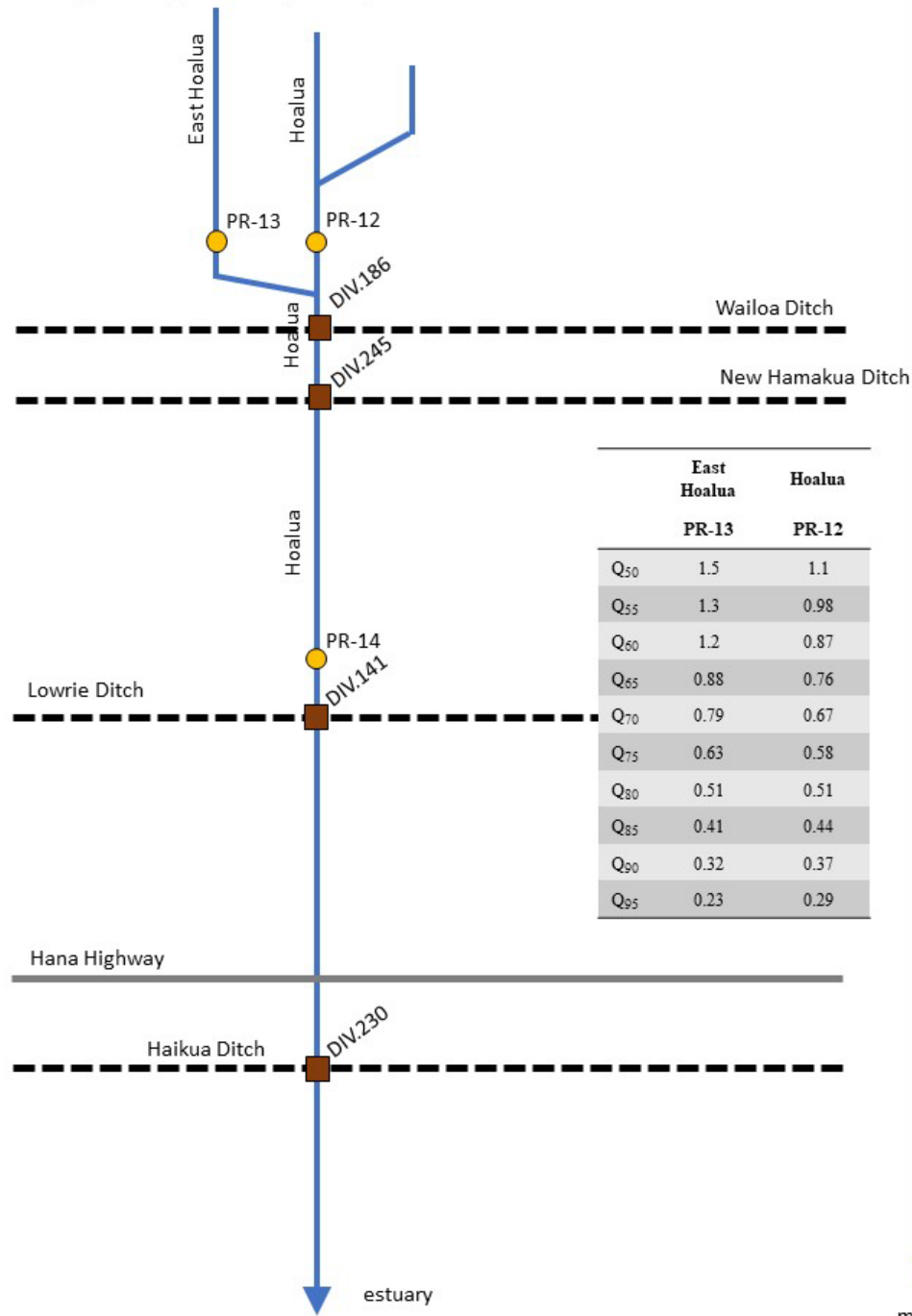
Total Watershed Rating: 7/10

Riparian vegetation: hau bush encroachment at mouth and at 600-700 feet; bamboo encroachment at 300-450 feet



Hoalua Hydrologic Unit (6038)

mauka



Hoalua Hydrologic Unit

Hoalua mouth

Hoalua at 450 ft

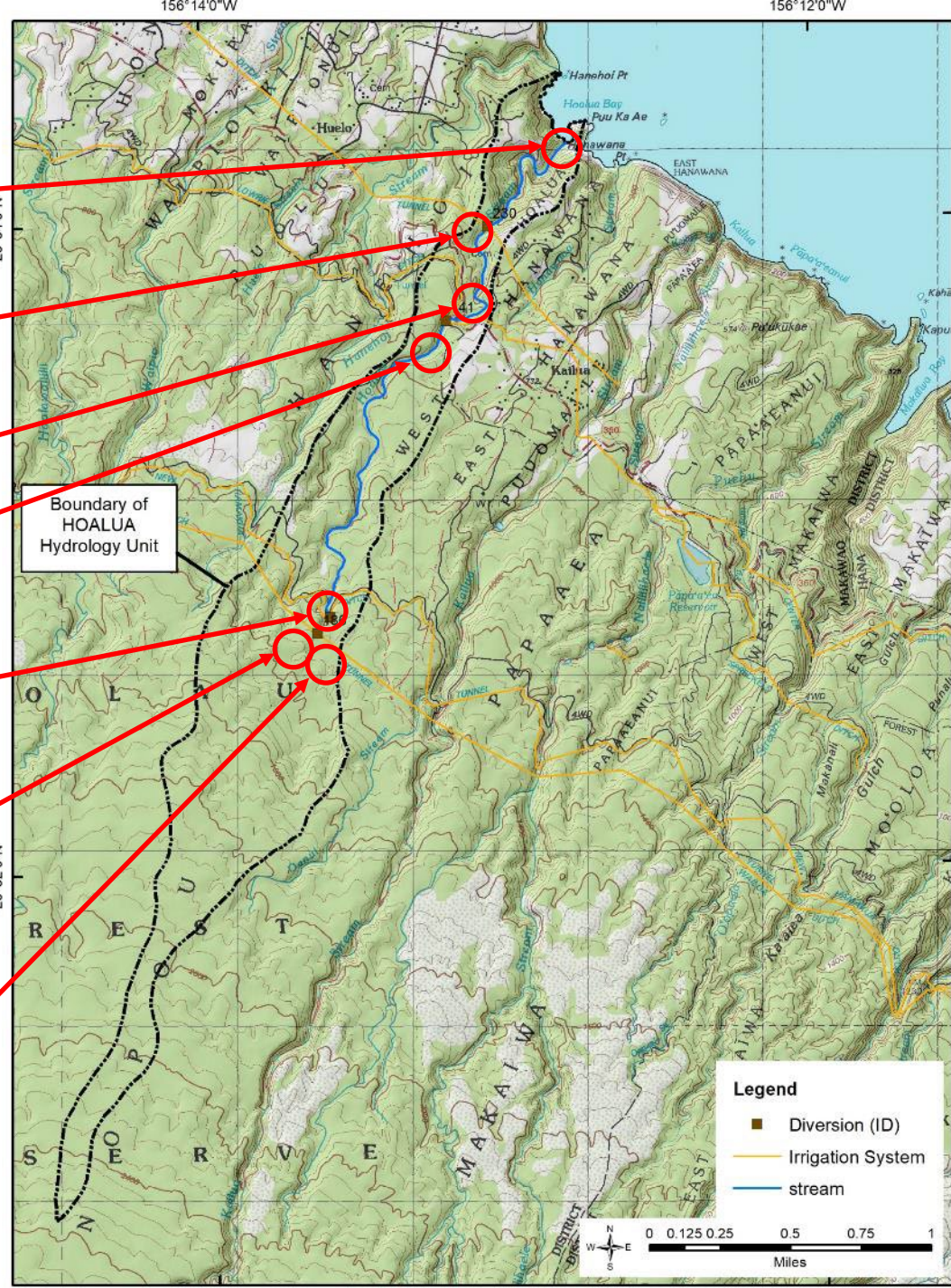
Hoalua at 650 ft

Hoalua at 750 ft

Hoalua at 1100 ft

Hoalua at 1350 ft

East Hoalua at 1350 ft



Hoalua Mouth



Hoalua at 450ft (Hā'iku Ditch)

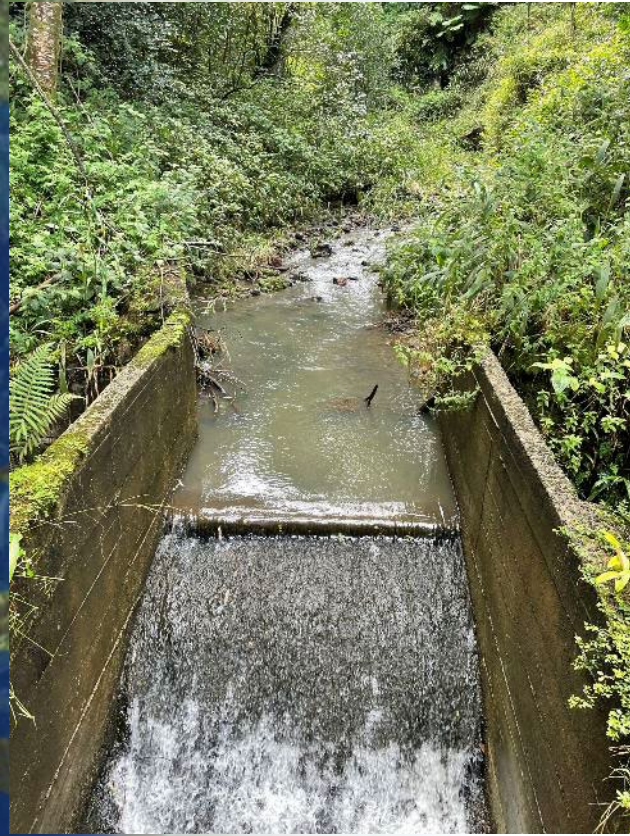


Hoalua at 750ft (Lowrie Ditch)

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-14	Hoalua Stream abv Lowrie Ditch	1984-2013	4.0	3.7	3.4	2.8	2.5	2.3	2.0	1.6	1.4	1.1



