Commission on Water Resource Management

Waimea ʻAnaehoʻomalu Aquifer System Area Updates

2019 update
to Water Resource Protection Plan of the Hawaiʻi Water Plan

Briefing in Waimea

June 18, 2019

Presentation Outline

- Introduction & Background of WRPP
- Updated information on Ground Water Management
- Proposed amendments to Waimea/ ʻAnaehoʻomalu Aquifer System Area

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CWRM Vision

Flowing streams,

sustainable aquifers,

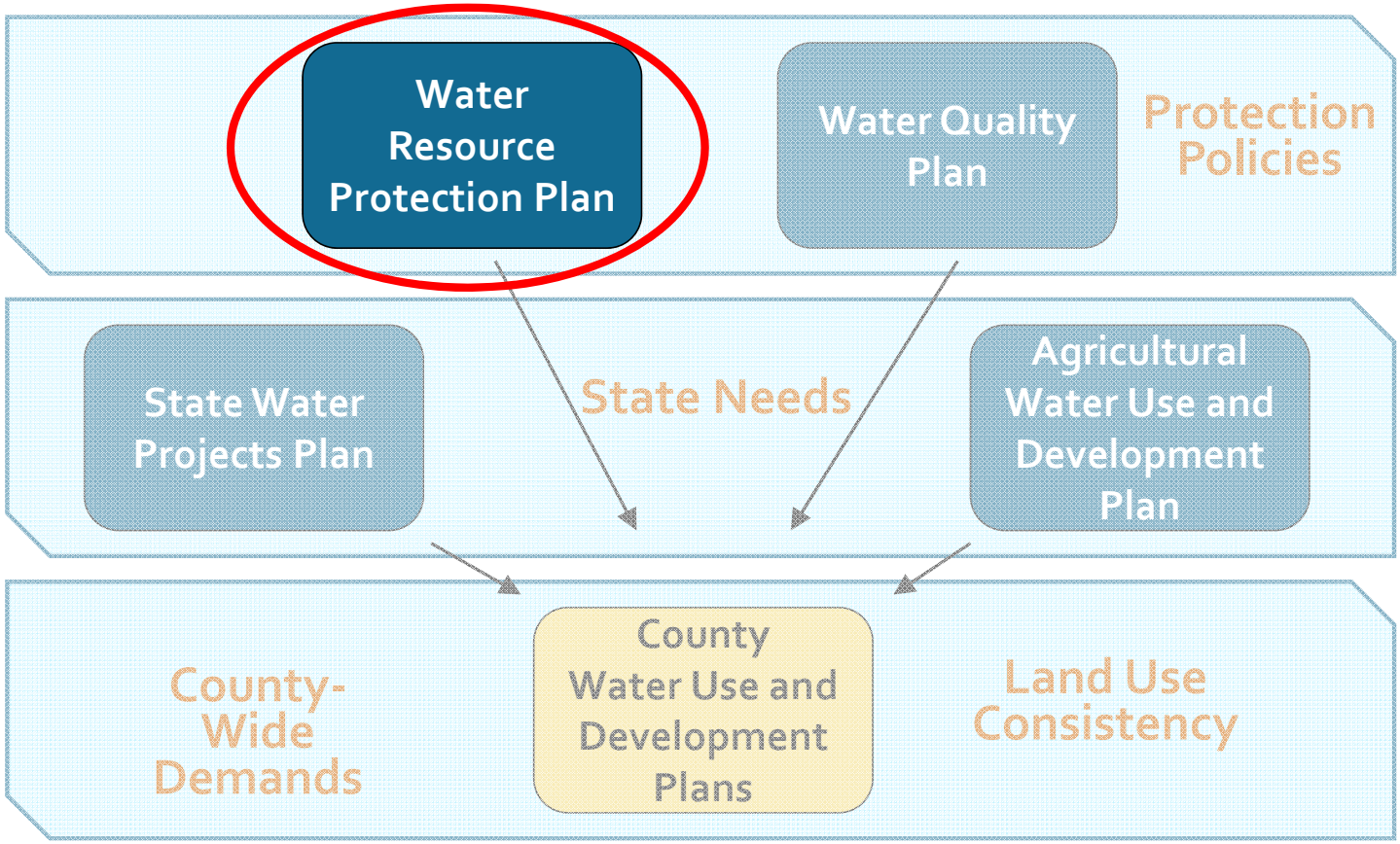
and functioning watersheds

for the use, enjoyment, and benefit of all.

CWRM Mission

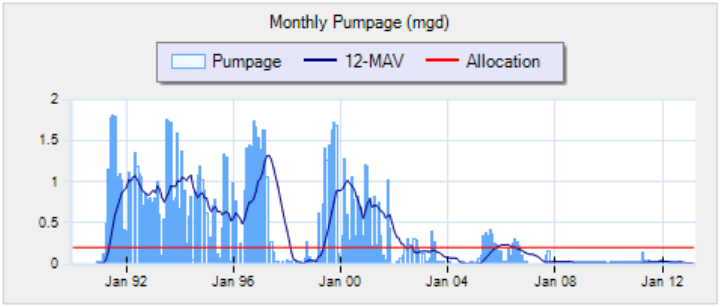
To protect and manage
the waters of the State of Hawai‘i
for present and future generations.

Hawai‘i Water Plan



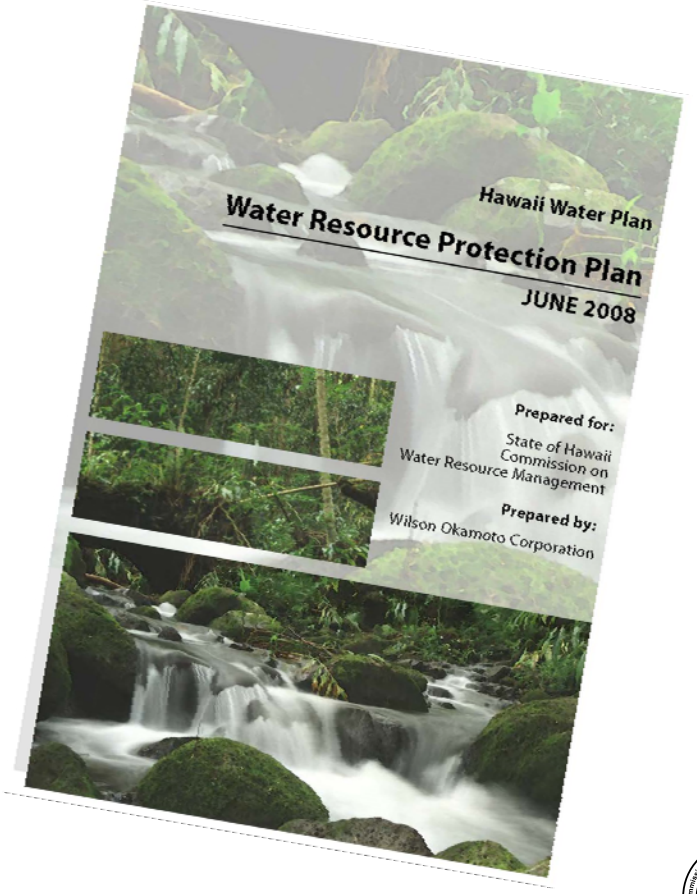
Water Resource Protection Plan

- Nature and occurrence of water
- Hydrologic units and their characteristics
- Existing and contemplated uses of water
- Programs to conserve, augment, regulate and protect the resource



Background/History/Timeline

- Initial adoption: 1990
- First update: 1992
- Most recent update: 2008
- Current draft update: 2019 (July)



