

**Commission Meeting
UH Maui College
March 20, 2018**



Staff presentation to

Amend the Interim Instream Flow Standards for the Surface Water Hydrologic Units of

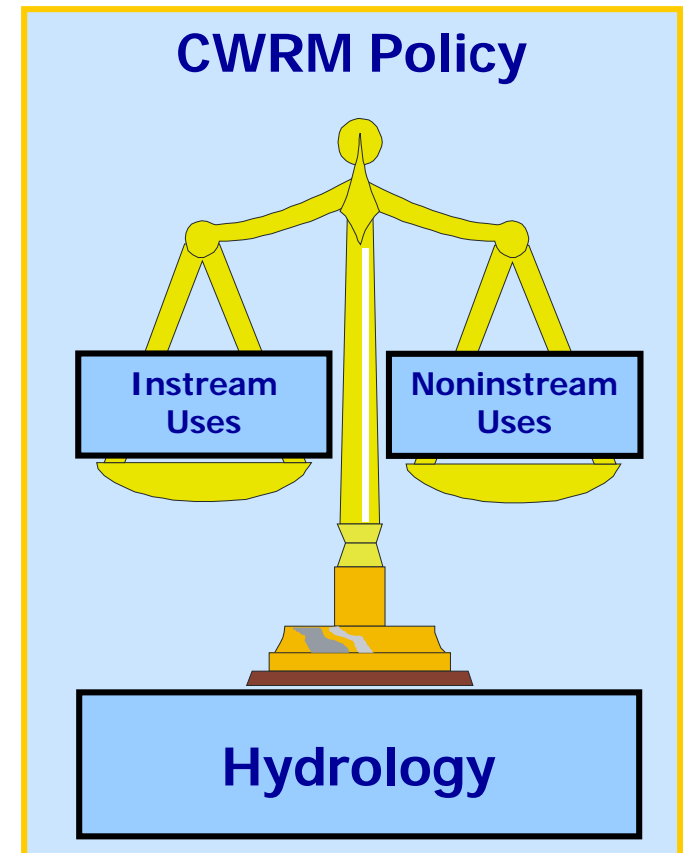
Ukumehame, Olowalu, Launiupoko, Kaua'ula



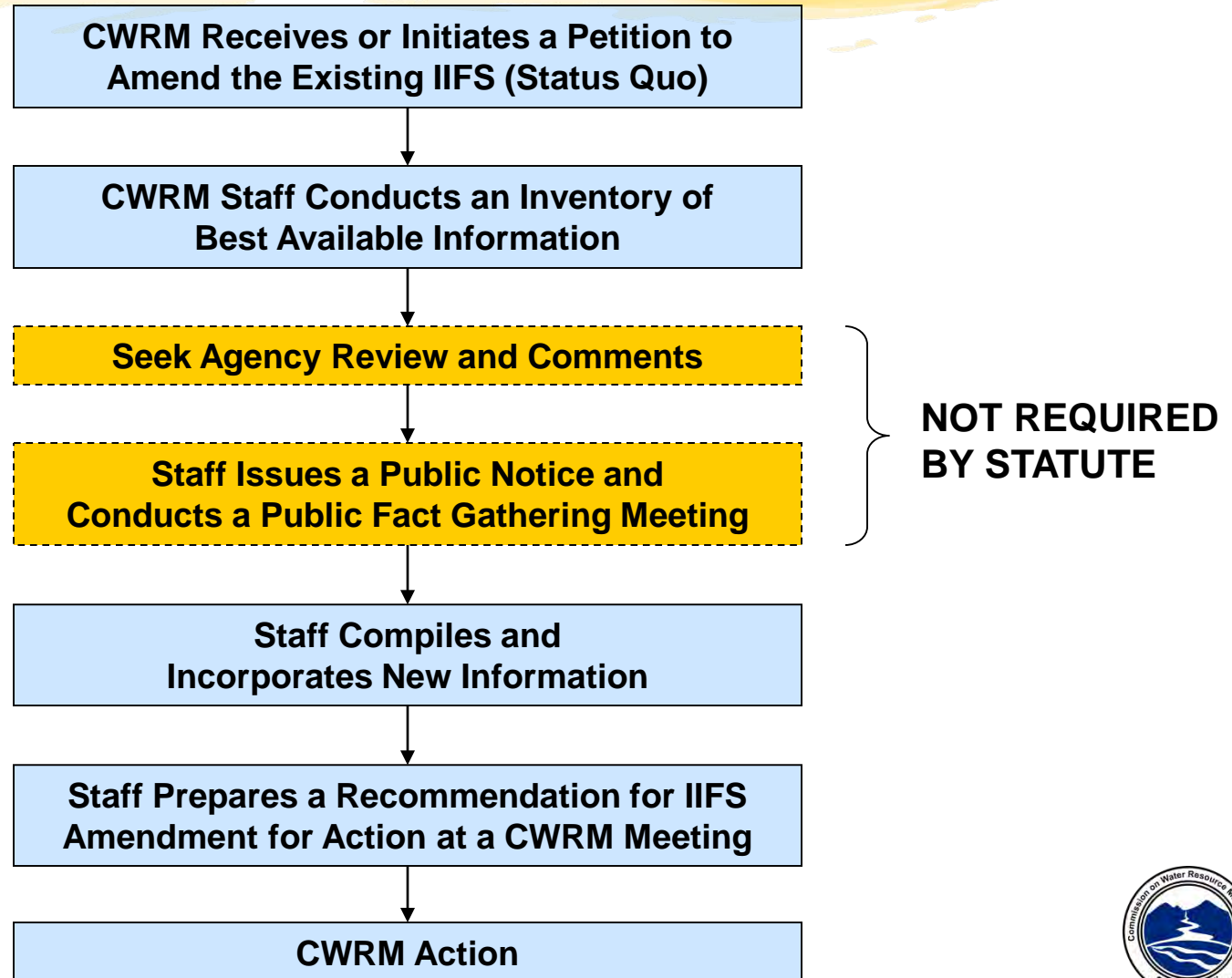
**State of Hawaii
Department of Land and Natural Resources
Commission on Water Resource Management**

State Water Code

“The Commission shall weigh the importance of the present or potential instream values with the importance of present or potential uses of water for noninstream purposes, including the economic impact of restricting such uses.”



Interim IFS Process



Presentation Outline

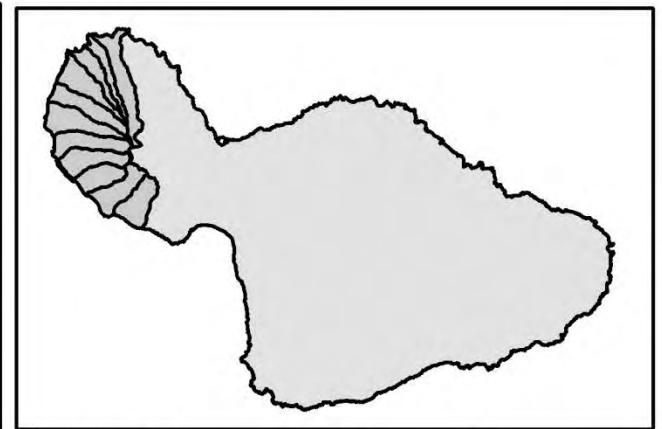
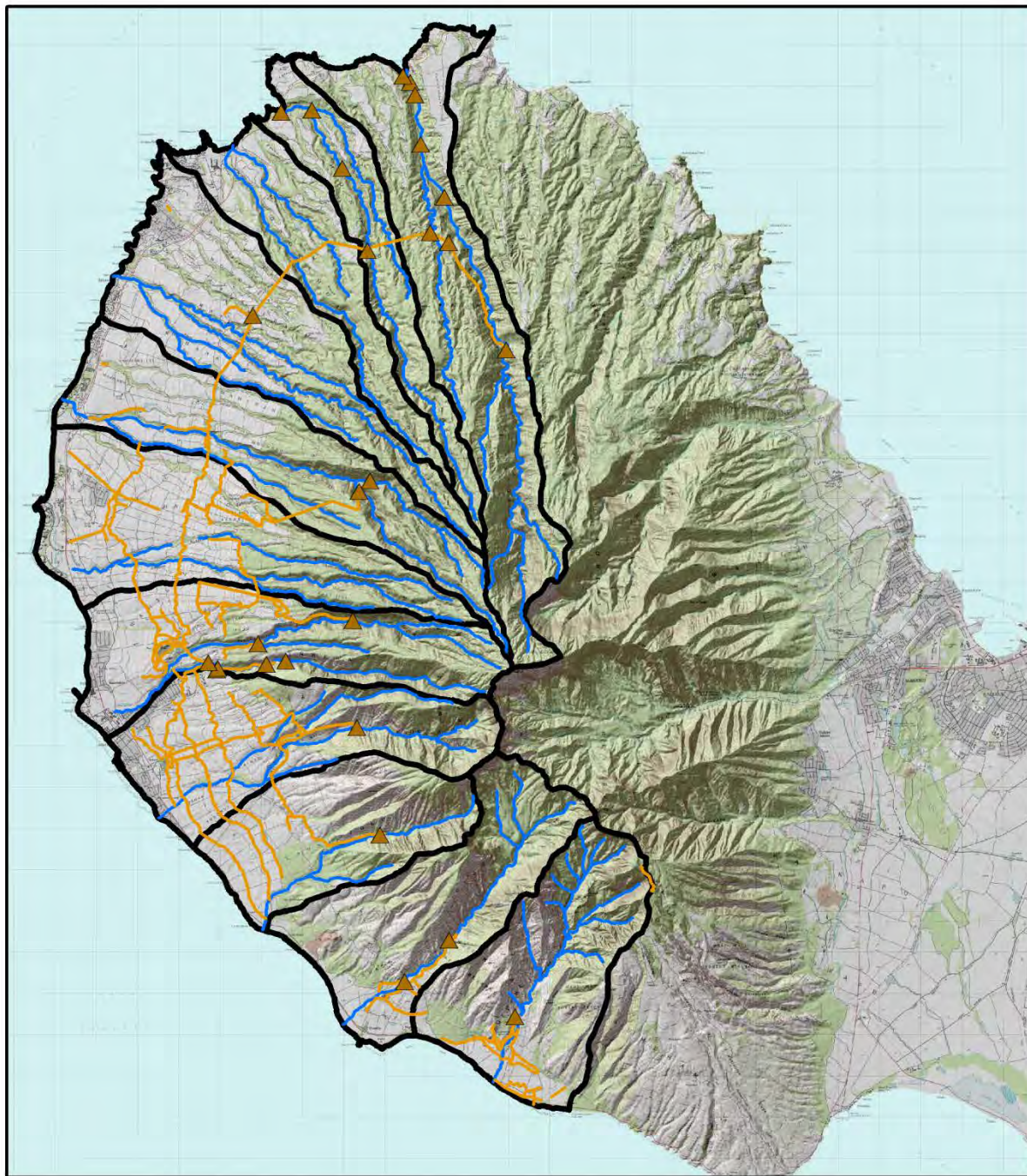
1. Background on West Maui

- USGS Report
- Hydrology/Geology: Rainfall/Groundwater

2. Hydrologic Unit Summary and recommendation





3. Implementation of IIFS





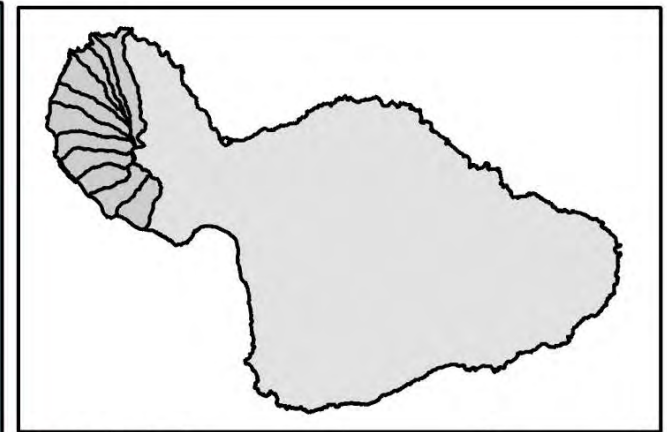
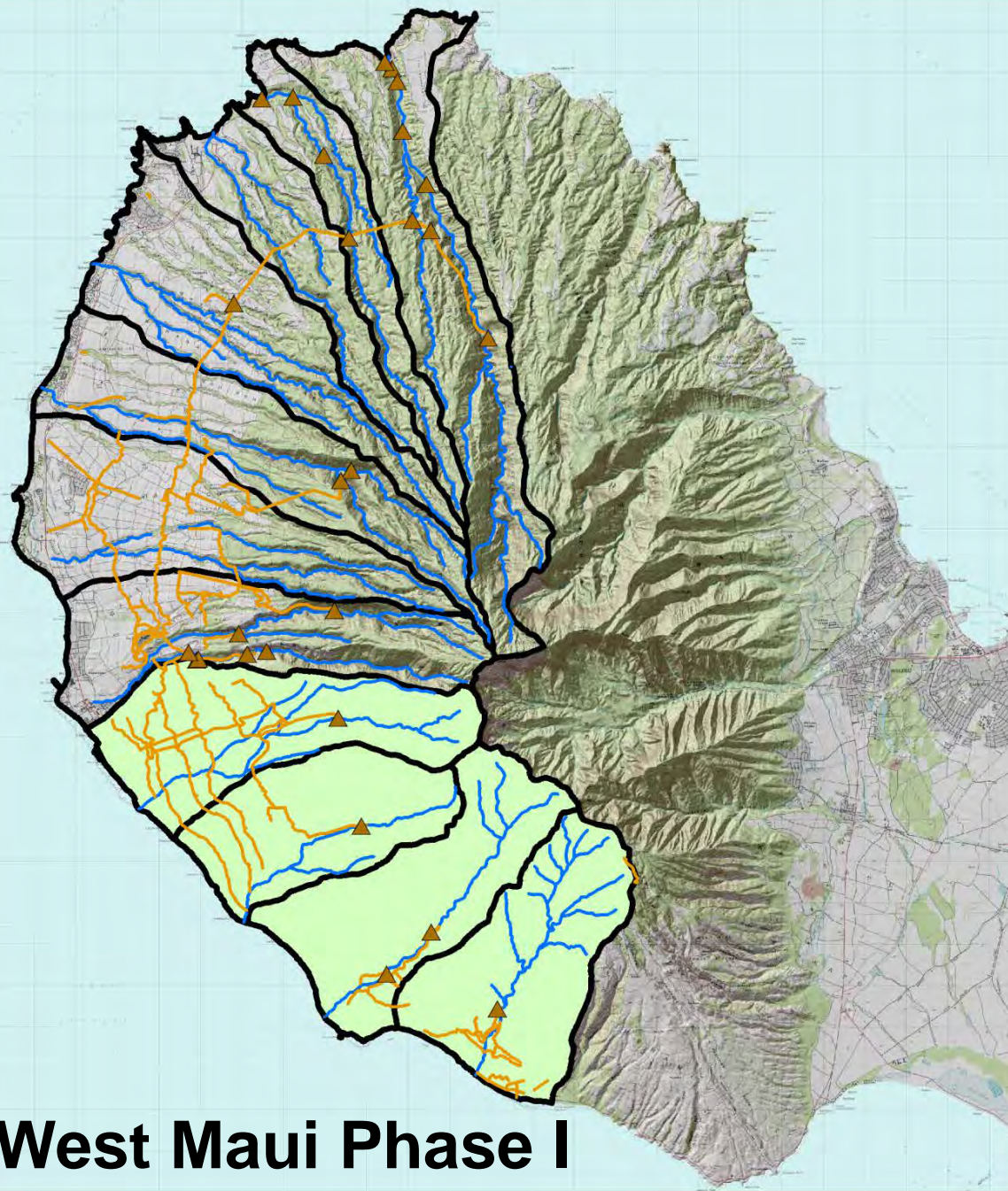
Miles

Legend

-  registered diversions
-  ditches/pipelines/tunnels
-  stream
-  West Maui watersheds



West Maui Phase I



Legend

- ▲ registered diversions
- ditches/pipelines/tunnels
- stream
- West Maui Watersheds

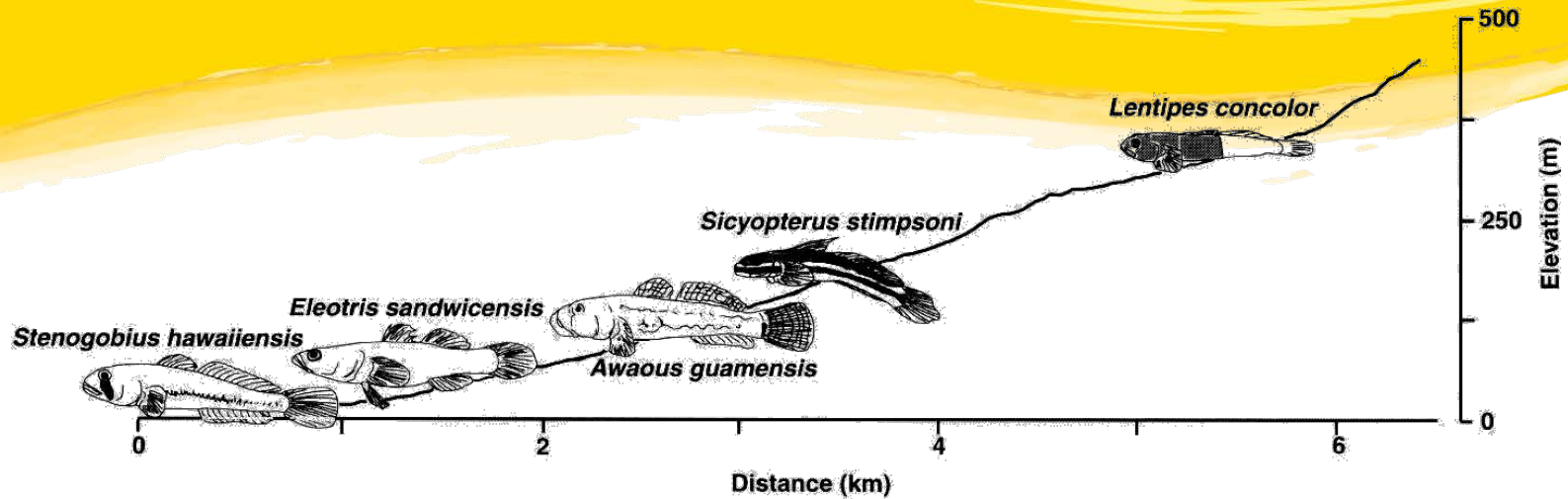


Instream Uses

- Traditional and customary Hawaiian rights
 - Mauka-to-makai flow
 - Gathering of native species
 - Taro cultivation
- Fish Habitat & Ecosystem Services
- Aesthetic & Recreational Value
- Water Quality
- Navigation
- Hydropower