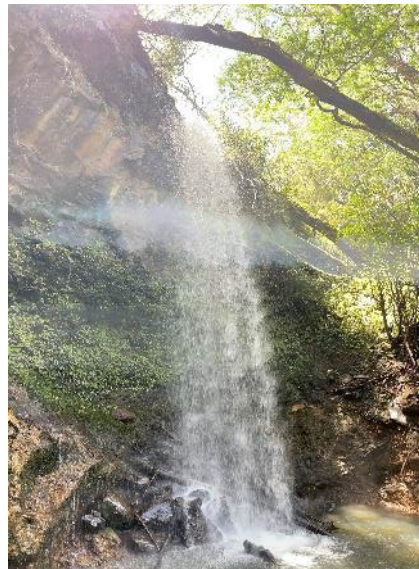
Hoalua at 1100 ft (New Hamākua Ditch)



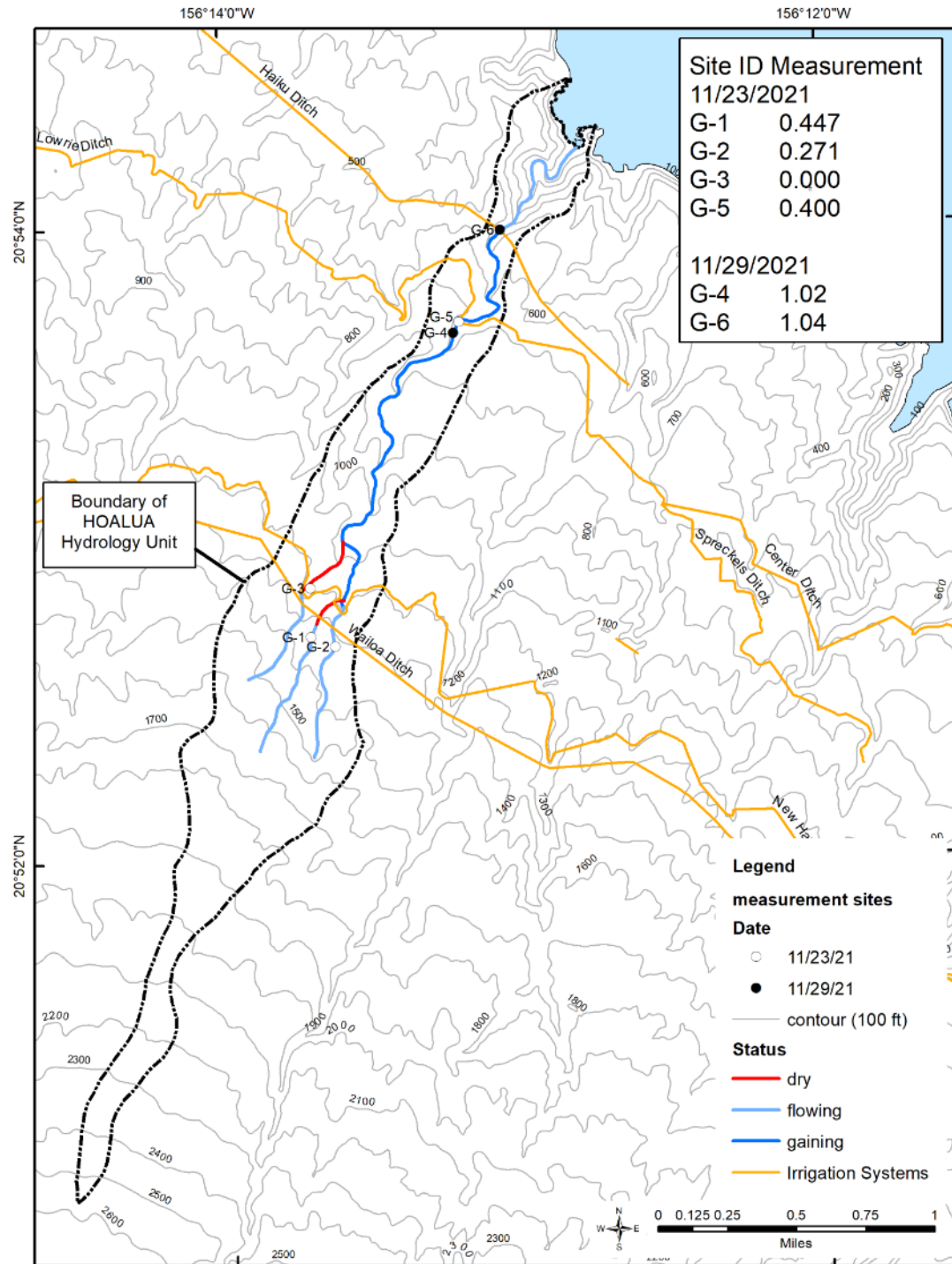
Hoalua abv Wailoa Ditch

East Hoalua abv Wailoa Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-12	Hoalua Stream abv Wailoa Ditch	1984-2013	1.3	1.1	1.0	0.94	0.85	0.76	0.68	0.61	0.53	0.44
PR-13	East Hoalua Stream abv Wailoa Ditch	1984-2013	1.1	0.98	0.87	0.76	0.67	0.58	0.51	0.44	0.37	0.29



Hoalua Hydrologic Unit: Seepage Run



Hoalua Hydrologic Unit: Instream Uses

Kalo not grown in watershed

No recognized hiking trails

Biotic Information:

Terminal reach estuary

20 point-quadrant biota surveys (1 reach) conducted biota survey 100 ft above mouth (nothing observed) and at 700 ft below Lowrie Ditch (no native species observed) with continual flow restored below New Hamakua Ditch, Lowrie Ditch, and Haikua Ditch since 2016.

Hawaii Stream Assessment:

HSA aquatic resources: not ranked

HSA riparian resources: detrimental animals (pigs); 0% native forest

HSA cultural resources: ranked outstanding; substantial information to assist prediction; 2 sites; low density; pre-contact or early contact sites with important information, and culturally noteworthy sites

HSA recreational resources: none; ranked a 1 of 4 by regional committee



Waipi'o Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 0.6 mi²

Maximum elevation: 1529 ft

Land Use: 39.7% agriculture; 60.3% conservation

Total Stream Length: 2.8 mi

Terminal Order: 1

Watershed Rating:

Landcover: 9/10

Shallow Waters Rating: 0/10

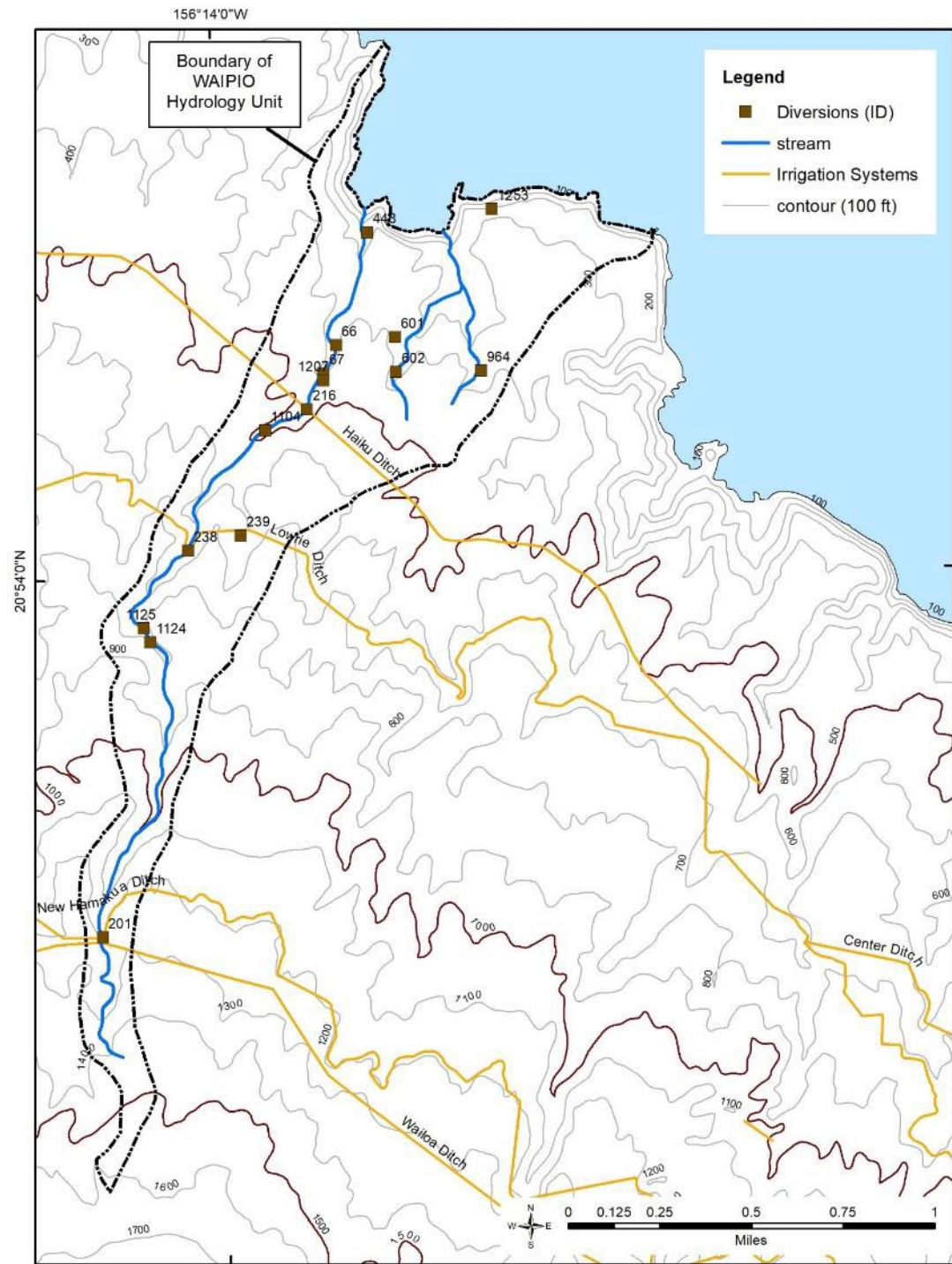
Stewardship Rating: 4/10

Size Rating: 1/10

Wetness Rating: 5/10

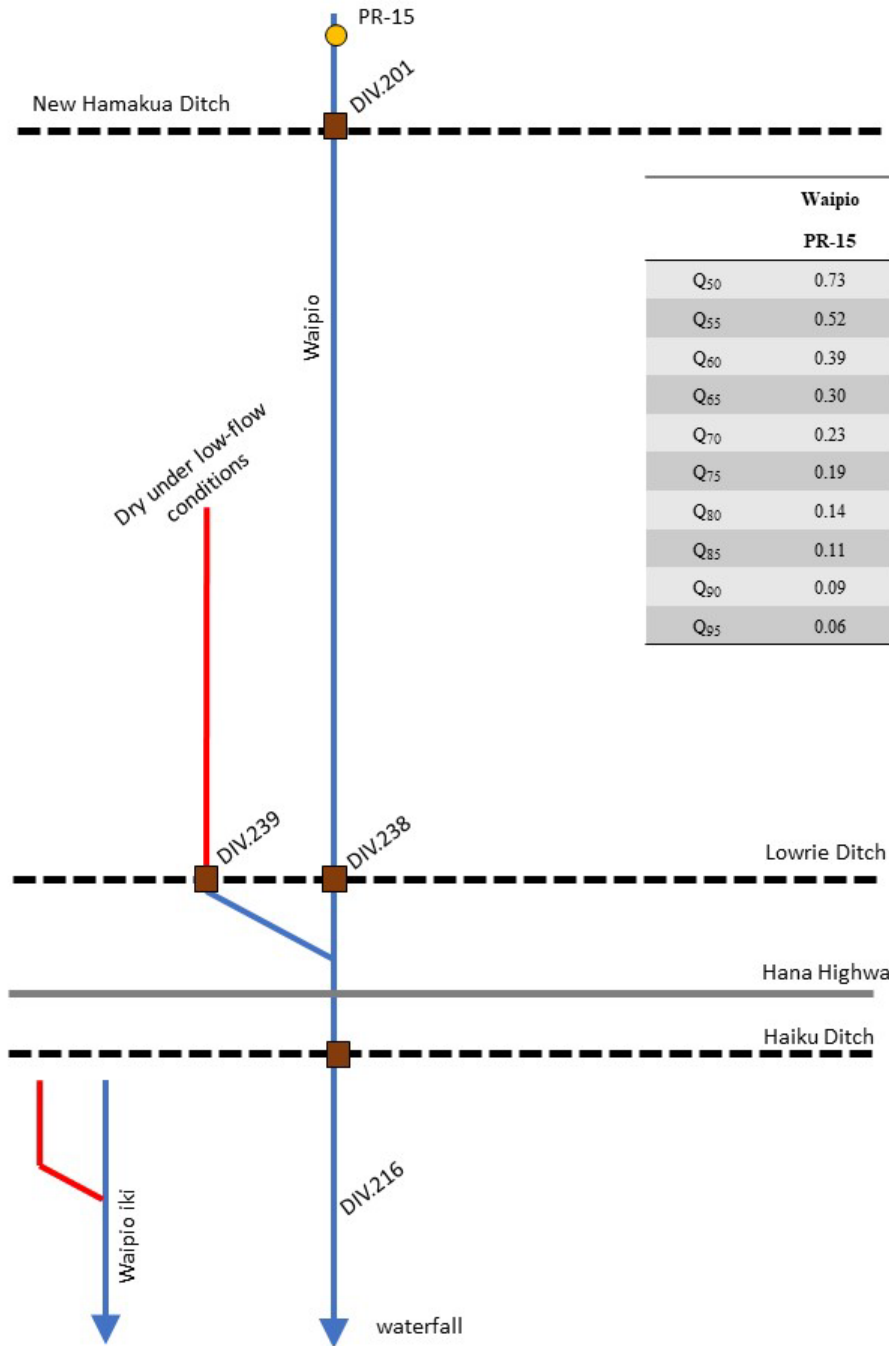
Reach Diversity Rating: 3/10

Total Watershed Rating: 5/10



Waipio Hydrologic Unit (6036)

mauka



Waipio PR-15	
Q ₅₀	0.73
Q ₅₅	0.52
Q ₆₀	0.39
Q ₆₅	0.30
Q ₇₀	0.23
Q ₇₅	0.19
Q ₈₀	0.14
Q ₈₅	0.11
Q ₉₀	0.09
Q ₉₅	0.06