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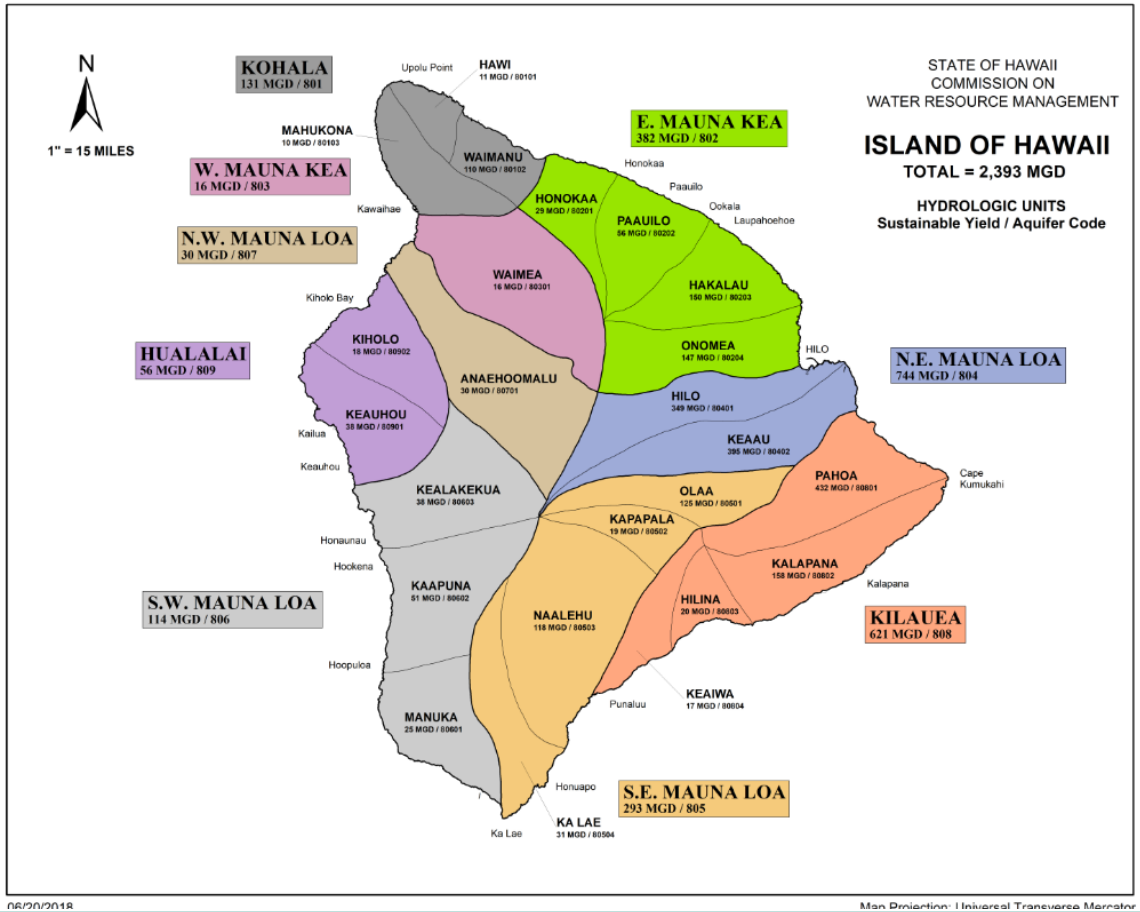
Groundwater Management

