

David Dorn Testimony #2 CPAC 3/8/2023:

Using traditional Hawaiian Watershed Management for Resilient Systems

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By contrast, the Final Kihei Drainage Master Plan 2022 does not mention the word groundwater one time!

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Hi my name is David Dorn,

Watershed management, cultural protection, and resilient systems, all go together.

Hawaiian Culture developed a sophisticated system of watershed management that mimicked natural processes and cooperated with nature where possible. This philosophy is actually in keeping with the latest practices in watershed management sciences. The Hawaiian way was a sustainable and climate resilient system that survived in this environment for many hundreds of years. I believe that by learning about Hawaiian attitudes towards water management and land management (Example, the ahupua'a system) we can begin to correct some of the dysfunctional parts of our drainage systems, and also help control some of our flooding issues. And we can also protect water quality on land and in the ocean as well.

Hawaiians respected nature, and they acknowledged that nature was superior to people, so they did not try to defeat nature by making the land or the water go against its nature.

The Two Waters from the Kumulipo:

- There are two waters mentioned in the Kumulipo, the broadwater referring to all the surface water, streams, rivers, gulches, and stormwater, and the Narrow Water which is all the underground water, the springs, the groundwater, the aquifers, the water table, and the SGD in the ocean.
- As Clare Apana testified at a previous meeting, The Kumulipo talks about the Narrow Waters referring to groundwater.
- The kumulipo says "man was born of the broad waters (surface water), and woman was born of the narrow waters (groundwater).
- This passage talks about the fundamental connection between the two waters to the creation of human beings.
- Groundwater sources were well known to the Hawaiians,

Groundwater is a Hawaiian Cultural asset.

- Groundwater is Wahi Kupuna. This might be very obvious to a Hawaiian, but I think it needs to be stated here.
- Hawaiians are known to have regularly accessed groundwater in springs, pools, and wetlands, and also via SGD (submerged groundwater discharge), underwater springs in the ocean.
- Hawaiians also used SGD sources to cultivate Limu in their Fishponds to feed their fishstocks.
- This explains the phenomena of the massive amounts of limu growing near my home at Kawililipoa beach, near Waipuilani beach park.
- This was the site of a massive Loko Kuapa fishpond (one of the 4 Royal fishponds at Kula Kai), called “KeokeaKai” and although the Kuapa seawalls have long since fallen down, the SGD springs still feed the limu at this fishpond site.
- This fishpond site today still creates a specialized marine wetland environment that is important for fishing and limu gathering and recreation.

We should all agree that Groundwater is vital for many Hawaiian Cultural Activities, and to maintain the environments that support them.

Especially here on the leeward sides of Haleakalā and Kahālāwai (West Maui mountains) where water is more scarce.

By contrast, the Final Kihei Drainage Master Plan 2022 does not mention the word groundwater one time!

You can quickly see how western thinking has failed to see the total picture or make these connections between surface water and groundwater.

To maintain this important cultural resource (groundwater):

We need to address restoring these springs and maintaining them, and setting quality standards for South Maui Groundwater.

- Groundwater flows Mauka to makai.
- Groundwater flows through each Ahupua'a.
- Groundwater connects and impacts a series of ecosystems and habitats.
- Many habitats are dependent on groundwater. Such as wetlands, and nearshore sealife.
- Groundwater joins the aquifer and protects the aquifer from seawater intrusion.
- Groundwater is necessary for sustaining many ecosystems, and habitats and the plants and animals that depend on them.
- Any contamination of the groundwater affects all the connected ecosystems, and lifeforms that depend on them, including humans.
- Humans are getting sick from sewage contaminated groundwater entering the ocean.
- We also need to ensure that groundwater is not impacted by chemicals and wastewater.
- Minimum Groundwater levels need to be set and monitored, and there shall be restrictions on groundwater use when the groundwater levels drop.

We also need to look at how developments are being done, and that unnecessary excavations and substrate materials are not disturbed that are part of the groundwater system:

- Maui is also home of the Volcanic PseudoKarst Aquifers, and Limestone Karst Aquifers that are unique and are legally-controlled water systems.
- There are Legal restrictions on how you can use Recycled water over these karst systems, which we are currently doing in South Maui.
- This was in Clare Apana's testimony at a previous meeting.
- This has serious implications to the types of developments that we shall be doing in our watershed.
- This gives us more reasons to require EIS Environmental Impact Studies for projects that may impact our unique and precious groundwater systems.