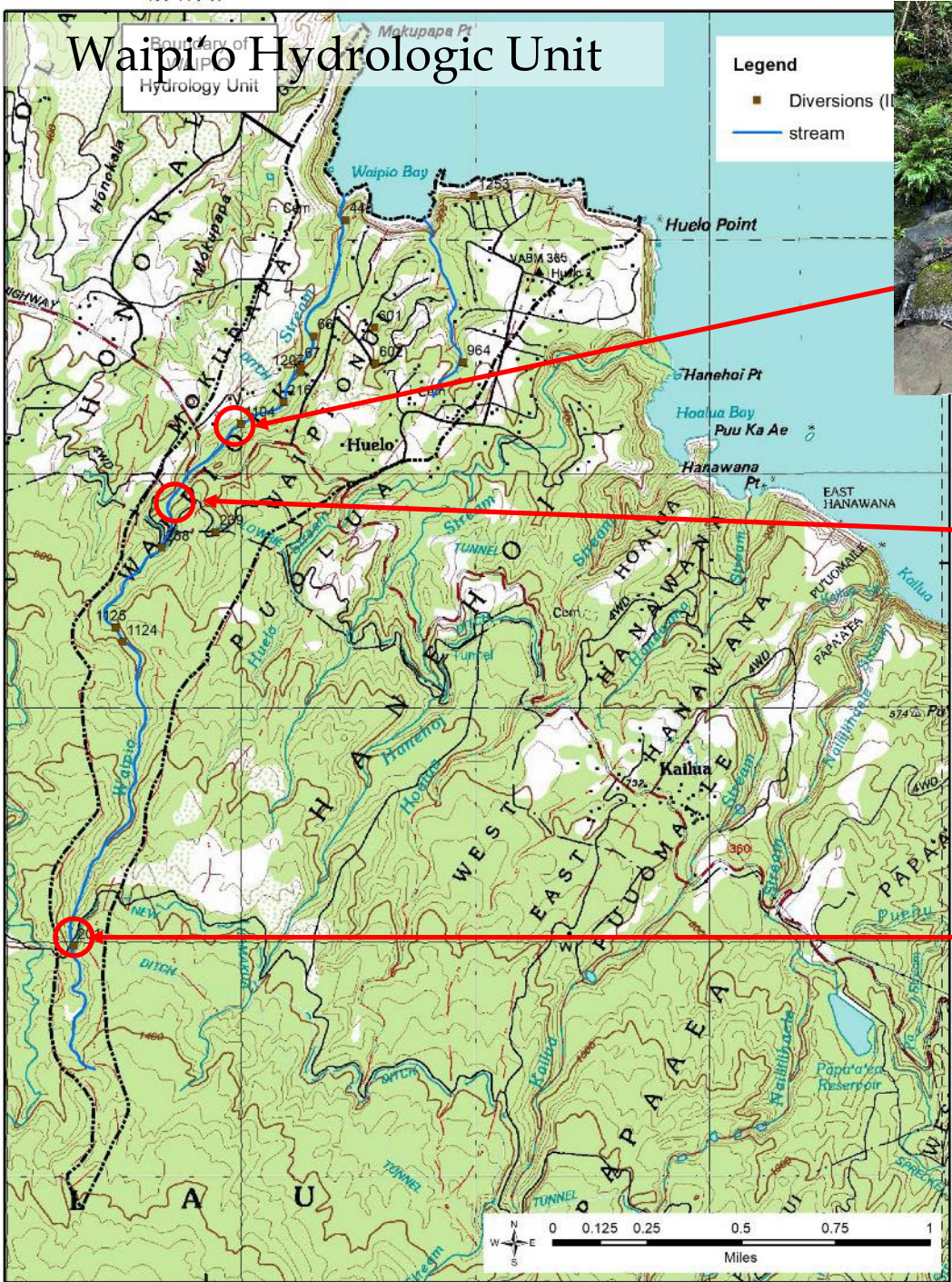


156°14'0"W

Waipio Hydrologic Unit

Boundary of
Waipio
Hydrology Unit

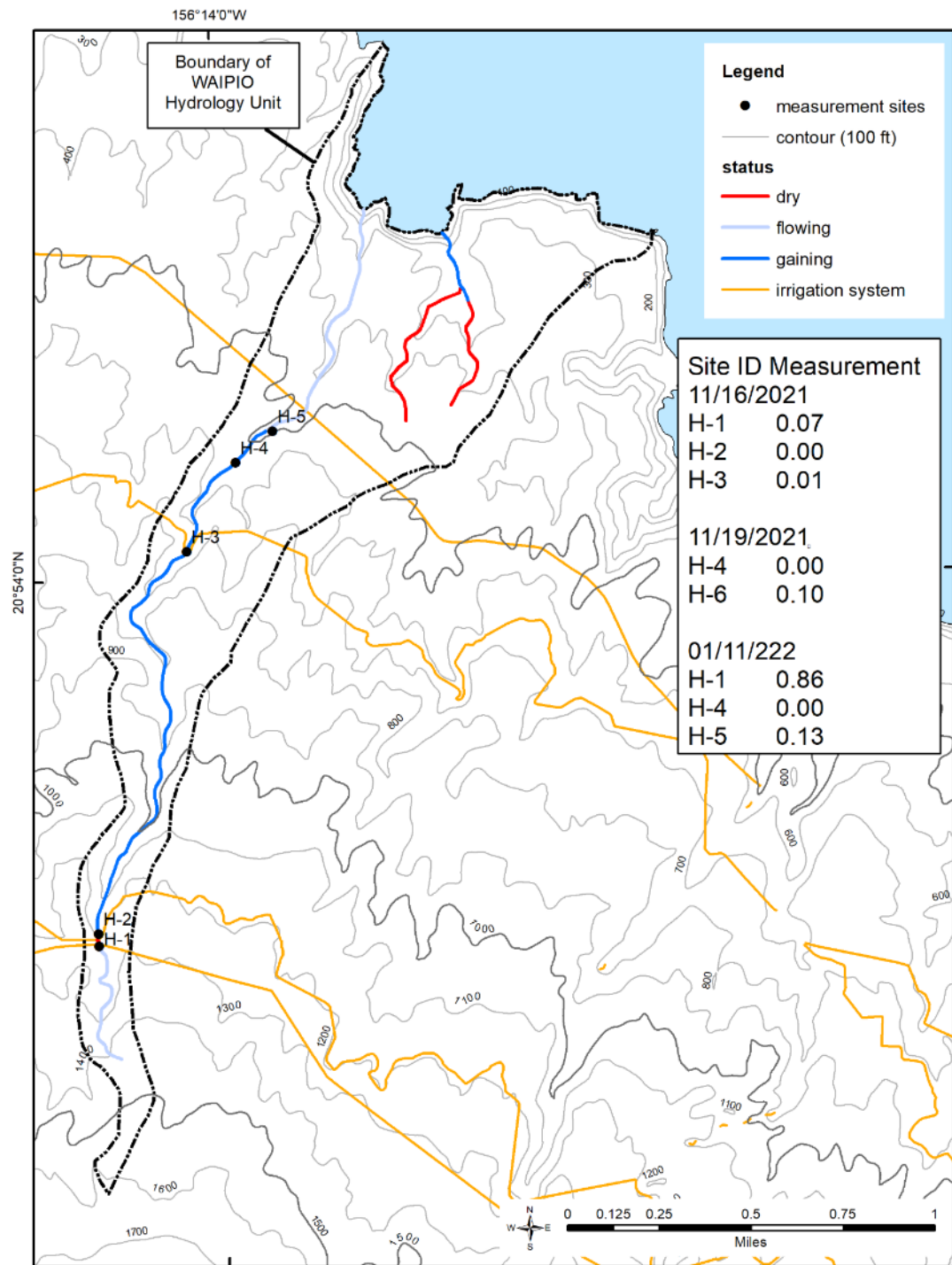
- Legend**
- Diversions (I)
 - stream



Waipi'o at 1250ft (above New Hāmākua Ditch)



Waipi'o Hydrologic Unit: Seepage Run



Waipi'o Hydrologic Unit: Instream Uses

No recognized trails

Registered riparian uses of water (agriculture, domestic)

kalo historically grown in watershed

Biotic Information:

Terminal reach waterfall

No native species observed in 18 site visits

Hawaii Stream Assessment

HSA aquatic resources: not ranked

HSA riparian resources: Detrimental plants (hau); Detrimental animals (pigs); 0% native forest; small palustrine wetland

HSA cultural resources: not surveyed

HSA recreational resources: none; ranked a 1 of 4 by regional committee



Waipi'o Hydrologic Unit: Non-EMI diversions



Ho'olawa Hydrologic Unit: Diversions

Watershed Characteristics:

Area: 3.6 mi²

Maximum elevation: 3481 ft

Land Use: 14.6% agriculture; 85.4%
conservation

Total Stream Length: 11.0 mi

Terminal Order: 2

Watershed Rating:

Landcover: 10/10

Shallow Waters Rating: 0/10

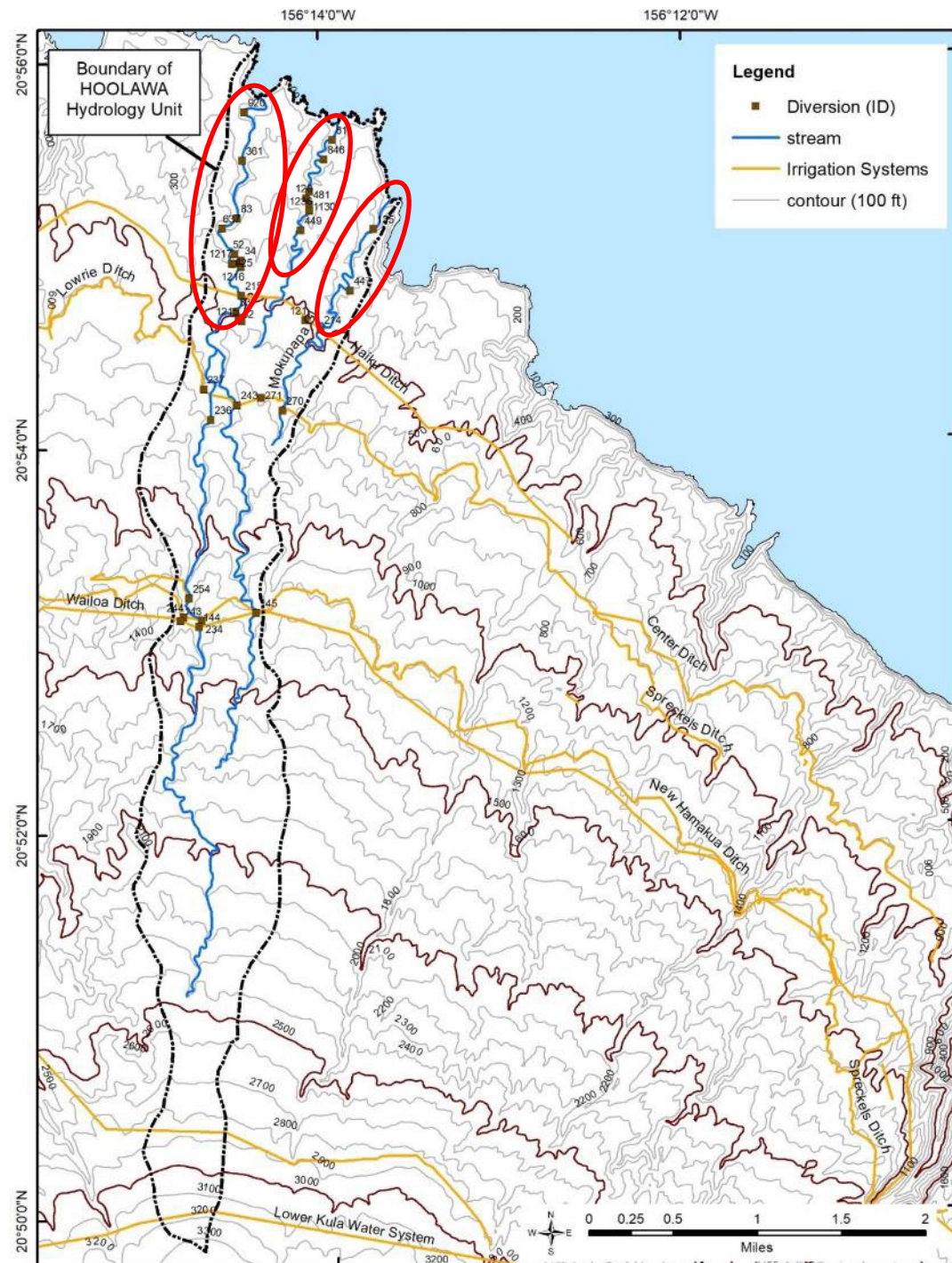
Stewardship Rating: 5/10

Size Rating: 2/10

Wetness Rating: 6/10

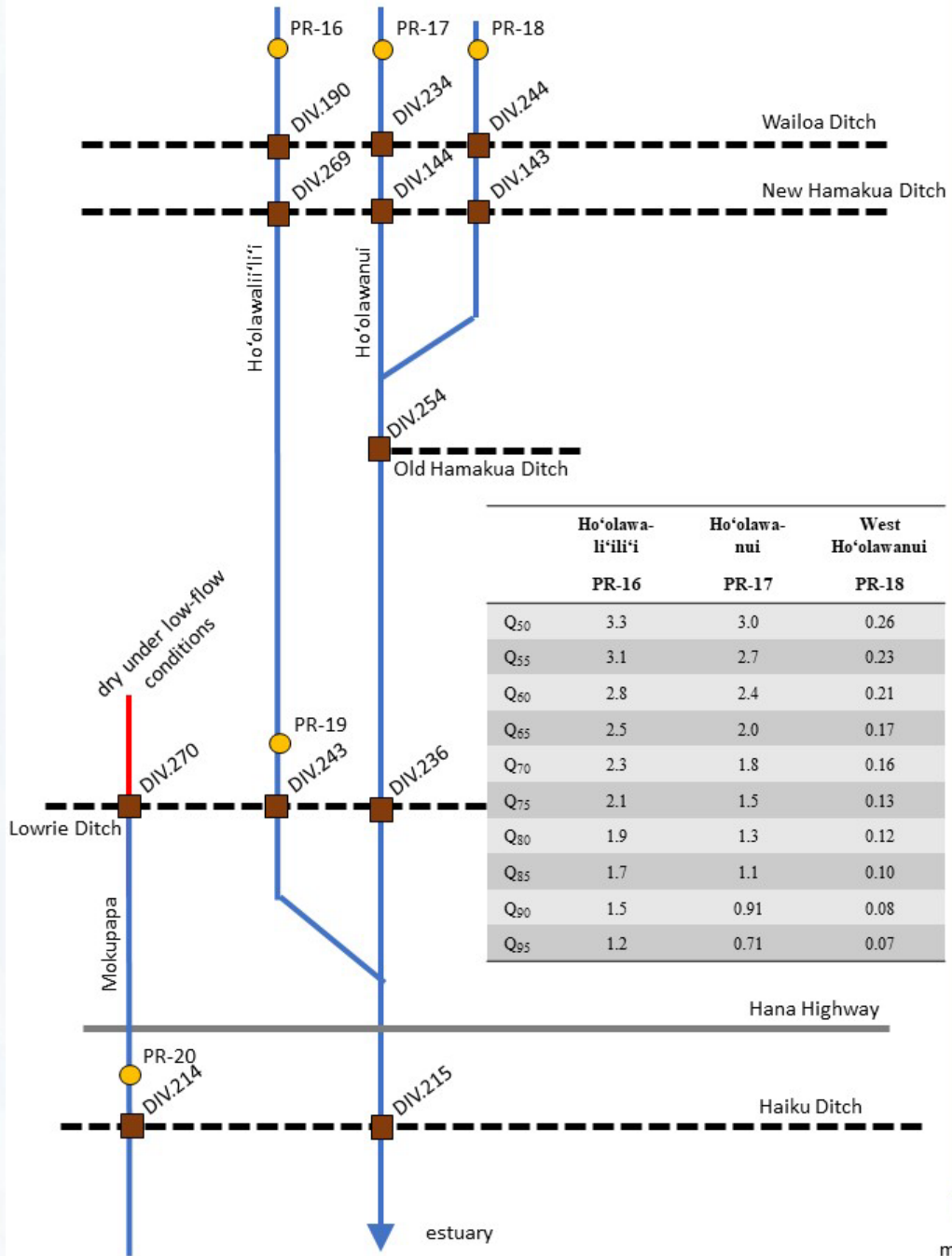
Reach Diversity Rating: 4/10

Total Score: 7/10



Ho'olawa Hydrologic Unit (6035)