Sustainable limits for each management unit

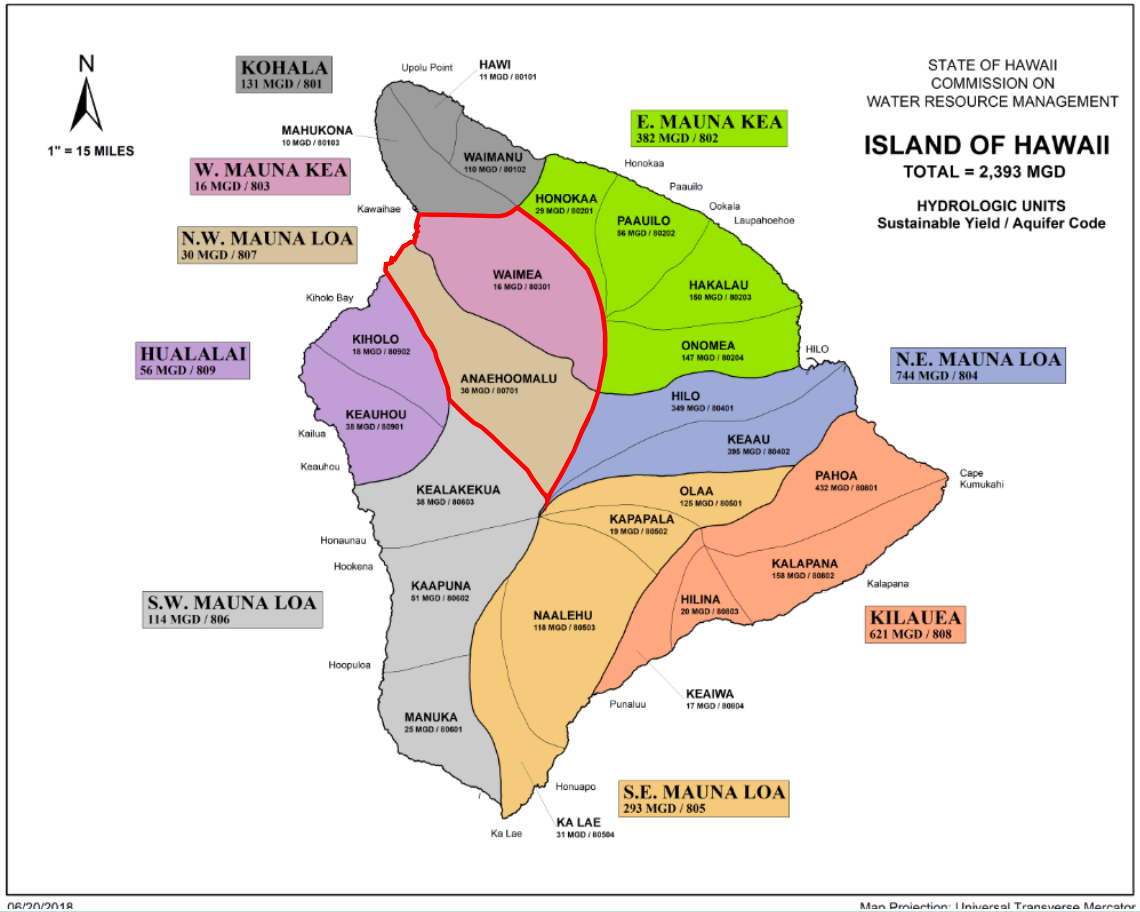


Groundwater Management

Sustainable limits for each management unit

Aquifer System Areas

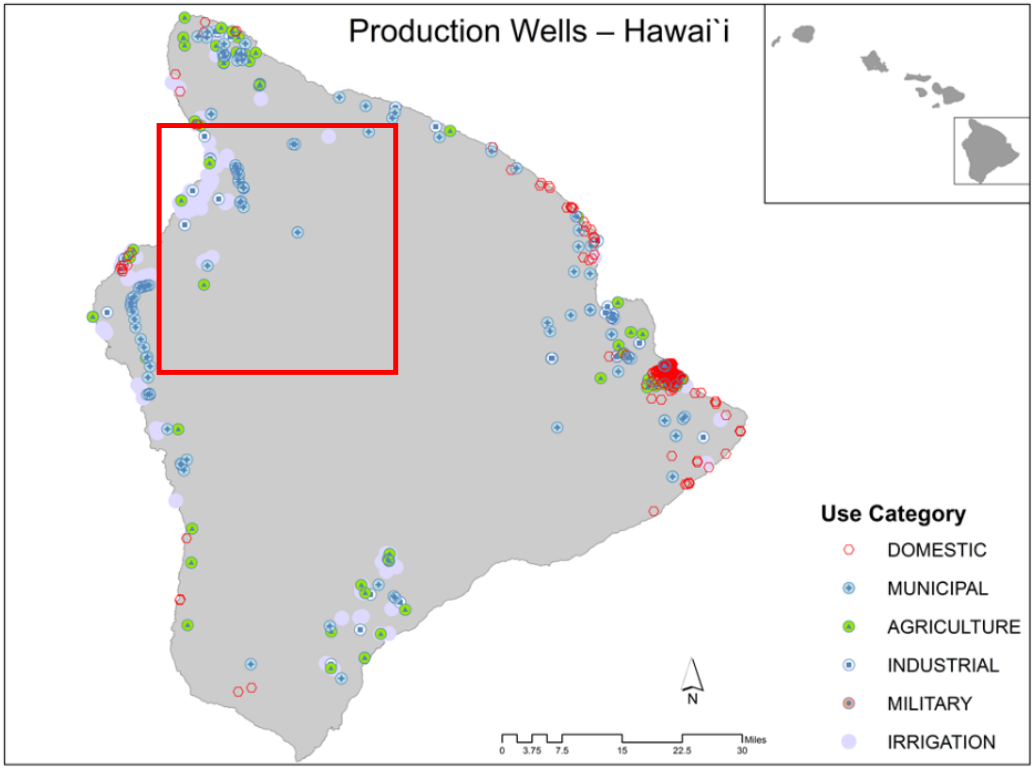
- Waimea
- ʻAnaehoʻomalu



Groundwater Management

5000 Wells in State

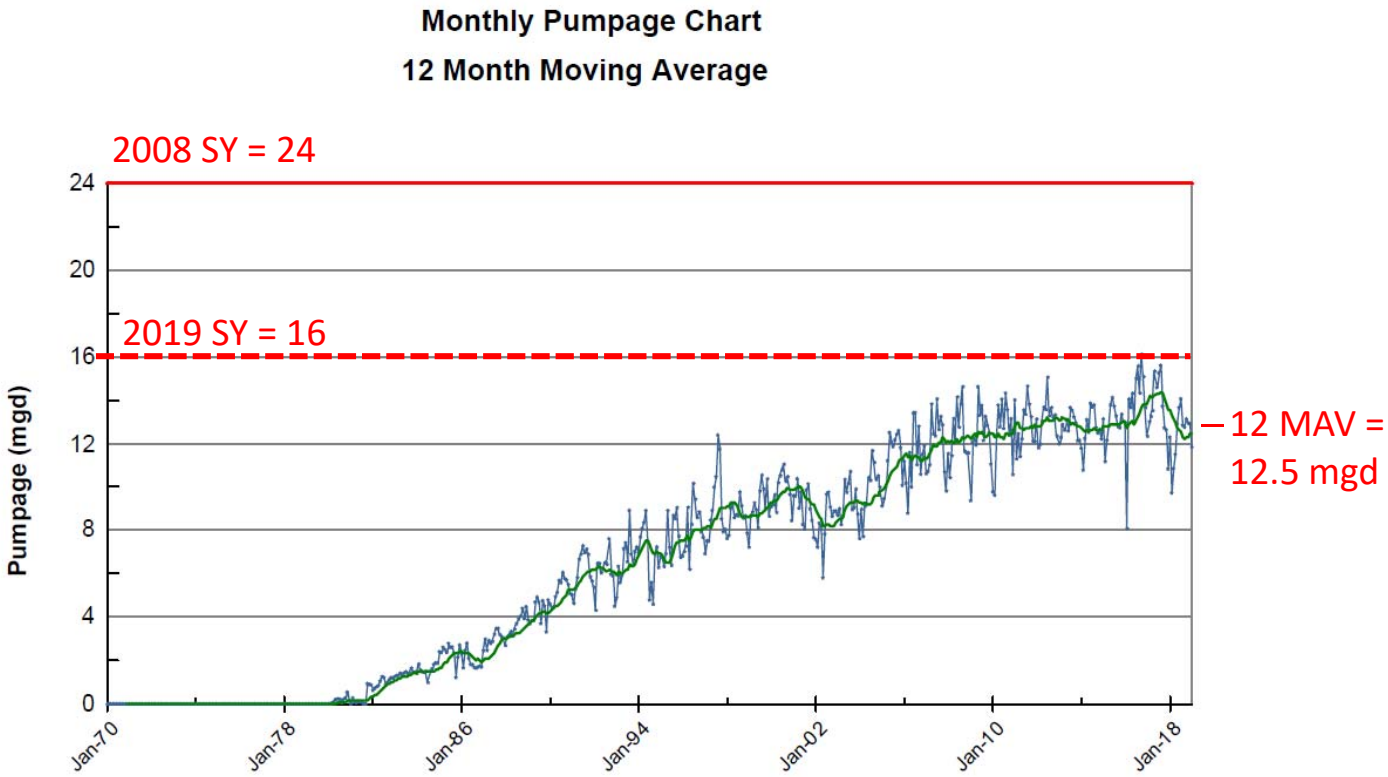
1,342 Wells on Hawai'i



80 Wells in Waimea ʻAnaehoʻomalu ASAs

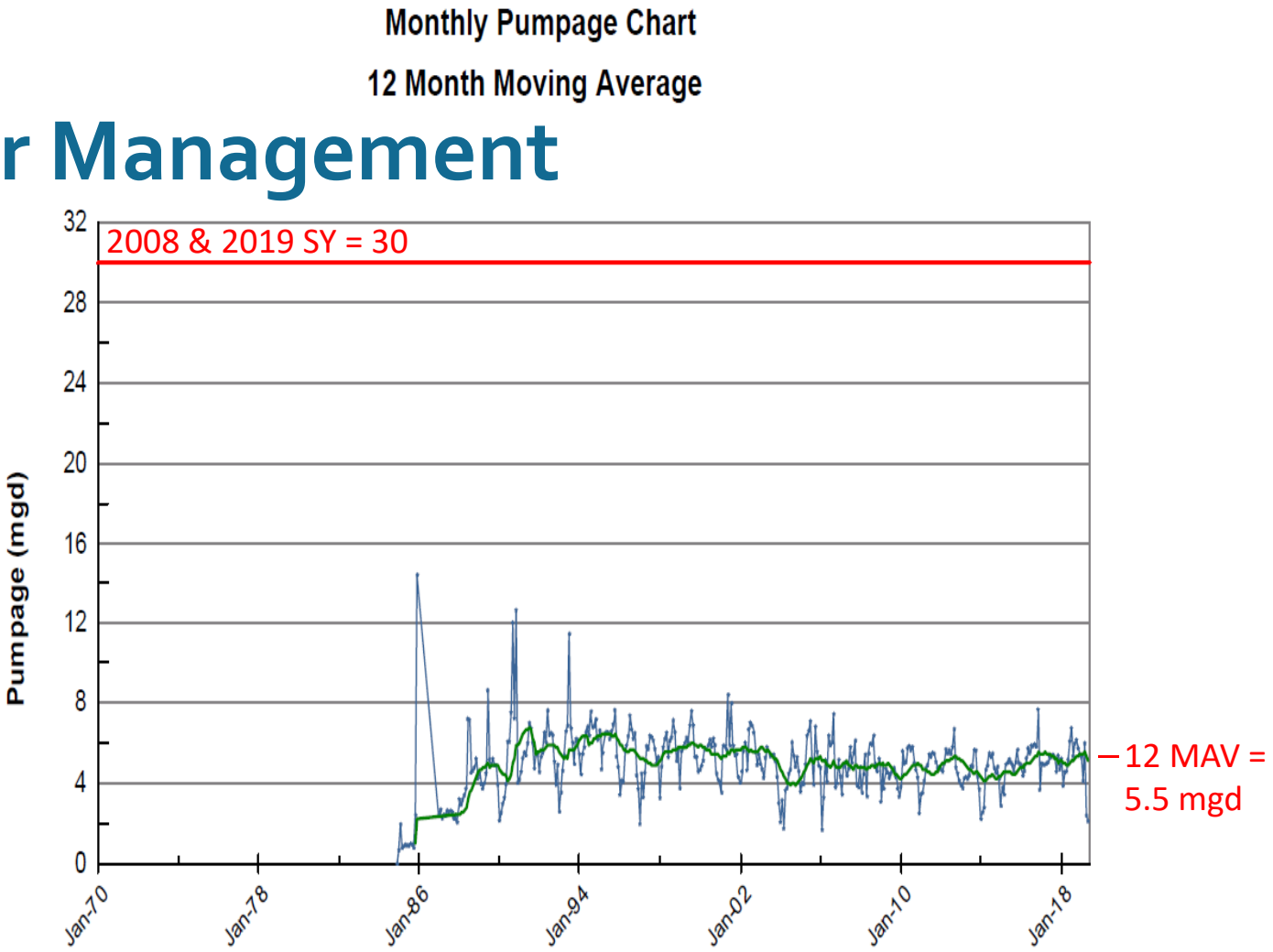
Groundwater Management

51 Wells in Waimea



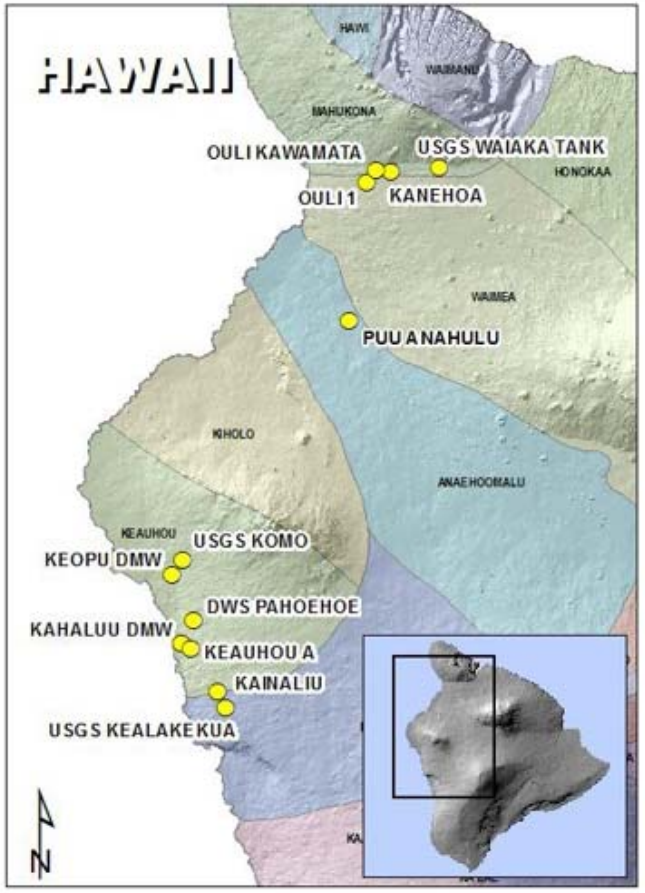
Groundwater Management

29 Wells in ʻAnaehoʻomalu



