Cesspools in Hilo and Kea`au
Community Meeting
University of Hawaii at Hilo
July 25, 2018
5:00pm to 7:00pm
Agenda

I. Opening Remarks
II. What is a Cesspool and Septic System
III. Overview of Report
IV. Prioritization Method and Priorities
V. Hilo and Kea`au
VI. University of Hawaii Research
VII. Question and Answer Session
VIII. Next Steps

DAVID Y. IGE
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

Report to the Legislature
Relating to Cesspools and Prioritization for Replacement

What are cesspools?

- Cesspools are little more than holes in the ground that collect and discharge raw, untreated human waste. Cesspools can contaminate ground water, drinking water sources, streams and oceans with disease-causing pathogens.

How many cesspools do we have in Hawai`i?

- There are approximately 88,000 cesspools in the State, with nearly 50,000 located on the Big Island, almost 14,000 on Kauai, over 12,000 on Maui, over 11,000 on Oahu and over 1,400 on Molokai.

What is Act 125?

- Act 125 was passed in the 2017 legislative session and requires the replacement of all cesspools by 2050. It directs the Hawaii Department of Health (DOH) to evaluate residential cesspools in the state, develop a Report to the Legislature that includes a prioritization method for cesspool upgrades, and work with the Department of Taxation on possible funding options to reduce the financial burden on homeowners.

How many cesspools pose a risk to our water resources in Hawaii?

- The Report to the Legislature – Relating to Cesspools and Prioritization for Replacement identifies 14 areas in the state where an evaluation of data on hand indicates greatest need for action. These areas include approximately 43,000 cesspools.

- The Report identifies 4 priority categories. **Priority 1** are areas where cesspools present a Significant Risk of Human Impacts, Drinking Water Impacts, or Draining to Sensitive Waters. **Priority 2** are areas where cesspools present a Potential to Impact Drinking Water. **Priority 3** are areas where cesspools have the Potential to Impact Sensitive Waters in our state. **Priority 4** is a placeholder for all cesspools whose impacts DOH have yet to fully analyze.

- Kea`au is located in a Priority 2 area. In this area of the Puna District, many residents rely on privately owned wells for domestic water, and there is little soil to mitigate the impact of 9,300 cesspools. A DOH investigation found that 25 percent of domestic wells sampled in this area tested positive for wastewater indicator bacteria, demonstrating the potential for disease transmission.

- Hilo Bay is located a Priority 3 area. Heavy rainfall upslope of Hilo Bay results in significant amounts of stream and groundwater discharge to Hilo Bay, where a breakwater prevents that discharge from mixing with ocean waters. There are 8,700 cesspools that are potentially discharging to the streams and groundwater that flow into Hilo Bay.

How can I get a copy of the report?

- The Report is available for download from the following website: https://health.hawaii.gov/opppd/files/2017/12/Act-125-HB1244-HD1-SD3-CD1-29th-Legislature-Cesspool-Report.pdf

Who do I contact if I have questions about the report or cesspools in general?

- Contact our Safe Drinking Water Branch at (808) 586-4258 or email at sdwb@doh.hawaii.gov for questions or concerns about the quality of the drinking water in Kea`au.

- Contact our Wastewater Branch at (808) 586-4294 or email at wwb@doh.hawaii.gov for all other questions.

Hawaii Island Priority Upgrade Areas

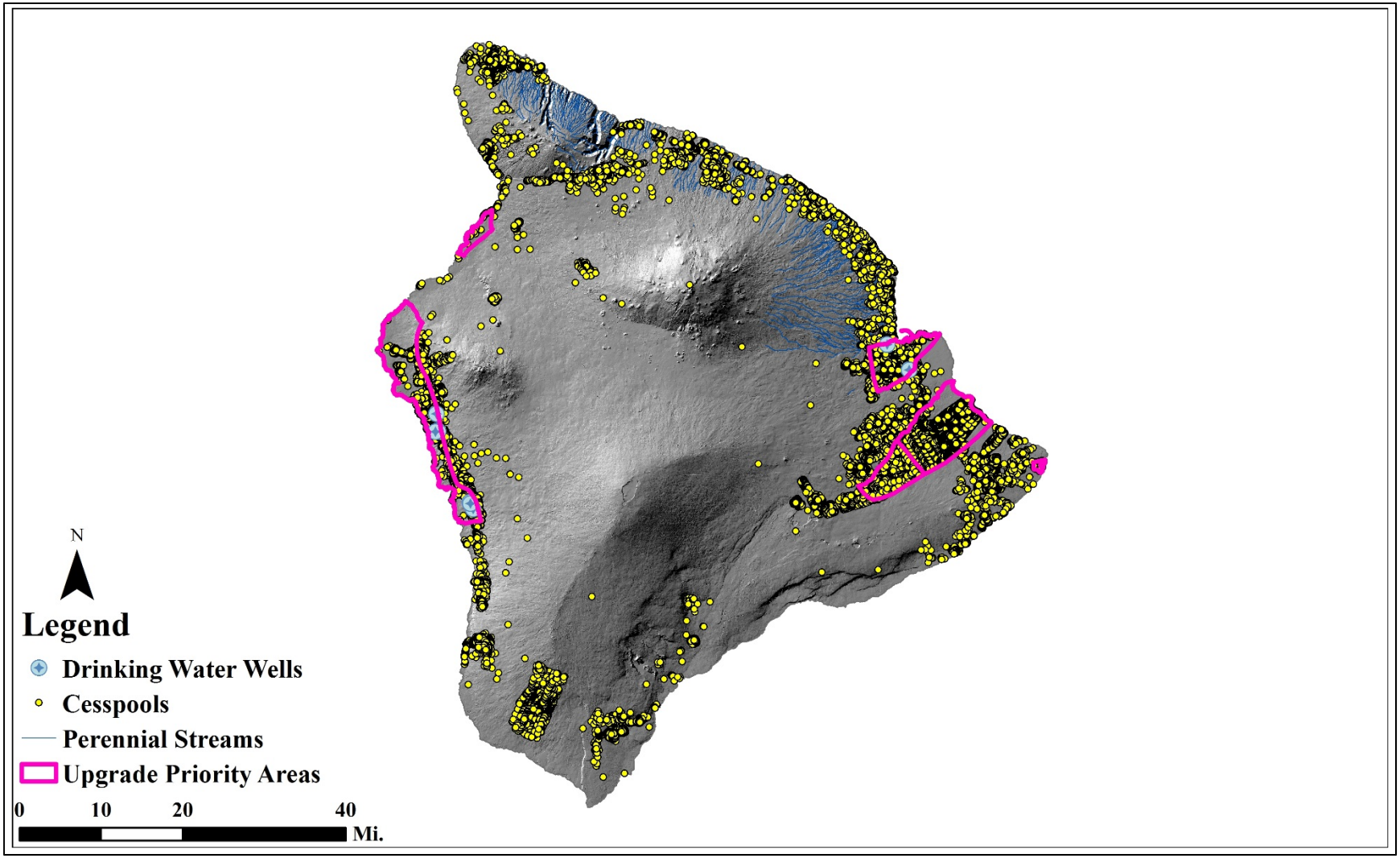


Figure 1 Hawaii cesspool locations, priority areas for upgrade, potentially affected drinking water sources, and perennial streams

Department of Health
Healthy People • Healthy Communities • Healthy Islands

State of Hawaii
Department of Health

Cesspools in
Hilo and Kea`au

Topics of Discussion

- Opening Remarks
- What is a Cesspool and Septic System
- Overview of the Report
- Prioritization Method and Priorities
- Hilo and Kea`au
- Question and Answer Session
- Next Steps

Opening Remarks

- Act 125, S.L. 2017 – Required DOH to evaluate cesspools and develop a prioritization method for cesspool upgrades.
- Spent months analyzing existing data on existing cesspools
- Report identifies 13 areas in the state that are priorities for cesspool upgrades to protect public health and environment.
- Highest priority for action is located in Kahalu`u and Upcountry Maui; Kea`au is in a Priority 2 area and Hilo is in a Priority 3 area
- Introduction of Team

What is a Cesspool?



Cesspools are little more than holes in the ground;

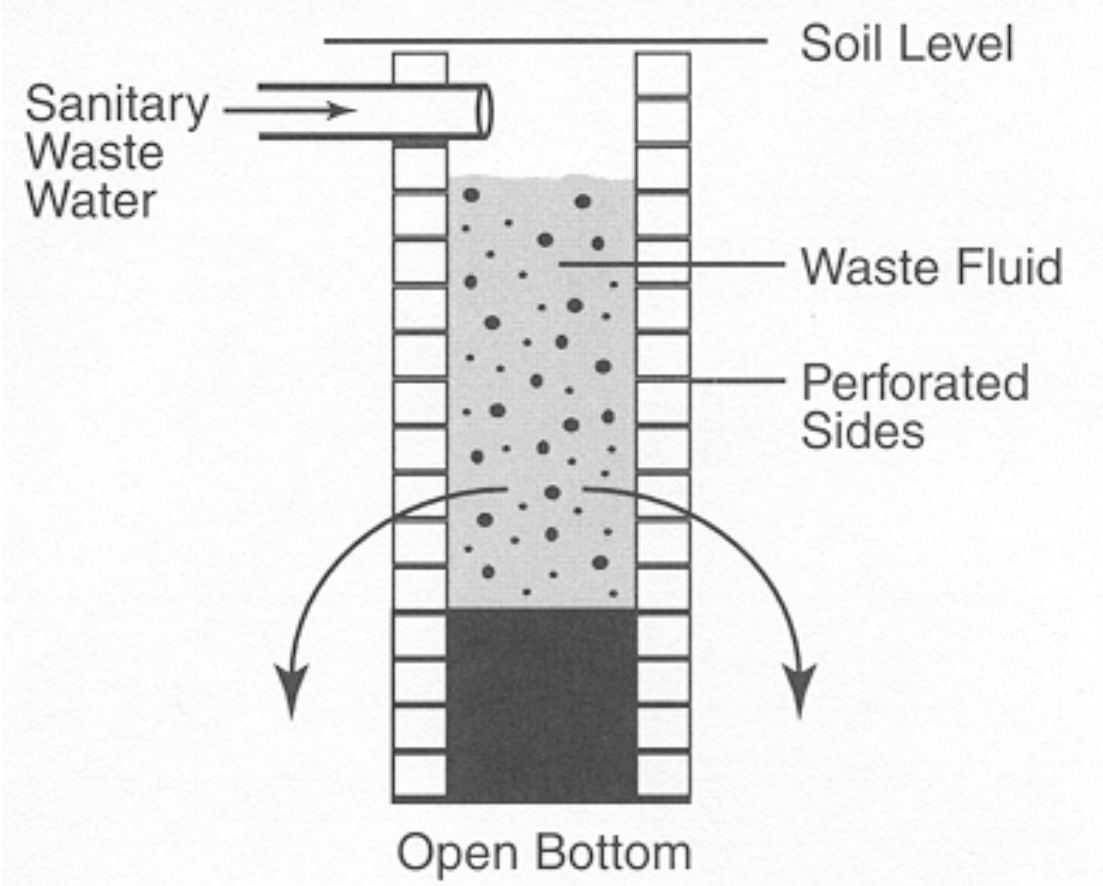
Cesspools discharge raw, untreated human waste into the subsoil;