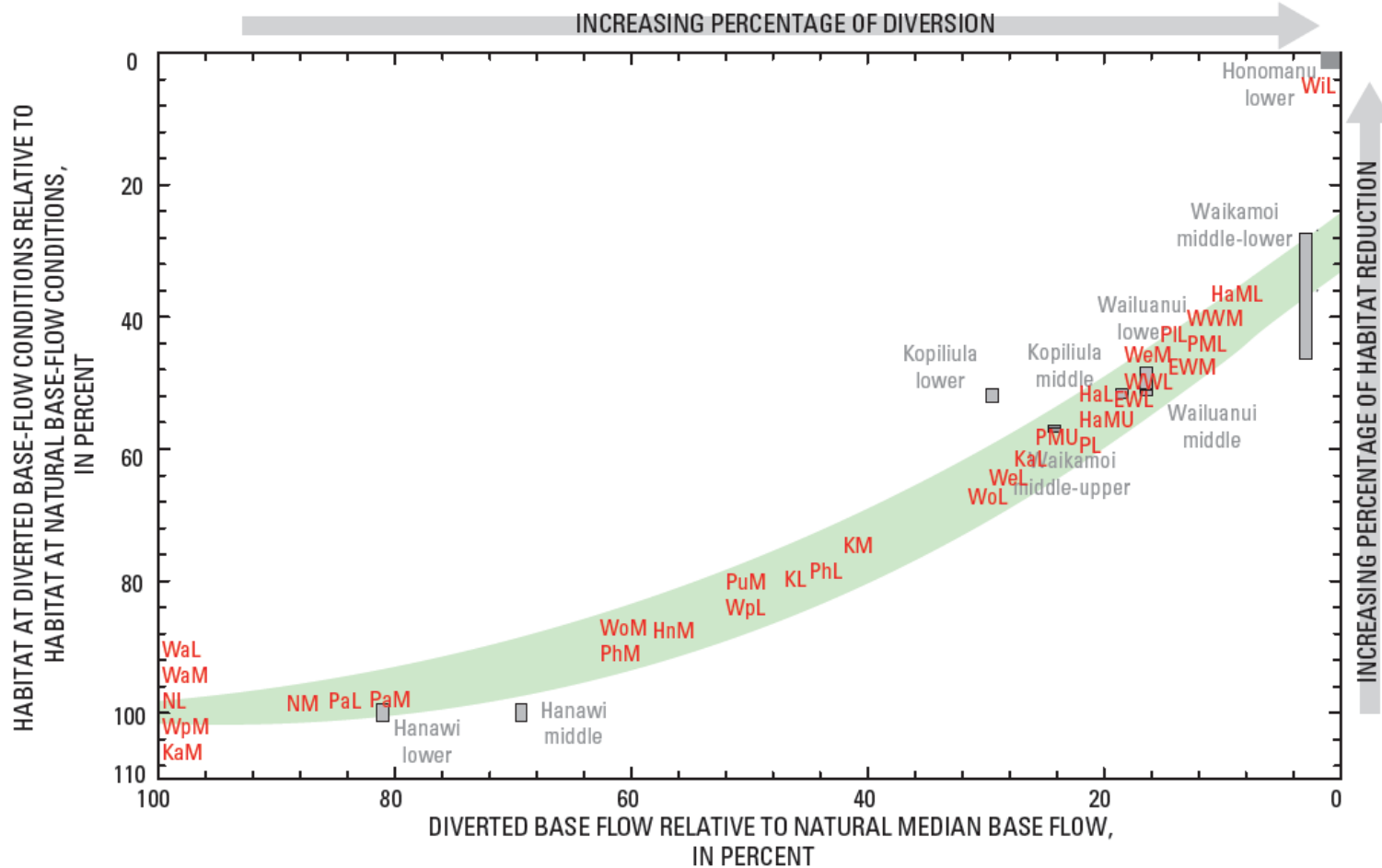
Native Stream Biota



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	●	●	

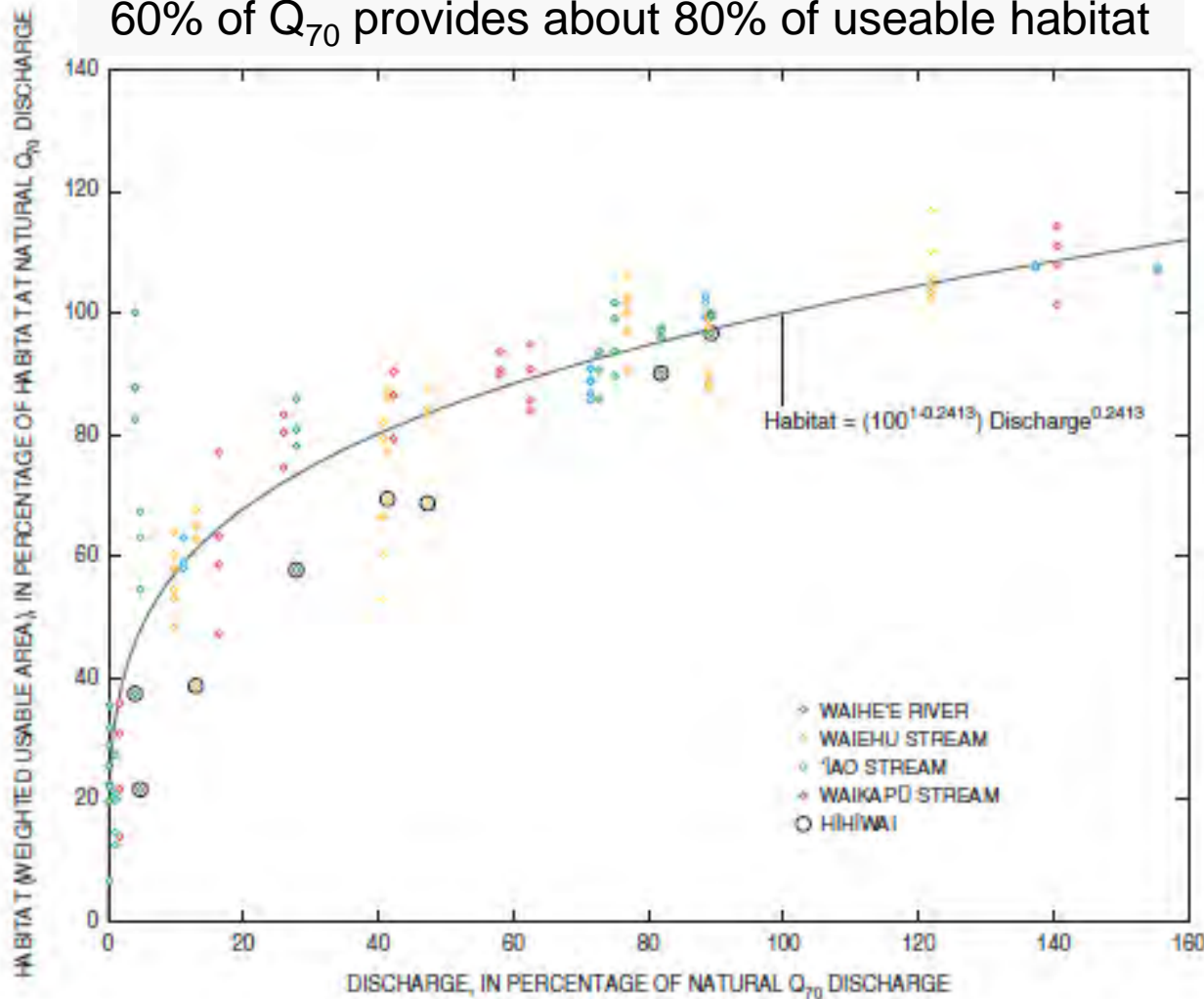
Habitat Availability

80% of median baseflow (BFQ₅₀) provides 100% of useable habitat



Habitat Availability

Q_{70} provides 100% of useable habitat
60% of Q_{70} provides about 80% of useable habitat

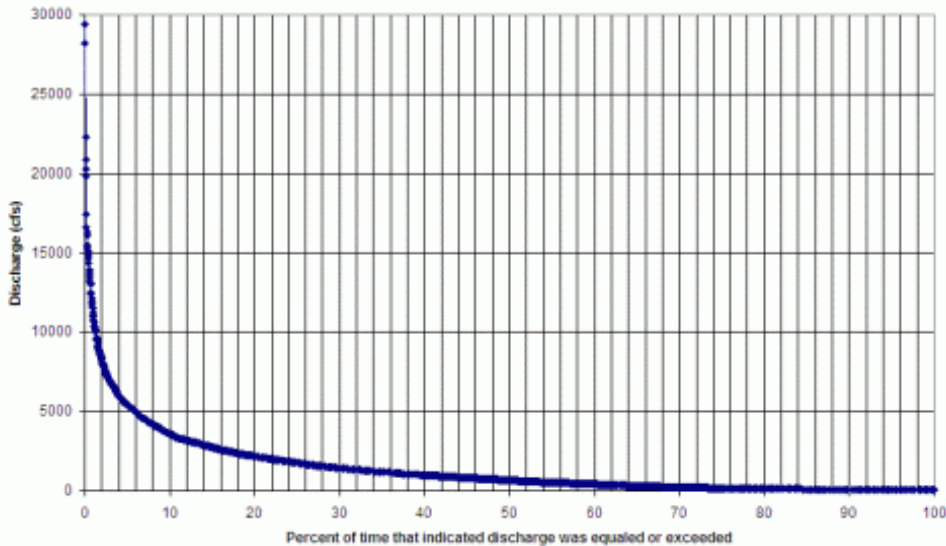


Flow Duration Curves

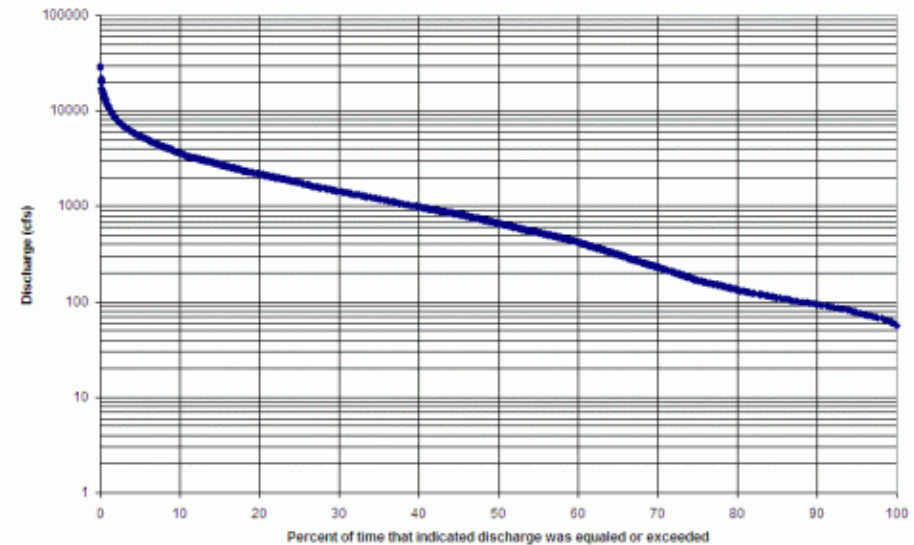
Linear scale

Logarithmic scale

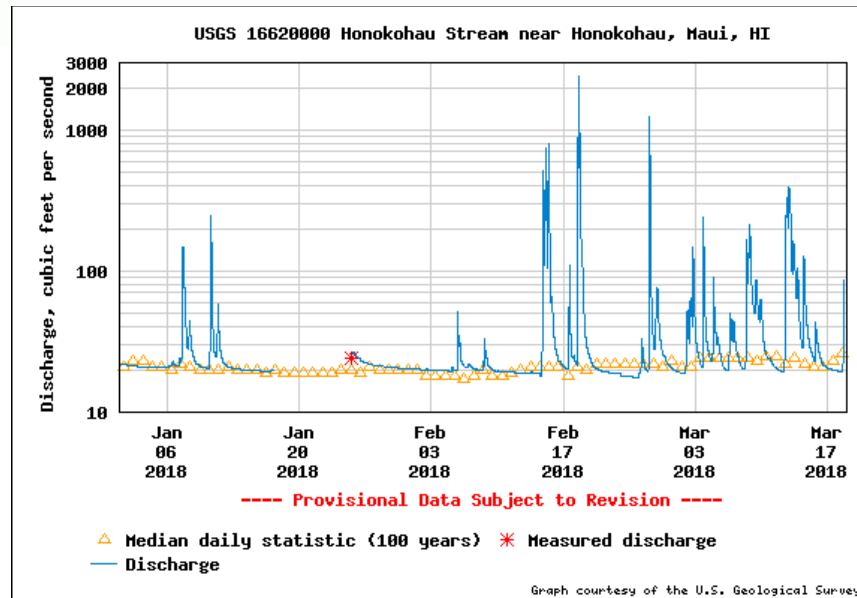
Flow Duration Curve for Alsea River at Tidewater (WY 1991-2000)



Flow Duration Curve (Log Intervals) for Alsea River at Tidewater (WY 1991-2000)



Time-series data

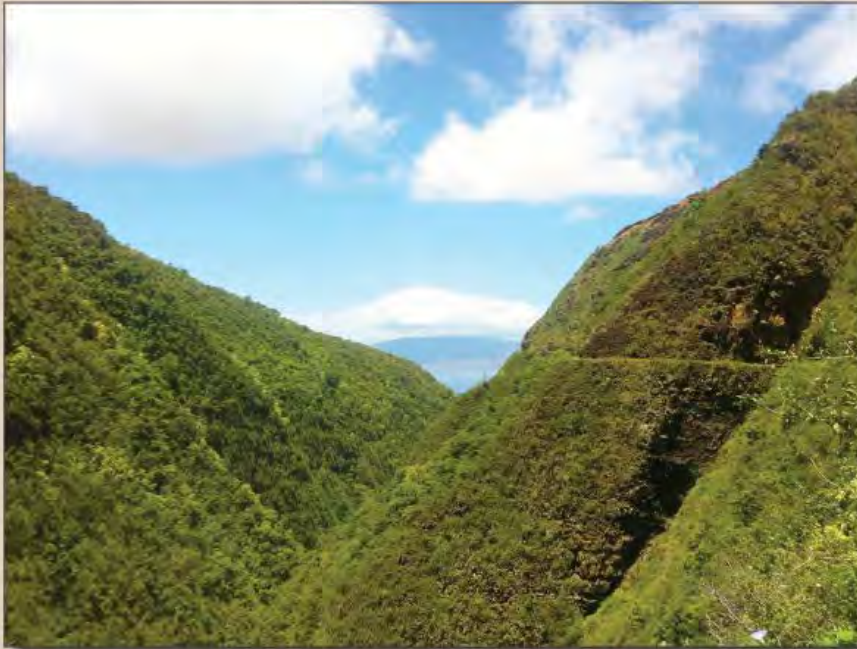


Background- USGS Report



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

Low-Flow Characteristics of Streams in the Lahaina District, West Maui, Hawai'i

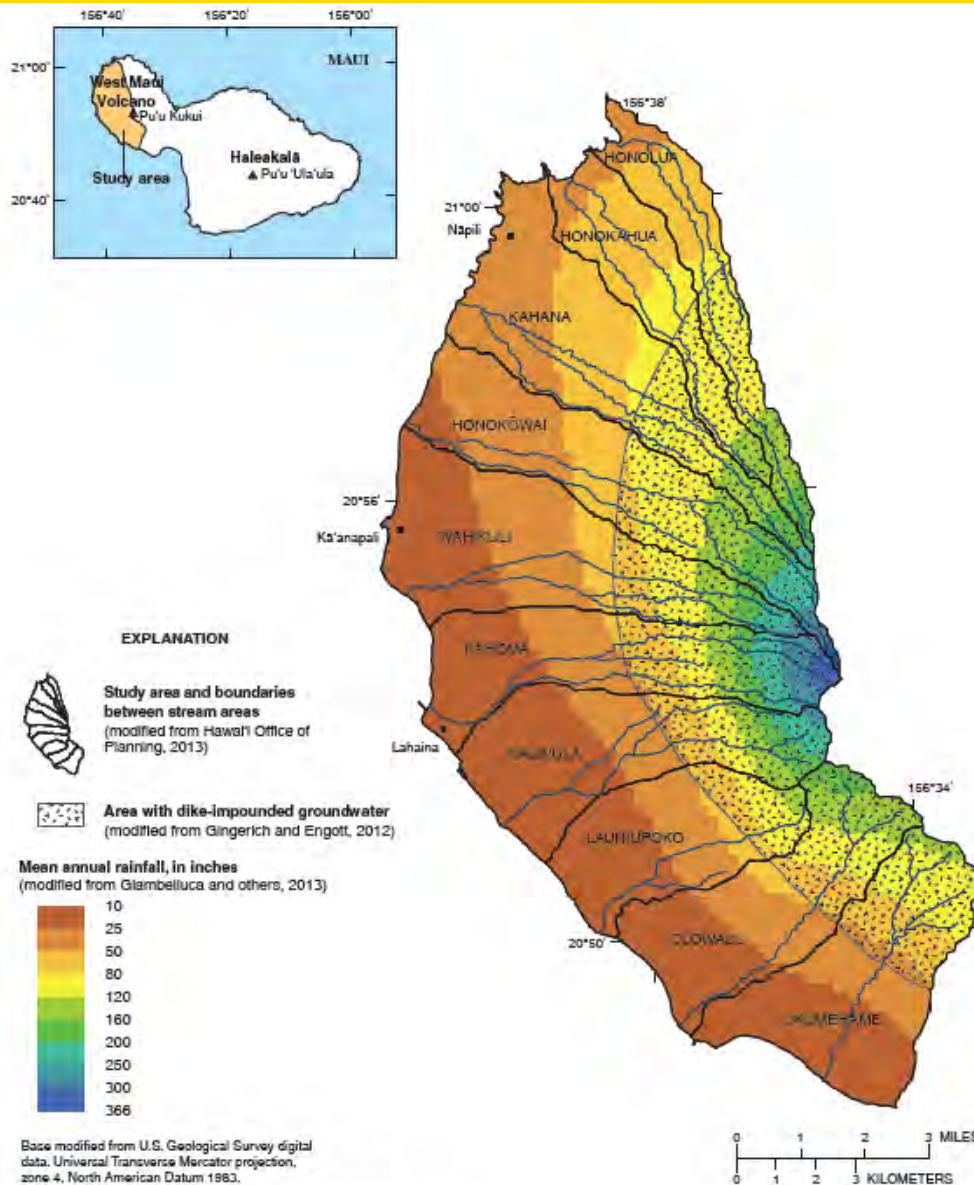


Scientific Investigations Report 2014–5087

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



Background- Hydrology



1. Orographic rainfall driven by trade winds at high elevations contributes runoff

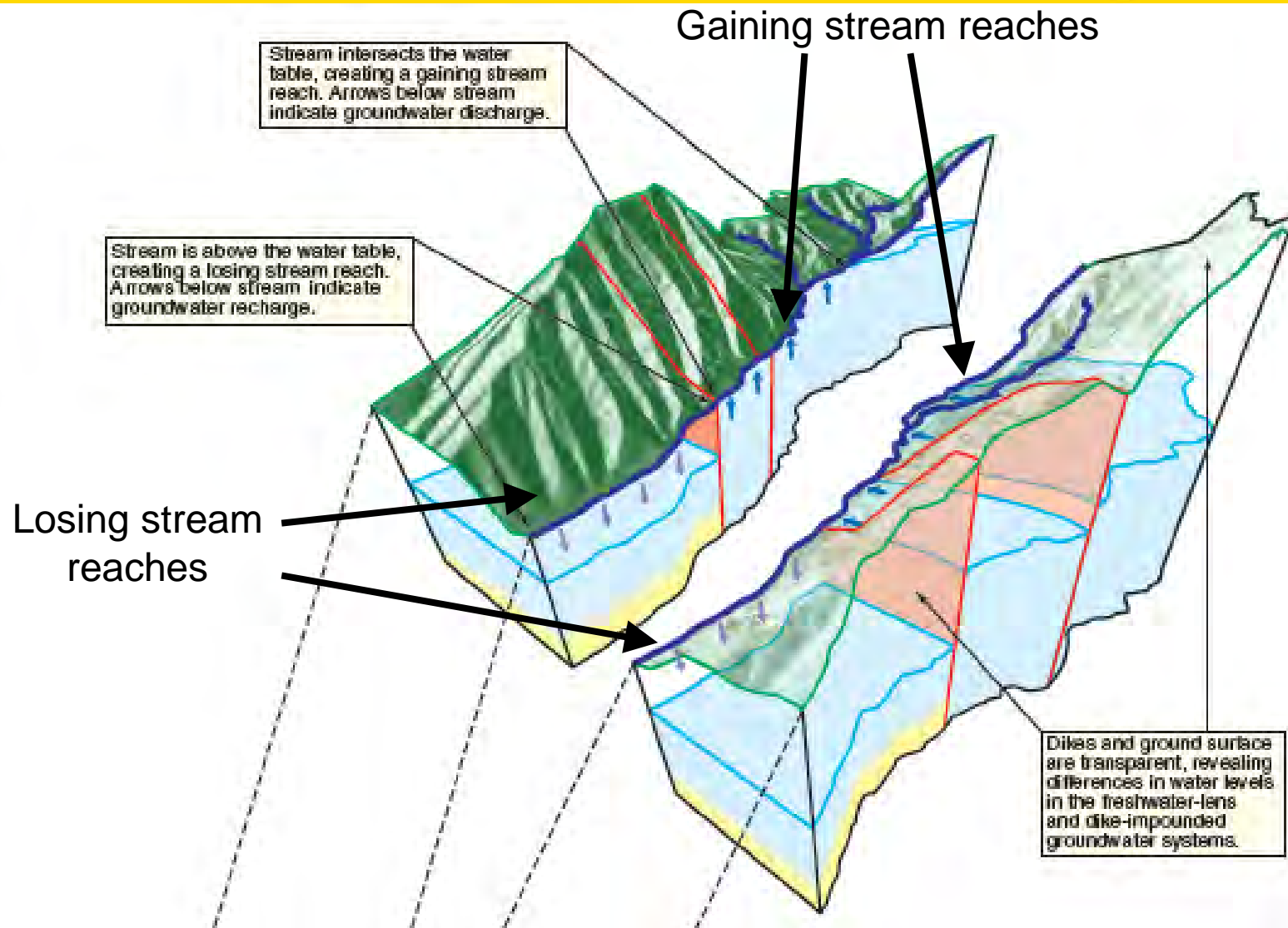
2. Dike-impounded groundwater and development tunnels contributes baseflow