Groundwater Management

5 Observation Wells in Region

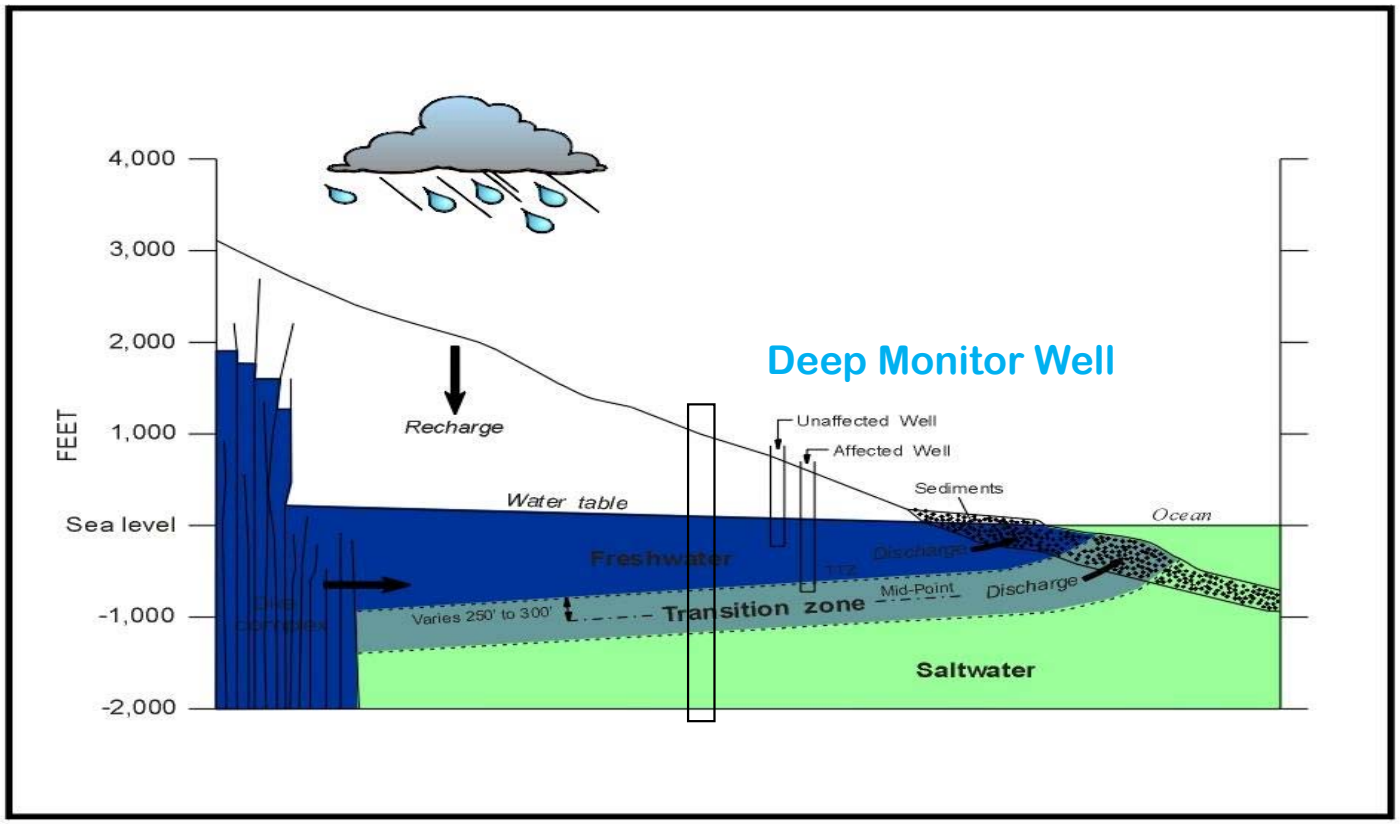


HAWAII WELLS

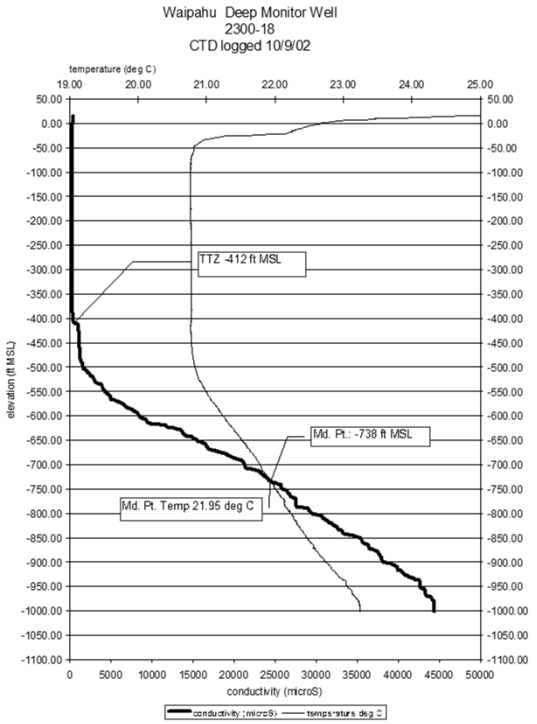
- Ouli 1
- Ouli Kawamata
- Kona Basal
- USGS Waiaka Tank
- Kanehoa

- DWS Pahoehoe
- Kahaluu DMW
- Kainaliu & Keauhou Kam 2
- Keauhou A
- Keopu 1 DMW
- USGS Kealakekua
- USGS Komo
- Total Reported Keauhou Aquifer System Area Pumpage

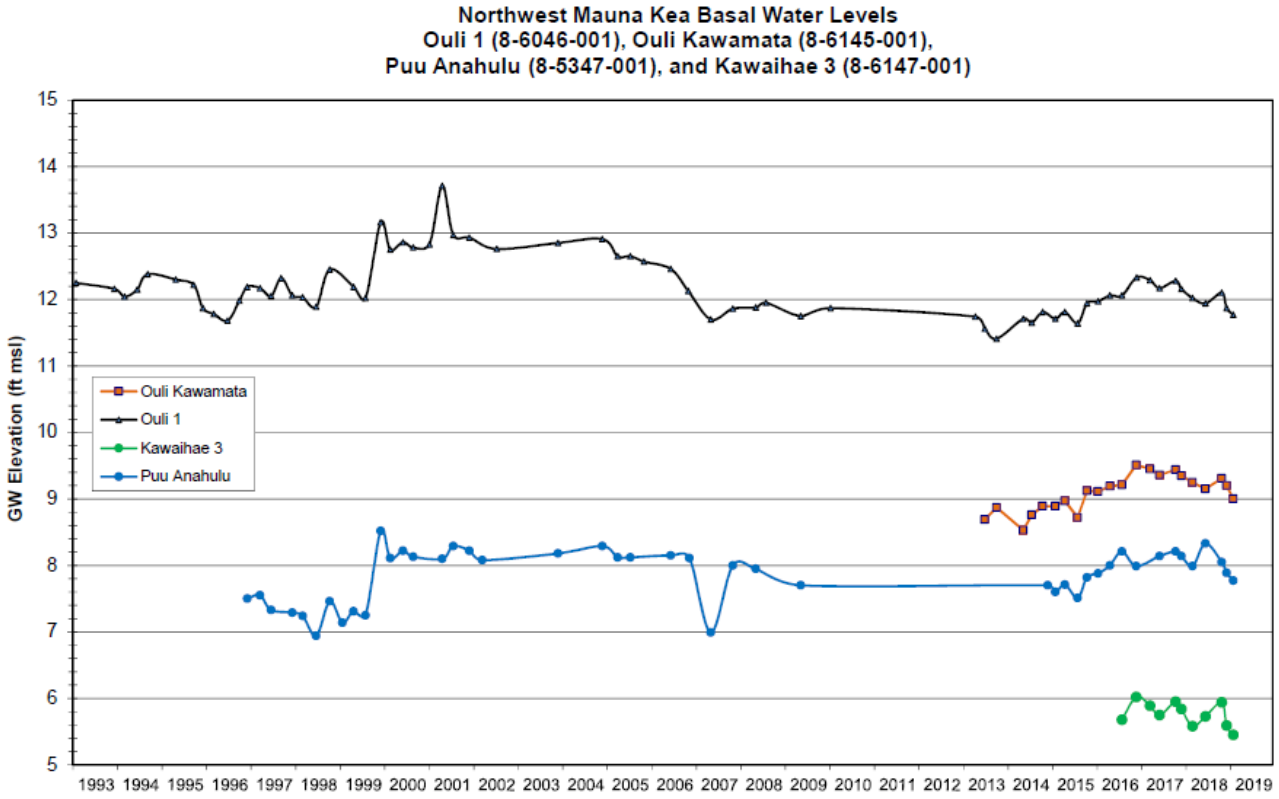
Groundwater Management



Groundwater Management (Deep Monitor Data)



Groundwater Management



- How does CWRM estimate Sustainable Yields?