Cesspools can contaminate ground water, drinking water sources and the ocean;

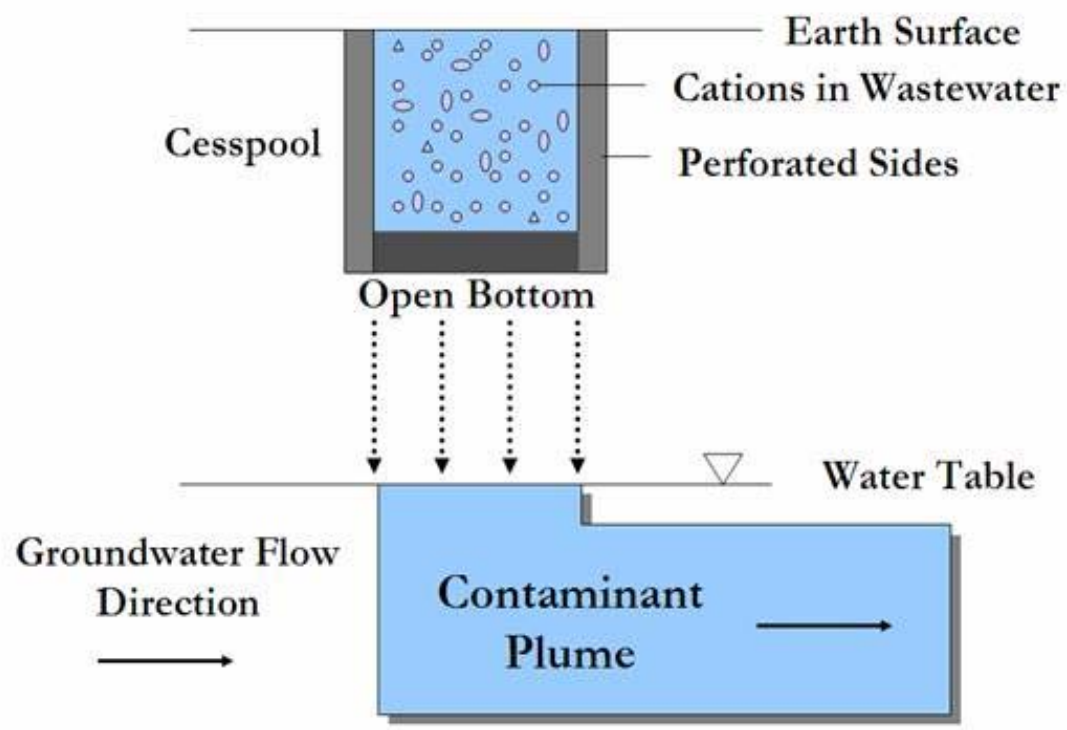
Presents risks to human health and the environment; and

Contains higher concentrations of nitrogen, phosphorus, and fecal coliform bacteria than septic tank systems.

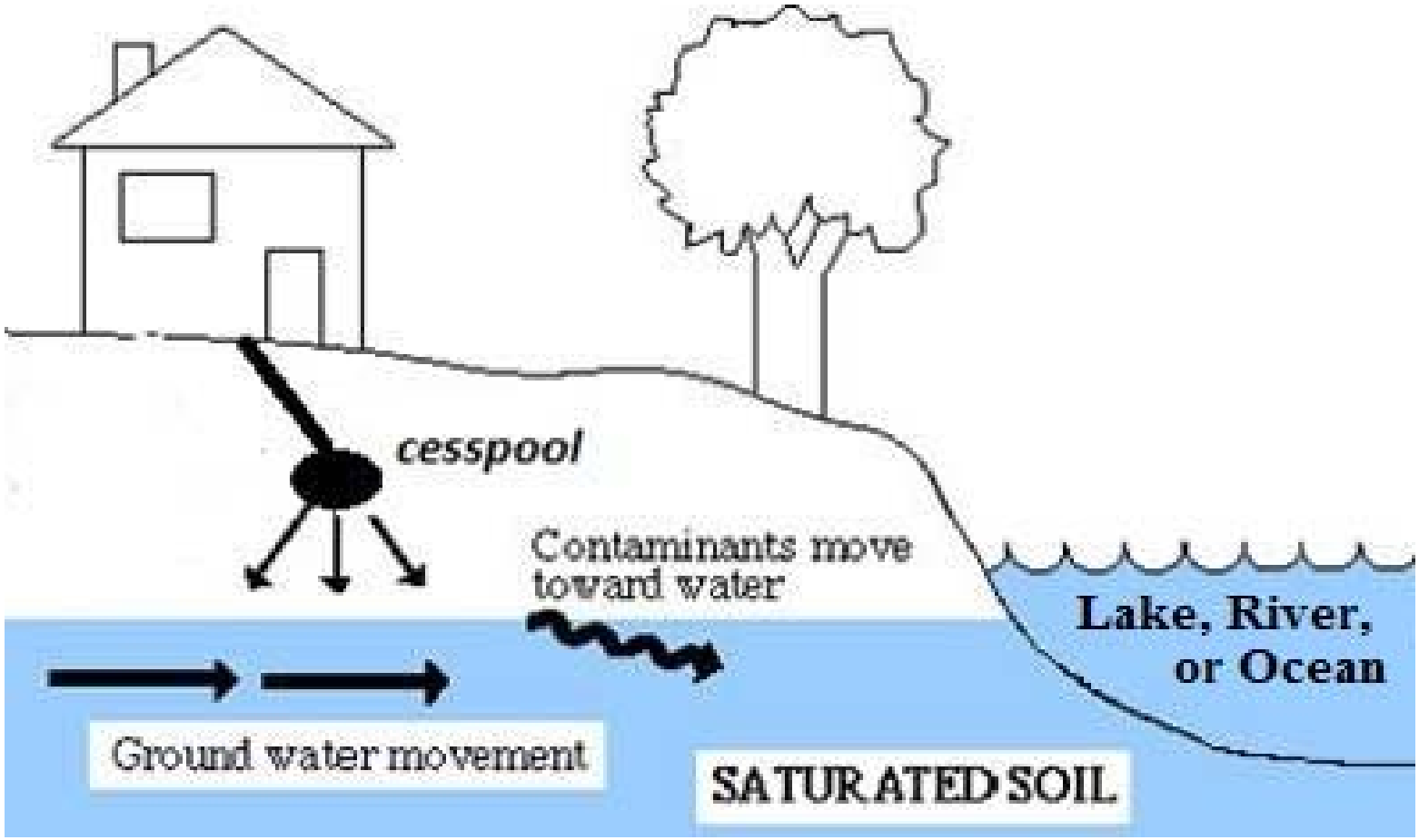
Cesspools discharges raw, untreated human waste into the subsoil



Cesspools contaminate groundwater



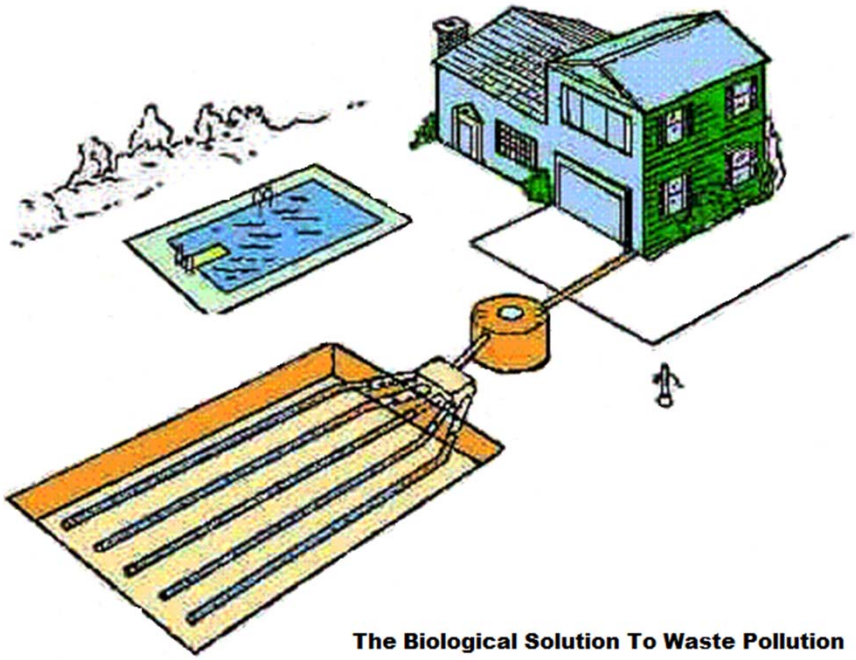
Cesspools contaminate ground and surface waters

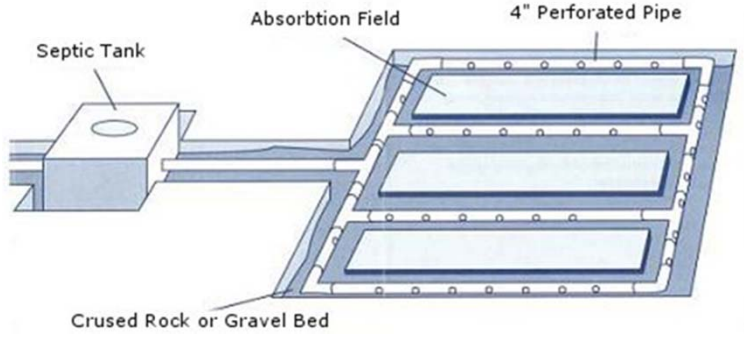


Septic Tank Systems



Polyurethane tank





Septic tank with leach field

Overview of the Report

- Cesspools are a major source of water pollution in Hawaii
- 88,000 cesspools that discharges 53 million gallons of raw sewage
- Public health depends on clean drinking water.
- Report identifies 13 areas in the state that are priorities for cesspool upgrades to protect public health and environment.
- 43,000 cesspools located in the 13 areas

Prioritization Method and Priorities

- DOH analyzed data collected
- Report identifies 4 priority categories

Priority 1

Areas where cesspools present a Significant Risk of Human Health Impacts, Drinking Water Impacts, or Draining to Sensitive Waters

Two areas identified:

- Upcountry Maui: 7,400 cesspools
- Kahalu`u: 740 cesspools

Priority 2

Areas where cesspools present a Potential to Impact Drinking Water.

Three areas identified:

Kea`au – Island of Hawaii

Kapaa/Wailua and Poipu/Koloa – Island of Kauai

Priority 3

Areas where cesspools have the potential to impact sensitive waters in our state.