→ Gaining reaches at high elevations, losing reaches at lower elevations

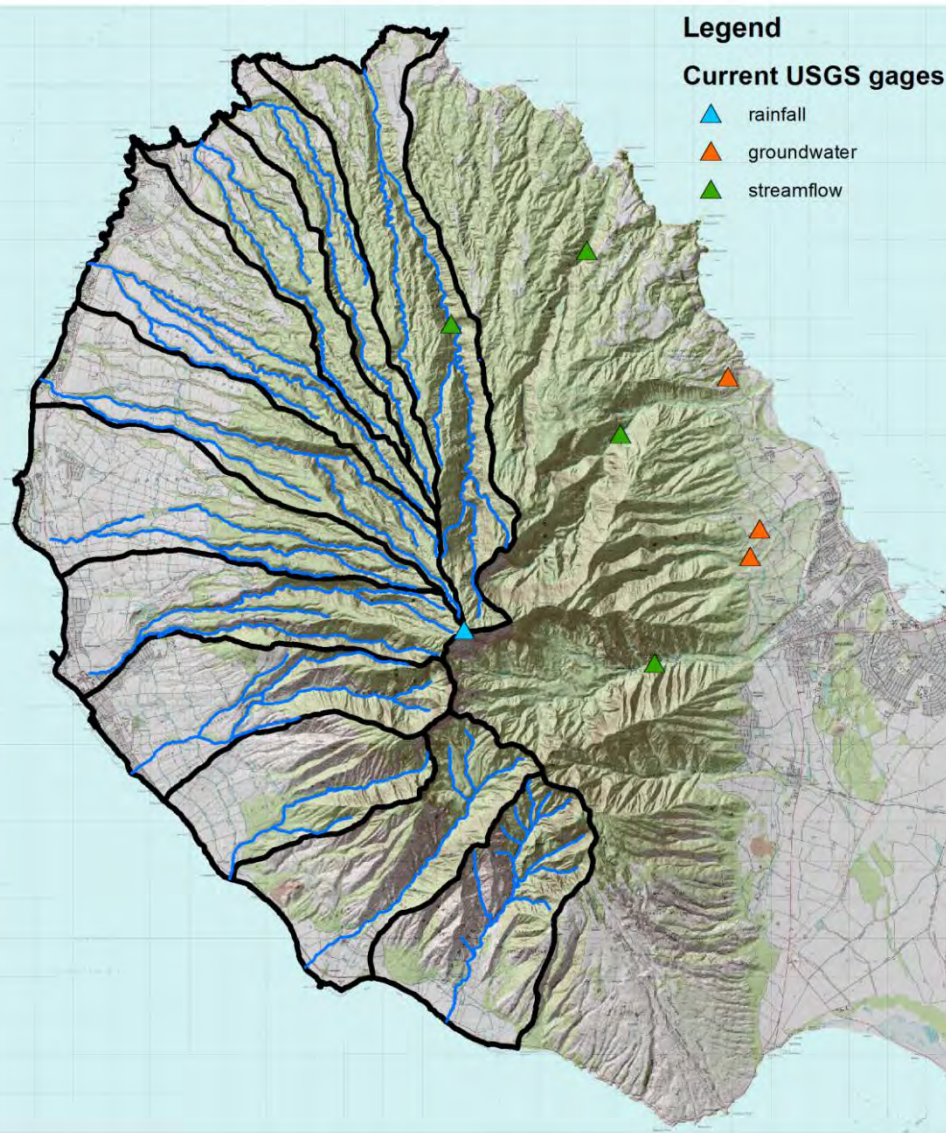
Figure 2. Map of mean annual rainfall, west Maui, Hawai'i.



Background- Hydrology



Background- USGS gages



1. Honokohau Stream (16620000)

Active: 1913-present

2. Other stations only active 1911-1917

Honolua Stream (16623000)

Honokowai Stream (16630000)

Kahoma Stream (1663400)

Kanaha Stream (16636000)

Ukumehame (16647000)

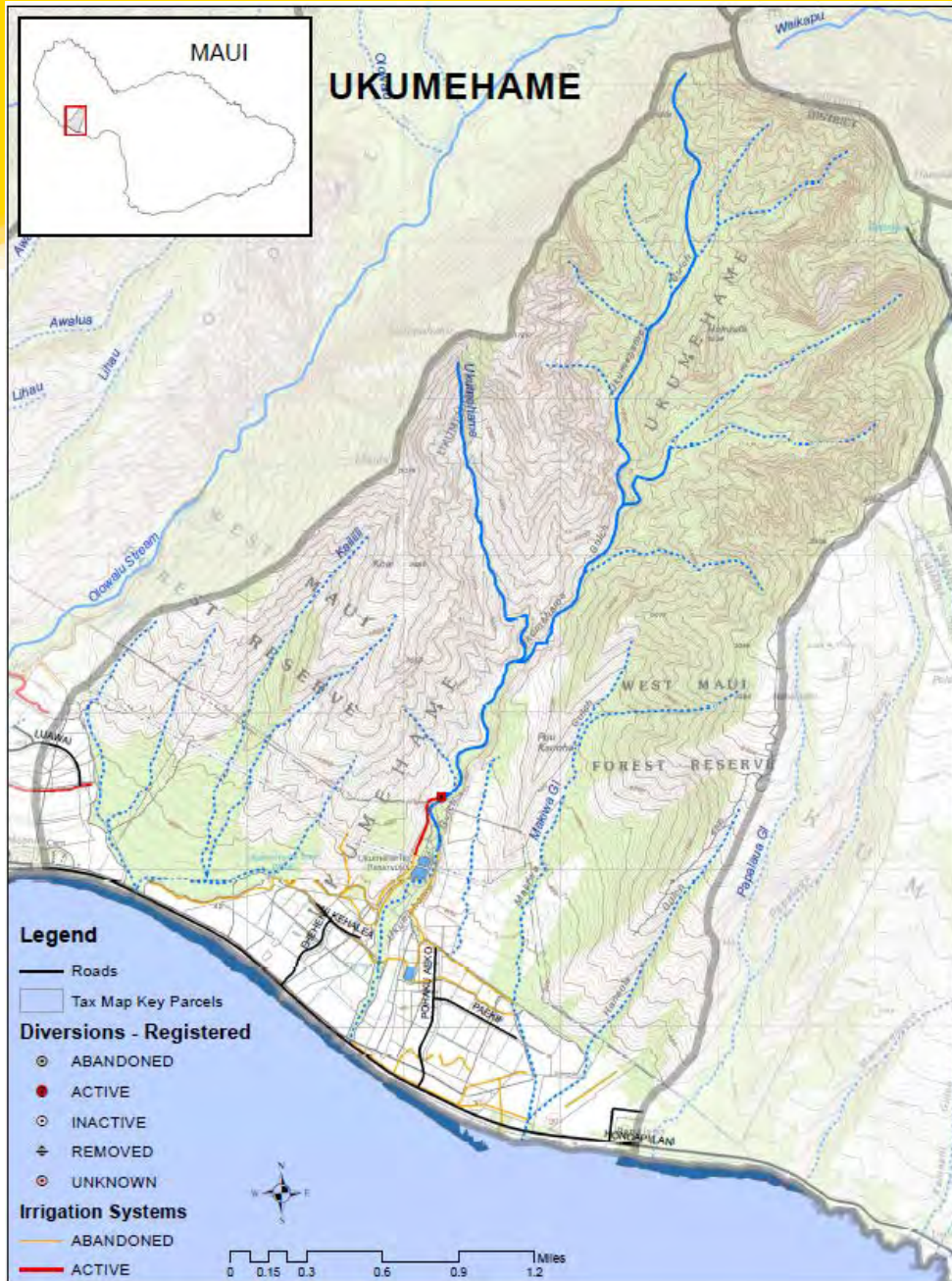
Kauaula Stream (16641000)

East Maui & Nā Wai 'Ehā used long-term continuously gaged stations for development of stream statistics

**Need to use a different method to develop low-flow stream statistics
→ partial-record gaging stations**



Ukumehame



Ka'akau Auwai: ~16 active lo'i

Former plantation diversion:

4 active lo'i

2 commercial farms (9.089 acres)

45 proposed agriculturally-zoned lots (only two built)

Unregistered diversion: domestic use



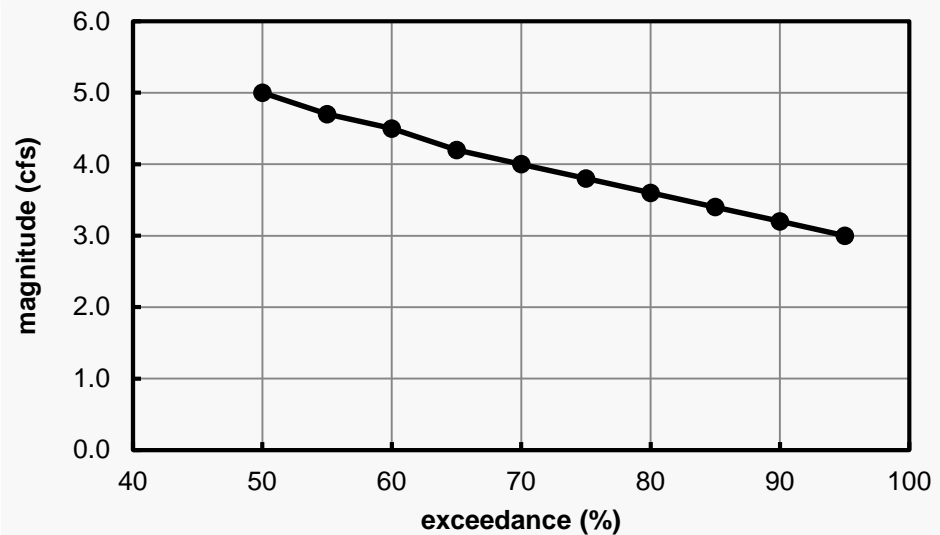
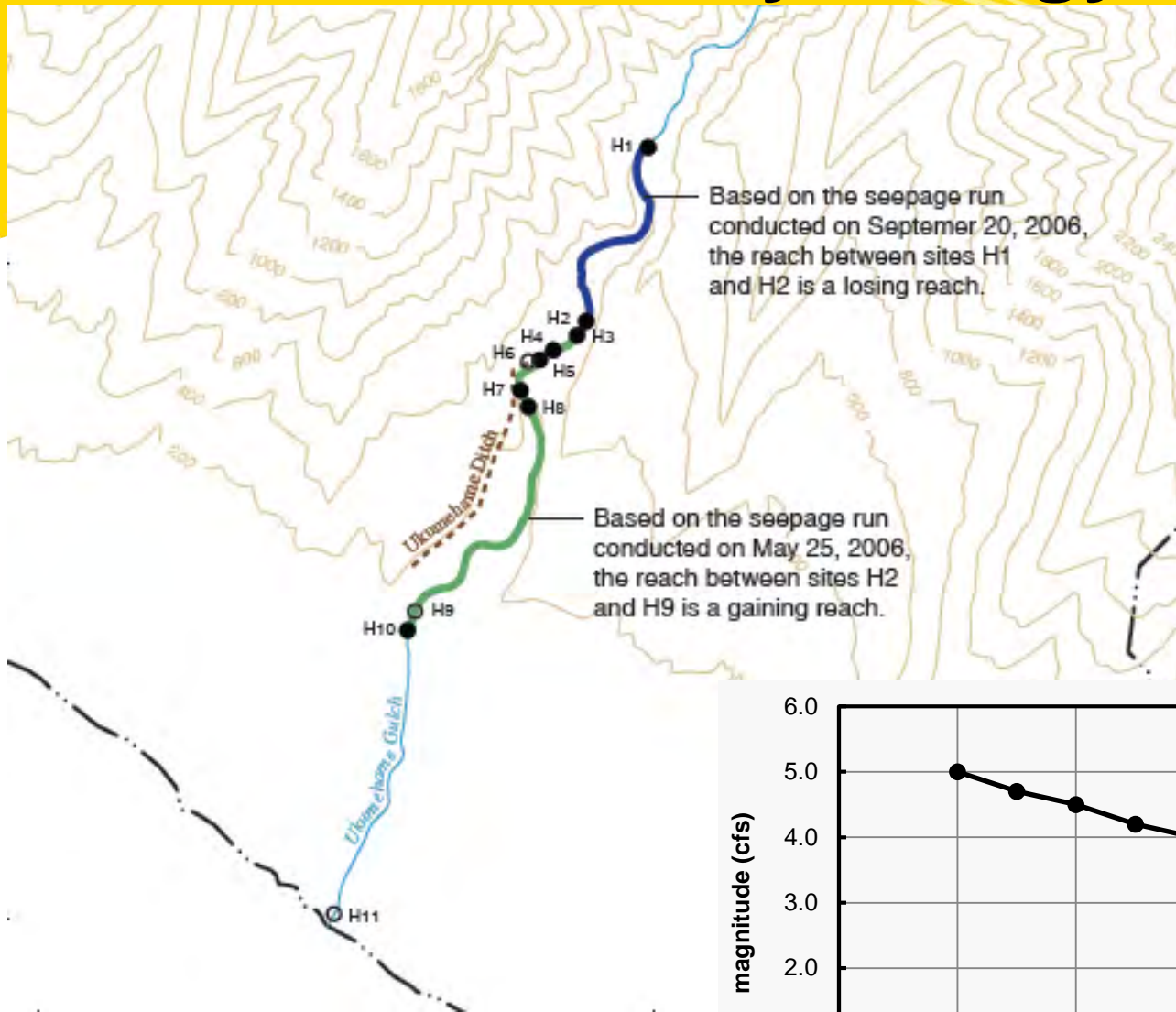
Ukumehame- Stream



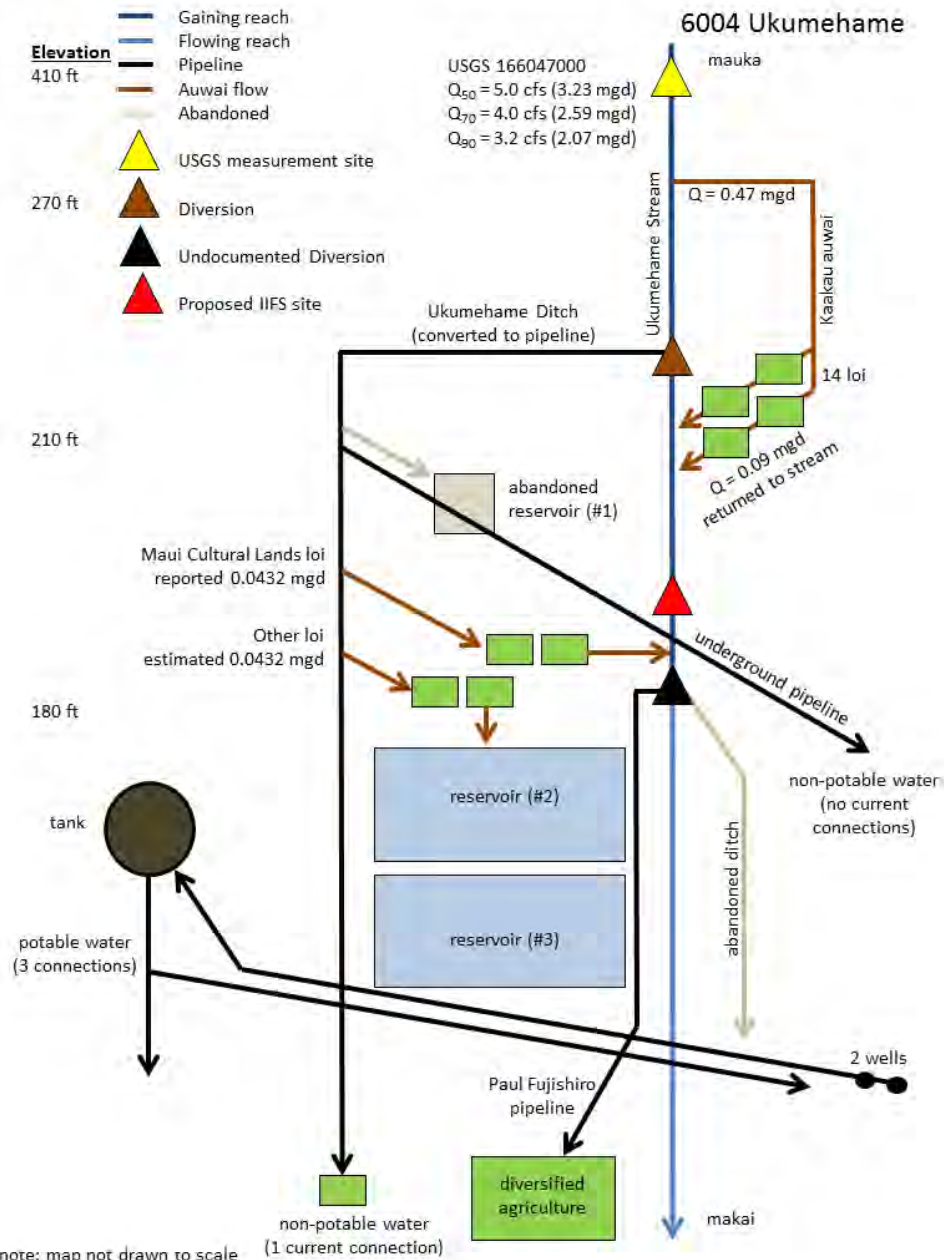
Ukumehame- Stream



Ukumehame- Hydrology



Ukumehame- Simplified



Ukumehame- Ka'akau Auwai



Ukumehame- Kaakau Auwai



Ukumehame- loi in use



Ukumehame- Plantation Diversion



Ukumehame- Plantation Diversion



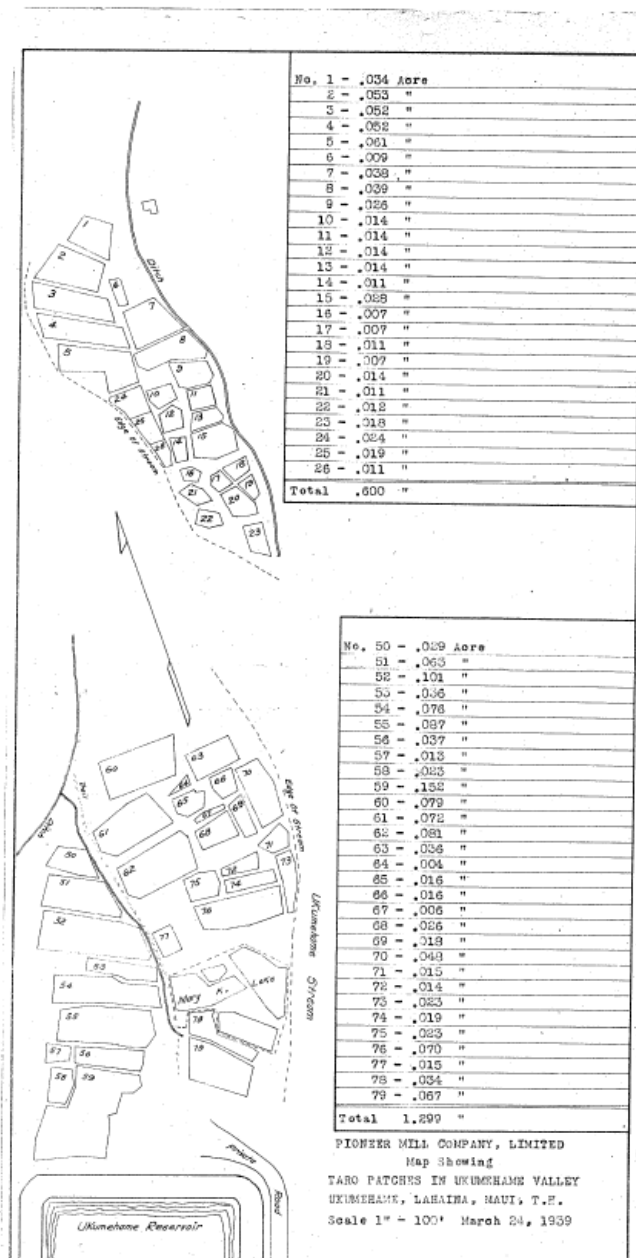
Ukumehame- loʻi in use



Ukumehame- lo'i in use



Ukumehame- historic lo'i



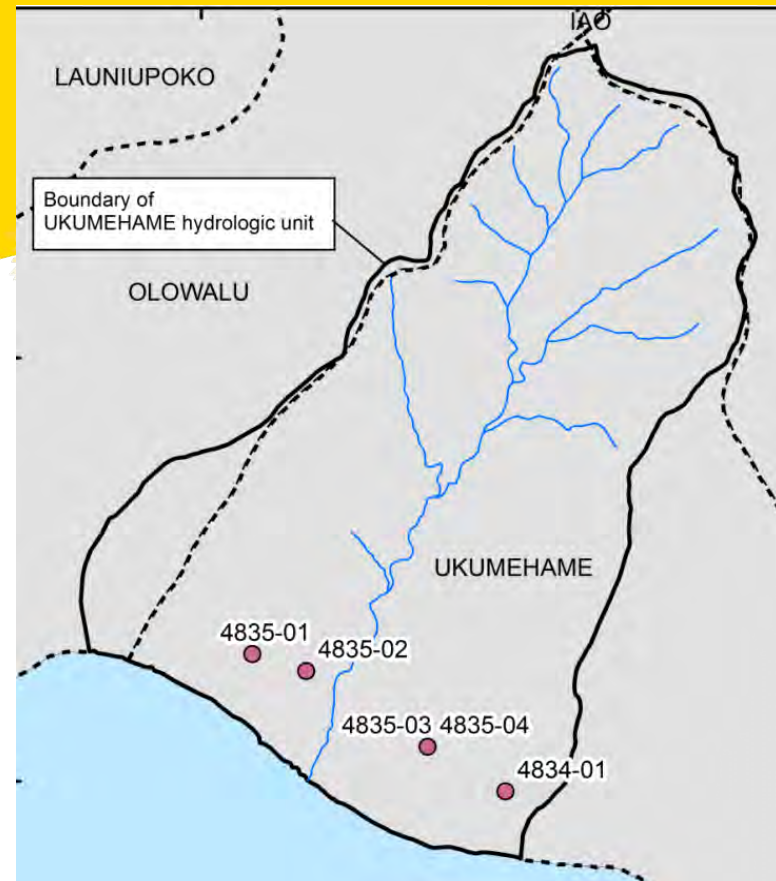
Ukumehame- freshwater habitat

Aquatic species surveys

	1994	2017
<i>Atyoida bisulcata</i> (opae kalaole)	Present	Present
<i>Macrobrachium grandimanus</i> (oheaa)	--	--
<i>Awaous guamensis</i> (nakea)	Present	Present
<i>Stenogobius hawaiiensis</i> (naniha)	--	Present
<i>Eleotric sandwicensis</i> (akupa)	--	--
<i>Sicyopterus stimpsoni</i> (nopili)	Present	Present
<i>Lentipes concolor</i> (alamoo)	Present	Present
<i>Neritina granosa</i> (hihiwai)	--	Present
<i>Neritina vespertina</i> (hapawai)	--	Present