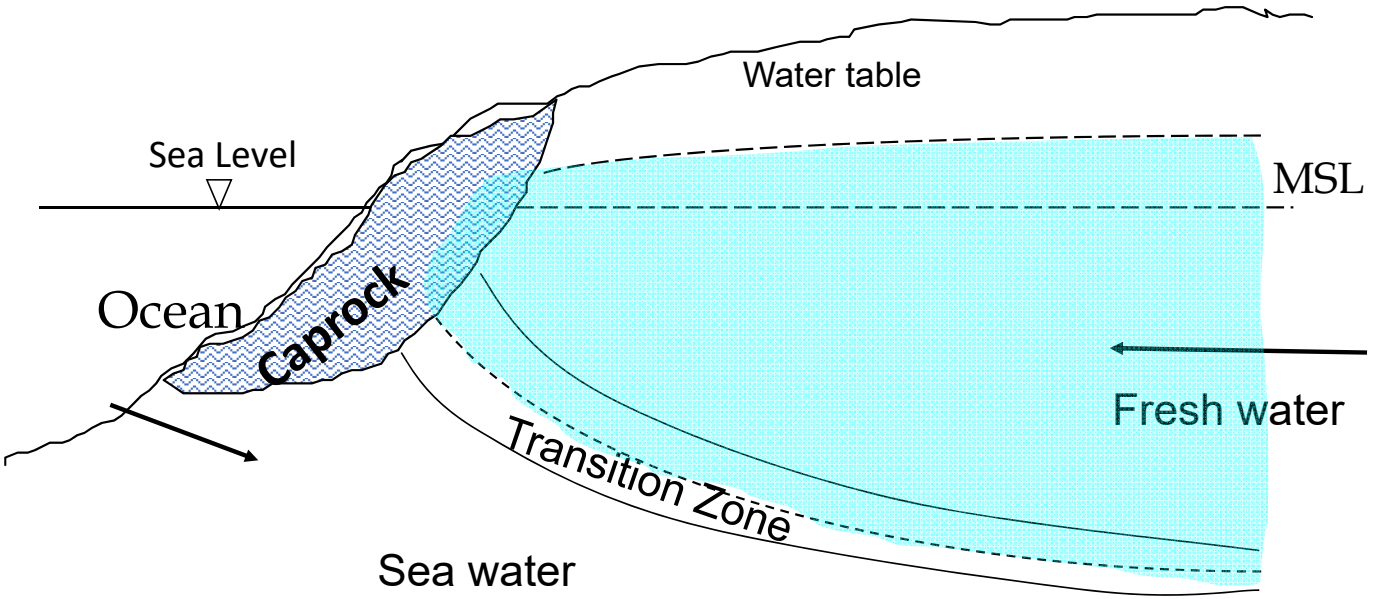
  - Use best public information available
  - ✓ RAM
  - RAM2
  - Numerical Models and other public studies

What is RAM?

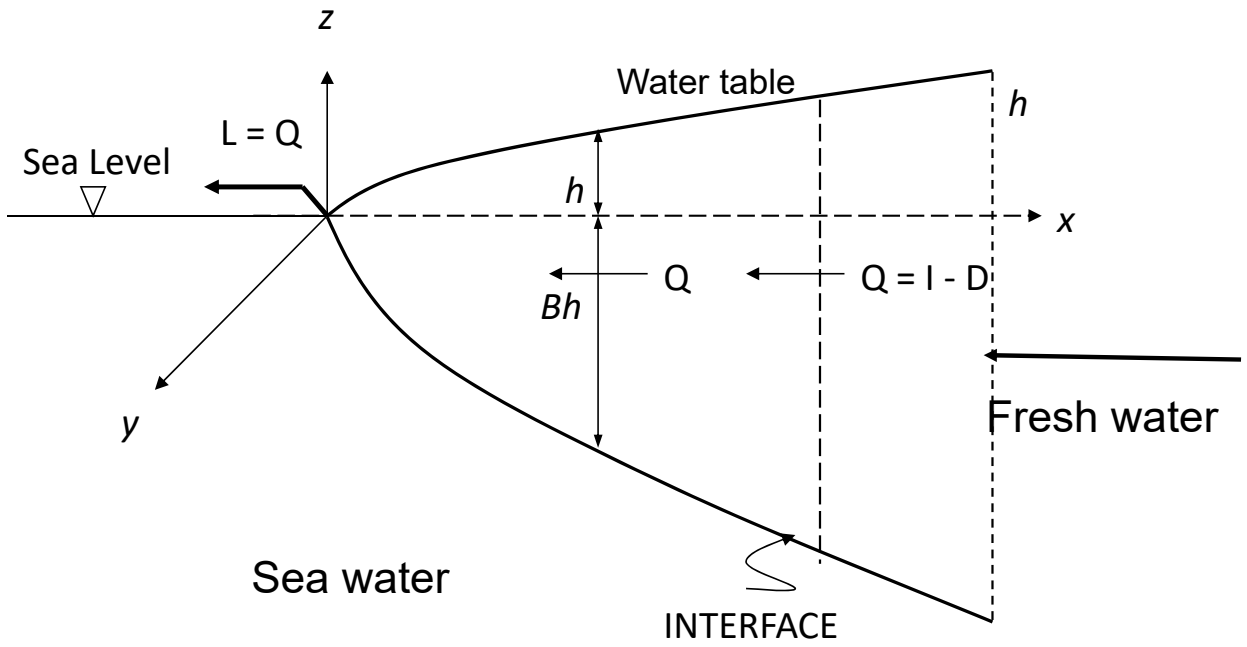
Robust Analytical Model (RAM)

(Mink, J.F. 1981.Determination of Sustainable Yields, in:Groundwater in Hawaii – A Century of Progress, Water Resources Research Center, University of Hawaii)

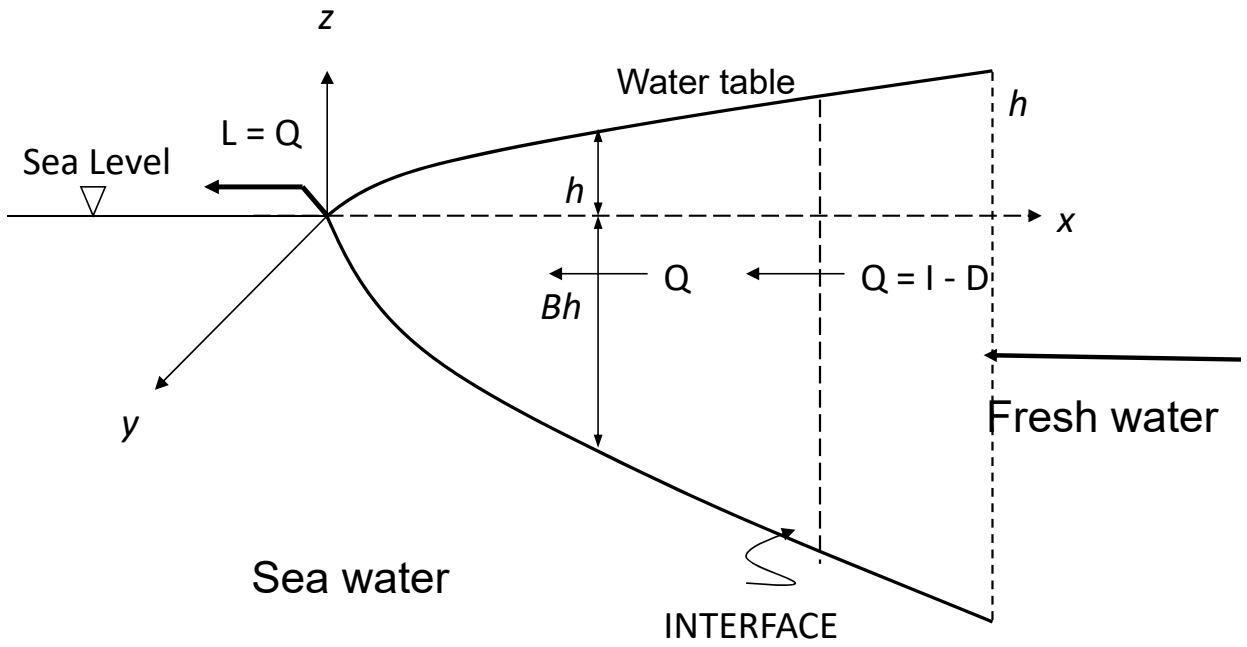
Conceptual RAM Model



Conceptual RAM Model



Conceptual RAM Model



By combining Darcy's Law, conservation of mass, and GH principle - RAM Model:

Solution:

$$h_{i+1} = h_0\sqrt{\frac{I-D}{D}}\left[\frac{[\sqrt{I-D}+\frac{h_i}{h_0}\sqrt{I}]\cdot\exp\left\{\frac{2\sqrt{(I-D)I}\,(t_{i+1}-t_i)}{V_0}\right\}-\sqrt{I-D}+\frac{h_i}{h_0}\sqrt{I}}{[\sqrt{I-D}+\frac{h_i}{h_0}\sqrt{I}]\cdot\exp\left\{\frac{2\sqrt{(I-D)I}\,(t_{i+1}-t_i)}{V_0}\right\}+\sqrt{I-D}-\frac{h_i}{h_0}\sqrt{I}}\right]$$

John Mink's Robust Analytical Model (RAM)

(Mink, J.F. 1981.Determination of Sustainable Yields, in:Groundwater in Hawaii – A Century of Progress, Water Resources Research Center, University of Hawaii)

$$D = I\{1 - (h/H)^2\}$$

D = allowable draft (i.e. sustainable yield)
I = Recharge
H = original head before pumping (important calibration point)
h = equilibrium head

Limitations

- Assumes uniform distribution (optimized) pumpage
- Difficult, if not impossible, to define original & equilibrium head
- Does not directly assess changes in chlorides or water levels at a specific well
- Does not consider GDE impacts directly

John Mink's Robust Analytical Model (RAM)

(Mink, J.F. 1981.Determination of Sustainable Yields, in:Groundwater in Hawaii – A Century of Progress, Water Resources Research Center, University of Hawaii)