Nine areas identified:

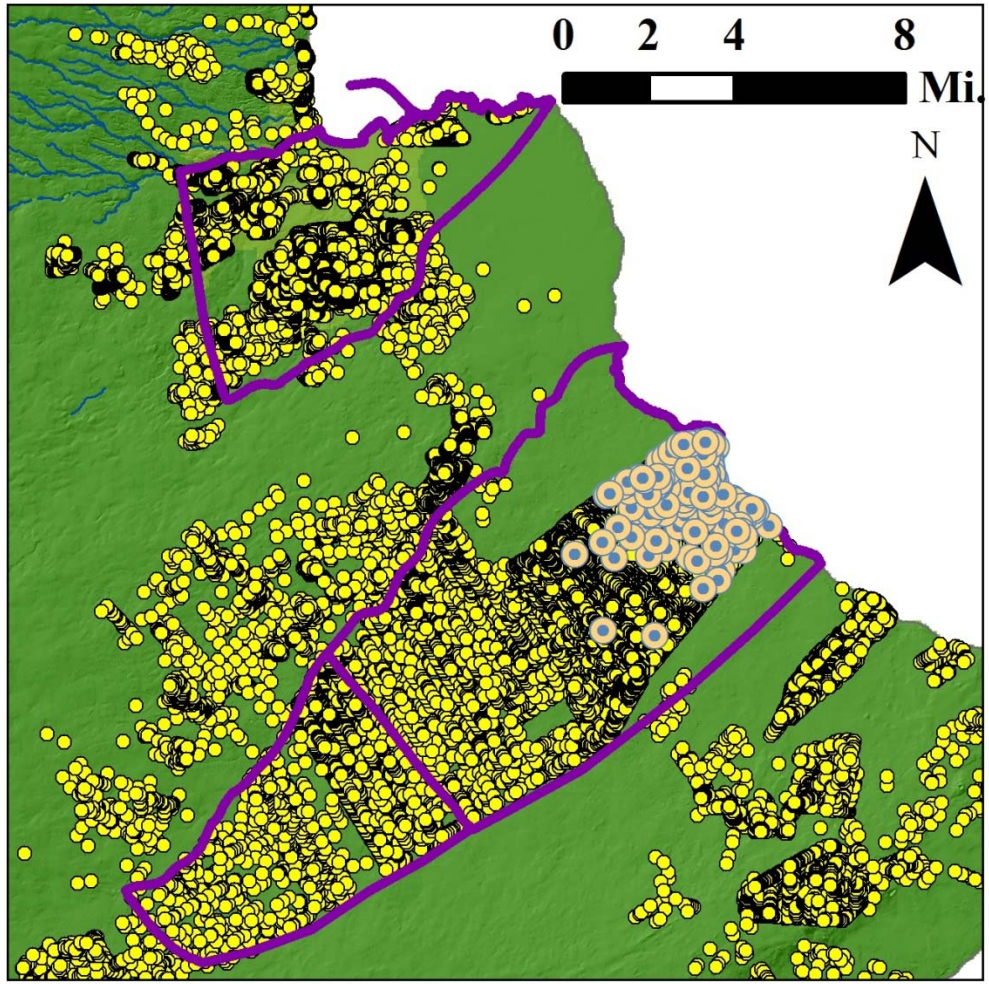
- Hilo Bay, Coastal Kailua/Kona, and Puako of Hawaii
- Hanalei of Kauai
- Diamond Head, Ewa, Waialua and Waimanalo of Oahu

Priority 4

Placeholder for all cesspools whose impact we have yet to fully analyze, which are the remainder of cesspools in the state.

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Hilo – 8,700 cesspools; Kea`au – 9,300 cesspools



Spatial and Temporal Sewage Pollution Patterns in Hilo Bay

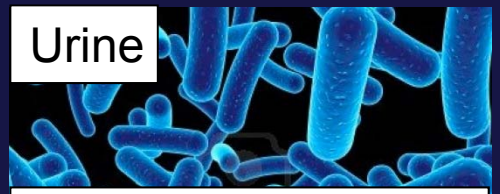
Tracy Wiegner[1], Caree Edens[2], Leilani Abaya[2], Kaile'a Carlson[1], Amber Lyon-Colbert[3], Stephanie Molloy[3]

[1]Marine Science Department, University of Hawaii at Hilo
[2]Tropical Conservation Biology and Environmental Sciences Graduate Program, University of Hawaii at Hilo
[3]Department of Biological Sciences, California State University East Bay

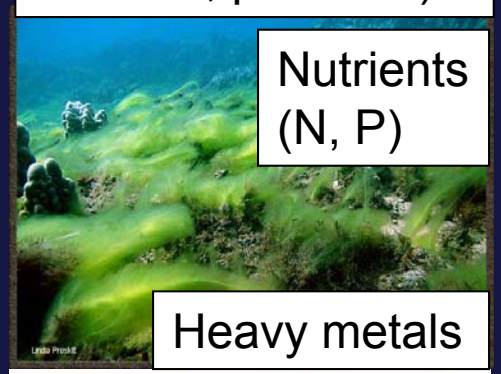
What is sewage?

Nasty cocktail of hundreds of different compounds

Urine



Pathogens (viruses, bacteria, protozoa)



Nutrients (N, P)

Heavy metals



Pharmaceuticals



Feces



Hydrocarbon

Cleaning chemicals



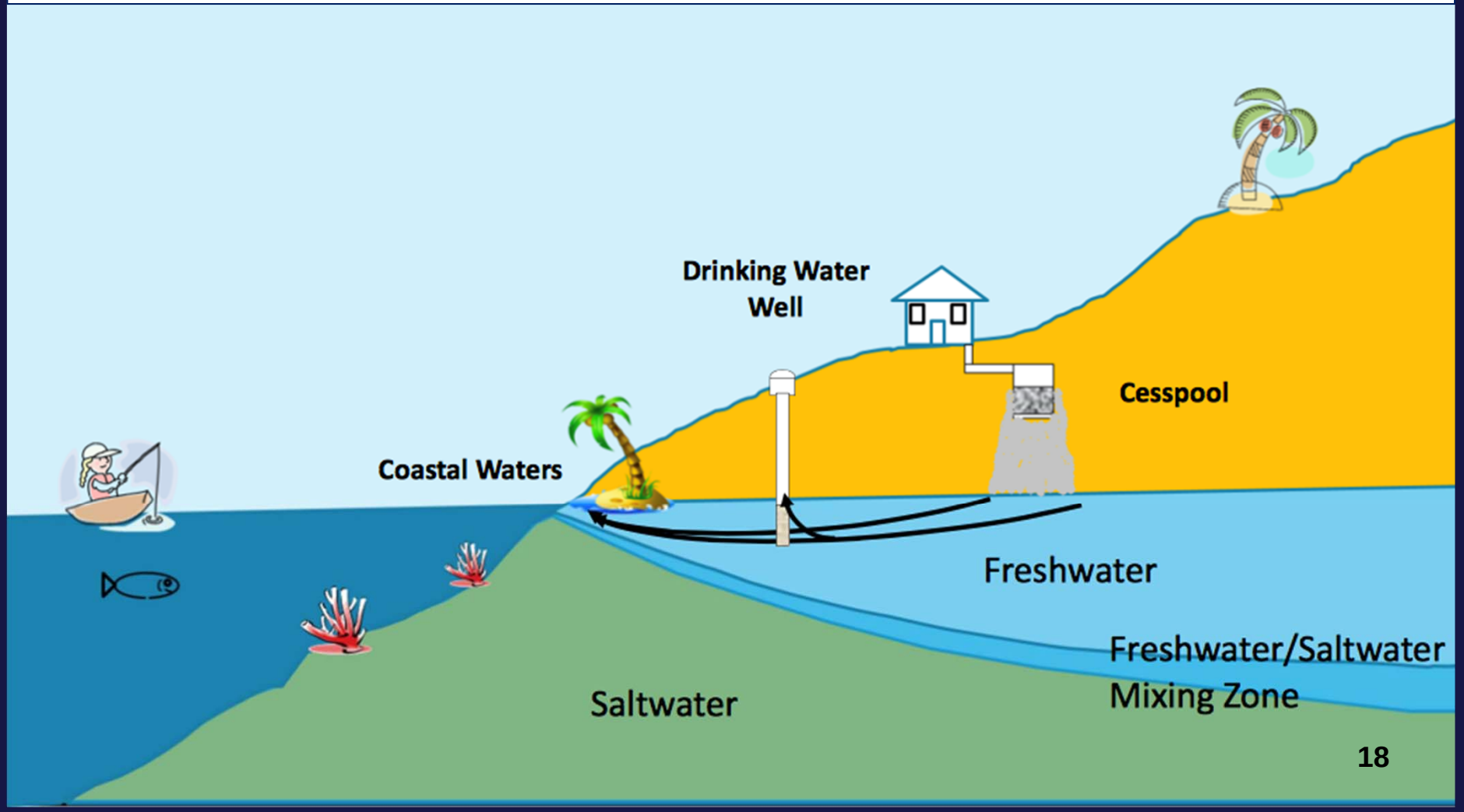
Toxins



Freshwater

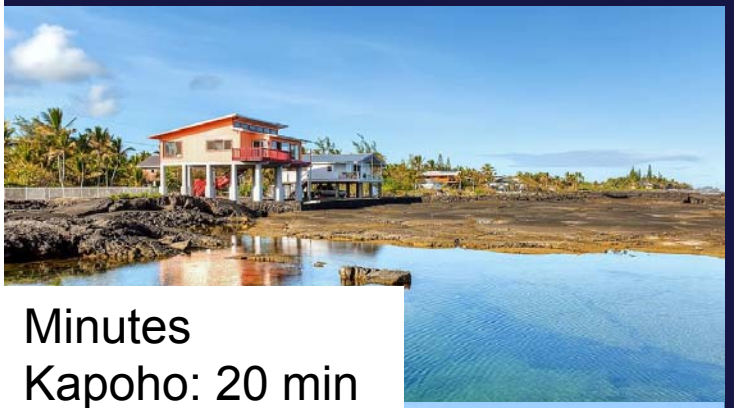
How does sewage get to the ocean?

For cesspools, septic tanks, ATUs, and injection wells: groundwater



How fast does sewage reach the ocean?