The surface Water (broad waters) in Hawaiian Culture:

Streams are central to the ahupua'a system, and for the wealth of the community that lives in the ahupua'a. From the earliest days, streams were among the most important natural resources sought after by native Hawaiians. Battles were fought and lives sacrificed for the right to use stream water. Water was sacred, and water quality was important. It was kapu to pollute a stream, and water was seen as imbued with spiritual power. Water was used in purification rituals, and sacred bathing rituals. Access to water was controlled so that water could be distributed fairly, and no one could monopolize the water. Many kapu surround the use of water.

Rules based on Kapu and Ahupua'a methodology for Stream Protections:

- All the water in a natural stream is public property.
- Streams cannot be diverted without a permit (and permission of the Konohiki).
- Stream beds shall not be diverted or landscaped or channelized. As that constitutes a stream diversion.
- Streams shall be left in their most natural state, that meets their hydrological and ecological needs.
- Streams shall not be filled or covered over. Streams shall not be converted to Golf courses, lawns, parking lots, or grassy swales.
- Protecting the integrity of the natural streams, stream beds and gulches, ensures the **quality of the water**, and the continuity of the natural streamways.
- Streams shall be left as natural streams running through housing areas, golf courses, and urban areas. Streams and gulches must be left natural in urban planning, development planning, park design, and landscape design.
- Open streams are safer than culverts, they function as green spaces, and natural habitat for native species, and allow for communication and travel of plant, seeds, animal, insect species, along the streams using them as corridors.

- Native Hawaiians also need uninterrupted access to streams, in the pursuit of cultural activities including hunting, gathering, ceremonial, educational, and recreational activities.
- Streambeds shall not be lined with concrete, or other materials, stream beds shall be left in their natural condition to allow for maximum water infiltration in the stream beds.
- Streambeds shall not be artificially constricted or narrowed, as this impacts the stream's natural flow dynamics and increases velocity and erosion.
- Stream banks shall not be covered with concrete or other non-porous material. Streambanks shall have natural vegetation and natural surfaces to maximize water infiltration.
- Streams and their gulches shall only be crossed by roads and utilities.
- Road crossings of gulches shall be bridges that span the streambed for the greatest clearance. To allow for natural stream flows, plant distribution, and the natural movements of water, minerals, sediments according to stream forces.
- Road crossings of smaller streams may be “dipped” roadways that do not impede stream flow. Note these crossings should be closed during flash flooding. Small streams may cross roads using BROAD BASED DIPs (BBD).
- Stormwater Drains, culverts, tunnels, and pipes shall be avoided to the greatest extent possible as these severely interfere with natural stream functions and benefits. And they are also an affront to cultural beliefs
- Check dams may be used in the case of stream mitigations to control flooding, check dams can be designed to be ecologically sound.
- Materials for check dams: check dams shall only use natural materials, such as rock. Rock walls shall use the most culturally appropriate materials such as those traditionally used on the Hawaiian landscape. Rock walls can also be removed and repaired as needed.
- Check Dams and Retention basins shall avoid the use of foreign materials such as concrete and steel. With the exception of emergency overflows, installed monitoring devices, or other essential mechanical apparatus.

- Example: Loosely fitted 1000-pound boulders can be used to create leaky- weir type dams that allow for stream water to flow through.
- Check Dams shall be gapped to allow smaller flows to pass unimpeded.
- Check dams are not stream diversions; they are considered stream mitigations.
- No check dam or stormwater detention basin shall divert or detain more than half the stream flow.
- No retention basins in Gulches and streambeds. No Detention basin is to be constructed across a streambed. Detention basins will be located adjacent to streambeds out of the main stream flow paths. The mainstream must always be kept in natural form and path.
- No Excavations in Streambeds: Streambeds are doorways for the groundwater infiltration, and are conduits for natural water pathways Streambeds and their underlying rock layers are sacred pathways for the mo'o guardian spirits, and the sacred groundwaters.
- Excavations in streambeds and gulches disturb the natural substrates that contain and conduct the groundwater and aquifer.
- Bridge footings should be constructed above grade wherever possible to avoid disturbing the substrates of the aquifer.
- Ideal Stream Crossings, allow for low-flow passage of water, allow for high flow passage of floodwaters, have high degree of openness, and are resistant to clogging from debris, and safe for humans to passage/transit alongside streams.
- Stream Crossings should Allow for swift-water rescues of people caught in floodwaters. Allow for the natural transportation of minerals, animals, and plant life along the stream.
- Steam beds and streambanks should be planted with native plants.