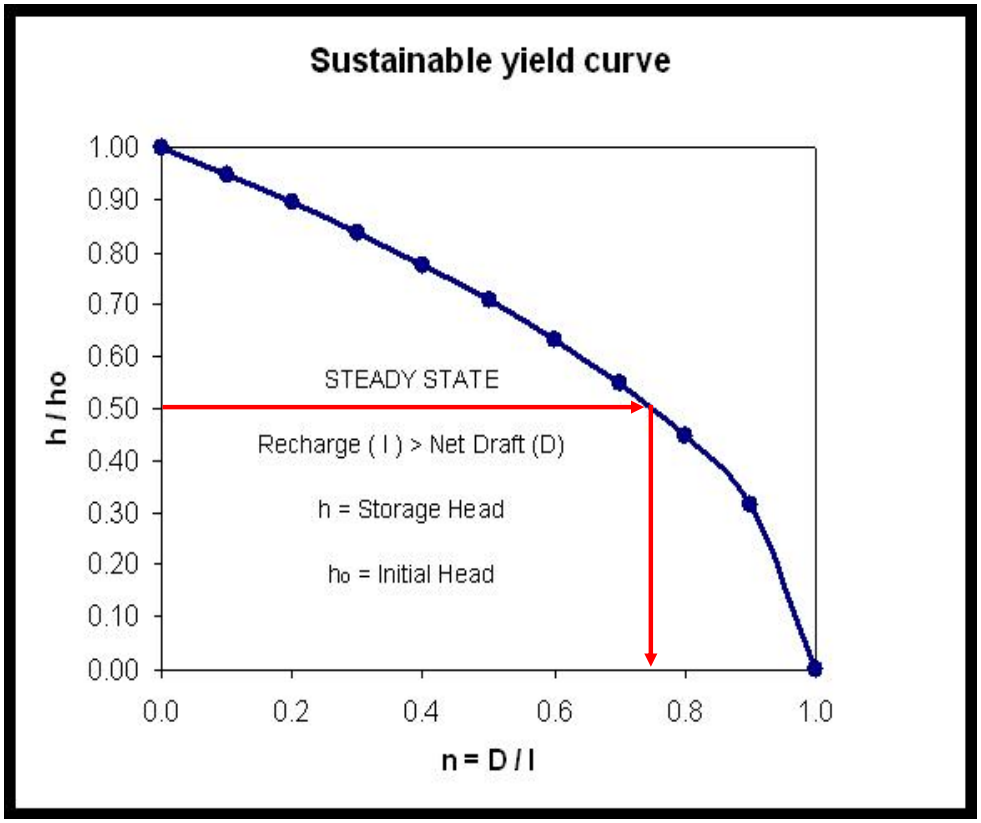


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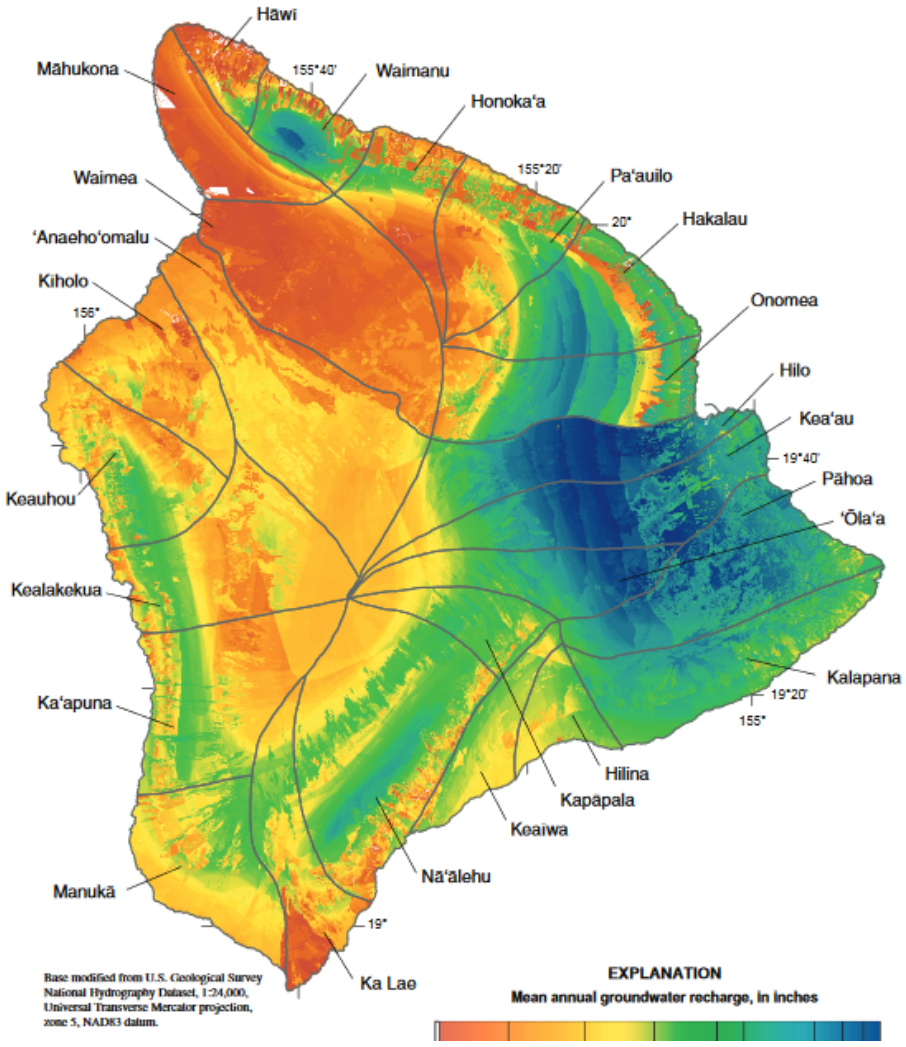
Table 2. Relationships Between Initial Head and Minimum Equilibrium Head of Hawaii Basal Aquifers, Established by CWRM (1990)

Range of Initial Head, h_0 (ft)	Ratio of Minimum Equilibrium Head and Initial Head, h_e/h_0	
4–10	0.75	44
11–15	0.70	51
16–20	0.65	58
21–25	0.60	64
> 26	0.50	75