How do we know? Dye Tracer Studies



Minutes
Kapoho: 20 min

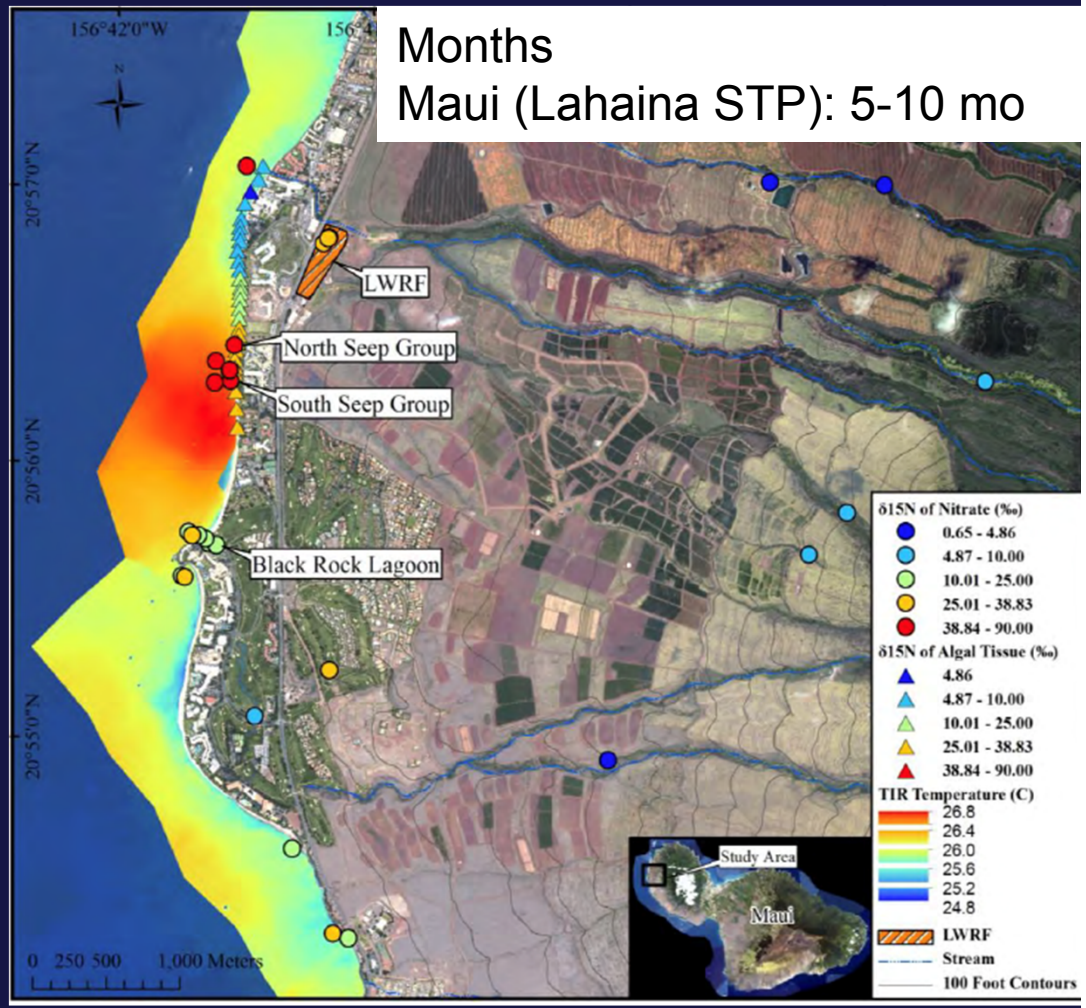


Hours
Puakō: 9 h



Days
Puakō: <1 -10 d

Months
Maui (Lahaina STP): 5-10 mo



What if I swim in or drink sewage-contaminated water?

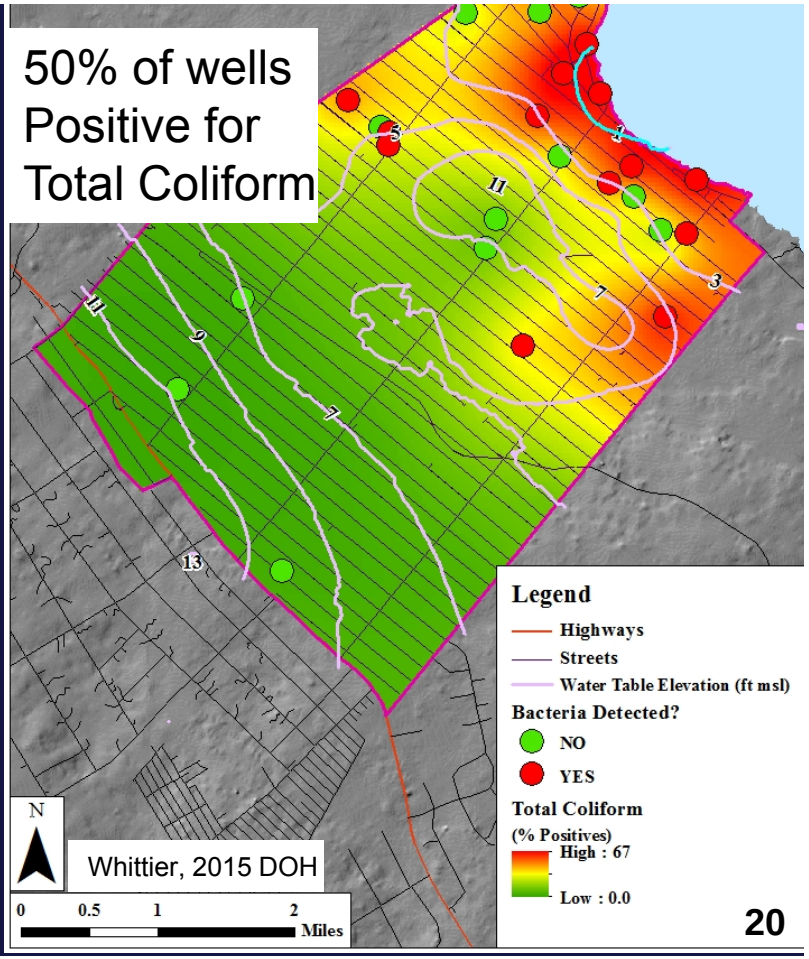
<u>You can get sick:</u>

Campylobacteriosis Leptospirosis
Cryptosporidiosis Encephalitis
Gastroenteritis Giardiasis
Hepatitis A Poliomyelitis
Salmonellosis Shigellosis
Paratyphoid Fever Typhoid Fever
Yersiniosis
Escherichia coli Diarrhea
Methaemoglobinaemia

Waikiki, Oahu



Hawaiian Paradise Park, Big Island



What is my risk of getting sick?

<u>USEPA Recreational Marine Water Standard</u>
Enterococcus spp.: 35 CFU/ 100 mL

3.6% chance of Gastrointestinal (GI) disease

<u>Under development:</u>
Quantitative microbial risk assessment for other bacteria

Bacteroides: (Boehm et al. 2015)
BacHum: 4800 copies/ 100 mL
HumM2: 2800 copies/ 100 mL

3% chance of GI disease







How does sewage pollution affect the ocean?

Eutrophication

Shift from coral- to seaweed dominated reefs

Declines in coral & reef fish

Increased prevalence & severity of coral and reef biota disease & infection







Hypnea musciformis bloom - Maui



Cladophora bloom – Maui

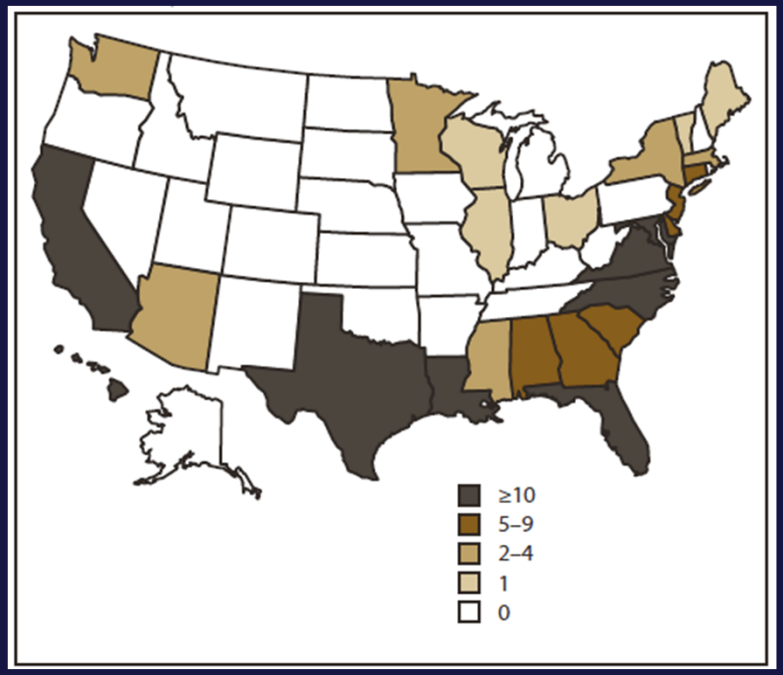


Hawai`i: high prevalence of waterborne infections associated with recreational water use

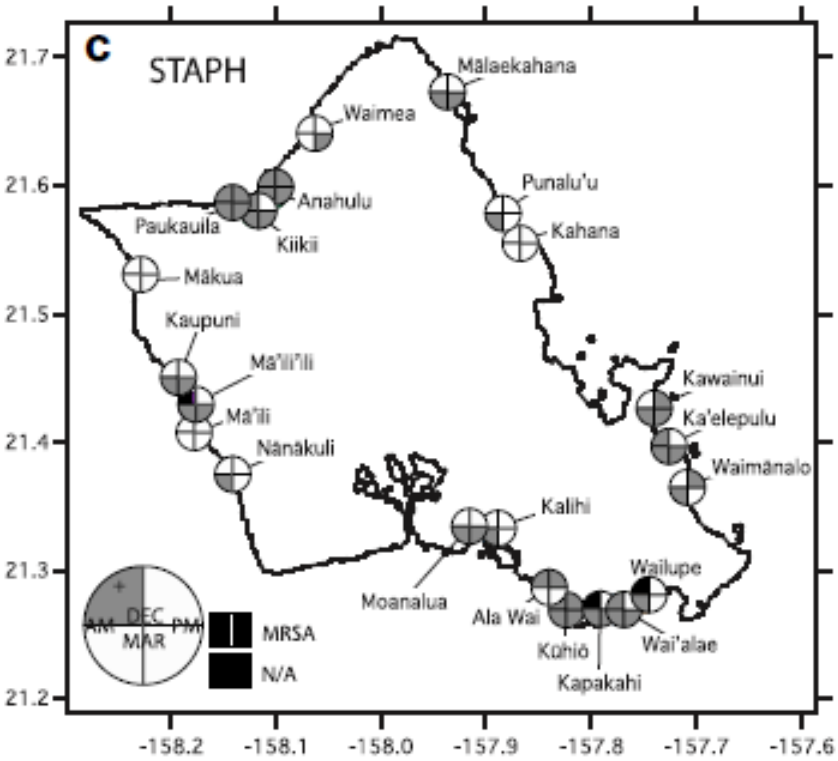
Newspaper Headlines:

Hawai`i Leads Nation in Deadly Staph Infections
Hawai'i Sees Many *Leptospirosis* Cases