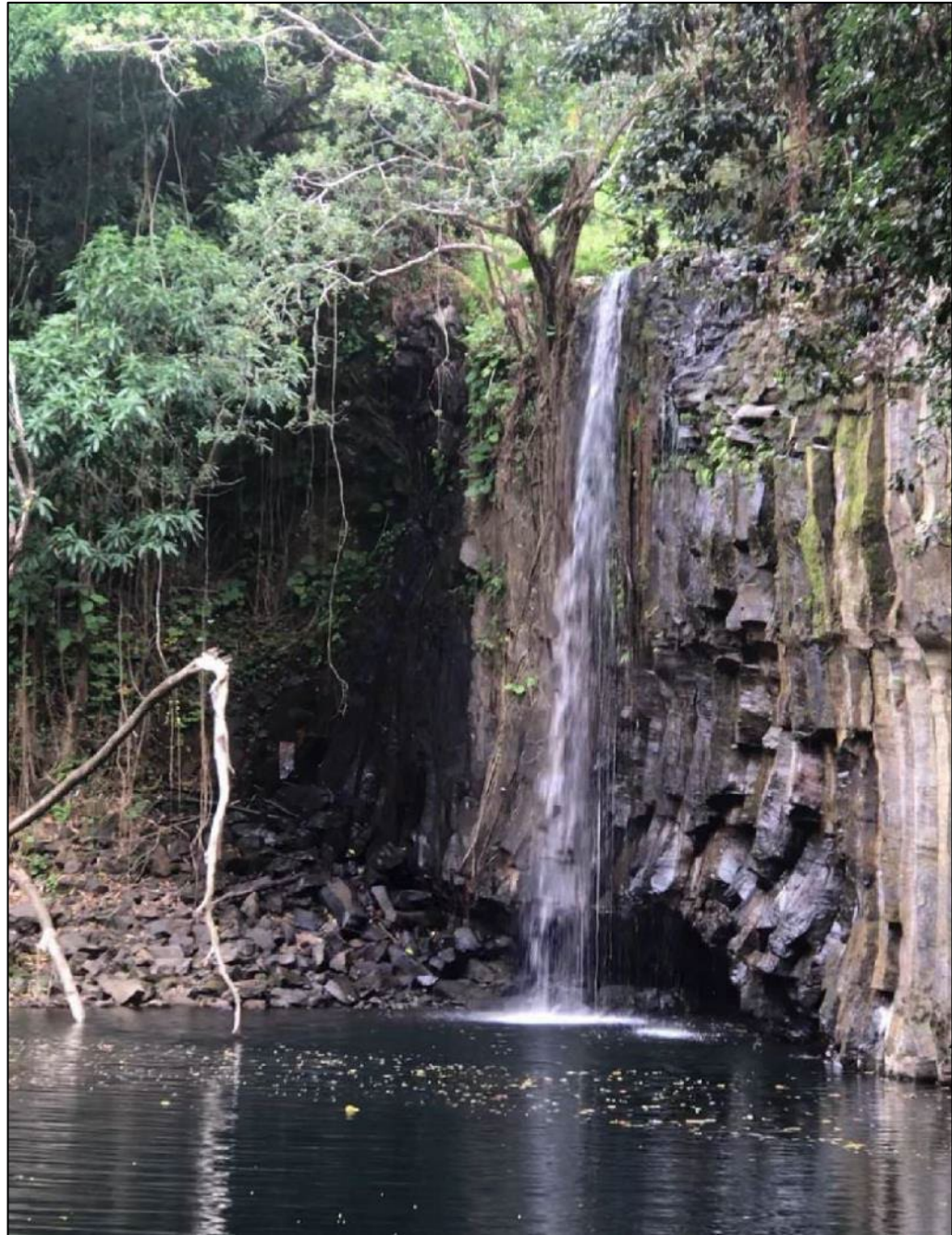
mauka

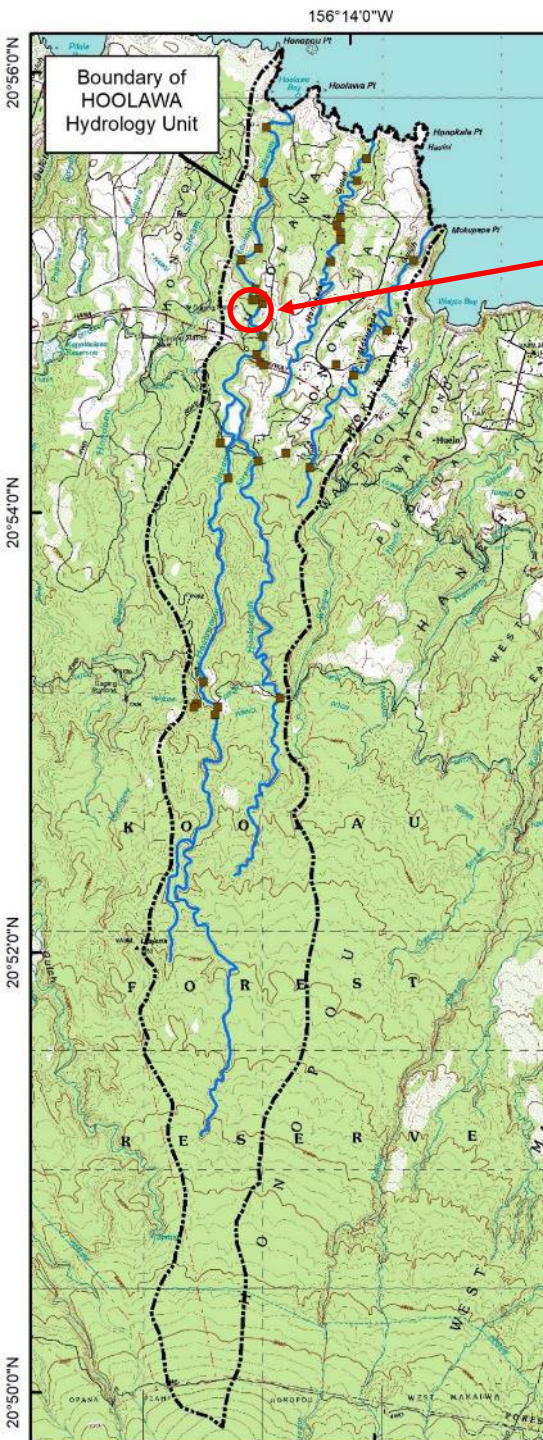


Ho'olawa Mouth



Ho'olawa <100 ft elevation

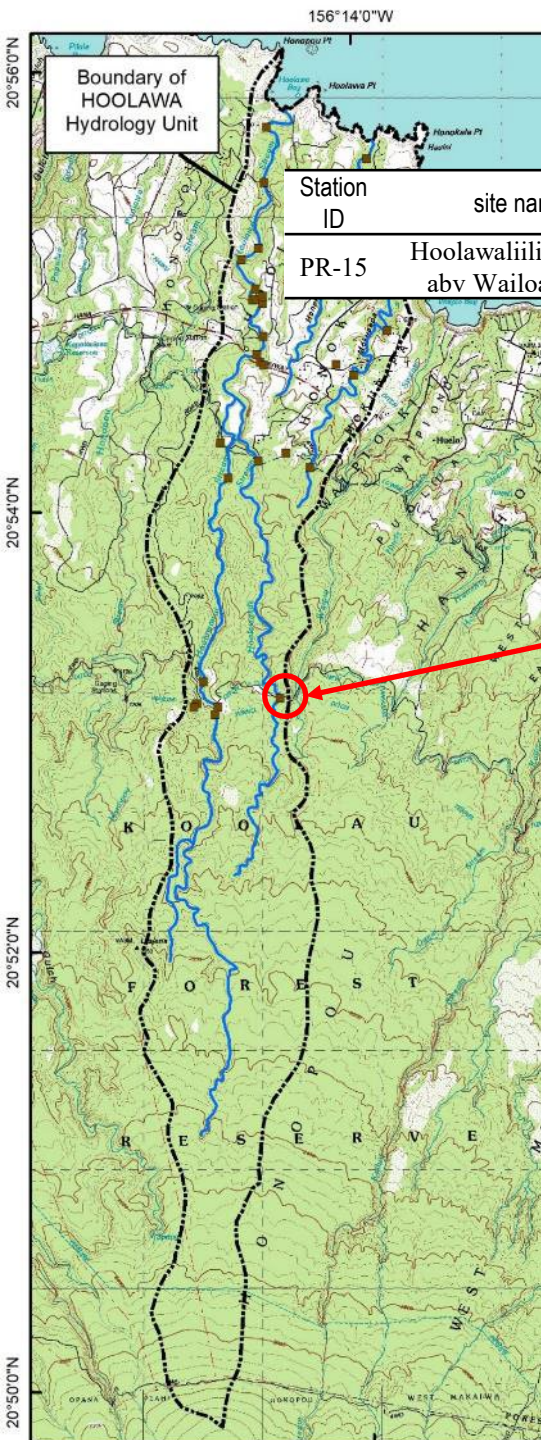




Ho'olawa Stream above Haiku Ditch



Hoolawaliilii abv Wailoa Ditch



Boundary of
HOOLAWA
Hydrology Unit

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-15	Hoolawaliilii Stream abv Wailoa Ditch	1984-2013	3.3	3.1	2.8	2.5	2.3	2.1	1.9	1.7	1.5	1.2