Large trees of all types should be preserved:

- The long thorn Kiawe is a nuisance introduction that is performing a virtual service. It is stabilizing shorelines and the landscape, and holding soils together. They can survive in drought conditions. However they are not ideal in wetlands

landscapes as they suck up all of the available water and compete with native plants.

- The small-thorn kiawe is a mutation that is unique to Hawaii. It is our own variety of Kiawe.
- Trees perform many beneficial services. Such as providing shade, and shelter for animals and insects, they create micro environments and colonies for plants and organisms to grow together. Shading can cool the ground up to 45 degrees cooler than unshaded ground.
- They cool the area through evapotranspiration.
- Large Kiawe trees should not be removed unless there is a better replacement put in its place. The replacement should be grown in close proximity to the kiawe and be established before the kiawe is removed, large trees might need to be removed in stages, to minimize impacts.
- Downed Kiawe trees can still live many years and provide beneficial services.
- Trees and plants should NOT be cleared from dune tops without better replacements in place.
- Even dead trees provide benefits to the environment. Tree roots, even when dead, will still anchor soil for a long time, sometimes years or decades. Tree trunks provide moisture retention, shelter, shade and housing for insects, and birds.
- For every dead tree or plant there are specialized bacteria (necrophytic bacteria) called Decomposers, that need the dead plant to complete their life cycles.
- Dead plants, especially native ones, need to stay in site to provide their nutrients back to the soils and to provide food for the microbiological community that feeds on them.

Ground Disturbances during Construction:

Ground disturbance during should be minimized for two reasons:

- 1) Iwi Kupuna are buried there, and Arch sites.
- 2) Groundwater Systems/Pseudokarst Aquifer Systems.

Volcanic Substrates:

The South Maui Watershed is based on top of a volcanic substrate. Relatively shallow soil deposits on top of multiple layers of volcanic rock. Shield Volcano activity has created layered rock strata, and multiple lava tubes, that have resulted in a porous strata with multiple air pockets and connected passageways called Volcanic PseudoKarst.

The Volcanic Pseudokarst has a network of cavelike openings in the rocks that provide areas for water transport.

Rainwater falling in the upper watersheds can transit into groundwater and reach the ocean in less than a month. These are exceptionally short transit times compared to non-volcanic watersheds with the same topography.

On the mainland for example, it might take up to 25 years for rainwater to enter the aquifer, in South Maui it can take 25 days to reach the ocean or less.

Short Transit times affects water quality:

With short transit times, any contaminants in rainwater can find their way faster and more easily into the aquifer, because it passes through less rock and soil, so it doesn't get the same filtering effect as it would with longer transit times through denser materials.

- In short, our aquifer is vulnerable to contamination.
- It also means that our assumptions with Injection wells are all wrong,
- and that the untreated wastewater that is injected into the ground, will find its way a lot faster to the aquifer and into the ocean.

Our ocean is already contaminated with Wastewater:

Water Quality testing has shown extremely high levels of Wastewater pathogens, and contaminants and nutrients in seawater samples taken along the coast in South Maui and Lahaina. Water samples show the highest contamination close to groundwater springs that connect the sources of pollution, such as Wastewater Sewage plants, and

the beaches next to them. There is a direct correlation and connection to this contamination from Sewage Sources.

We can no longer put our sewage into the ground:

We need to treat our sewage more completely on the surface, disinfect 100 percent of all wastewater, and then reuse the reclaimed water at the surface.

We have recorded high levels of contaminants directly makai of kihei WWT, maui meadows, Ulua beach, keawakapu, and Maluaka, adjacent to Wailea WWTO

How does this Apply to the CPAC Today:

The Cultural Assets/ Wahi Kupuna are not just the Pohaku stones and iwi kupuna, and artifacts in a museum, It is also mostly the living treasure, that includes the natural elements on which Hawaiians depend for their sustenance, cultural needs, and recreation. Water should not be taken from the groundwater that is meant to be supporting the natural water systems, that feed springs, wetlands, and the vegetation that stabilized the watershed. Keeping the water in the landscape, not only reduces pollution from stormwater runoff, it also creates a healthier watershed. More water means more vegetation, which helps to stabilize soils, and cools the climate through evapotranspiration.