Data

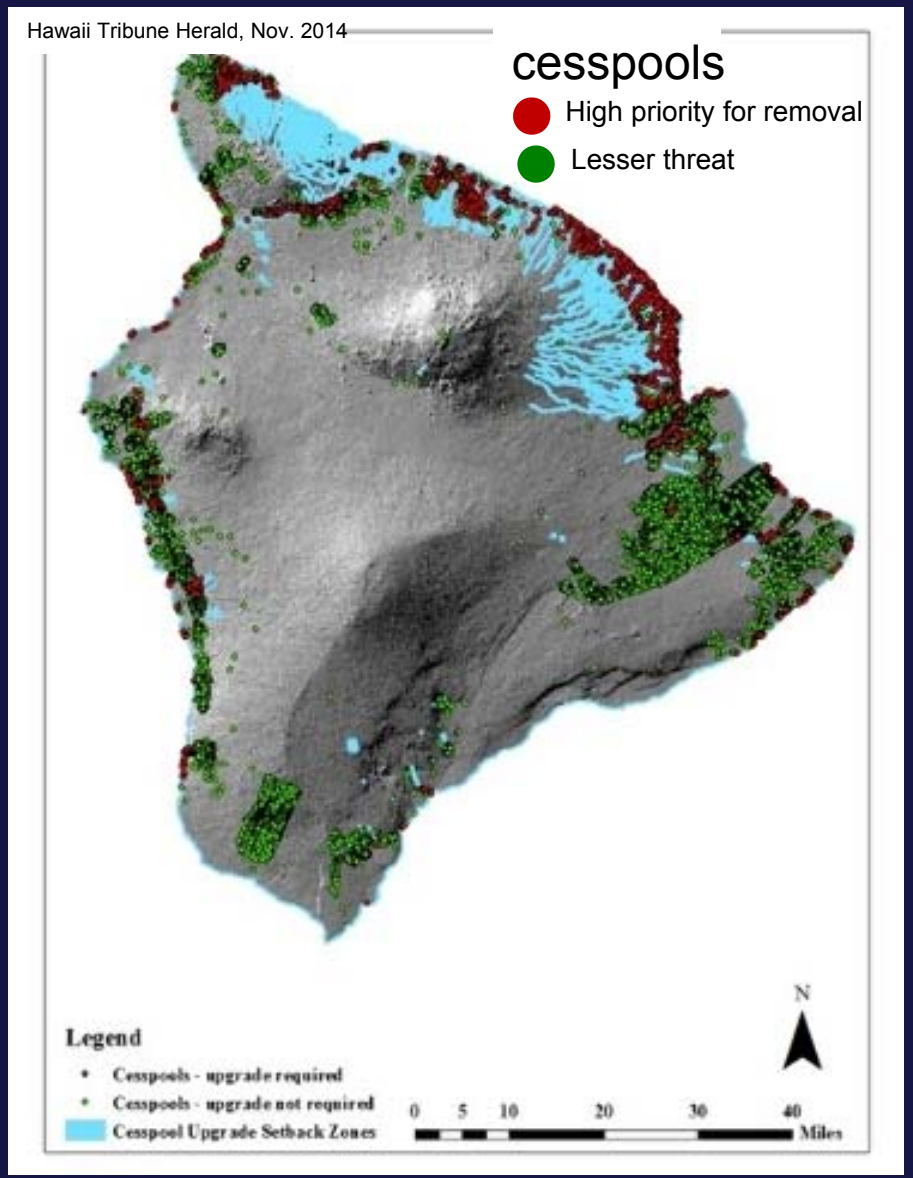


Number of *Vibrio* cases associated with recreational water exposure 2007-2008 (Hlavsa et al. 2011)



Presence of *Staphylococcus aureus* in 22 Oahu streams (Viau et al. 2011)

Hawai`i: Most coastal waters are impacted by sewage from cesspools

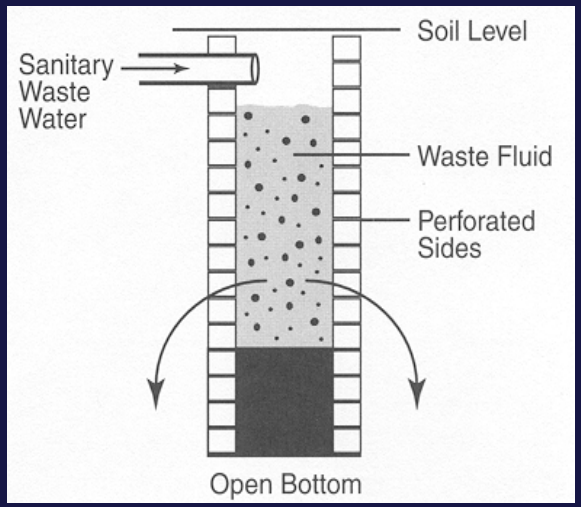


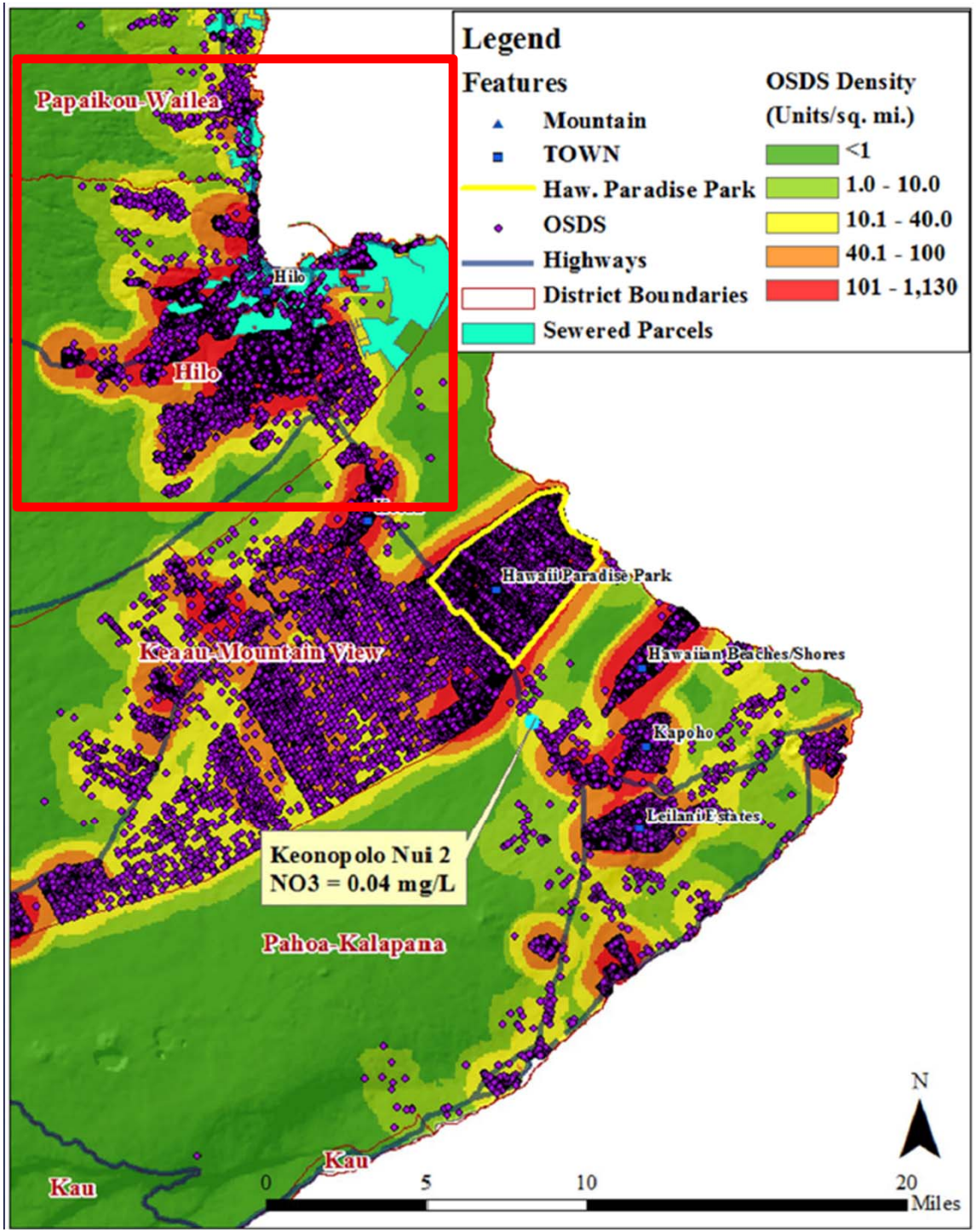
Most commonly used domestic waste depositories

~90,000 statewide, ~50,000 on Big Island

Used more in Hawai`i than any other state

Cesspool





OSDS in Hilo

8,700 OSDS in Hilo

41 OSDS/mi^2 – 2nd highest on island – a density likely to contaminate groundwater (USEPA, Yates, 1985)

5.6 MGD of untreated effluent into Hilo Bay

Volume of 8.5 Olympic sized pools per day

0.04% of Hilo Bay's volume

(like peeing in a bathtub)

Whittier & El-Kadi 2014 and HDOH 2017 reports

Hilo Bay

Listed on USEPA's 303 (d) list of impaired waters for high FIB levels

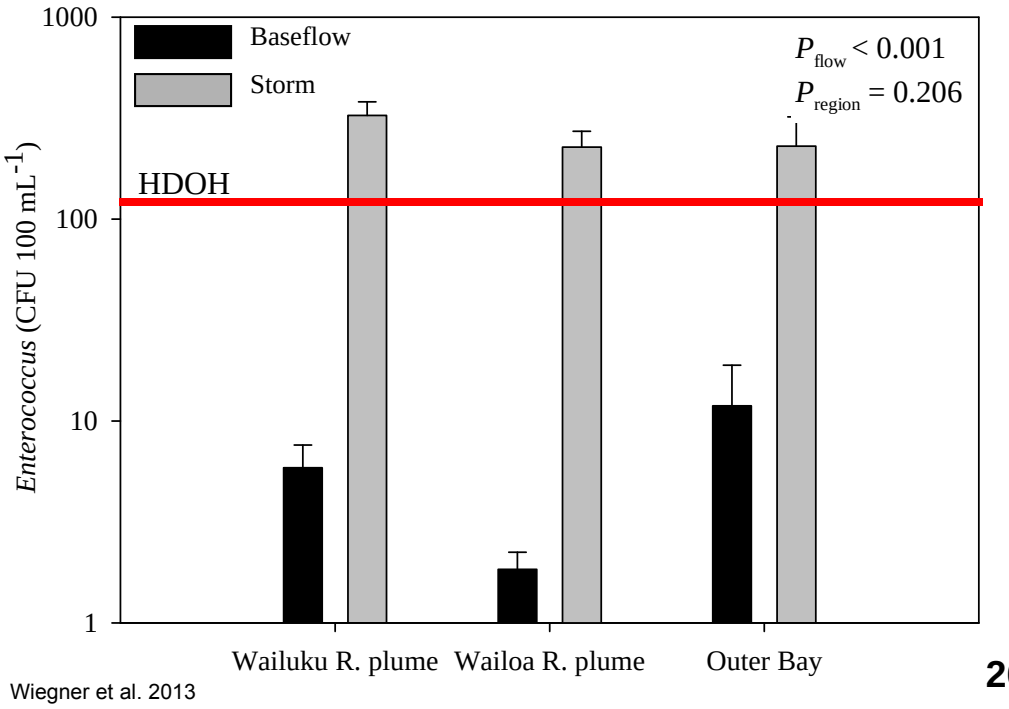
60-70% of urban Hilo not connected to sewer line

USEPA, Hawai`i State, & Hawaii County want to reduce number of houses with cesspools