Hoolawanui abv Wailoa Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-16	Hoolawanui Stream abv Wailoa Ditch	1984-2013	3.0	2.7	2.4	2.0	1.8	1.5	1.3	1.1	0.91	0.71

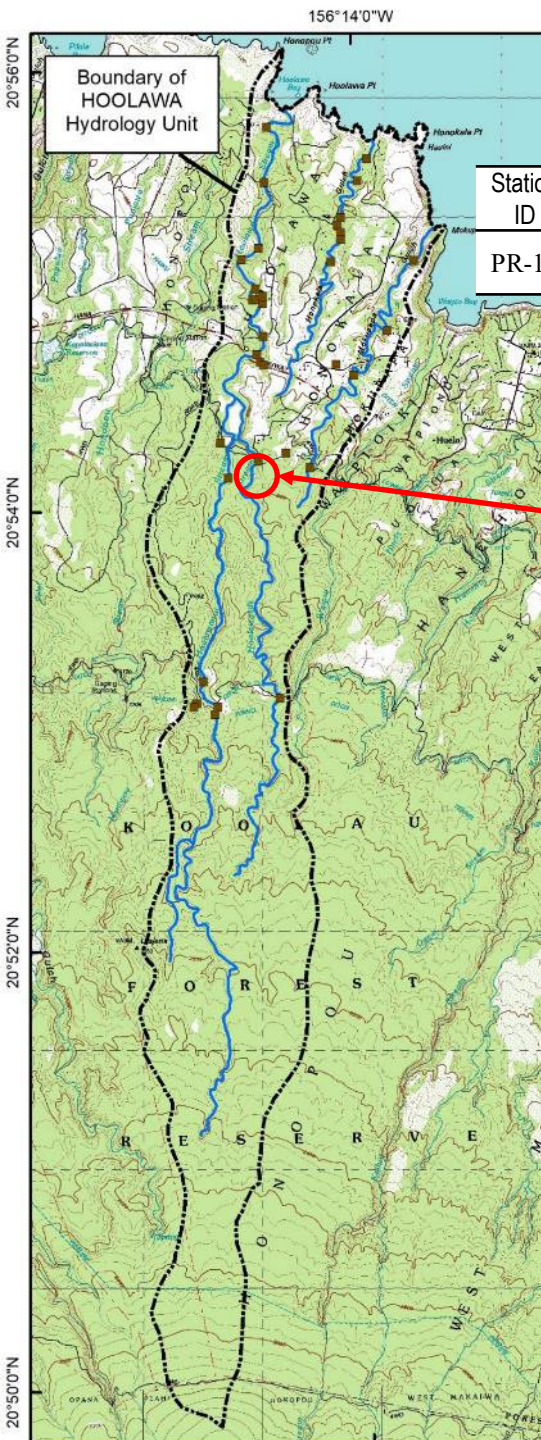


West Hoolawanui abv Wailoa Ditch

Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-17	West Hoolawanui Stream abv Wailoa Ditch	1984-2013	0.26	0.23	0.21	0.17	0.16	0.13	0.12	0.10	0.08	0.07



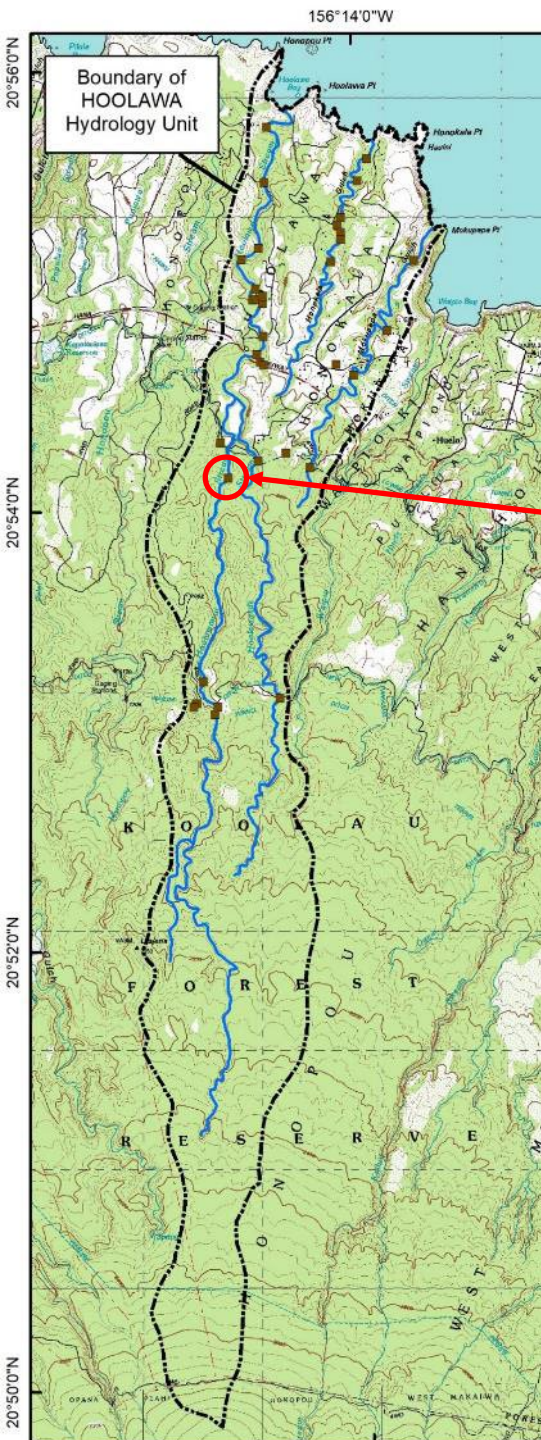
Hoolawaliilii abv Lowrie Ditch



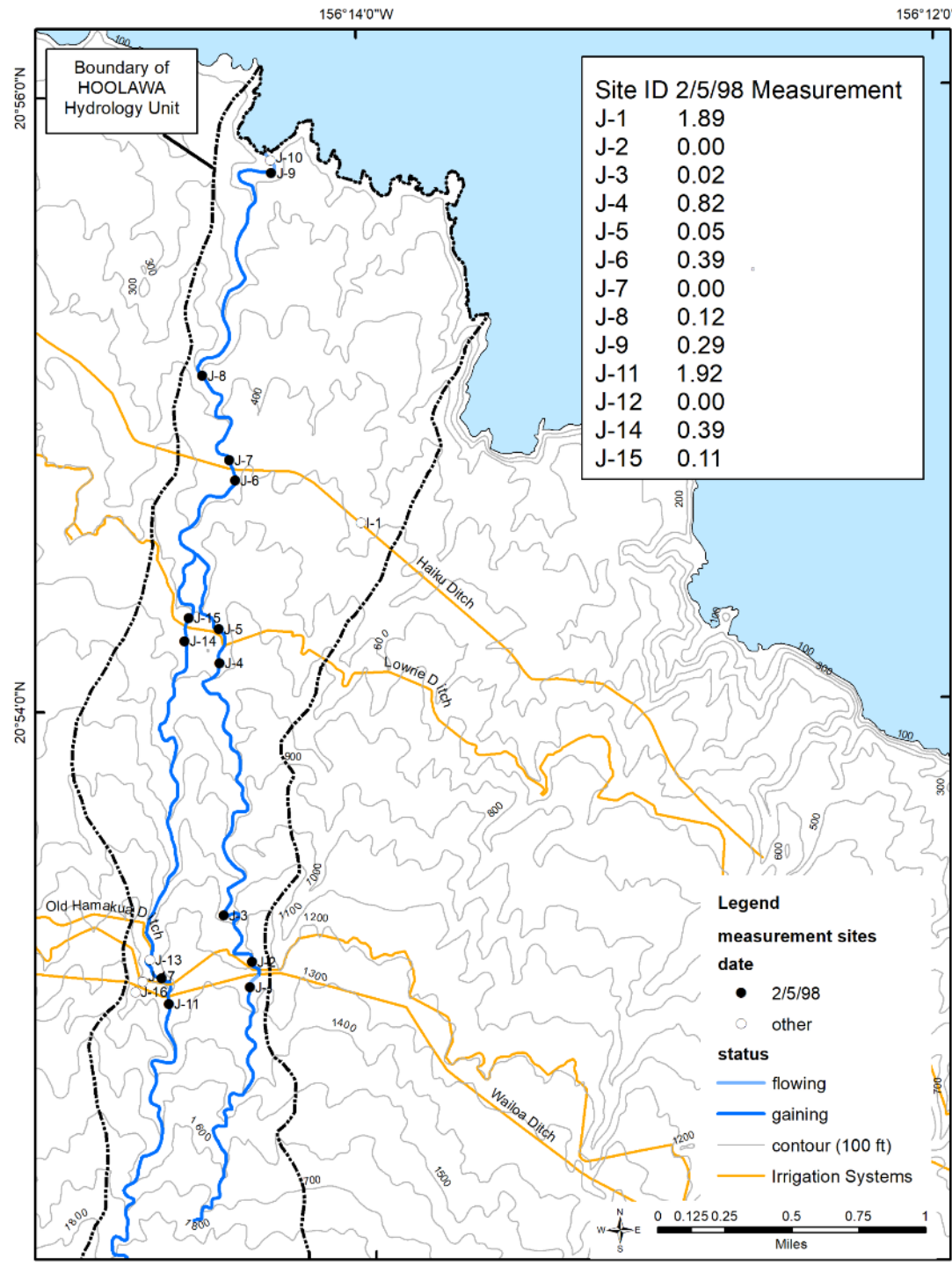
Station ID	site name	Period of Record	Q ₅₀	Q ₅₅	Q ₆₀	Q ₆₅	Q ₇₀	Q ₇₅	Q ₈₀	Q ₈₅	Q ₉₀	Q ₉₅
PR-18	Hoolawaliilii Stream abv Lowrie Ditch	1984-2013	4.4	4.1	3.8	3.3	3.2	2.8	2.5	2.2	2.0	1.7