To help us achieve our goals of a healthier, more resilient system of watershed management, and to enhance the living conditions of all South Maui residents, we need to acknowledge this ancient wisdom and adopt it into our Community plan.

Mahalo,

David Dorn

Hawaiian Mindset and Water Conservation:

“One of the most unique things about Hawaiian’s sustainability was their water conservation and water protection rules. First of all, Hawaiians tried hard to conserve the water they got. One way they did that was by making irrigation systems, such as the lo’i kalo irrigation system, as I explained earlier. Also, the Hawaiians took notice of limited water and created strict kapu to make sure nobody got *too* much water, because then it wouldn’t really be conserving. As with all kapu, **death could be a consequence**. Overall, Hawaiians were very careful of their water usage”. (Source: <https://www.awesomestories.com/asset/view/The-Ancient-Hawaiians-Sustainable-ways>)

Seabathing for Purification - Kapu Kai:

KAPU KAI Kapu kai is defined in the Hawaiian Dictionary as: Ceremonial sea bath for purification; purification by seawater. Nānā I Ke Kumu describes kapu kai as the ceremonial bath taken in the sea or salt water to purify oneself after evil or defilement, physical or spiritual, and to remove the kapu (taboo) under which the person usually came because of his defilement. The kapu kai was done in privacy and with prayers.”

<https://www.awadevelopment.org/wp-content/uploads/2014/01/KEEPING-OUR-TRADITIONAL-PURIFICATION-PRACTICES-PURE.pdf>

HI’UWAI – A one-time only annual event:

The Hawaiian Dictionary says: Water purification festivities held on the second night of the month of Welehu. The people bathed and frolicked in the sea or stream after midnight, then put on their finest tapa and ornaments for feasting and games. (Source: <https://www.awadevelopment.org/wp-content/uploads/2014/01/KEEPING-OUR-TRADITIONAL-PURIFICATION-PRACTICES-PURE.pdf>)

NATIVE HAWAIIANS AND STREAMS

From the earliest days, streams were among the most important natural resources sought after by native Hawaiians. Care was taken not to pollute the water in streams that flowed down from mountains through the valleys into plains and out to sea.

<https://dlnr.hawaii.gov/dar/habitat/about-streams/cultural-importance/>

DO NOT TAKE MORE THAN HALF OF THE STREAM FLOW:

There were many rules for how water was apportioned; for example, a single 'auwai could not take more than half of the flow of a stream.

<https://seagrant.soest.hawaii.edu/ola-i-ka-wai-water-is-life/>

LOKO I'A A Manual on Hawaiian Fishpond Restoration and Management.

Graydon "Buddy" Keala with James R. Hollyer and Luisa Castro:

"Limu (edible seaweed) can be cultured in the ocean, in a fishpond, or in a netpen. The typical Hawaiian fishpond is capable of sustaining many types of edible and saleable animal and plant species, often at the same time. Many fishponds in Hawai'i may already be home to various limu species. Limu production can be a profitable enterprise when cultured in netbeans along with fish. In general, the limu in a limu-fish system uses the nutrients from unconsumed fish feed as fertilizer. At the same time, the limu consumes much of the nitrogen that is excreted when the fish discharge waste products. As a result, the entire limu–fish production system is "cleaner" than a system with only fish".

<https://www.ctahr.hawaii.edu/oc/freepubs/pdf/Loko%20I'a%20Full%20Publication.pdf>

LOKO WAI (Types of Fishponds):

“Loko wai Located inland and mostly of freshwater origin, a loko wai (Figure 1, Type 3) was typically made from a natural depression, lake, or pool whose water was mainly from diverted streams, natural groundwater springs, or percolation from an aquifer. Various ‘o‘opu were commonly found in these ponds”.