Financial resources & data are limited

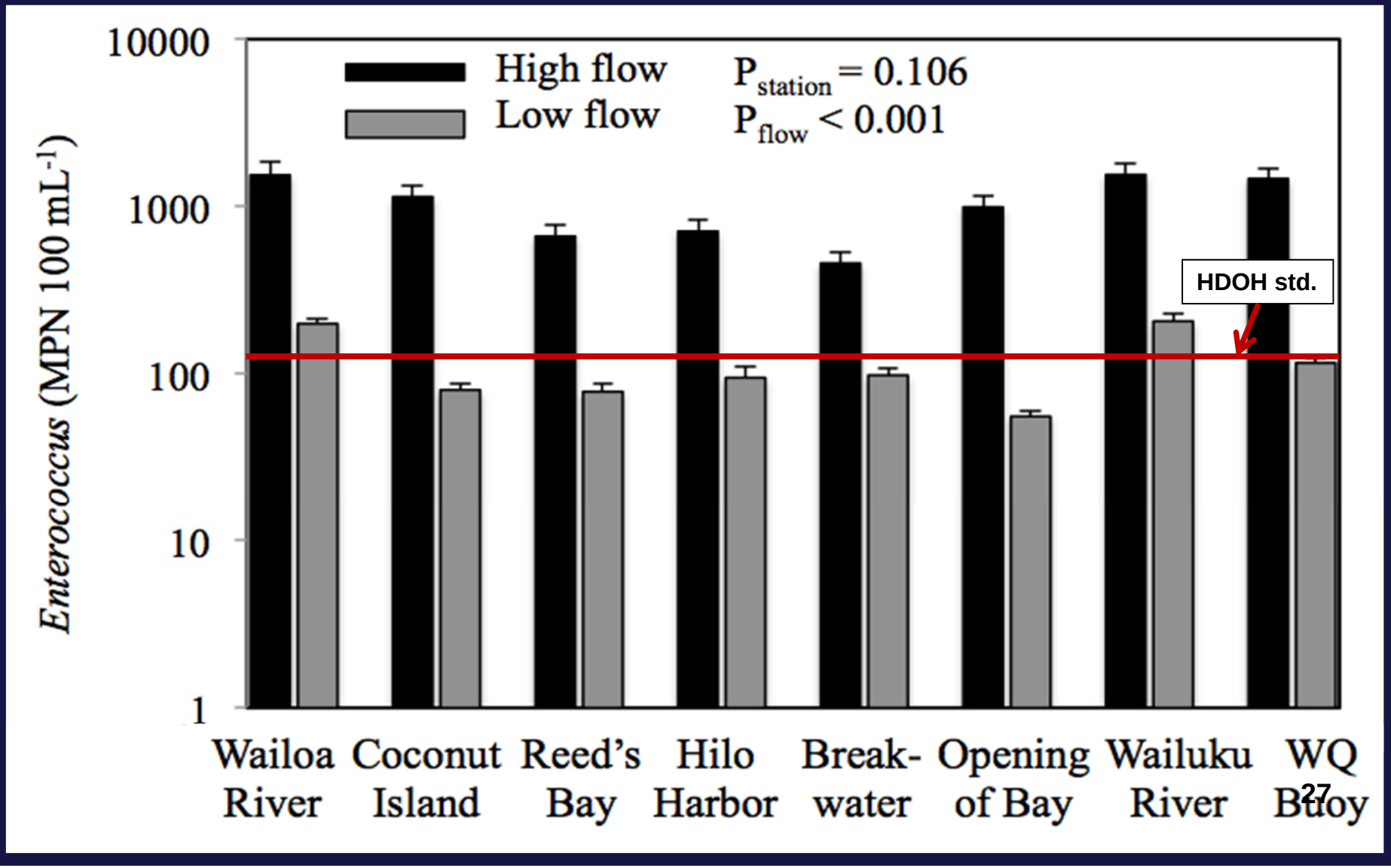
HDOH (2017): Priority 3 for cesspool upgrades



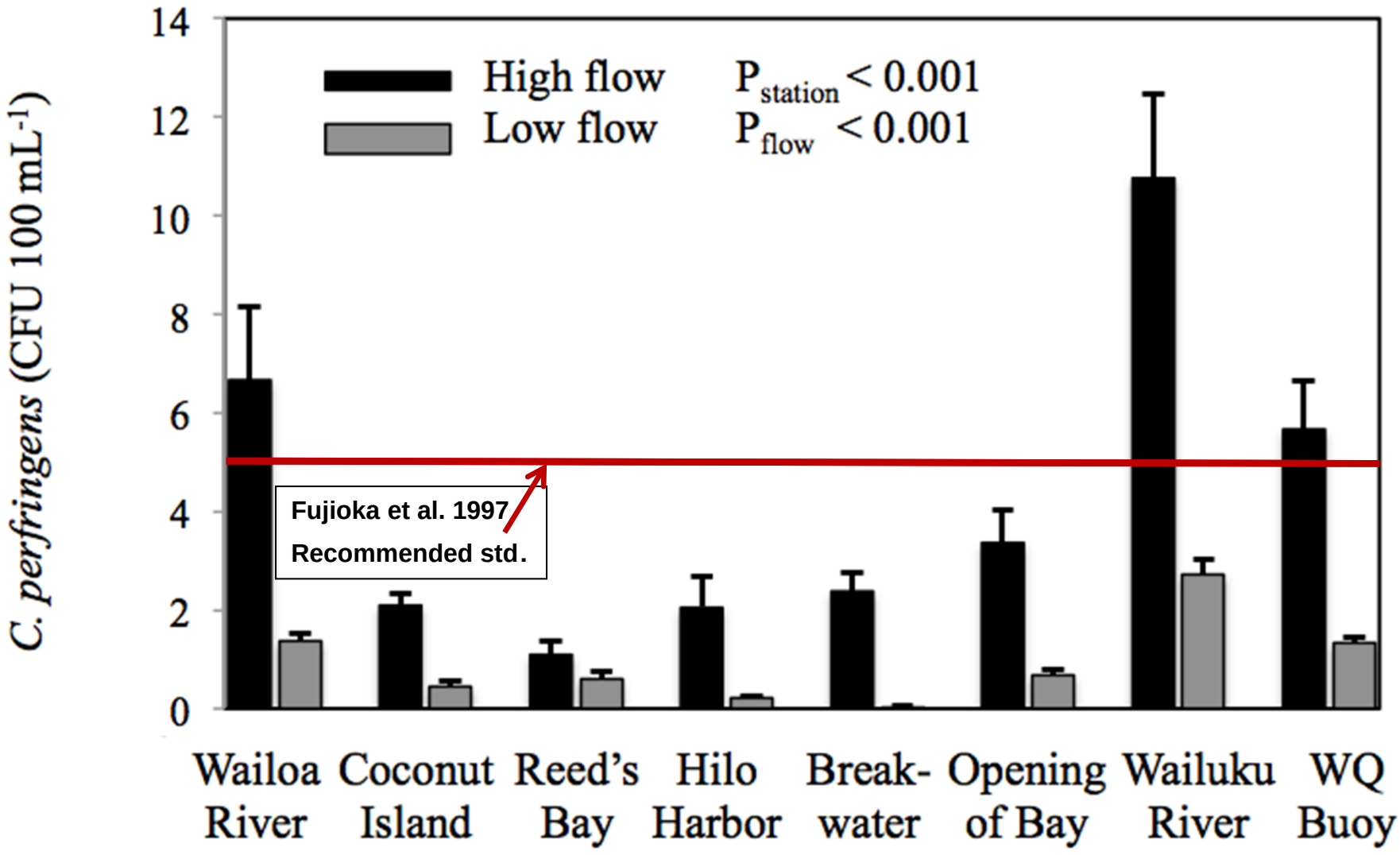


Wiegner et al. 2013

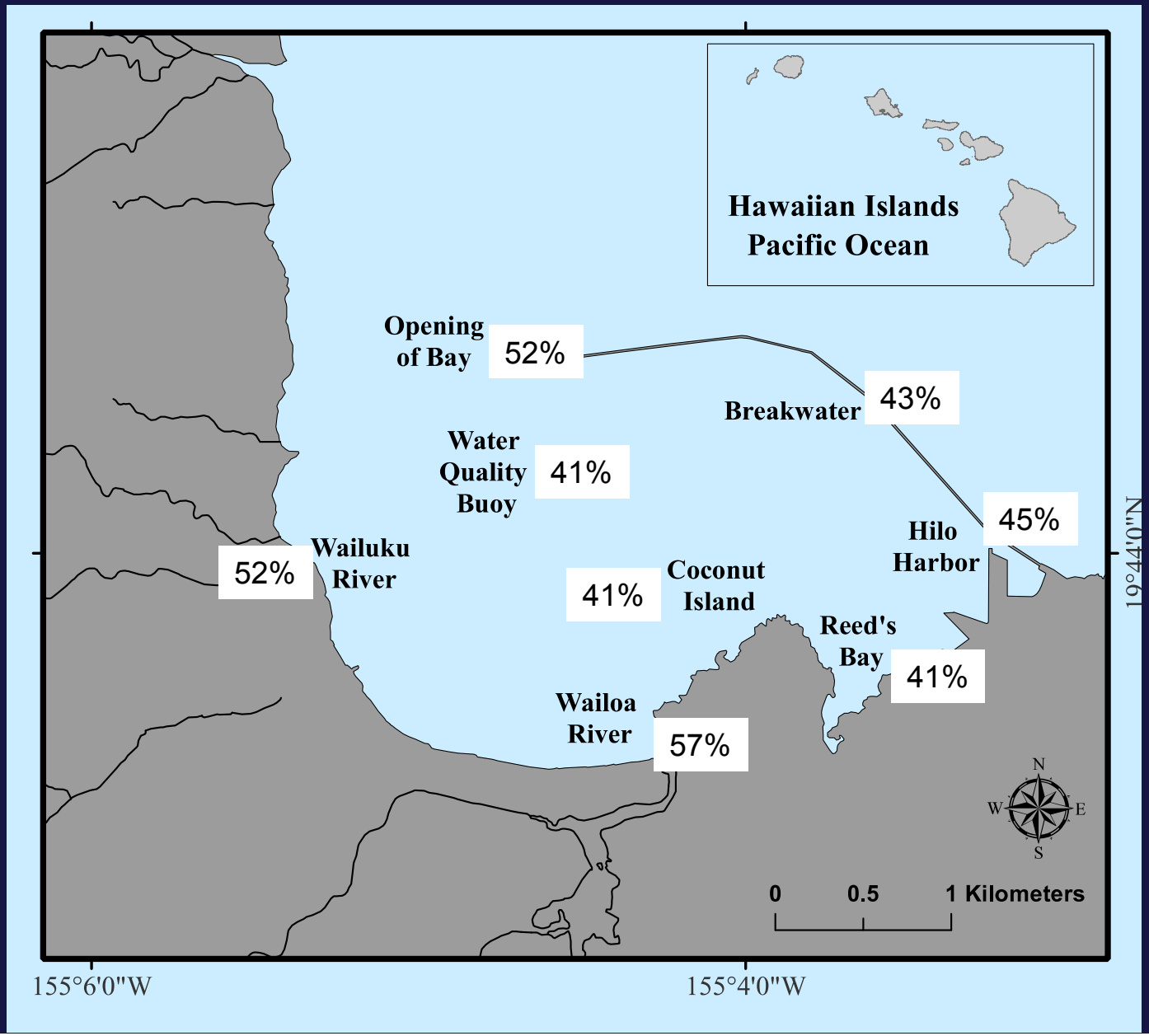
Enterococcus: No spatial variability = multiple sources
Temporal variability = higher during storms