Ukumehame- groundwater resources

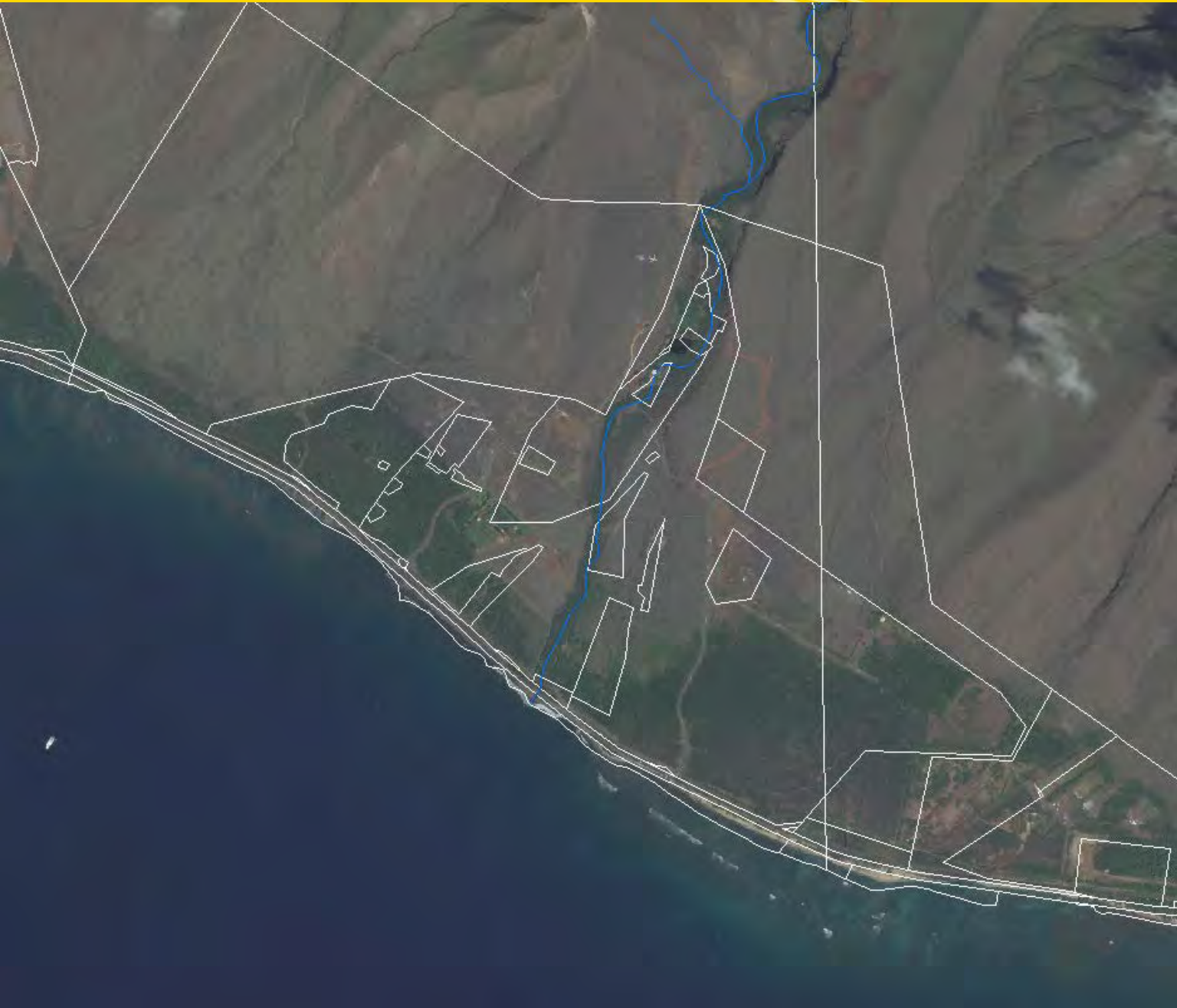


Total installed pump capacity: 0.116 mgd
 12-month moving average (2017): 0.062 mgd
 Aquifer sustainable yield: 2.0 mgd

Well number	Well Name	Well Owner	Year drilled	Pump rate (mgd)
4834-01	Environmental	Army National Guard	2003	0.101
4835-01	Ukumehame-Pump P	Pioneer Mill	1934	4.694
4835-02	Sugar Way 1	Uka LLC	2003	0.036
4835-03	Sugar Way 2	Uka LLC	2004	0.058
4835-04	Ukumehame 3	Uka LLC	2005	0.058



Ukumehame- off-stream use



Ukumehame- off-stream use

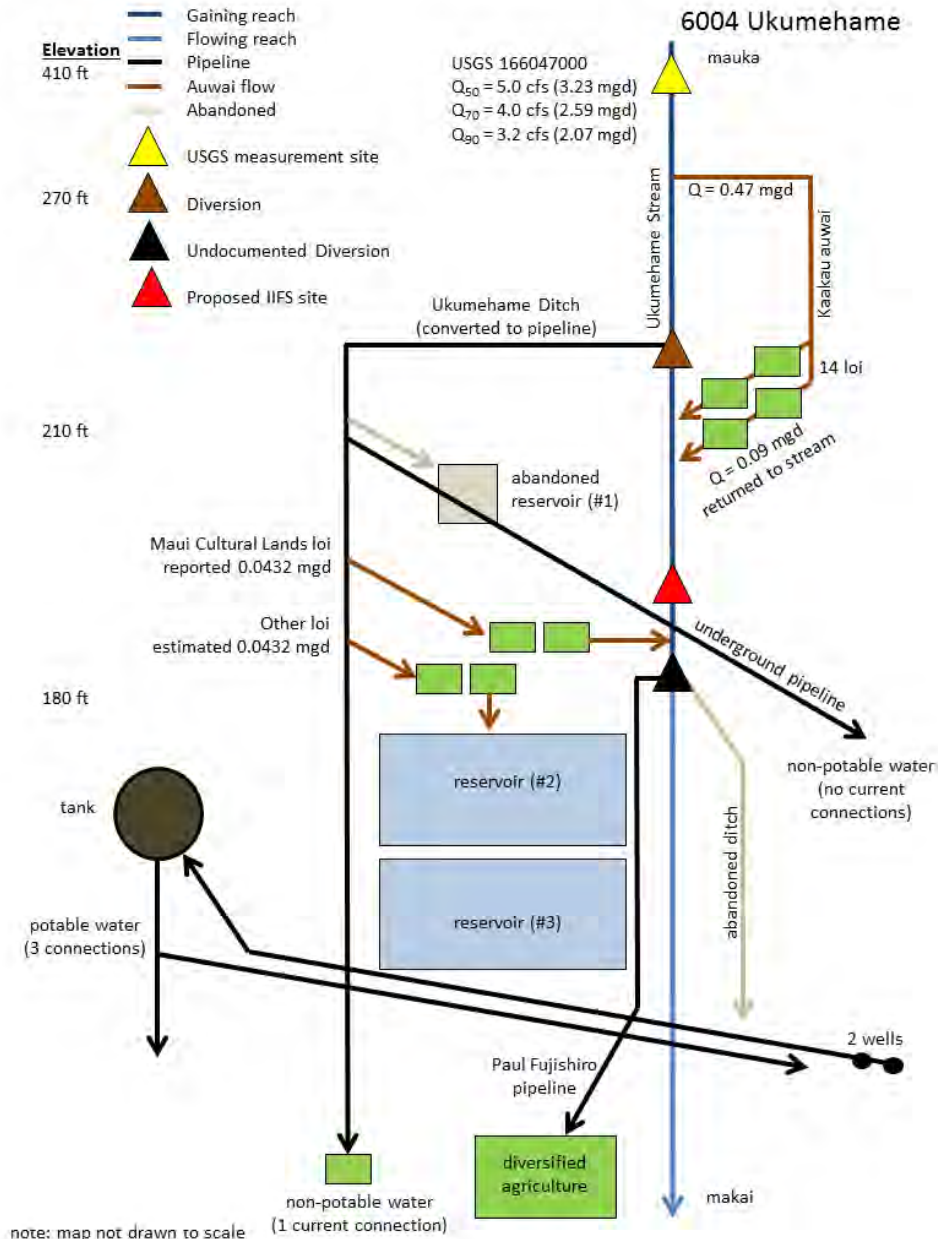
Uka, LLC

- 4 potable service connections
- 4 non-potable service connections
 - 2 commercial farms:
 - Maui Sunset Farm: 1.484 acres → 0.0074 mgd
 - Ukumehame Nursery: 7.605 acres → 0.038 mgd
- Landscaping Demand: 0.813 acres → 0.004 mgd (estimated)

Non-potable system damaged in 2016 fire → total water demand for potable and non-potable needs supplied by groundwater for 2017 (0.062 mgd)



Ukumehame- proposed IIFS

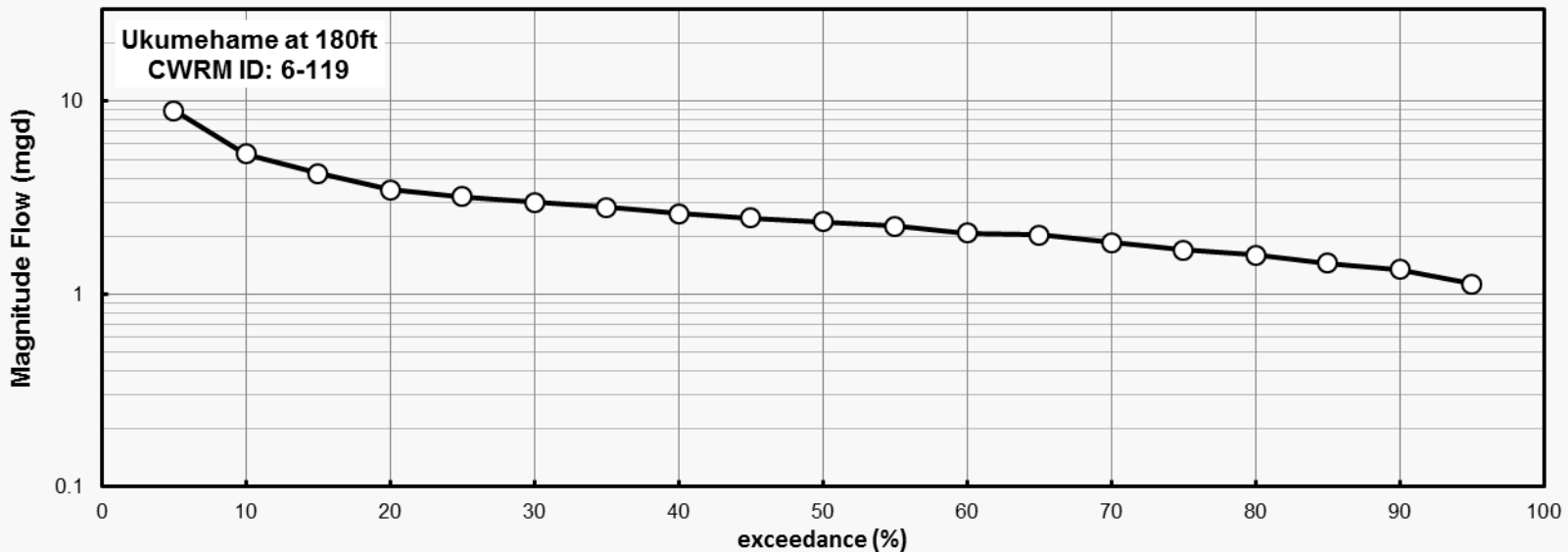


Q_{50}	Q_{60}	Q_{70}	Q_{90}
5.0 cfs (3.23 mgd)	4.5 cfs (2.91 mgd)	4.0 cfs (2.59 mgd)	3.2 cfs (2.07 mgd)

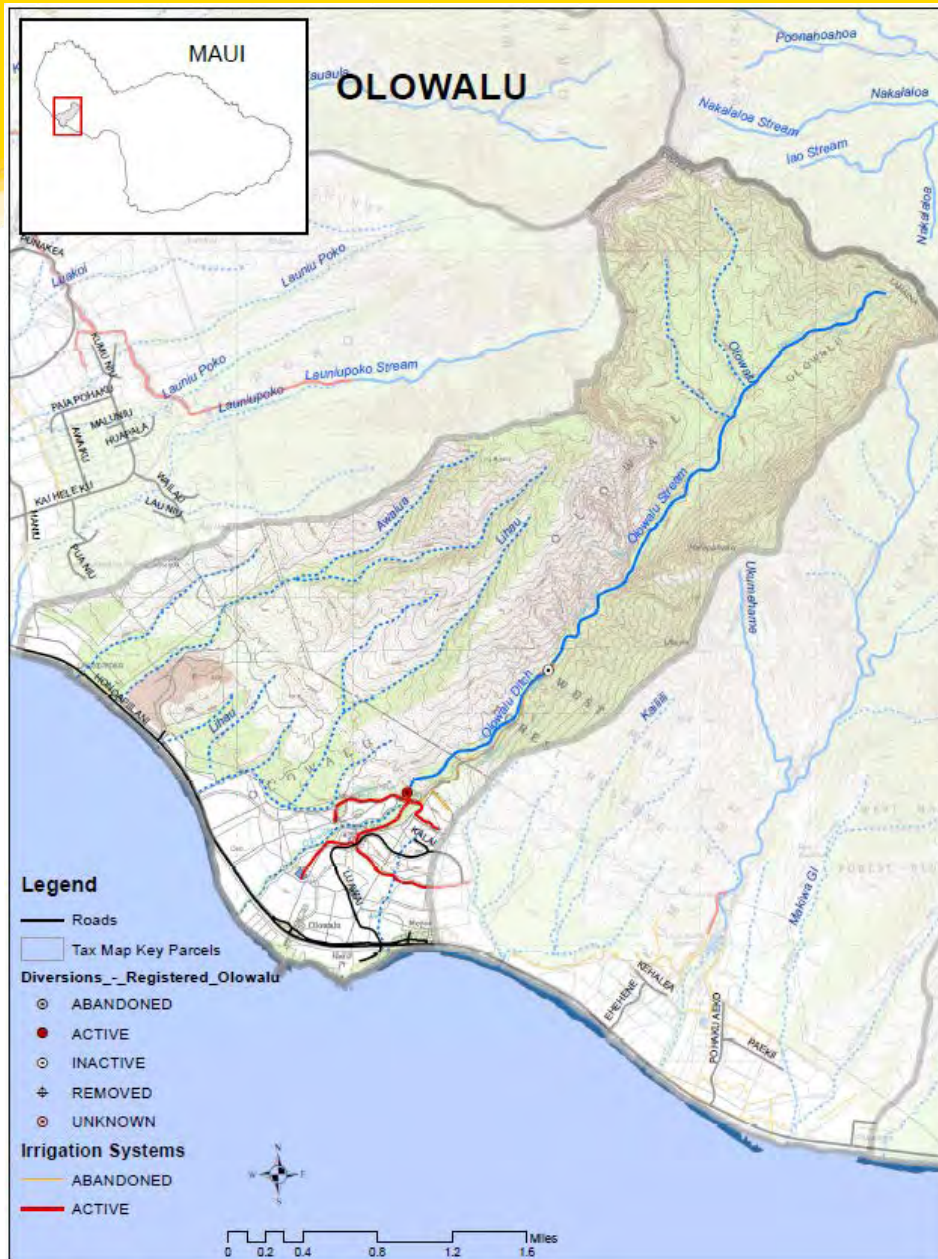
2016 Estimated Amount Diverted	Proposed IIFS	location
0.016 mgd	2.9 mgd	below diversion



verification of attainability of IIFS



Olowalu



Upper Plantation Diversion: intake destroyed by flood 9/2016

Lower Plantation Diversion:

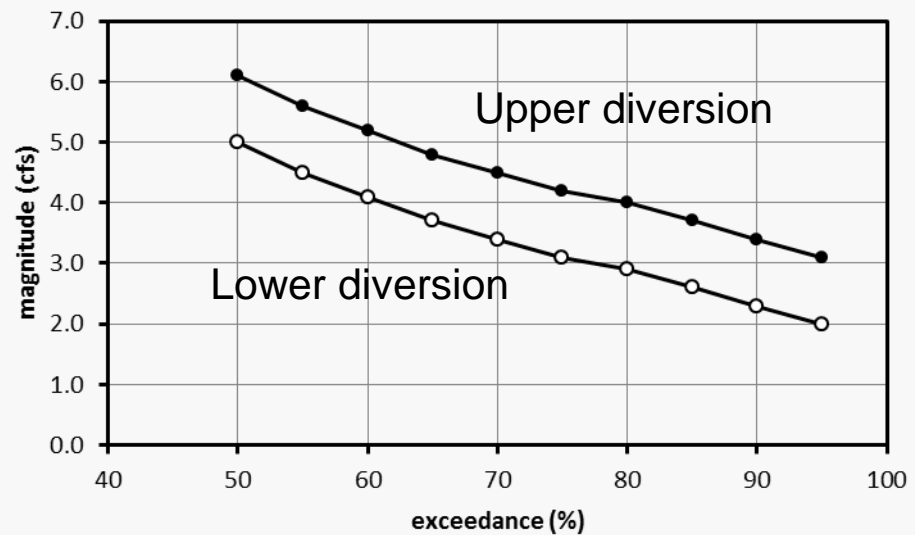
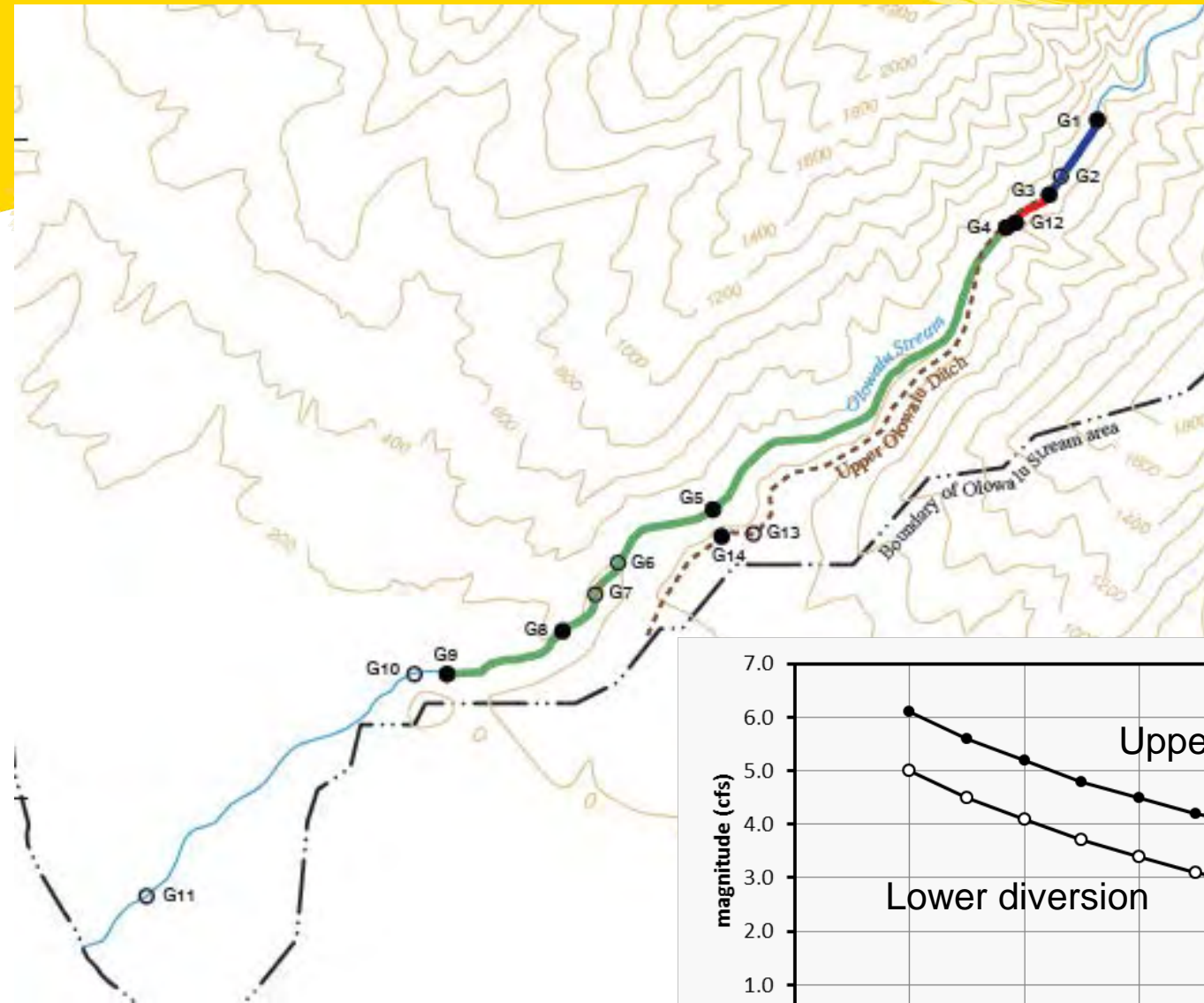
- 9-12 inactive lo'i
- multiple commercial farms
- agriculturally-zoned parcels (49.41 acres)
- Landscape irrigation (28.3 acres)
- Cattle pasture



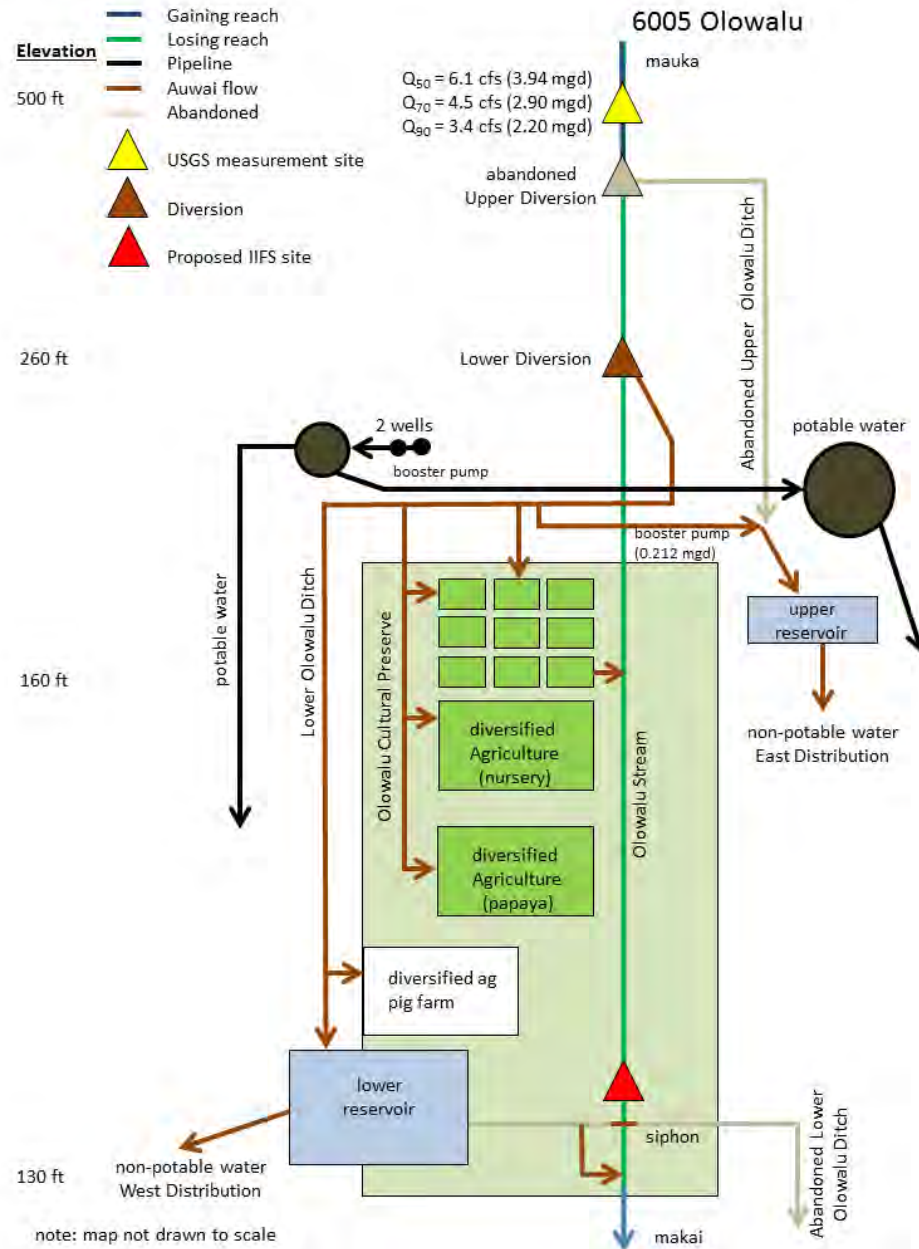
Olowalu- Stream



Olowalu- Hydrology



Olowalu- Simplified



Olowalu- Upper Diversion



Olowalu- Lower Diversion



Olowalu- Lower Diversion



Olowalu- Lower Diversion



Olowalu- Lower Diversion



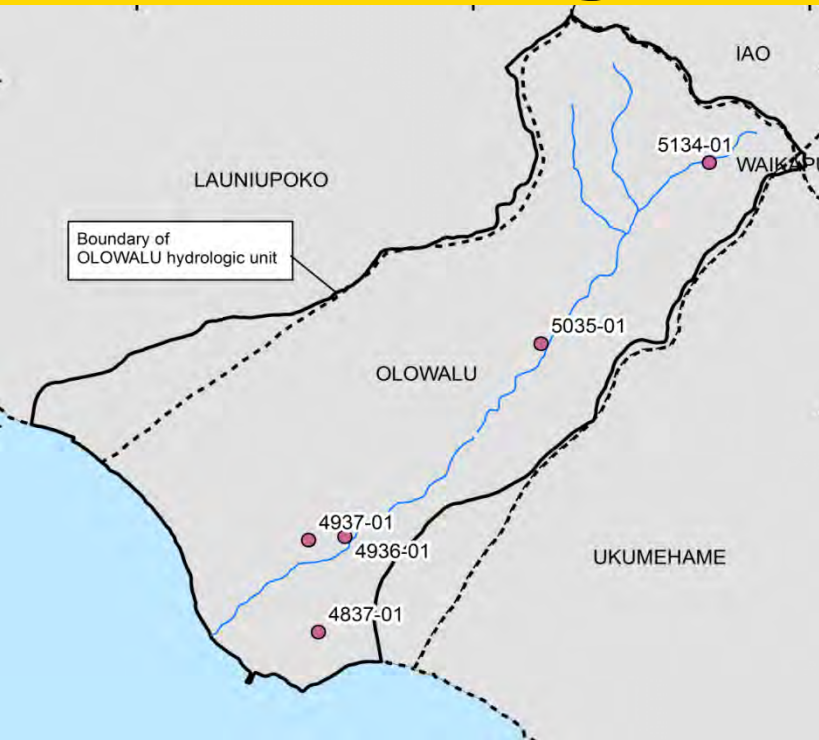
Olowalu- freshwater habitat

Aquatic species surveys

	1994	2017
<i>Atyoida bisulcata</i> (opae kalaole)	Present	--
<i>Macrobrachium grandimanus</i> (oheaa)	--	Present
<i>Awaous guamensis</i> (nakea)	Present	Present
<i>Stenogobius hawaiiensis</i> (naniha)	--	--
<i>Eleotric sandwicensis</i> (akupa)	--	--
<i>Sicyopterus stimpsoni</i> (nopili)	Present	Present
<i>Lentipes concolor</i> (alamoo)	Present	Present
<i>Neritina granosa</i> (hihiwai)	--	--
<i>Neritina vespertina</i> (hapawai)	--	--



Olowalu- groundwater resources

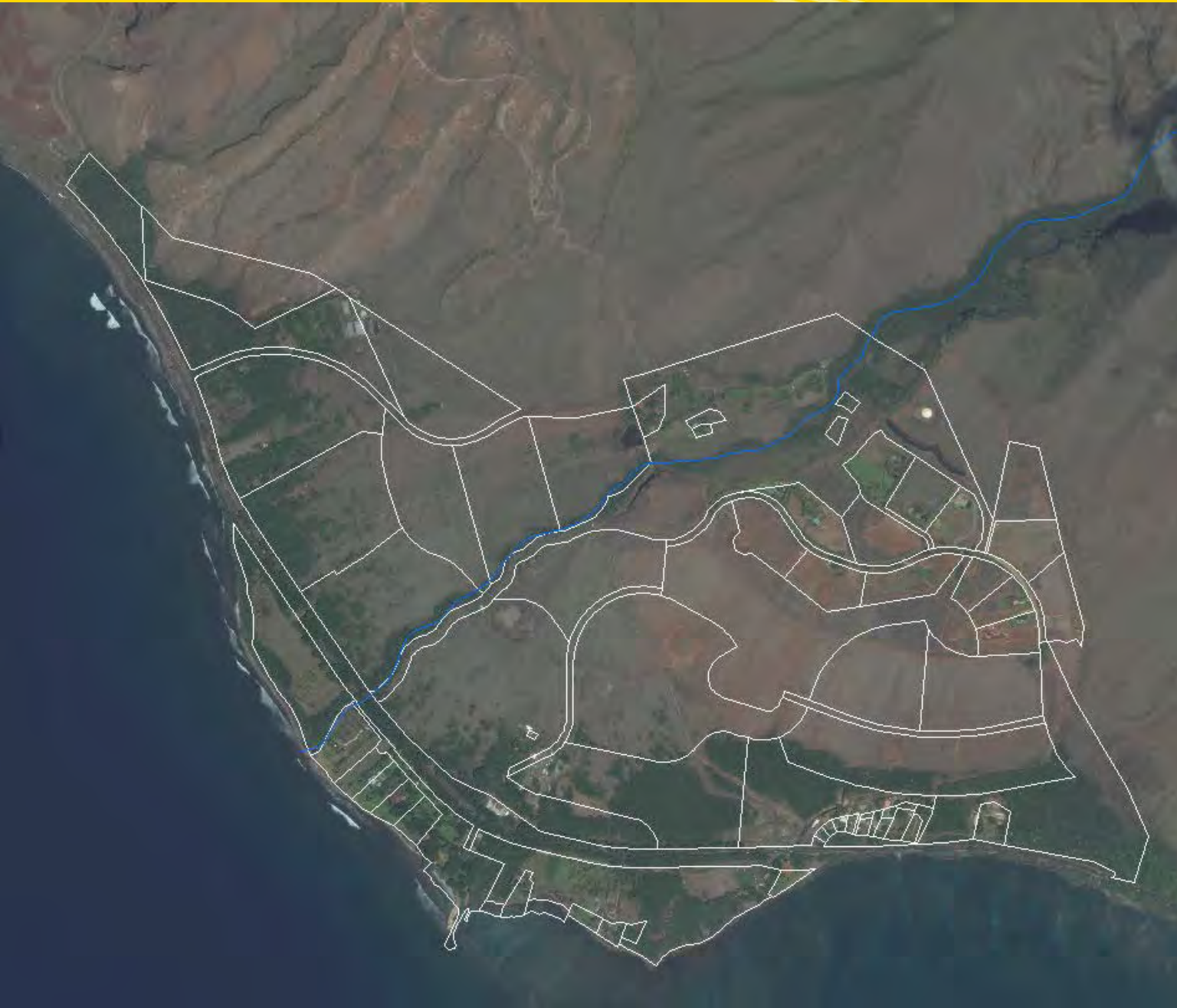


Total installed pump capacity: 0.36 mgd
 12-month moving average (2017): 0.104 mgd
 Aquifer sustainable yield: 2.0 mgd

Well number	Well Name	Well Owner	Year drilled	Pump rate (mpm)	status
5134-01	Olowalu Tun	Pioneer Mill	--		Not active
5035-01	Olowalu Tunnel	Pioneer Mill	1912		Not active
4937-01	Olowalu Pump N	Olowalu Elua A	1933	36.1	Active
4936-01	Olowalu Elua	Olawalu Elua	1999	250	Active
4837-01	Olowalu Pump O	Olowalu Elua A	1905	280	Active



Olowalu- off-stream use



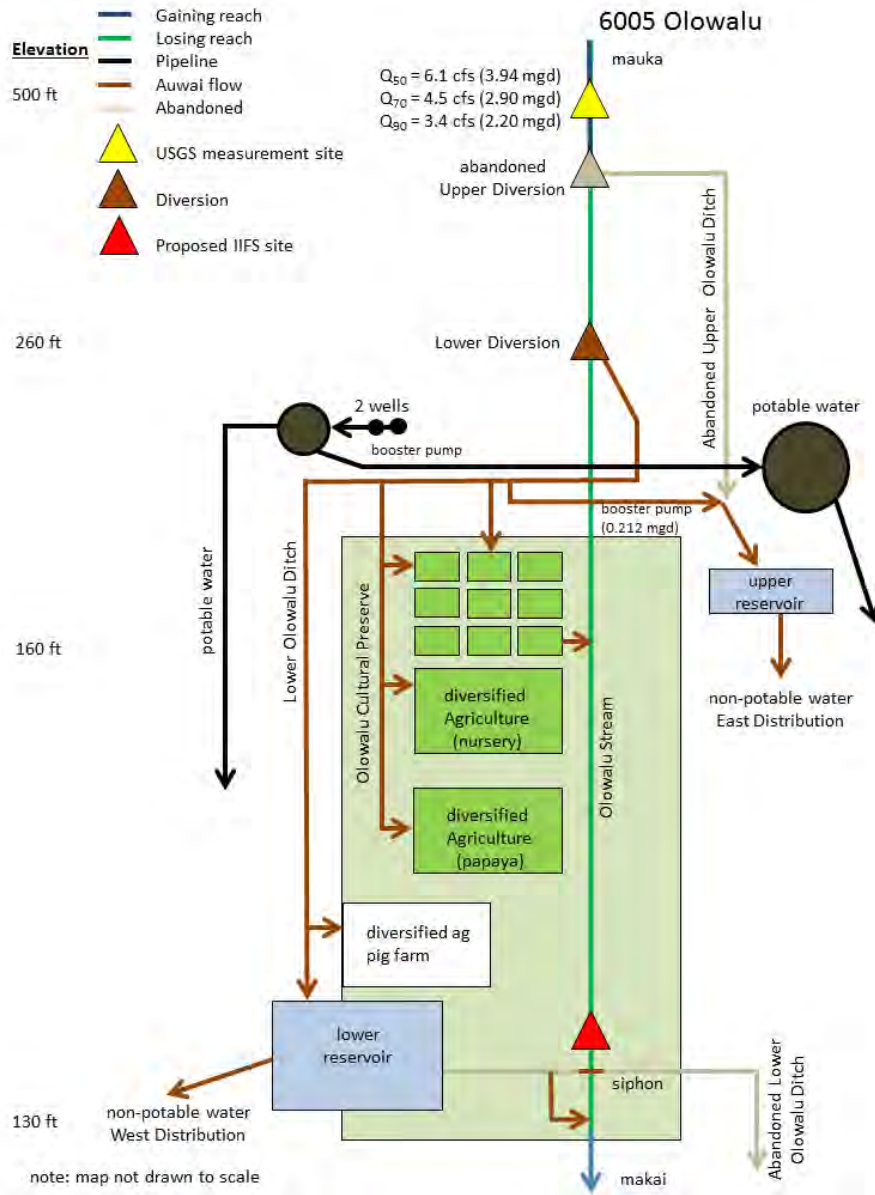
Olowalu- off-stream use

Olowalu Water Company

- 57 potable service connections
- 44 non-potable service connections
 - Average metered use: 0.281 mgd
 - PUC application for 0.273 mgd non-potable use
- Current Agricultural Demand (estimated)
 - Pasture: 300 acres (~10 head) → 0.002 mgd
 - Pig farm: 1.6 acres
 - Diversified Agriculture: ~35 acres → 0.119 mgd
 - Tree crops: ~19 acres → 0.055 mgd
- Landscaping Demand: 28.3 acres → 0.141 mgd



Olowalu- proposed IIFS



At lower diversion

Q_{50}	Q_{60}	Q_{70}	Q_{90}
5.0 cfs (3.23 mgd)	4.1 cfs (2.65 mgd)	3.4 cfs (2.20 mgd)	2.3 cfs (1.49 mgd)