Additional fishpond-related concepts: ‘Royal fishponds were protected by a number of cultural and religious restrictions. For example, any form of **pollution by sewage**, rubbish, and metabolites **was not tolerated**. In the latter category, women during their menstrual period were not allowed in or near a fishpond, to avoid “insult” to the guardian spirit of the fishpond. Another cultural aspect of fishponds were the ceremonial structures associated with them. Kū‘ula (shrines) were built to honor the gods Kū and Hina, his wife. **All fishponds had a guardian spirit called mo‘o, which manifested itself in either a lizard or mermaid-like form.** It was the duty of the kia‘i loko to make regular offerings to the gods at designated times of the lunar month to ensure the well-being of the fishpond”.

<https://www.ctahr.hawaii.edu/oc/freepubs/pdf/Loko%20'a%20Full%20Publication.pdf>

A ‘Ikena I Kai (Seaward Viewsheds): Inventory of Terrestrial Properties for Assessment of Marine Viewsheds on the Main Eight Hawaiian Islands

<https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Pacific-Region/Studies/2017-022.pdf>

Trees and vegetation lower surface and air temperatures:

Trees and vegetation lower surface and air temperatures by providing shade and through evapotranspiration. Shaded surfaces, for example, may be 20–45°F (11–25°C) cooler than the peak temperatures of unshaded materials. Oct 25, 2022

Kihawahine Mokuhinia Kalama'ula Kalā'aiheana was the daughter of the powerful sixteenth-century ruling chief of Māui, Pi'ilani,

and his sacred pi'o wife Lā'ieloheloheikawai. This exceptionally high 'Ulu line of genealogy carried down from Hāloa meant that pi'o unions of this branch would continue to produce gods. Kalā'aiheana's two brothers Lonoapi'ilani and Kihaapi'ilani were to become Mō'i of Māui, and her sister Pi'ikea would marry ruling chief 'Umialīloa. Kihawahine herself would leave a descendancy along the Maluna line that would later include the ruling Mō'i, Kalākaua and his sister Lili'uokalani. Upon Kalā'aiheana's death, her iwi (bones) were wrapped in kapa and placed in the waters of the royal fishpond at Mokuhinia, Lahaina. A ceremony deifying this high-ranking chiefess transformed her into the mo'o goddess Kihawahine. <https://hawaiilive.org/kihawahine/>

The objective to protect public health, avoid public nuisance is achieved by:

1. Reducing concentration of pathogenic bacteria, parasites, and enteric viruses in the recycled water. Raw wastewater contains a variety of pathogenic organisms of human origin. Disinfection means a process which inactivates pathogenic organisms in water by chemical oxidants or equivalent agents or through the process of reverse osmosis when sufficiently demonstrated. Disease caused by these pathogenic organisms can occur as a result of:

<https://health.hawaii.gov/wastewater/files/2013/06/reuse-final.pdf>

Hawaii's native forests absorb rain and cloud moisture across millions of acres - and are the source of Hawaii's fresh water:

At the same time, they help reduce erosion that can impact water quality and damage coral reefs. The majority of domestic potable water is coming from groundwater sources. But it takes 25 years for rainfall to reach the aquifer! That means we drink 25 year old water. While any kind of forest is better than no forest, our native forests have adapted to be super efficient at capturing and storing water. It has a multi-layer canopy of ferns, mosses, and trees, which help slow down the flow of water, allowing it to seep into the ground. A giant living sponge!

<https://health.hawaii.gov/sdwb/files/2018/09/05-11-Importance-of-Watershed-Protection-to-Groundwater-Katie-Ersbak-DLNR.pdf>

A Hawaiian saying goes: *He ali'i no ka 'aina, he kauwa wale ke kanaka.* "The land is chief, the human is but a servant."

<https://climate-xchange.org/2021/01/14/the-ongoing-fight-for-the-forests-and-freshwater-of-hawaii/>

DLNR & YOU – GUIDING RESTORATION OF HAWAIIAN FISHPONDS

Loko i'a essential to 'ahupua'a health, food security, community resilience and ecosystem services. Loko i'a, or traditional Hawaiian fishponds, are unique aquaculture systems that existed throughout ancient Hawai'i.

<https://dlnr.hawaii.gov/occl/2016/08/30/nr16-173o/>

The bridges or culverts used to cross these watercourses must be designed appropriately if negative impacts on the aquatic environment are to be minimized:

Poorly designed or poorly implemented stream crossings can have numerous negative effects on the aquatic environment including increased sediment mobilization and

changes in flow patterns. For example, flooding upstream of the road crossing can occur when the bridge or culvert is unable to transport a sufficient volume of water. Such floods can also wash out bridges or stream crossings, leading to increased costs for the road owner and downstream sediment pollution. Increased sediment mobilization results in loss of aquatic habitat and may extirpate threatened species including freshwater pearl mussel as well as destroying spawning habitat.