C. perfringens: Spatial variability = higher at river mouths
Temporal variability = higher during storms

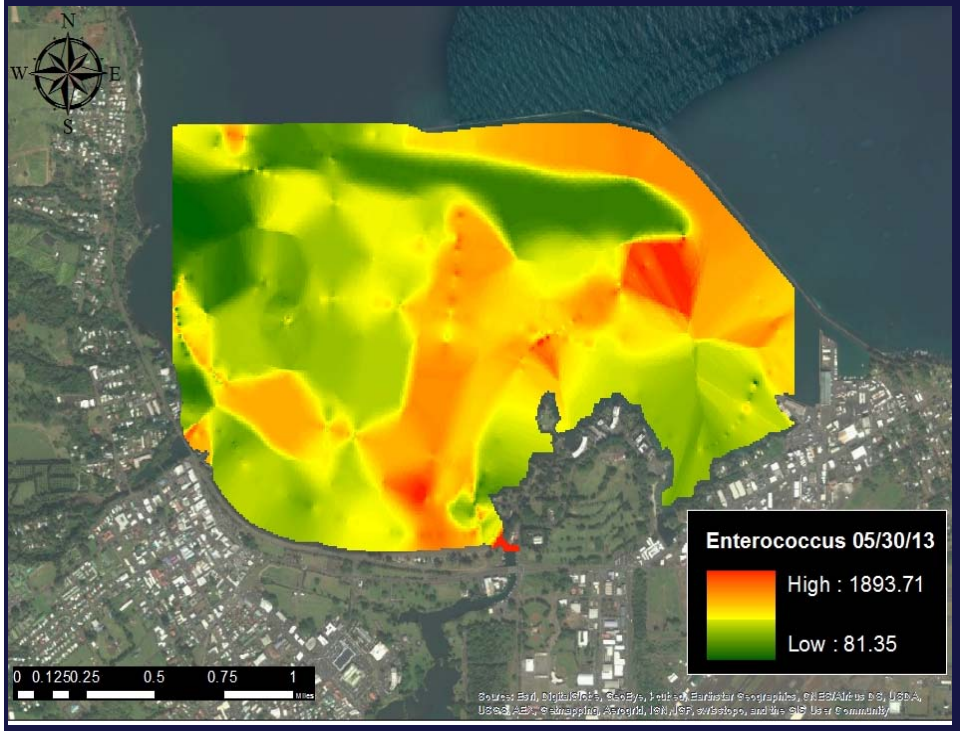


40 to over 50% of samples tested positive for human *Bacteroides* Indicating presence of human waste

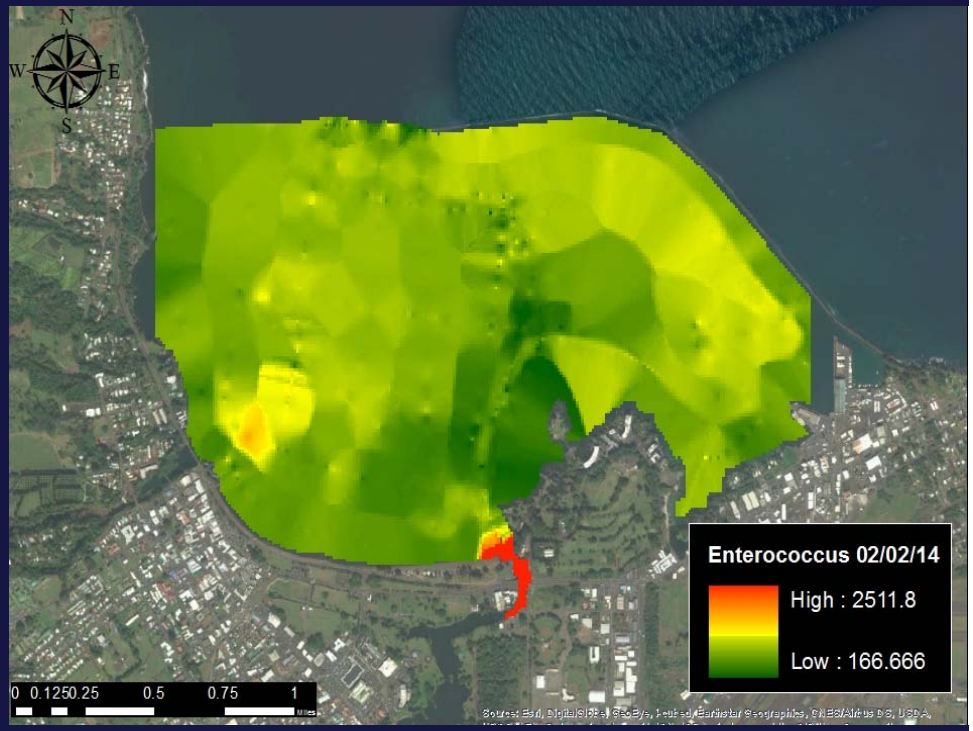


Enterococcus spp. maps
Comes in with river water, trapped by breakwall
Predict exceedances 64% of time

High Flow



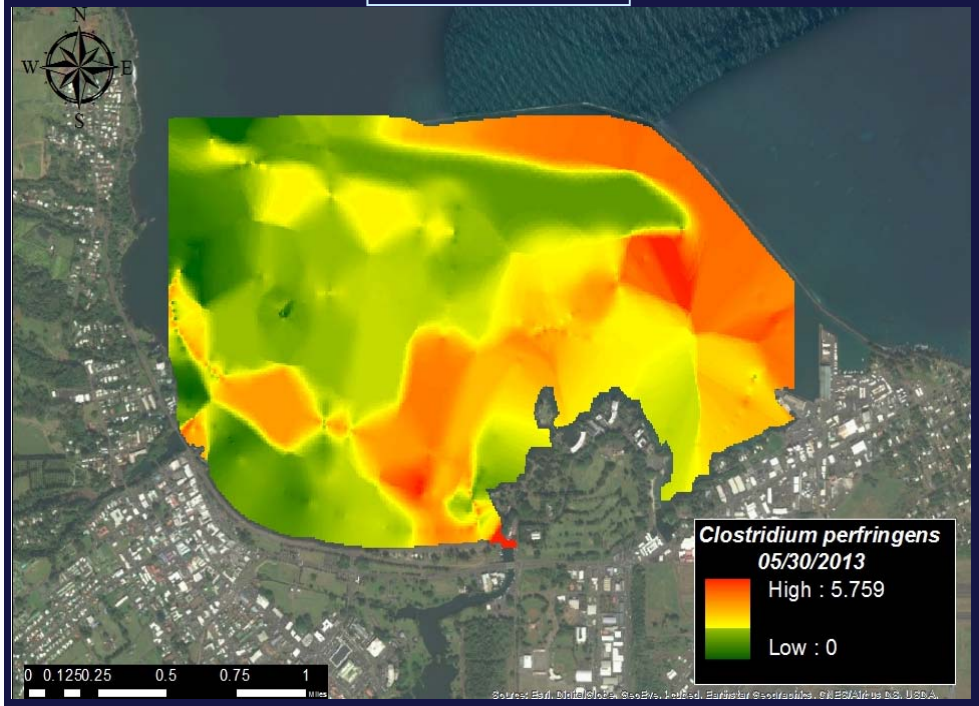
Low Flow



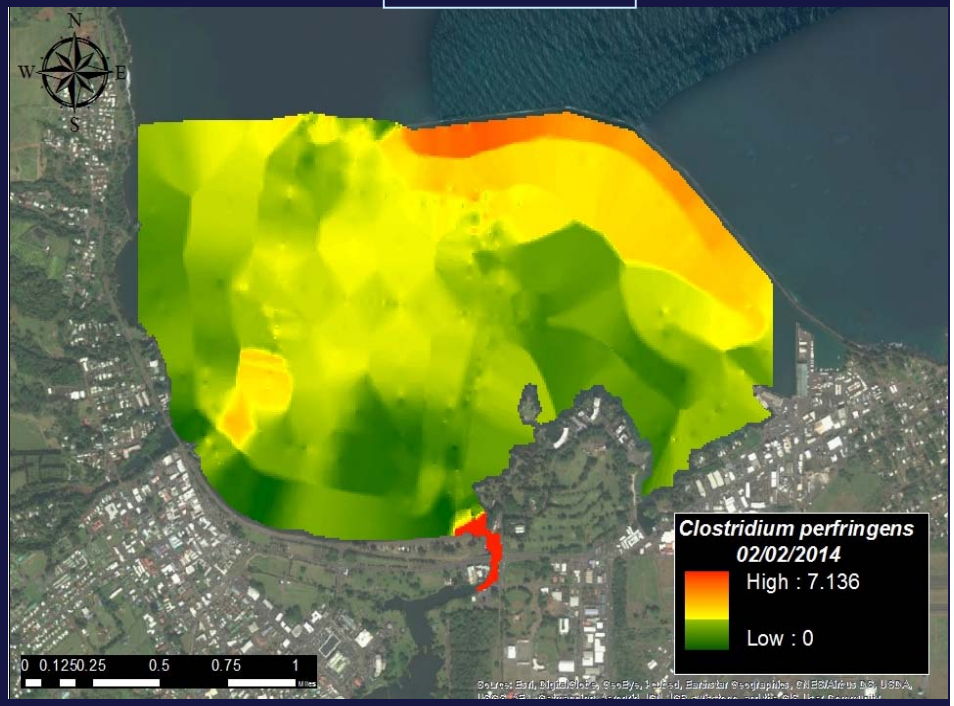
Multi-parameter regression: salinity, temperature, & turbidity (R^2= 0.44, p<0.001)

Clostridium perfringens map
Comes in with river water, trapped by breakwall
Predict exceedances 95% of time

High Flow



Low Flow



Multi-parameter regression: Salinity and Turbidity (R^2= 0.55, $p<0.001$)

Water quality buoy

Develop a ‘nowcasts’

Make real-time predictions of FIB concentrations from parameters buoy measures

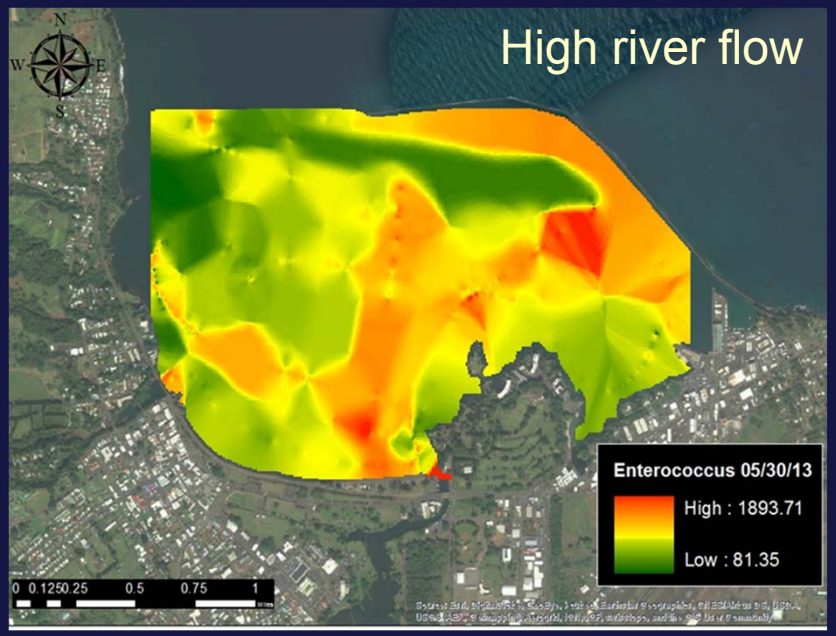
Make real-time decisions about swimming advisories & beach closings

Decrease health risks to water users



Conclusions

- FIB were highest near river mouths & increased during storms
- *Enterococcus* spp. concentrations 10 times higher than HDOH standards during storms
- >40% of samples tested positive for human waste during storms
- FIB maps helped visualize hotspots
- Developing real-time model to predict safe swimming conditions using water quality buoy





Mahalo!