SY=%Recharge

2011 USGS Hawai'i Recharge Updates

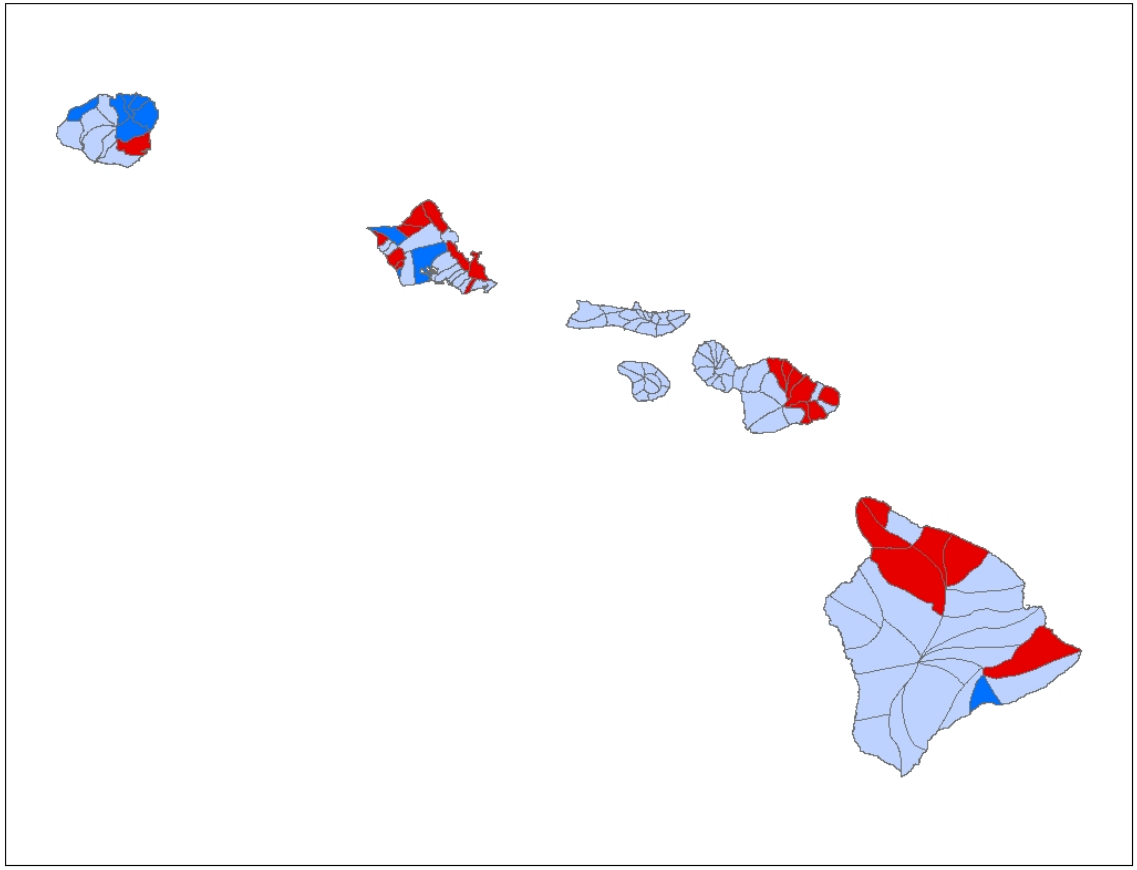


2019 WRPP Big Island SY

Units in Million Gallons per Day (mgd) unless otherwise noted

Aquifer Sector	Aquifer System	RAM SY (1990)	D/I 2019 CWRM Check	1990 Recharge	2008 SY Range	SY 2008	2019 R Range	2019 SY Range	SY 2019
Hawaii									
Kohala	Hawi	27	0.44	62	13-29	**13**	25 - 65	11 - 29	**11**
Kohala	Waimanu	110	0.75	147	110	**110**	147 - 171	110 - 128	110
Kohala	Mahukona	17	0.44	38	17	**17**	23 - 38	10 - 17	**10**
E. Mauna Kea	Honokaa	31	0.44	71	31	**31**	66 - 71	29 - 31	**29**
E. Mauna Kea	Paauilo	60	0.44	136	60	**60**	128 - 136	56 - 60	**56**
E. Mauna Kea	Hakalau	150	0.44	341	150	**150**	341 - 377	150 - 166	150
E. Mauna Kea	Onomea	147	0.44	336	147	**147**	336 - 430	147 - 189	147
W. Mauna Kea	Waimea	24	0.44	54	24	**24**	36 - 54	16 - 24	**16**
NE. Mauna Loa	Hilo	347	0.44	793	349	**349**	793 - 860	349 - 379	349
NE. Mauna Loa	Keaau	393	0.44	898	395	**395**	898 - 974	395 - 429	395
SE. Mauna Loa	Olaa	124	0.44	284	125	**125**	284 - 480	125 - 211	125
SE. Mauna Loa	Kapapala	19	0.44	44	19	**19**	44 - 120	19 - 53	19
SE. Mauna Loa	Naalehu	117	0.44	268	118	**118**	268 - 483	118 - 213	118
SE. Mauna Loa	Ka Lae	31	0.44	71	31	**31**	71 - 110	31 - 48	31
SW. Mauna Loa	Manuka	42	0.44	96	25 - 42	**25**	56 - 189	25 - 83	25
SW. Mauna Loa	Kaapuna	50	0.44	115	51 - 58	**51**	115 - 220	51 - 97	51
SW. Mauna Loa	Kealakekua	38	0.44	86	38	**38**	86 - 199	38 - 88	38
NW. Mauna Loa	Anaehoomalu	30	0.44	69	30	**30**	69 - 176	30 - 77	30
Kilauea	Panoa	435	0.44	994	437	**437**	981 - 994	432 - 437	**432**
Kilauea	Kalapana	157	0.44	359	158	**158**	359 - 531	158 - 234	158
Kilauea	Hilina	9	0.44	20	9	**9**	20 - 80	9 - 35	**20**
Kilauea	Keaiwa	17	0.44	39	17	**17**	39 - 103	17 - 45	17
Hualalai	Keauhou	38	0.44	87	38	**38**	86 - 183	38 - 80	38
Hualalai	Kiholo	18	0.44	42	18	**18**	42 - 91	18 - 40	18

Sustainable Yield Updates



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2019 WRPP Sustainable Yields

	mgd
Waimea	16 (reduced from 24)
‘Anaeho‘omalu	30 (unchanged from 1990)

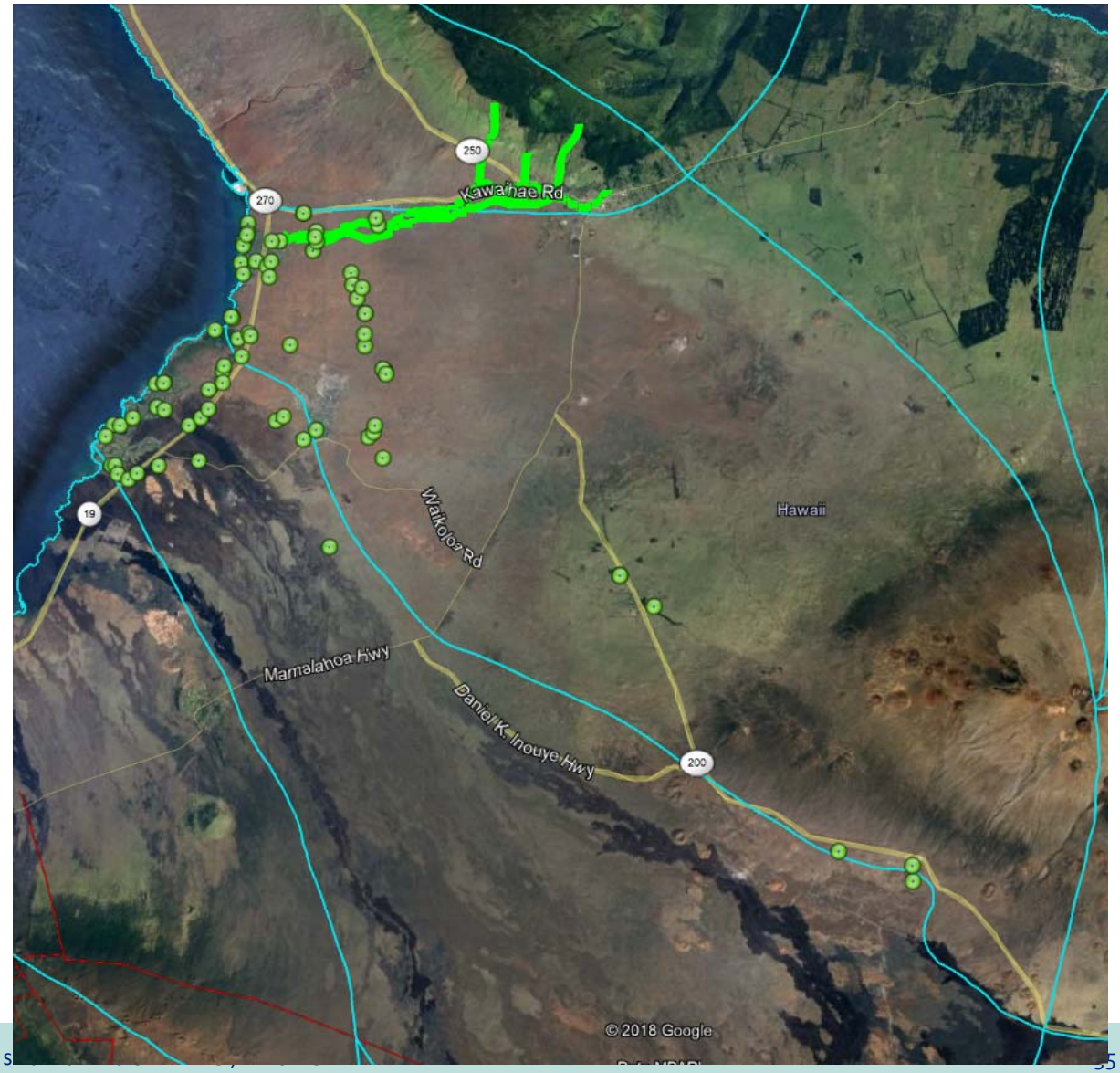
2019 WRPP Sustainable Yields

	Recharge % of all inputs
Waimea	11.4
‘Anaeho‘omalu	53.7

2019 WRPP Sustainable Yields

	Recharge % of all inputs
• Waimea, Hāwī, Mahukona	11
• Honoka‘a, Pa‘auilo, Hakalau	22-28
• Remainder Big Isle	44-70