Hoolawanui abv Lowrie Ditch



Ho'olawa Hydrologic Unit: Seepage Runs



Ho'olawa Hydrologic Unit: Instream Uses

High value aesthetic and recreational stream

Many registered riparian uses of water (agriculture, domestic)

Biological Rating:

Terminal reach estuary which increases recruitment of amphidromous species

Multiple inland waterfalls preventing upstream recruitment

20 point-quadrant biota surveys (1 reach) conducted biota survey 10 ft above mouth ('o'opu akupa and nākea observed) and at 400 ft above Haiku Ditch (no native species observed) with continual flow restored below Lowrie Ditch, and Haikua Ditch since 2016

Native Species Rating: 2/10

Introduced Genera Rating: 10/10

All Species Score: 5/10

Total Biological Rating: 5/10

Overall Rating: 6/10

Rating Strength: 5/10

Hawaii Stream Assessment:

HSA aquatic resources: ranked limited (0 high value species; 1 low value native species observed); 4 surveys, last was in 1980

HSA riparian resources: Detrimental plants (hau); Detrimental animals (pigs); 0% native forest; small palustrine wetland

HSA cultural resources: very limited survey coverage; 1 archeological site; moderate density; pre-contact/early contact, important information and culturally noteworthy; taro historically associated with stream

HSA recreational resources: hiking, swimming, scenic views; ranked substantial (4 of 4) by regional committee

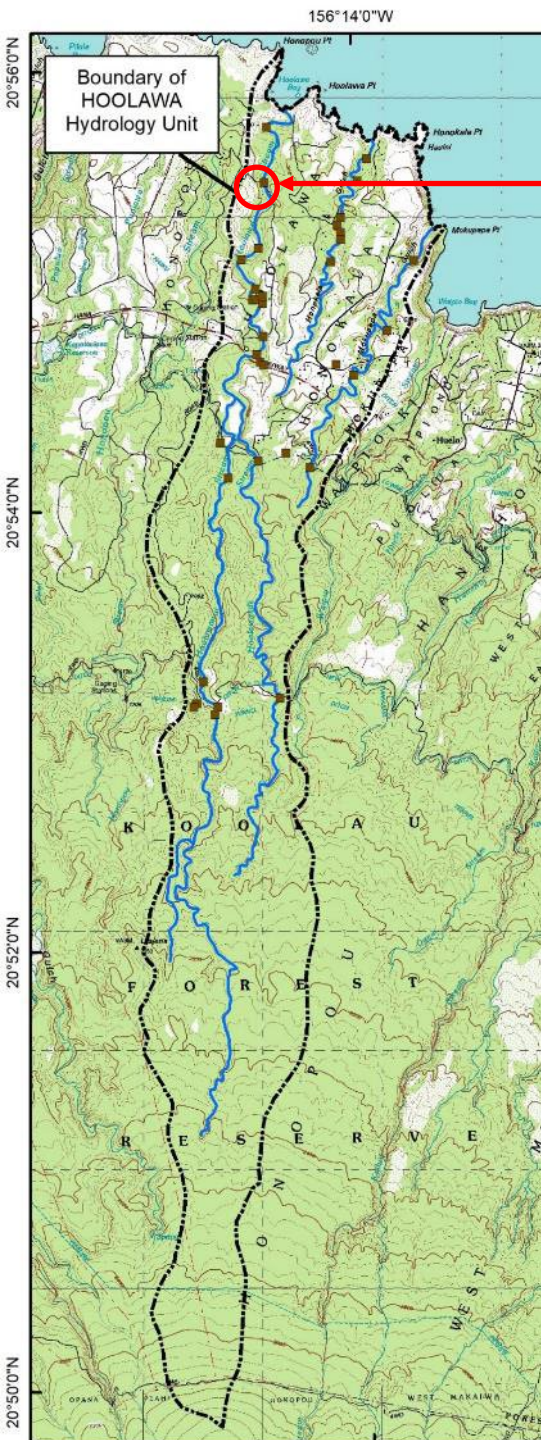




Exhibit Y-41



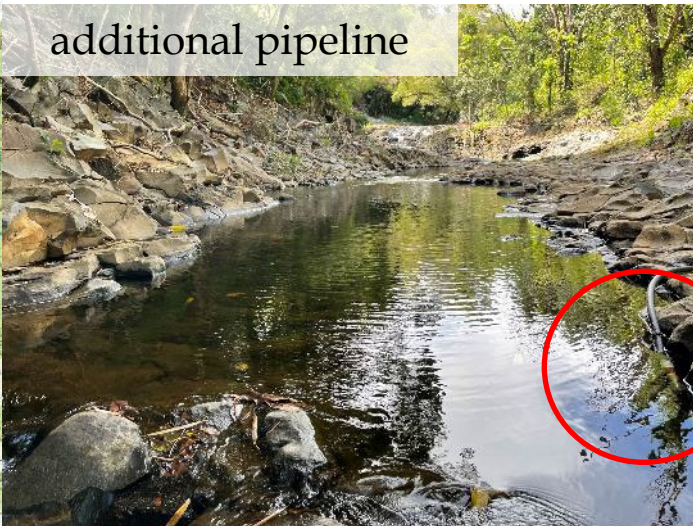
One survey station was briefly examined in the Hoolawa stream catchment. This was a western tributary to Hoolawanui Stream, at intake NH-20, which was not investigated during previous surveys in 2008. Little time was spent here on the current survey because no modification or abandonment is proposed at this site. Even so, the amount of discharge (Figs. 5, 6) indicates that this stream reach represents potentially suitable habitat for *Megalagrion* damselfly species.

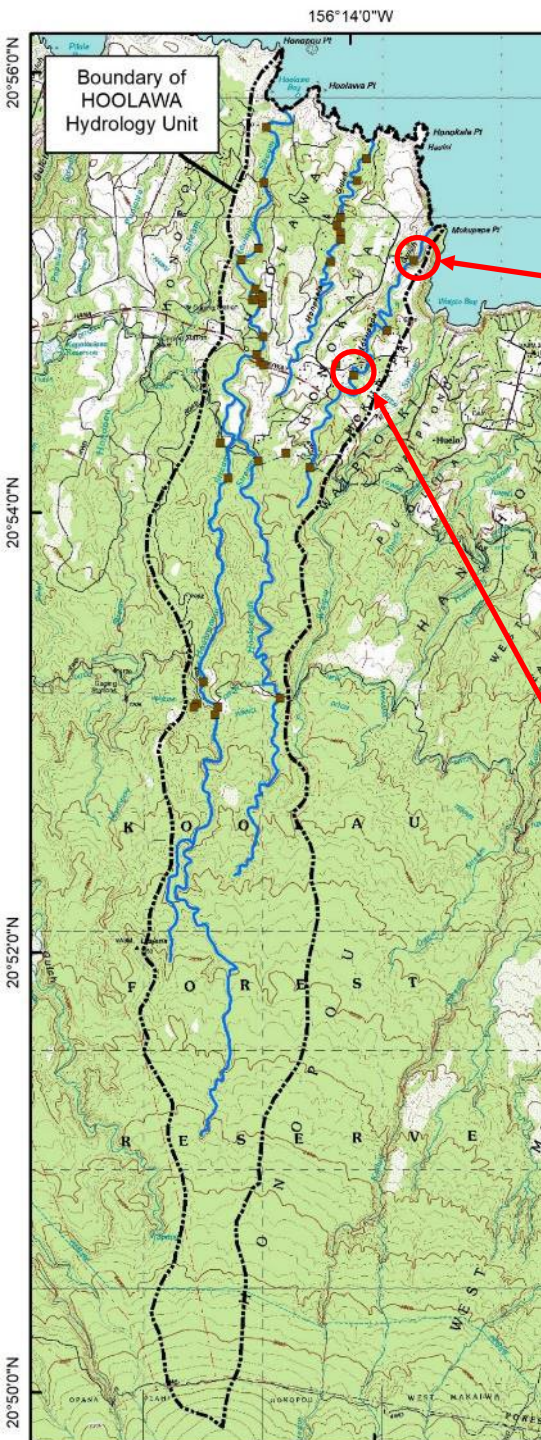


DIV.361 original diversion



additional pipeline





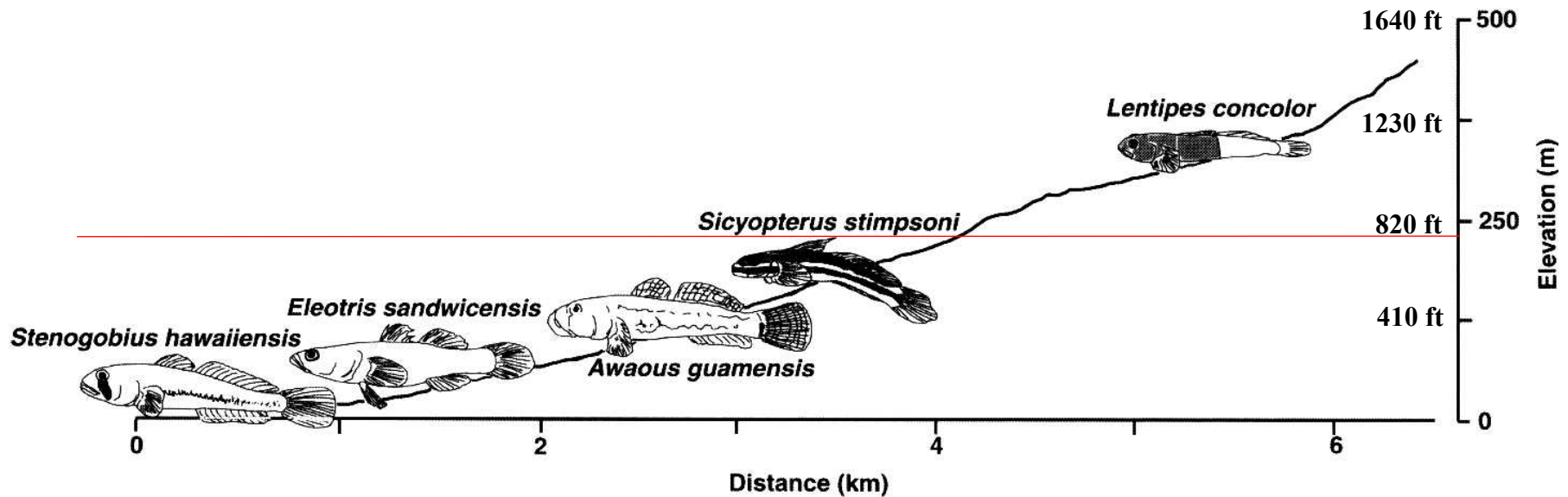
Abandoned diversion REG.135 on Mokupapa Stream