- **Field & Lab Crew :** Jon Marusek, Louise Economy, Hoang-Yen Nguyen, Jonathan Chandrasakaran, Jessica Loretero, Stephen Brown

- **Consultants:** Jason Adolf, & Jon Awaya

- **UH Hilo Analytical Lab**: Tara Holitzki & Erik Johnson

- **Funding Sources**: Hawai`i Sea Grant, PacIOOS, NSF C-MORE, NSF UH Hilo PIPES

Moving Forward Towards 2050

Where do we go from here?

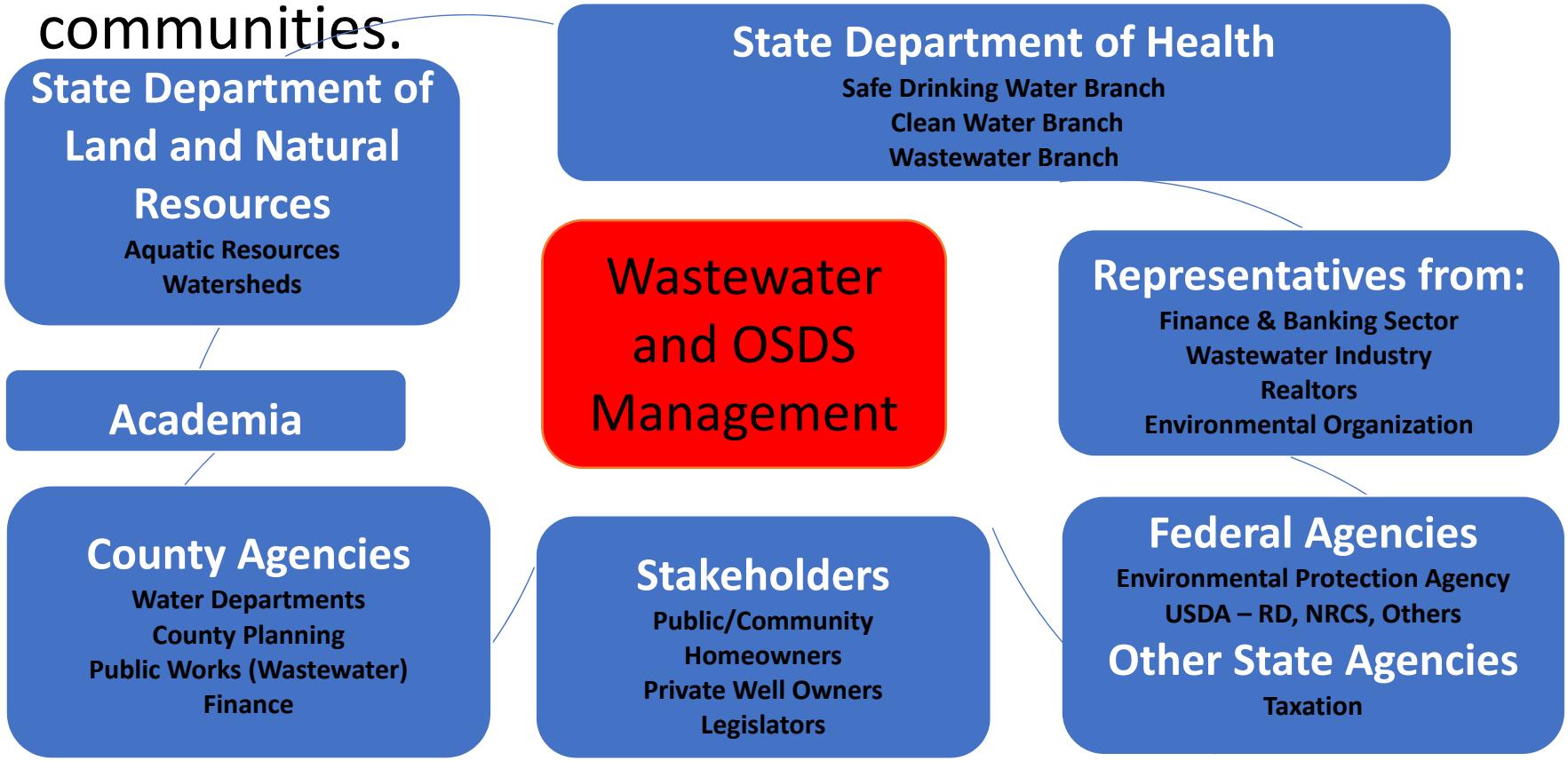
Next steps:

- Upgrades are expensive, average about $20,000
- Cost to upgrade 88,000 cesspools - $1.75 billion

How do we fund the solution to this problem?

Next steps:

- Partnerships and need for early collaboration with communities.



Next steps:

- Complex problem that will involve multiple solutions
  - Access to municipal sewer systems
  - Local Geology
  - Cesspool Density
  - Receiving Waters

What are the most appropriate treatment technologies to solve the problem?

Next steps (continued):

- Continue to provide public education and outreach.
- DOH to continue to work with communities, legislators, state and county agencies and stakeholder groups to find solutions.

Contact Us

Safe Drinking Water Branch
Phone Number: (808) 586-4258
Email: sdwb@doh.hawaii.gov

Wastewater Branch
Phone Number: (808) 586-4294
Email: wwb@doh.hawaii.gov

Mahalo!

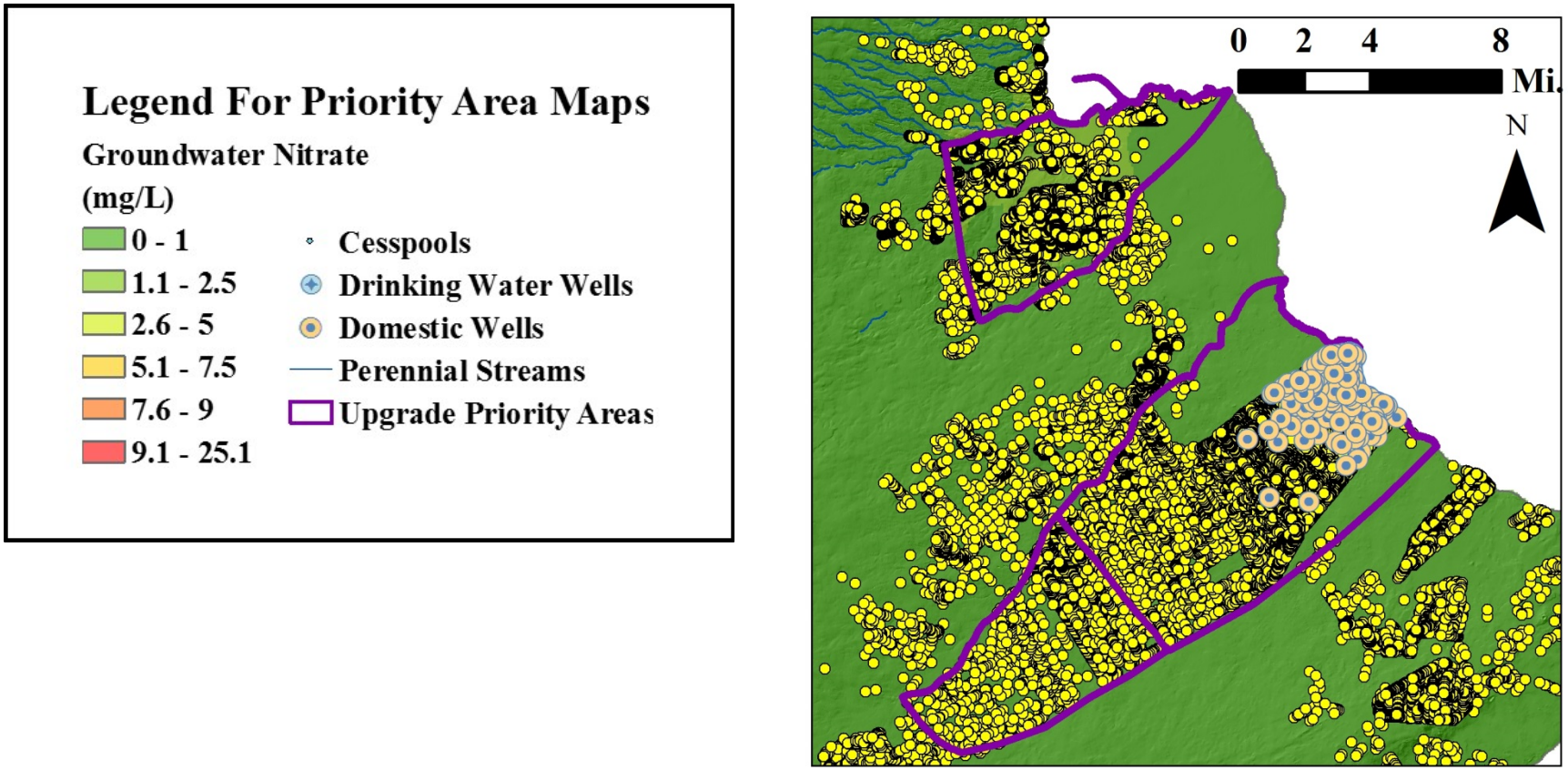


Figure 2 Hilo and Kea'au priority area and cesspool nitrate

Priority 2: Potential to Impact Drinking Water

- Kea'au Area of Hawai'i Island: In this area of the Puna District, many residents rely on privately owned wells for domestic water, and there is little soil to mitigate the impact of 9,300 cesspools. A DOH investigation found that 25 percent of domestic wells sampled in this area tested positive for wastewater indicator bacteria, demonstrating the potential for disease transmission.

Priority 3: Potential Impacts to Sensitive Waters

- Hilo Bay Area of Hawai'i Island: Heavy rainfall upslope of Hilo Bay results in significant amounts of stream and groundwater discharge to Hilo Bay, where a breakwater prevents that discharge from mixing with ocean waters. There are 8,700 cesspools discharging to the streams and groundwater that flow into Hilo Bay.