Streams flowing into Waimea ASA



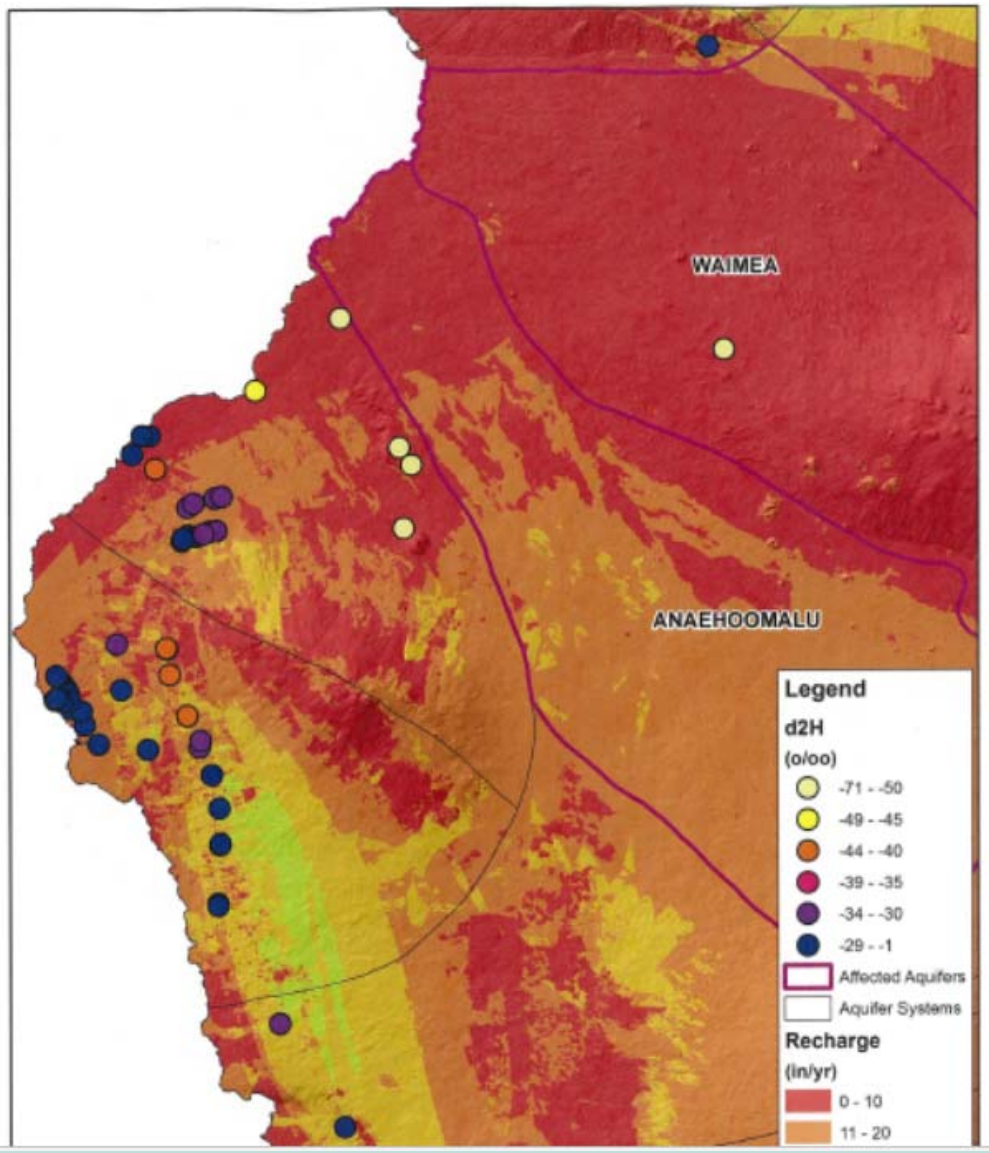
2019 WRPP Sustainable Yields

Missing inputs

Losing Streams into Waimea ASA	mgd
• Waikoloa	5
• Keanuimano	4
• Hauani	1

2019 Isotope Analysis

(rainfall elevation origin)



Boundary Geophysical Analysis

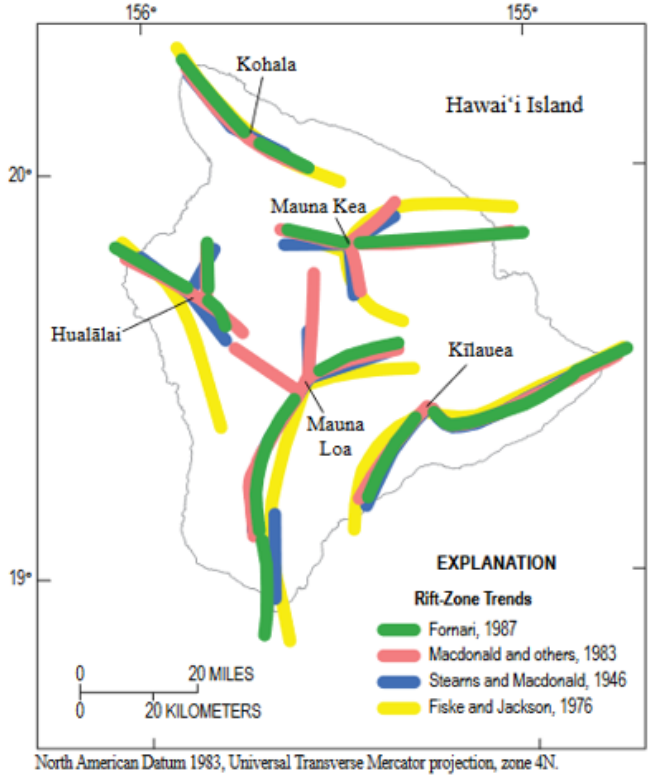


Figure 45. Interpretations of rift-zone trends on Hawai'i Island.

Figure 3 USGS Rift Zone Map (from 1946 to 1987 Studies)

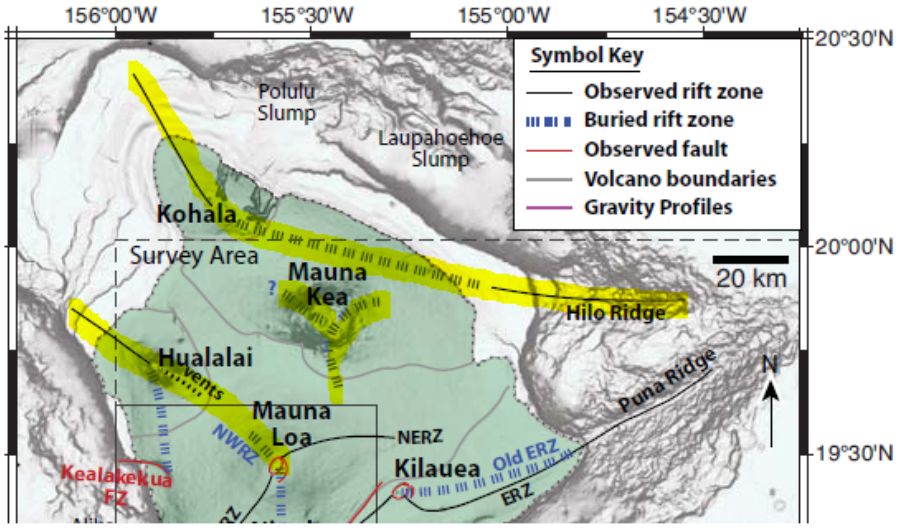
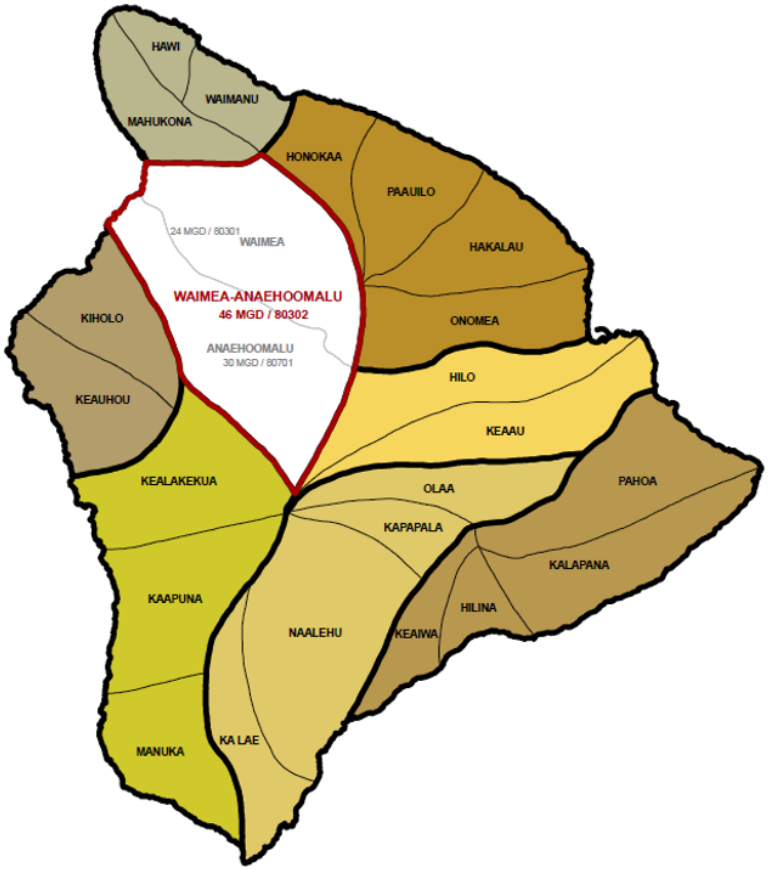


Figure 4 Section from 2010 Morgan Rift Zone Map

Proposed amendment to 2019 WRPP

- Maintains minimum range of latest recharge/sustainable yields
- Appears more consistent with observed hydrogeologic data
- Simple management change to address perceived threat to Waimea from drastic lowering of SY without changing USGS analysis



Proposed amendment to 2019 WRPP

Schedule (subject to change)

- June 18 - brief CWRM on Waimea/ʻAnaehoʻomalu boundary change
- July 2 - Public Hearing Notice of WRPP amendment for W/A change
- July 16 - Commission decision on entire final draft of 2019 WRPP
- October 3 - Public Hearing in Waimea
- November 3 - deadline for written comments on W/A boundary change
- December 17 - Commission action on W/A boundary change

For more information:

WRPP Update Website

http://dlnr.hawaii.gov/cwrm/planning/hiwaterplan/wrpp/