Average metered use: 0.281 mgd

2017 Estimated Amount Diverted	Proposed IIFS	location
1.45 mgd	2.33 mgd	at USGS 16646200 below diversion

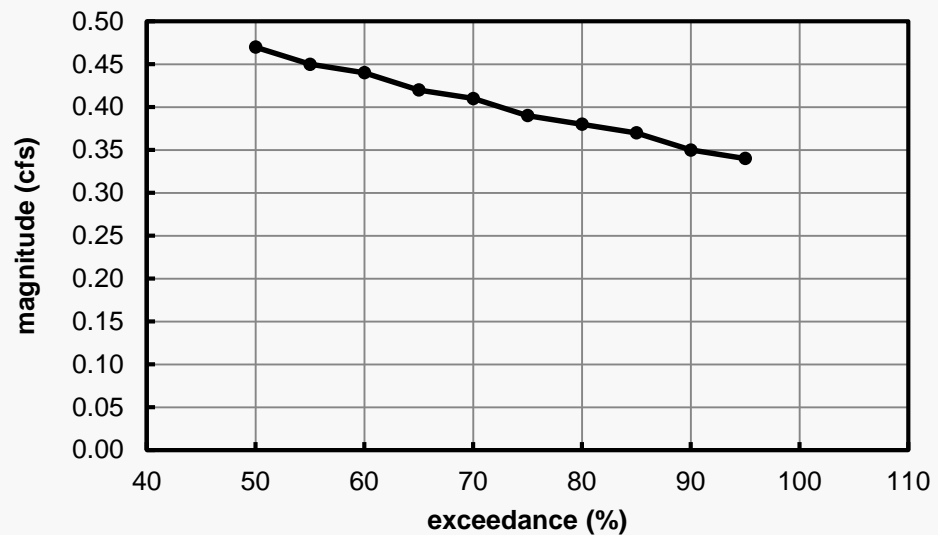
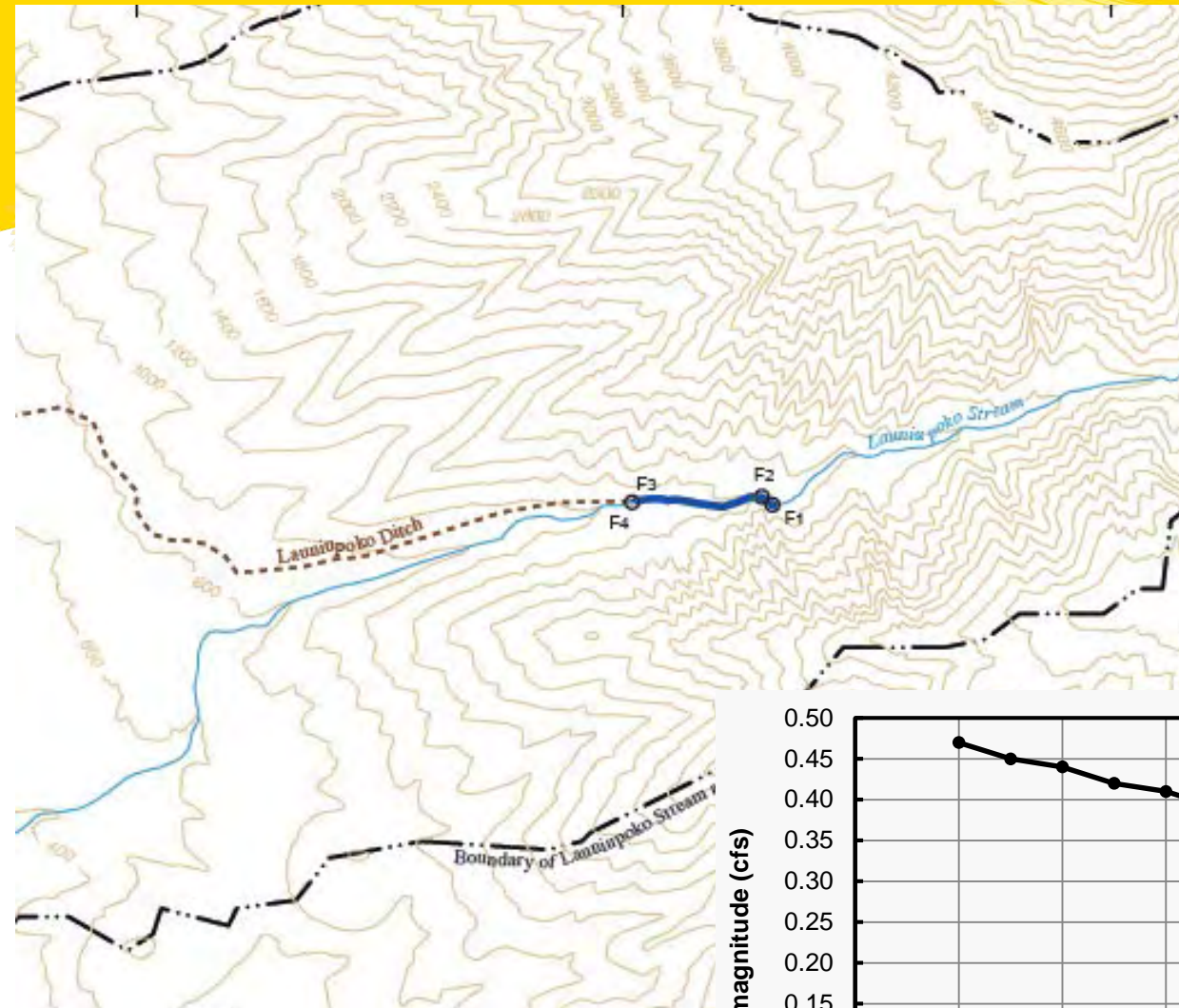
- Will meet agricultural demand at least 50% of time without the use of groundwater



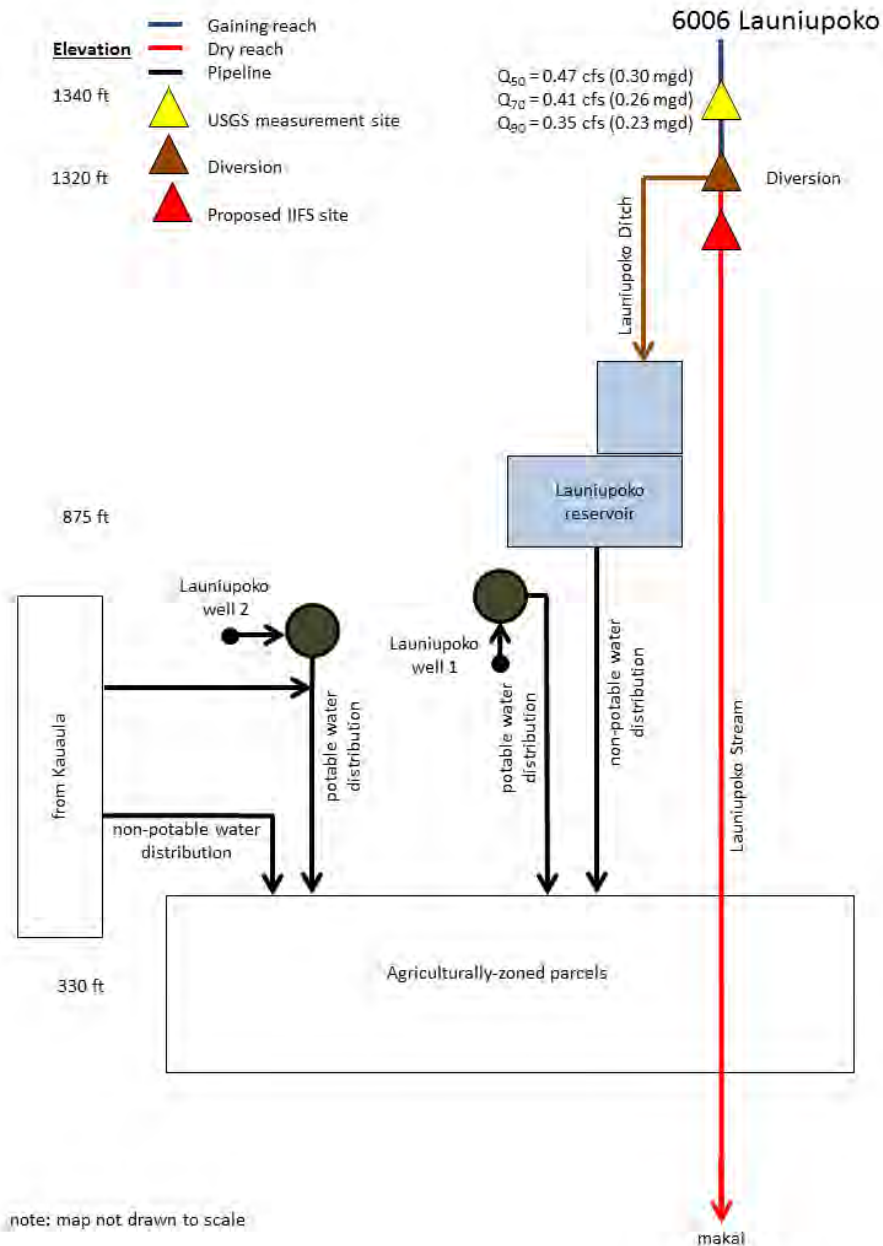
Launiupoko- Stream



Launiupoko- Hydrology



Launiupoko- Simplified



Launiupoko- Diversion



Launiupoko- Diversion



Launiupoko- Diversion

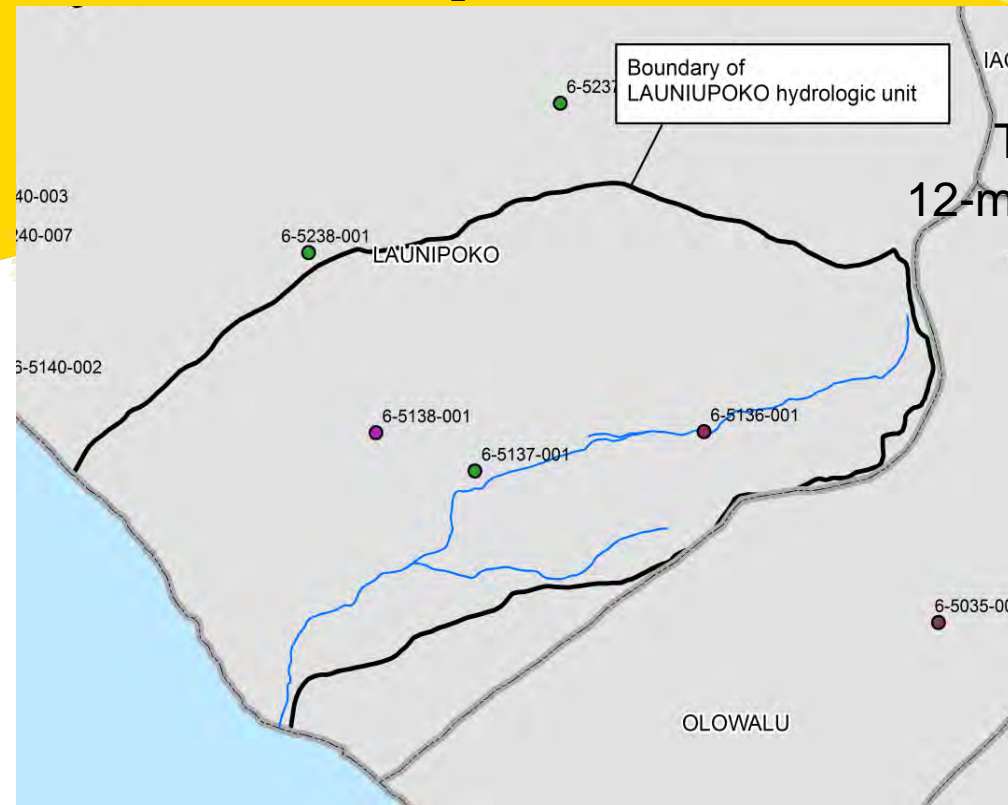


Launiupoko- freshwater habitat

Aquatic species surveys

	1994
<i>Atyoida bisulcata</i> (opae kalaole)	--
<i>Macrobrachium grandimanus</i> (oheaa)	--
<i>Awaous guamensis</i> (nakea)	--
<i>Stenogobius hawaiiensis</i> (naniha)	--
<i>Eleotric sandwicensis</i> (akupa)	--
<i>Sicyopterus stimpsoni</i> (nopili)	--
<i>Lentipes concolor</i> (alamoo)	--
<i>Neritina granosa</i> (hihiwai)	--
<i>Neritina vespertina</i> (hapawai)	--

Launiupoko- Groundwater resources

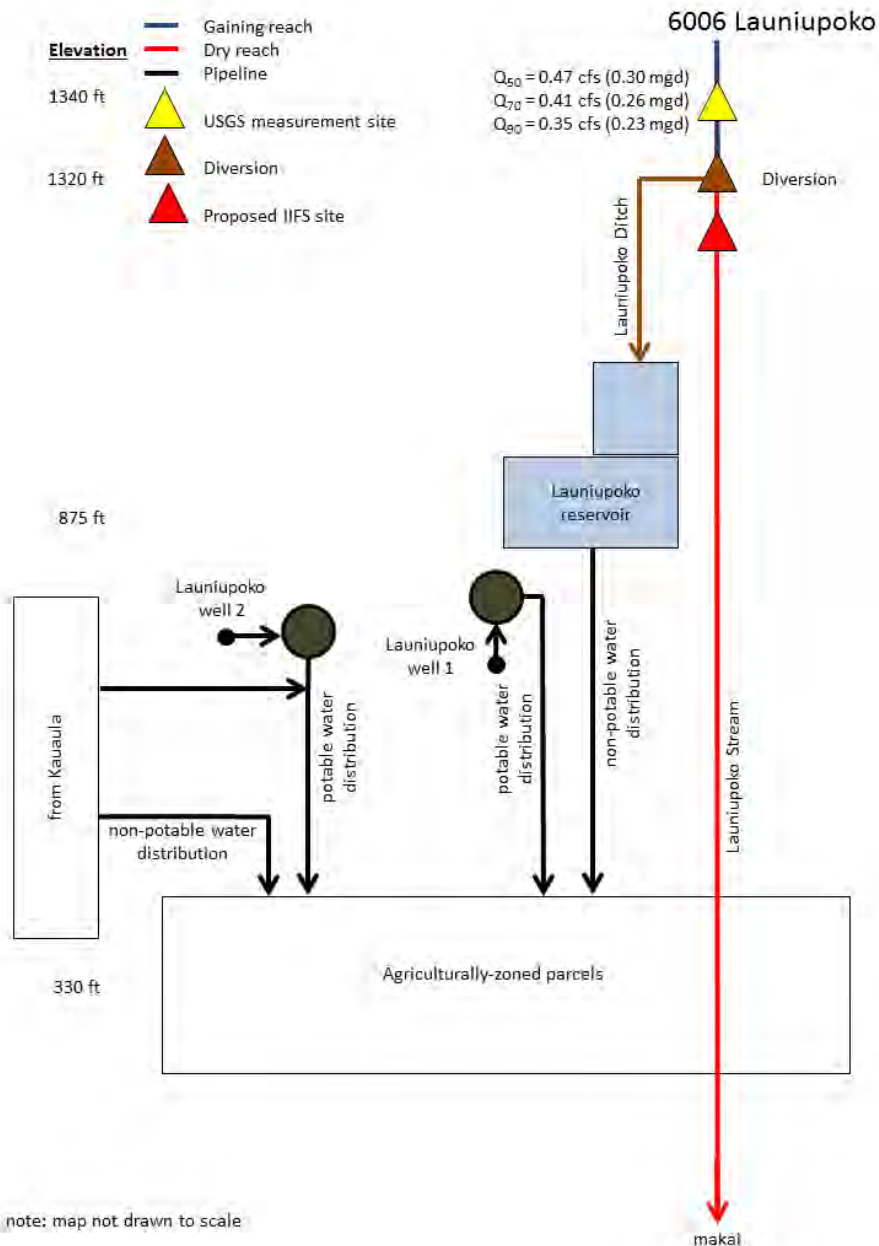


Total installed pump capacity: 4.019 mgd
 12-month moving average (2017): 0.864 mgd
 Aquifer sustainable yield: 7.0 mgd

Well number	Well Name	Well Owner	Year drilled	Pump rate (gpm)
5136-001	Launiupoko Tunnel	Pioneer Mill	--	0
5137-001	Launiupoko 2	Launiupoko Water Co.	2000	100
5138-001	Launiupoko 1	Launiupoko Water Co.	1979	500



Launiupoko- proposed IIFS

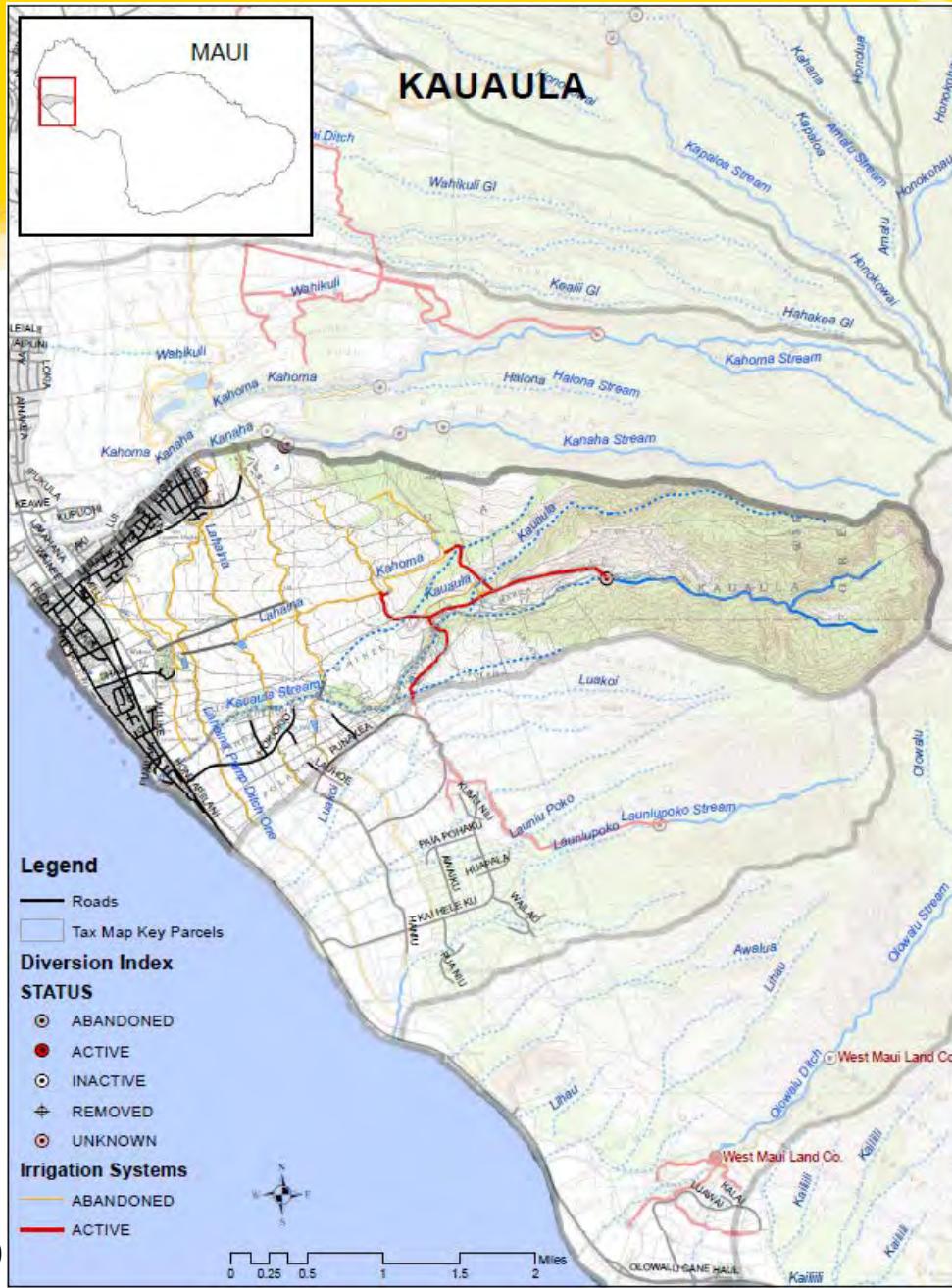


Q_{50}	Q_{60}	Q_{70}	Q_{90}
0.47 cfs (0.30 mgd)	0.44 cfs (0.28 mgd)	0.41 cfs (0.26 mgd)	0.35 cfs (0.23 mgd)

2017 Estimated Amount Diverted	Proposed IIFS	location
0.24 mgd	0 mgd	below diversion



Kaua'ula



Plantation Diversion:

- Replaced piilani auwai
- Kamehameha Schools lessees
- Hydropower plant
- Commercial farms
- agriculturally-zoned parcels (88.2 acres)
- Landscape irrigation (193.8 acres)
- Return to stream at siphon

Auwai:

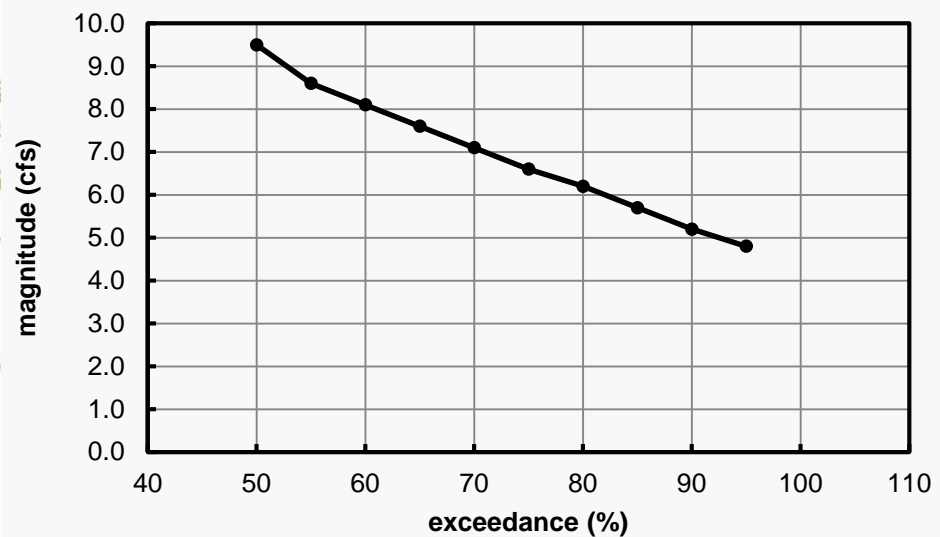
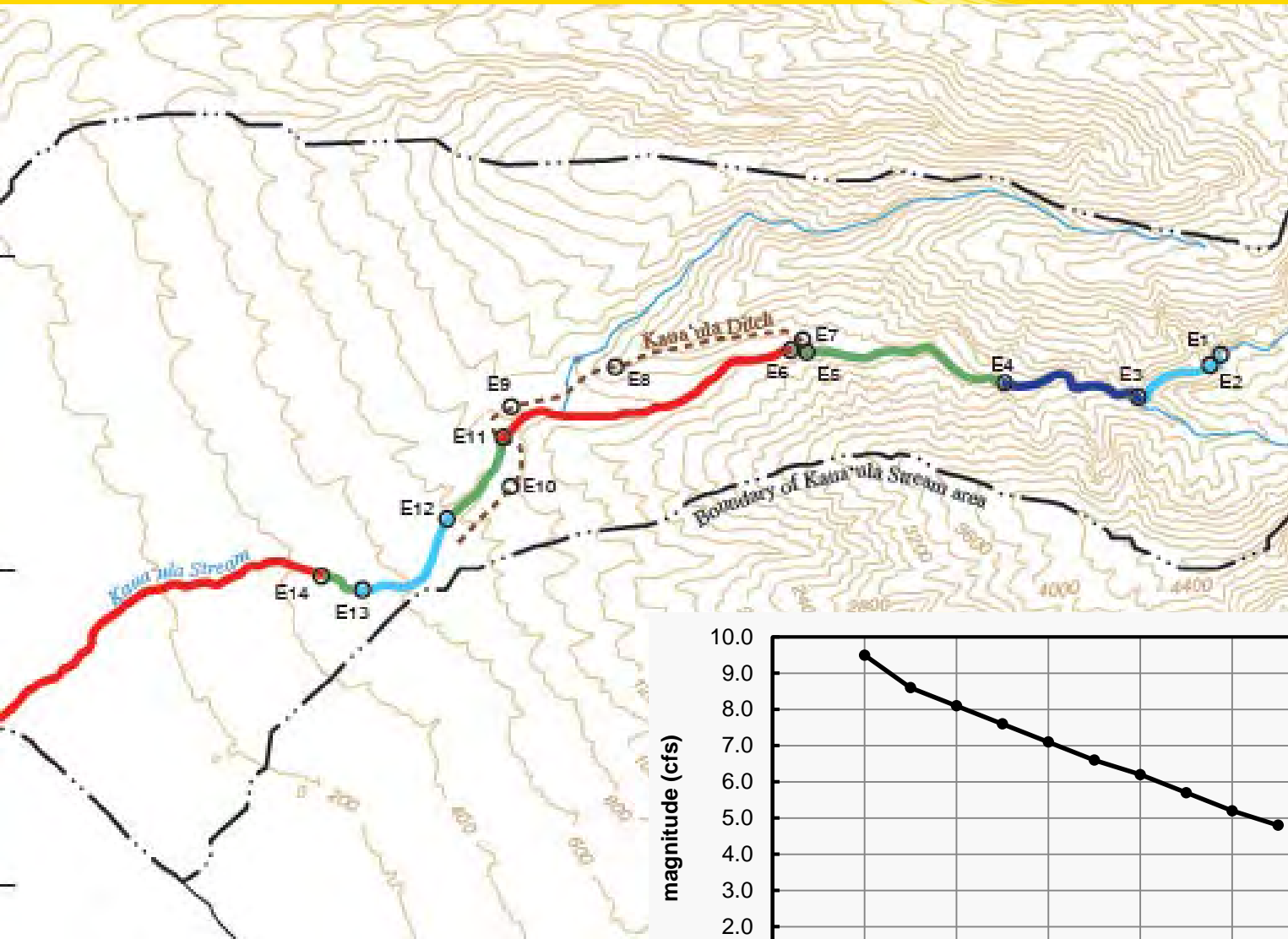
- 6 active loi
- 25 inactive loi



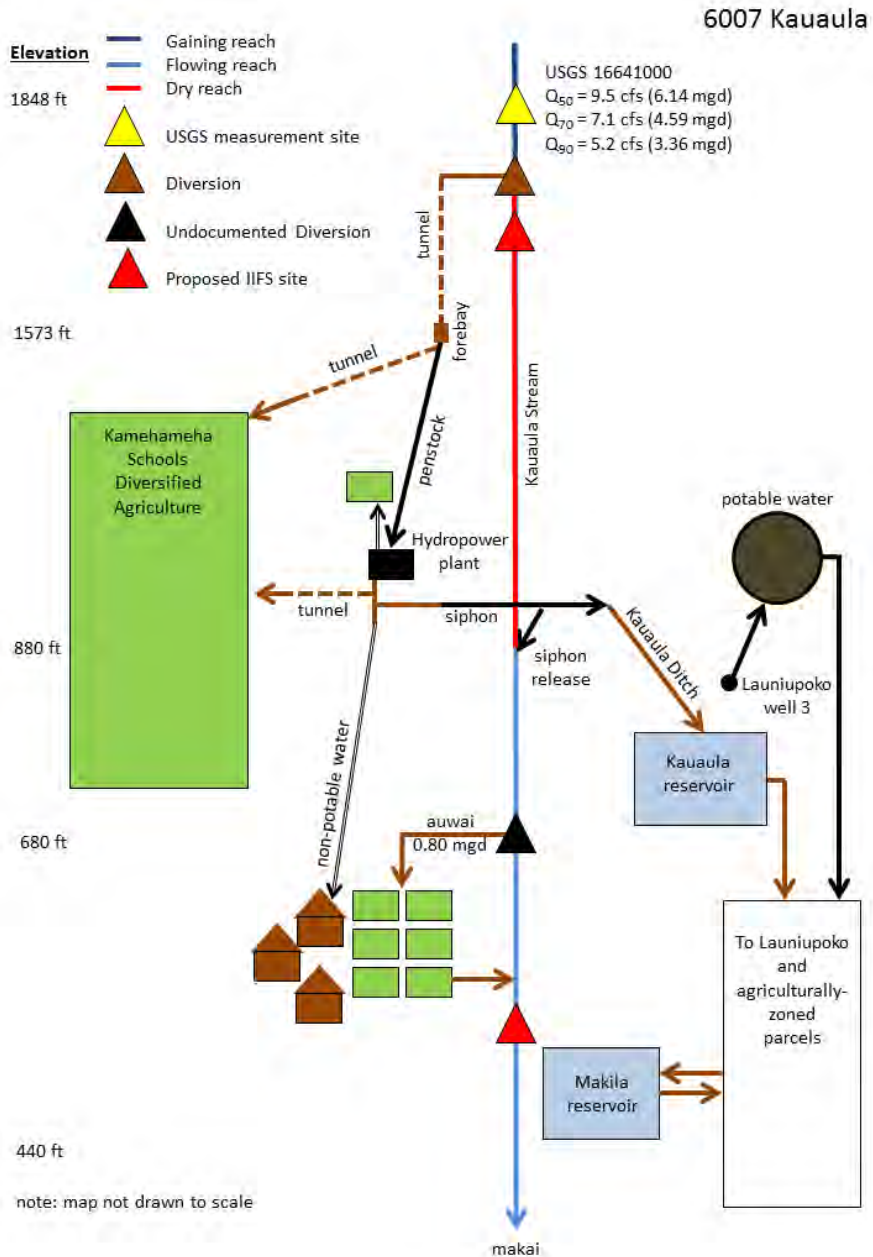
Kaua'ula- Stream



Kaua'ula- Hydrology



Kaua'ula- Simplified



Kaua'ula- Diversion



Kauaula- Diversion



Kauaula- Diversion



Kaua'ula- stream below diversion



Kaua'ula- stream below diversion



Kaua'ula- Hydropower Plant



Kaua'ula- return to stream



Kaua'ula- auwai



Kaua'ula- auwai



Kaua'ula- loi waiting for water



Kaua'ula- loi in use



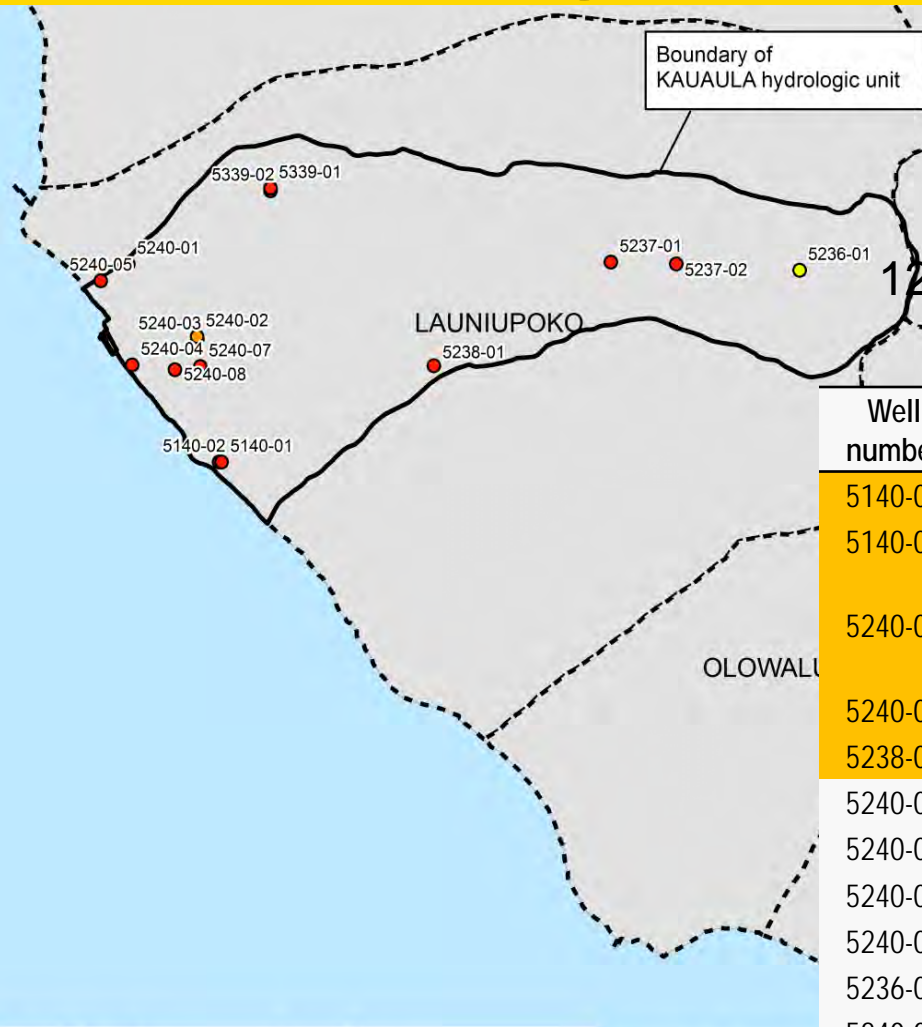
Kaua'ula- freshwater habitat

Aquatic species surveys

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<i>Awaous guamensis</i> (nakea)	Present	Present
<i>Stenogobius hawaiiensis</i> (naniha)	--	--
<i>Eleotric sandwicensis</i> (akupa)	--	Present
<i>Sicyopterus stimpsoni</i> (nopili)	Present	--
<i>Lentipes concolor</i> (alamoo)	Present	--
<i>Neritina granosa</i> (hihiwai)	--	--
<i>Neritina vespertina</i> (hapawai)	--	--

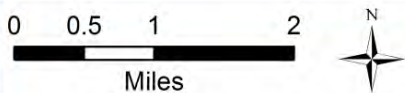


Kaua'ula- groundwater resources



Total installed pump capacity: 4.019 mgd
 12-month moving average (2017): 0.864 mgd
 Aquifer sustainable yield: 7.0 mgd

Well number	Well Name	Well Owner	Year drilled	Pump rate (gpm)
5140-02	Puamana Comm 2	Puamana Comm	1987	0.290
5140-01	Puamana Comm 1	Puamana Comm	1987	0.290
5240-08	Lahaina Rec Ctr	Maui Parks & Recreation	1986	0.144
5240-07	Lahaina Park	Maui Parks & Recreation	2002	0.158
5238-01	Launiupoko 3	Makila Land Co.	2003	0.72
5240-04	Lahaina	Shaw P	1956	0.22
5240-03	Lahaina-Pump B	Pioneer Mill	1897	2.00
5240-02	Lahaina-Pump A	Pioneer Mill	1897	10.00
5240-05	Lahaina UMC	Lahaina UMC	1989	0.04
5236-01	Kauaula Tunnel	Pioneer Mill		
5240-01	Mill Pump C	Pioneer Mill Co., LLC	1897	10.00
5237-02	Kauaula TH 2	State DLNR-Engineering	1970	
5237-01	Kauaula TH 1	State DLNR-Engineering	1970	
5339-02	Waipuka 2	Maui DWS	1963	0.36
5339-01	Waipuka 1	Maui DWS	1962	0.324

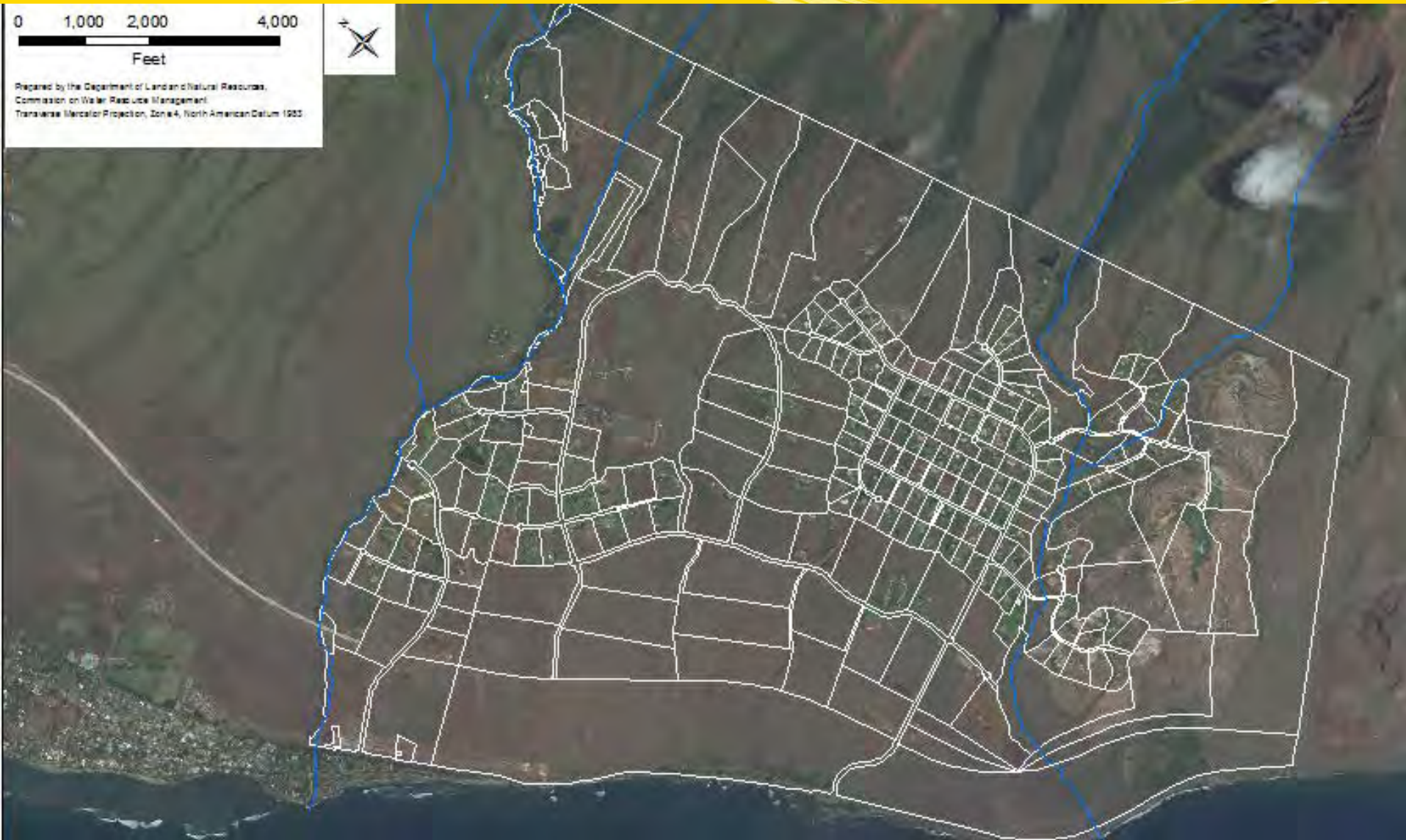


WELL TYPE

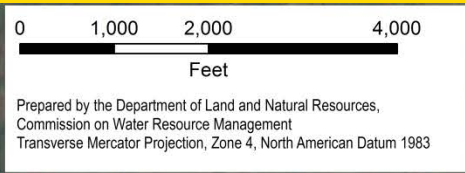
- WELL
- SHAFT
- TUNNEL

Prepared by the Department of Land and Natural Resources,
 Commission on Water Resource Management
 Transverse Mercator Projection, Zone 4, North American Datum 1983

Kaua'ula & Launiupoko- off-stream uses



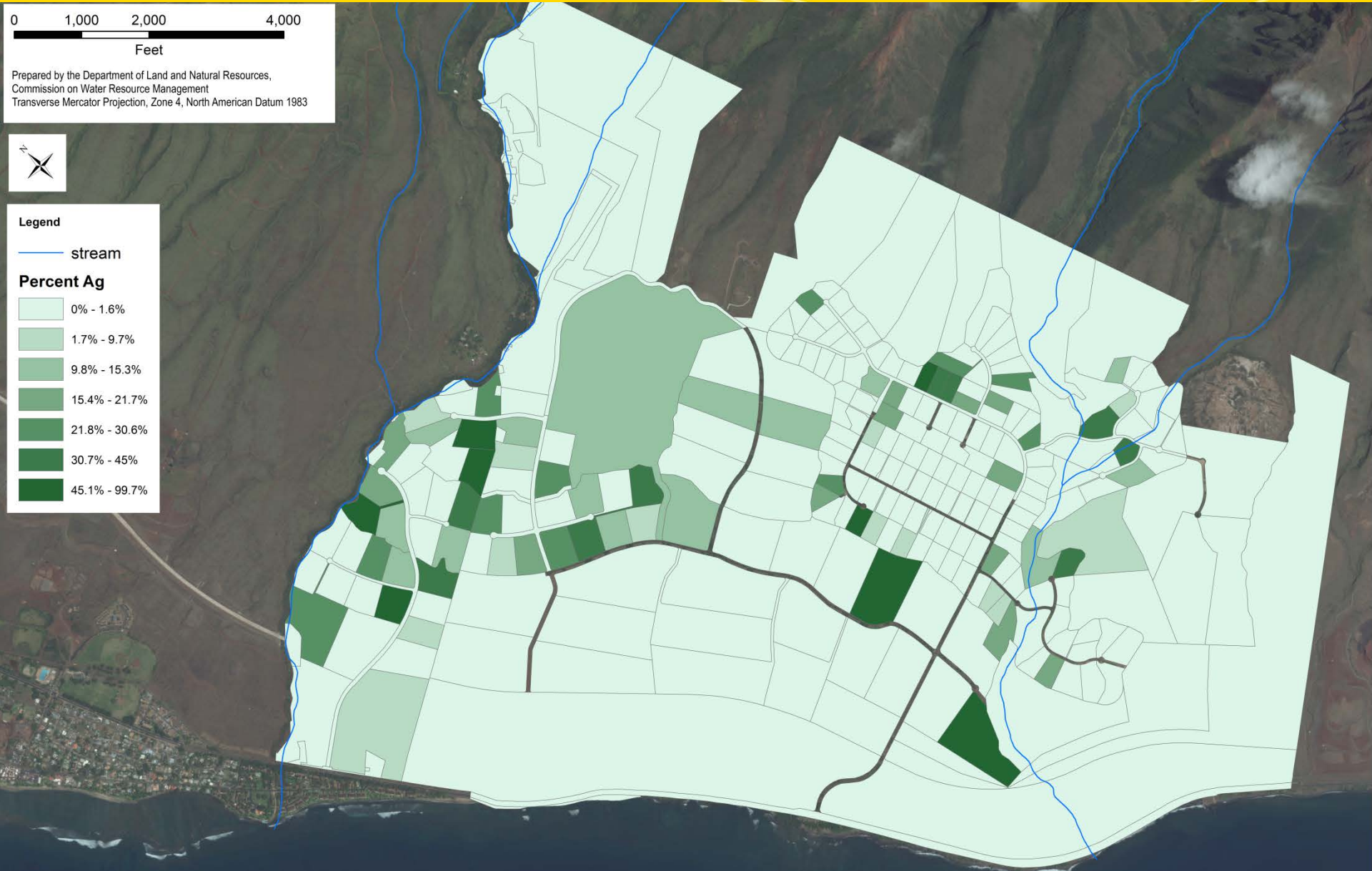
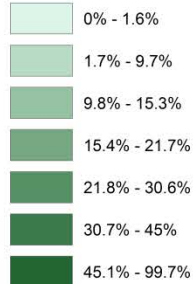
Kaua'ula & Launiupoko- off-stream uses