Mokupapa Stream above Haiku Ditch



Natural Distribution of Native Amphidromous Stream Biota



McRae 2007; adapted with permission from Nishimoto and Kuamoo 1991

Scientific Name	Hawaiian Name	Type	Biogeographic status	Distribution		
				Lower	Middle	Upper
<i>Stenogobius hawaiiensis</i>	‘O‘opu naniha	Goby	Endemic	●		
<i>Awaous guamensis</i>	‘O‘opu nakea	Goby	Indigenous	●	●	
<i>Sicyopterus stimpsoni</i>	‘O‘opu nopili	Goby	Endemic	●	●	
<i>Eleotris sandwicensis</i>	‘O‘opu akupa (okuhe)	Eleotrid	Endemic	●	●	
<i>Lentipes concolor</i>	‘O‘opu hi‘ukole (alamo‘o)	Goby	Endemic	●	●	●
<i>Macrobrachium grandimanus</i>	‘Opae ‘oeha‘a	Prawn	Endemic	●		
<i>Atyoida bisulcata</i>	‘Opae kala‘ole	Shrimp	Endemic	●	●	●
<i>Neritina vespertina</i>	Hapawai	Snail	Endemic	●		
<i>Neritina granosa</i>	Hihiwai	Snail	Endemic	●	●	

CWRM/DAR East Maui Biota Surveys

Stream	survey reach (elevation)	terminal reach
Honopou	Mouth (10), mauka (1210)	Estuary
Ho'olawa	Mouth (20), mid-elevation (440)	Estuary
Hanehoi	Mid-elevation (400)	Waterfall
Hoalua	Mid-elevation (640)	Estuary
Kailua	Mouth (270), Mid-elevation (680)	Waterfall
Nailiilihaele	Mouth (260), Mid-elevation (780), Mauka (1230)	Waterfall
'O'opuola	Mid-elevation (480)	Estuary
Ka'aiea	Mid-elevation (680)	Waterfall
Kōlea	Mid-elevation (710)	Waterfall
Waikamoi	Mouth (160)	Waterfall
Haipuaena	Mouth (210), Mauka (900)	Waterfall
Punalau	Lower (40), Mauka (940)	Estuary
Honomanu	Mouth (15), Lower (60), Mid-elevation (220)	Estuary
Nuaailua	Mouth (10), Mid-elevation (190)	Estuary
West Wailuaiki	Mouth (5)	Estuary
East Wailuaiki	Mouth (5), Mauka (1250)	Estuary
Waiohue	Mouth (5), Mauka (1240)	Estuary
Makapipi	Mouth (60), Mid-elevation (920)	Waterfall

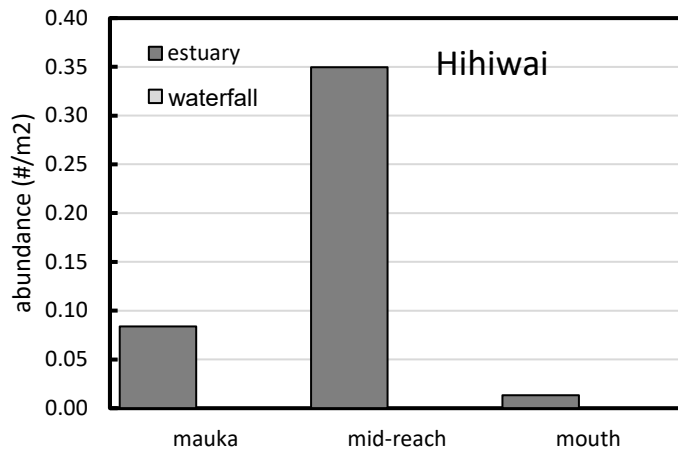
2020-2021

n = 31 surveys in East Maui

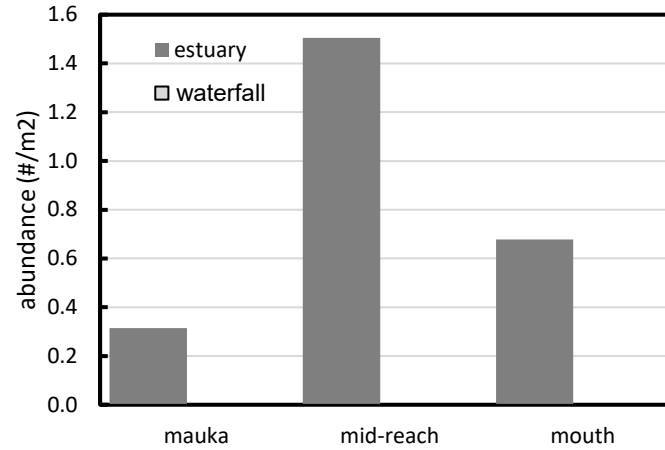
CWRM/DAR East Maui Biota Surveys: Influence of terminal reach



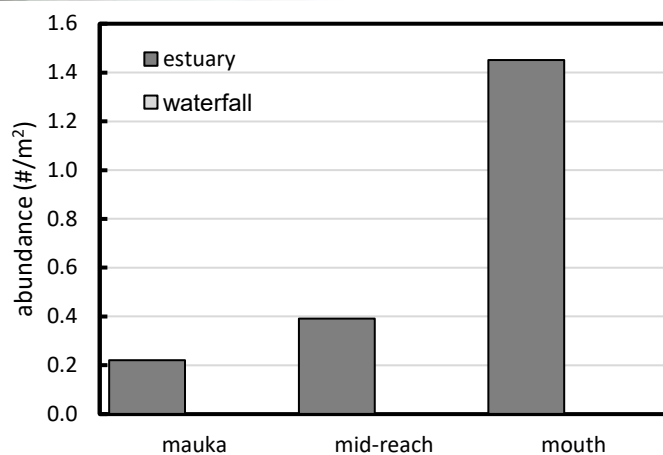
hīhīwai



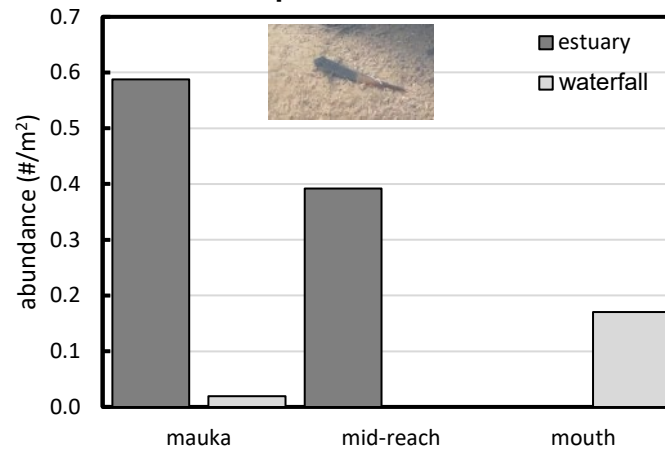
‘o‘opu nōpili



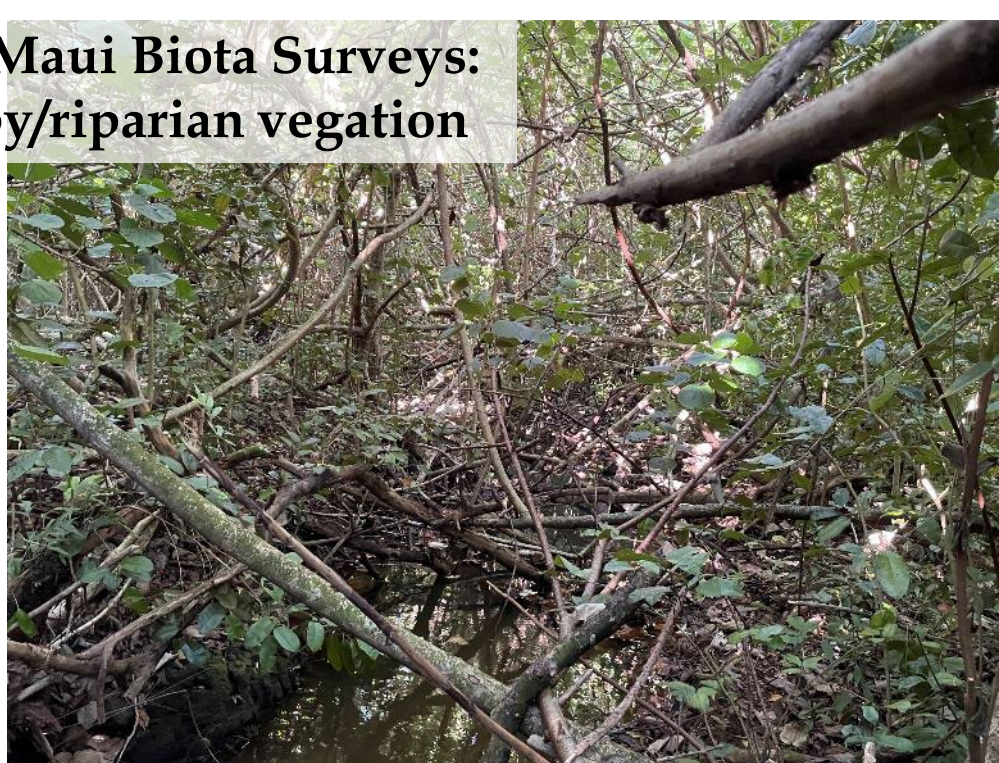
‘o‘opu nākea



‘o‘opu ‘alamo‘o



CWRM/DAR East Maui Biota Surveys: Influence of canopy/riparian vegetation





Thank you Skippy Hau!