<http://nwrn.eu/measure/appropriate-design-roads-and-stream-crossings>

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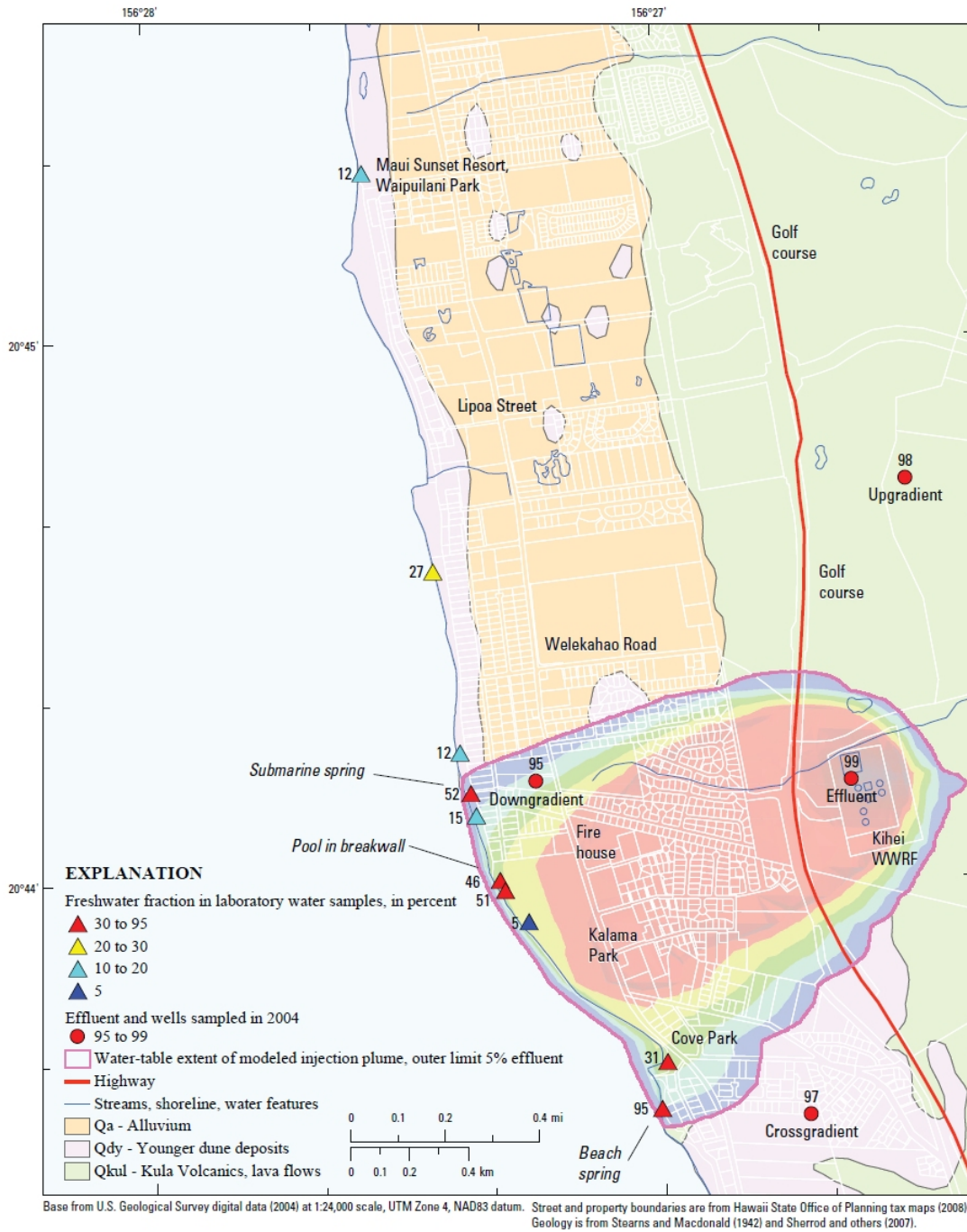


Figure B5. Freshwater fraction (computed from salinity) in laboratory water samples at Kihei, Hawaii.