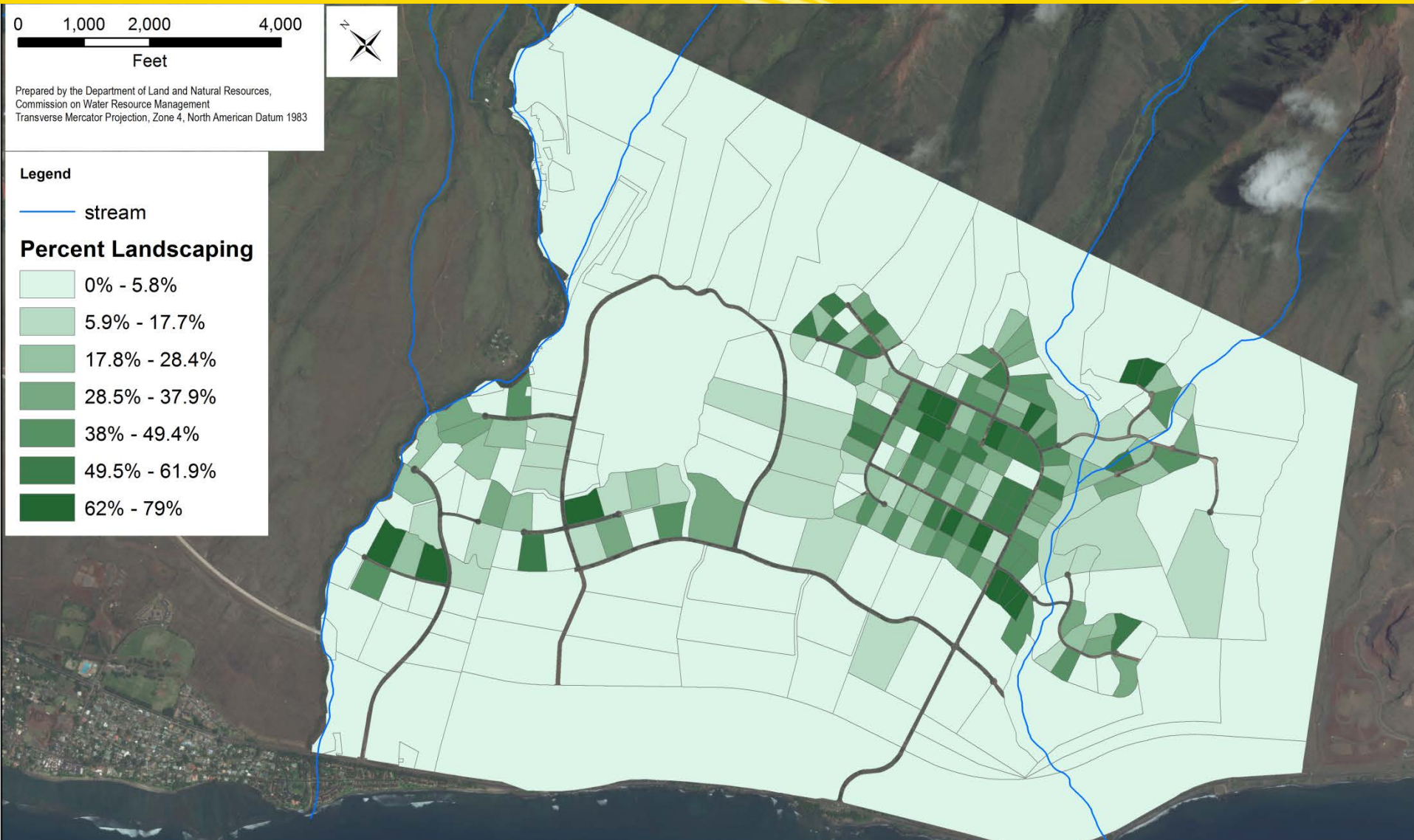
Legend

— stream

Percent Ag



Kaua'ula & Launiupoko- off-stream uses



Kauaula & Launiupoko- off-stream uses

Launiupoko Water Company

- 280 existing potable service connections → 0.800 mgd

Launiupoko Irrigation Company

- 280 non-potable service connections
 - Average metered use: 1.512 mgd (2,566 acres)
 - PUC application for 1.331 mgd when fully developed
- Current Agricultural Demand
 - Irrigated Pasture: ~10 acres → 0.025 mgd
 - Diversified Agriculture: ~43 acres → 0.147 mgd
 - Tree crops: ~35 acres → 0.102 mgd
- Landscaping Demand: ~194 acres → 1.5 mgd

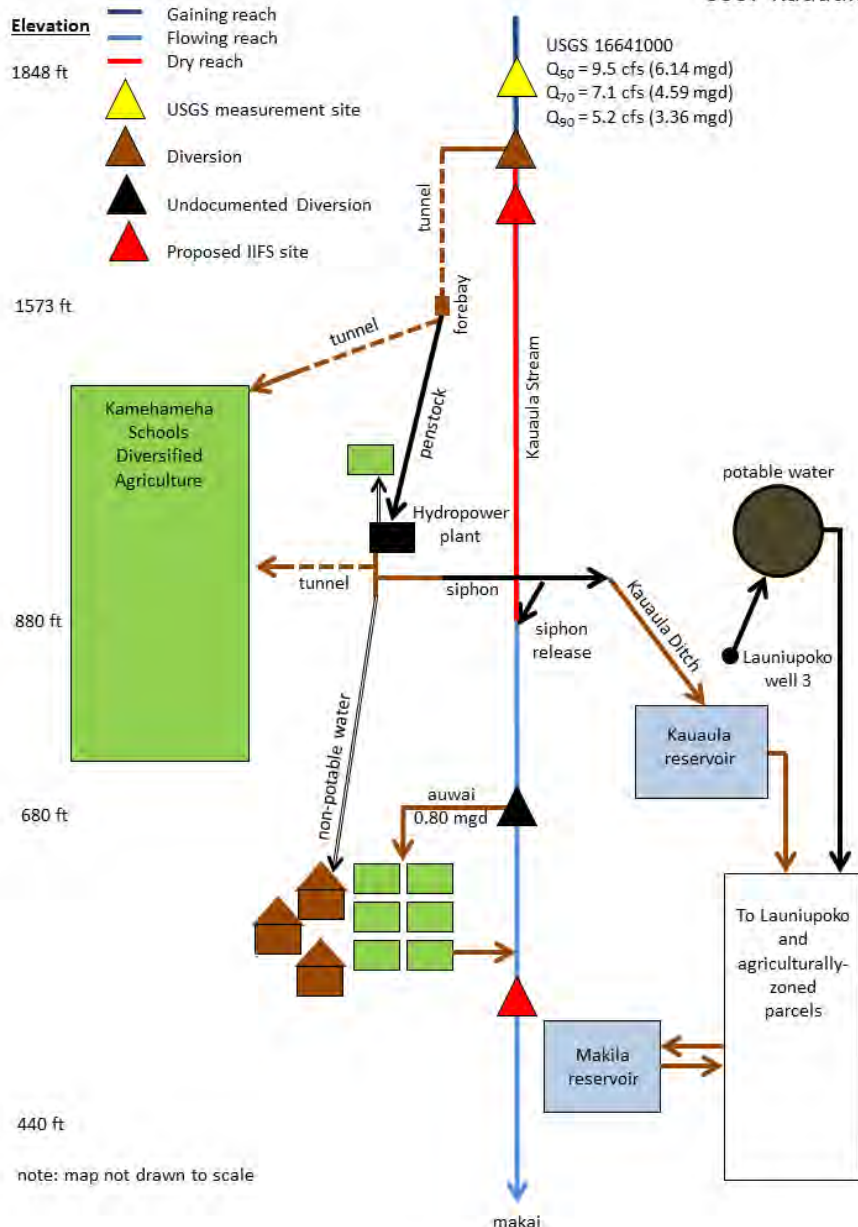
Kamehameha Schools lessees

- Diversified Agriculture: 13 acres → 0.078 mgd
- Cacao: 53 acres → 0.318 mgd



Kaua'ula- IIFS

6007 Kauaula



Q_{50}	Q_{60}	Q_{70}	Q_{90}
9.5 cfs (6.14 mgd)	8.1 cfs (5.24 mgd)	7.1 cfs (4.59 mgd)	5.2 cfs (3.36 mgd)

2017 Estimated Amount Diverted	Proposed IIFS	location
7.09 cfs (4.58 mgd)	3.36 mgd	below diversion
	4.1 mgd	below siphon

- Will meet Kamehameha Schools lessees needs 100% of time
- Will meet Launiupoko Irrigation Co ag demand 100% of time with Launiupoko Stream water (0.24 mgd)



Summary Proposed IIFS

Hydrologic Unit	Estimated Q_{50}	2017 Estimated Amount Diverted	Proposed IIFS	Location
Ukumehame	5.0 cfs (3.23 mgd)	0.025 cfs (0.016 mgd)	2.9 mgd	below diversion
Olowalu	6.1 cfs (3.94 mgd)	2.25 cfs (1.45 mgd)	2.33 mgd	below diversion at USGS 16646200
Launiupoko	0.47 cfs (0.30 mgd)	0.37 cfs (0.24 mgd)	0 mgd below diversion	below diversion
Kaua'ula	9.5 cfs (6.14 mgd)	7.09 cfs (4.58 mgd)	3.36 mgd	below diversion
Kaua'ula			4.1 mgd	below siphon



Implementation

Short-term Actions (1 year)

- Ukumehame: currently nothing needs to be done
 - Olowalu: modification of lower diversion intake gate to limit excess diverted water (flow through from reservoir)
 - Launiupoko: nothing (status quo)
 - Kaua'ula: return flow to stream at diversion
- Monitor hydrology below diversion and below siphon
- Determine how much needs to be released from siphon

Long-term Actions (3 years)

- Resurvey streams for native fauna
- With more monitoring data, determine accuracy of USGS low-flow statistics
- Re-evaluate IIFS



Implementation

Staff gage at Kaua'ula Stream below siphon



Index stations

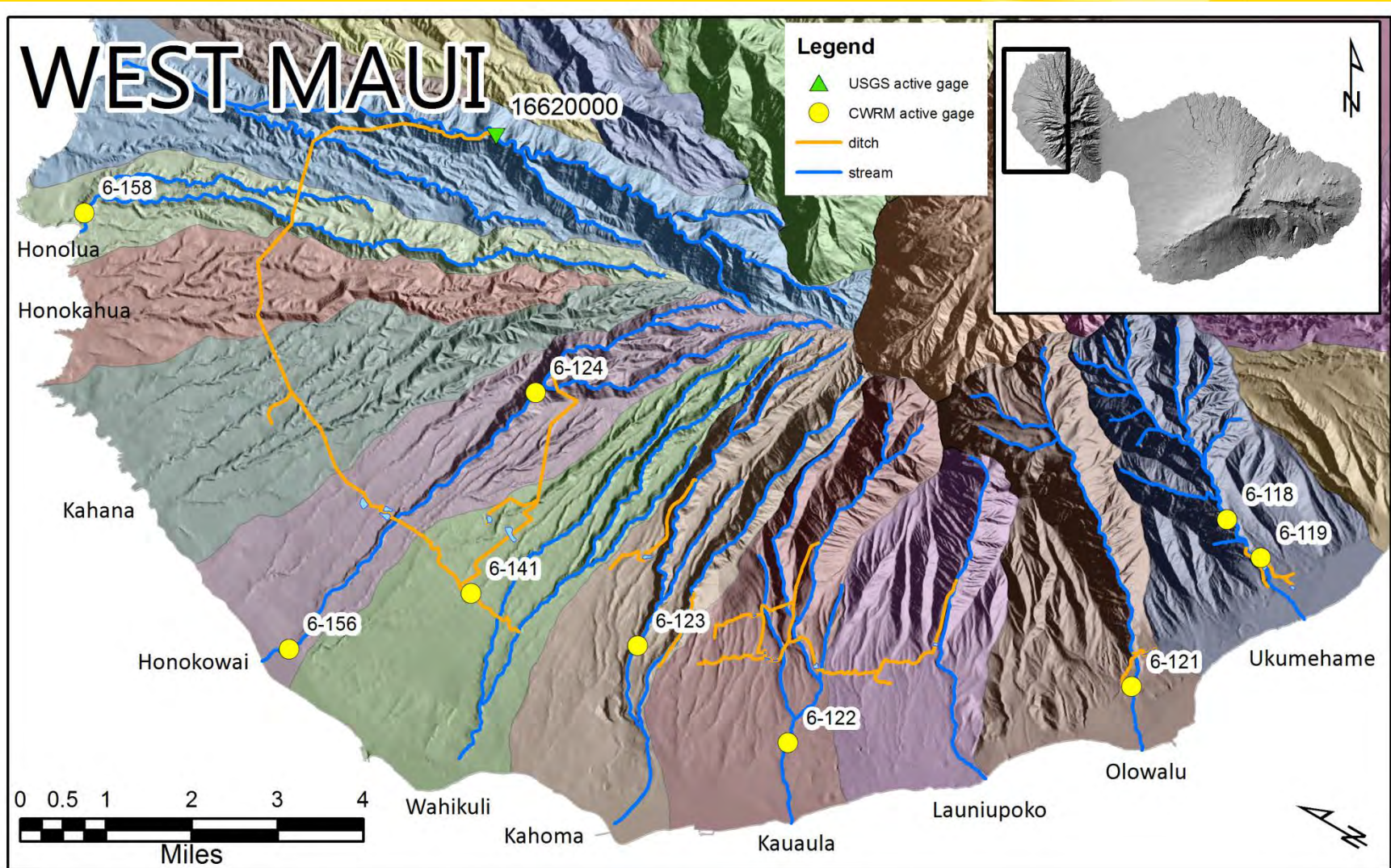
- Ukumehame
- Kanahā
- Olowalu?
- Kaua'ula?

Monitoring stations

- Installed at IIFS sites
- Rating curves developed



Monitoring



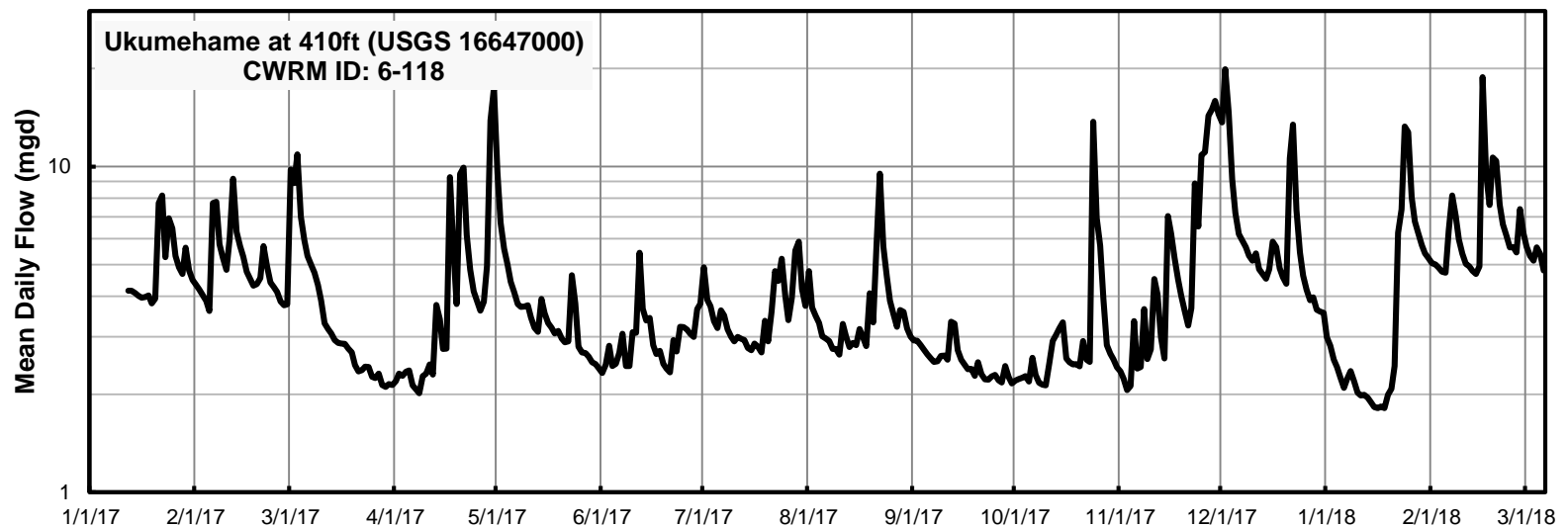
Monitoring- New Index Stations

Ukumehame at 410 ft (USGS station 16647000)

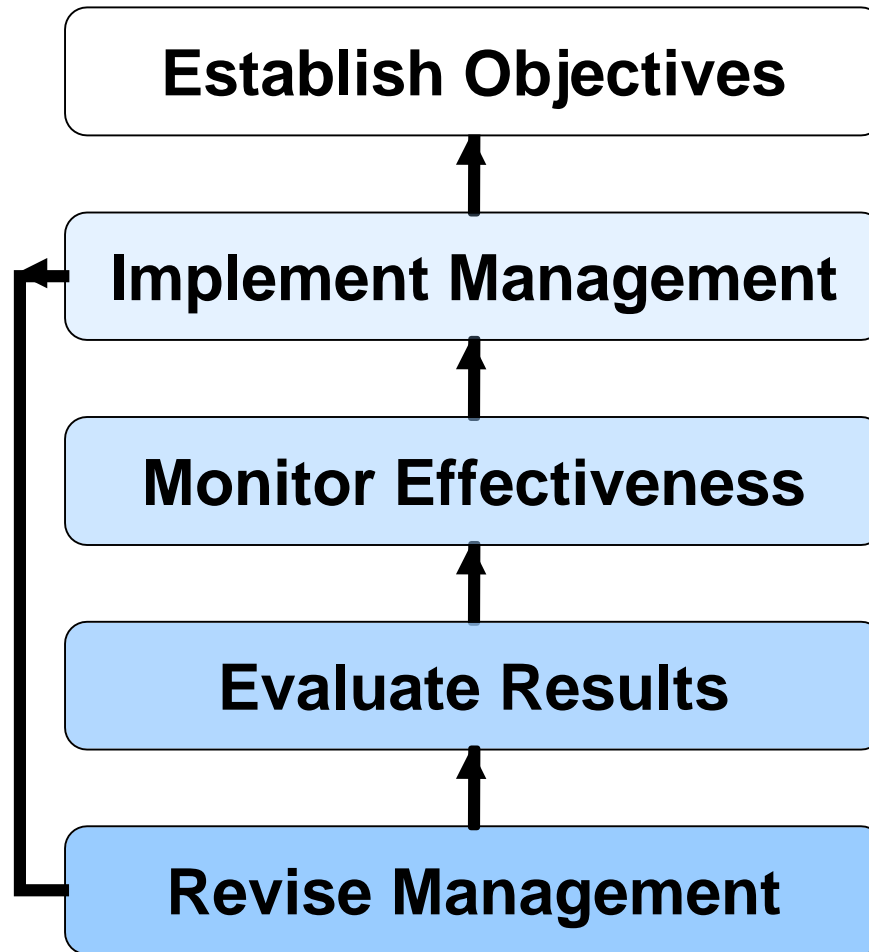


Monitoring- New Index Stations

Ukumehame at 410 ft (USGS station 16647000)



Adaptive Management



QUESTIONS