

South Maui CPAC 3/8/2023

2.3 Ready and Resilient Systems, 2.4 Mauka to Makai Watershed management

TABLE OF CONTENTS:

South Maui CPAC AREAS:

The South Maui Community Plan Area is Unique in the following ways:

Goals of the Maui County CIP (Capital Improvement program):

Maui County Floodplain Manager (CFM):

Deny Designs and Developments that Increase Flooding:

Floodplain Mismanagement, Wailani Villages:

Waipuilani Gulch Improvements (Waipuilani District):

The Waipuilani Gulch at Hoonani needs to be Widened to 100 feet with 15-foot floodwalls:

Kulanihakoi and Waipuilani Gulches converge on the floodplain:

The “De facto” Population in South Maui is higher than reported:

Set a Cap on Visitor Accommodations in South Maui:

Discourage foreign/mainland ownership of homes and housing speculators:

Set a maximum carrying capacity for South Maui:

The impacts of SLR will be felt long before the SLRXA line reaches your property:

Iron pipes rusting in brackish groundwater:

Maui County Obligations under the FEMA National Flood Insurance Program (NFIP):

South Maui is a vulnerable, underserved community with a lack of basic infrastructure:

Make South Maui is a safe and healthy place to live:

12 Things we need to do before we build any more housing:

South Maui’s current drainage system relies heavily wetlands on private land:

Restoring and protecting our natural systems for climate resilience:

Wetlands and sand dunes were able to act as flood plain filters:

Surface runoff collects into a number of major drainage features (gulches):

Stream and Gulch Depth in the Hapapa/Wailea watersheds:

Pollutants are transported via surface or groundwater (SMWP):

Fertilizers find their way to coastal waters:

Benefits of Properly Function Streams (SMWP):

A watershed-scale approach to address overall watershed function (USEPA):

Protect and Manage Existing Wetlands:

Natural Wetlands and Constructed Stormwater Wetlands (EPA):

Ephemeral Streams are losing or disappearing streams because water is infiltrated into the aquifer as it flows downstream:

[Potable water Reuse:](#)

[Cultural connection to Humpback Whales:](#)

[The six main styles of Hawaiian fishponds:](#)

[\(https://savethewetlands.org/six-main-styles-of-hawaiian-fishponds-peter-t-young/\)](https://savethewetlands.org/six-main-styles-of-hawaiian-fishponds-peter-t-young/)

[Kihei Population Predictions:](#)

[Population Projections for the County of Maui to 2045:](#)

[The goal of the Southwest Maui Watershed Plan to improve water quality:](#)

[The National Flood Insurance Program \(NFIP\)](#)

[Tsunami Evacuation Zone maps do not account for locally generated tsunamis:](#)

<https://dod.hawaii.gov/hiema/public-resources/tsunami-evacuation-zone/>

[REFERENCES:](#)

Dear SM CPAC,

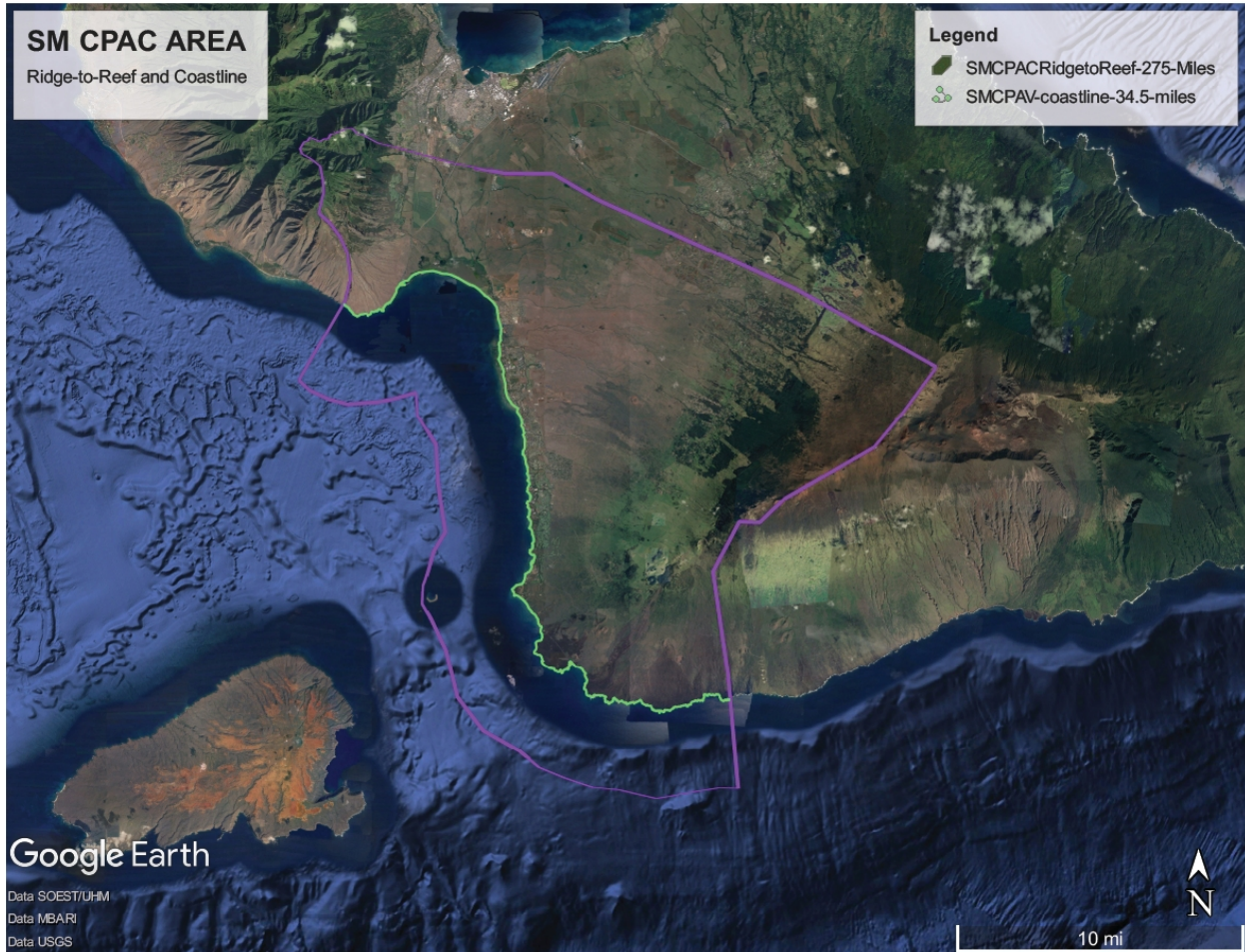
After listening to the Cultural Presentation at last week's meeting, I fully realized the enormity of the challenges we face. The scale of our Community Plan area is vast, and it impacts a huge area of land and sea.



South Maui CPAC AREAS:

1. South Maui CPAC Area is approx 60 Square Miles.
2. But our Watershed is 200 square miles (128,000 acres).
3. Our-ridge to reef area is 275 Square miles,
4. That means that we have 75 square miles of ocean to protect.
5. South Maui is the gateway for all our watershed's waters to enter Maalaea Bay,
6. What we do in our community not only affects our neighborhood, and also 75 square miles of ocean.
7. That includes all our South Shore reefs and 75 square miles of Humpback Marine sanctuary area.
8. SMCPAC Area has 34.5 miles of coastline.
9. And we have most of Maui's Beaches.
10. We have many examples of Ancient Hawaiian Fishponds, including examples of almost all of the 6 main known types.

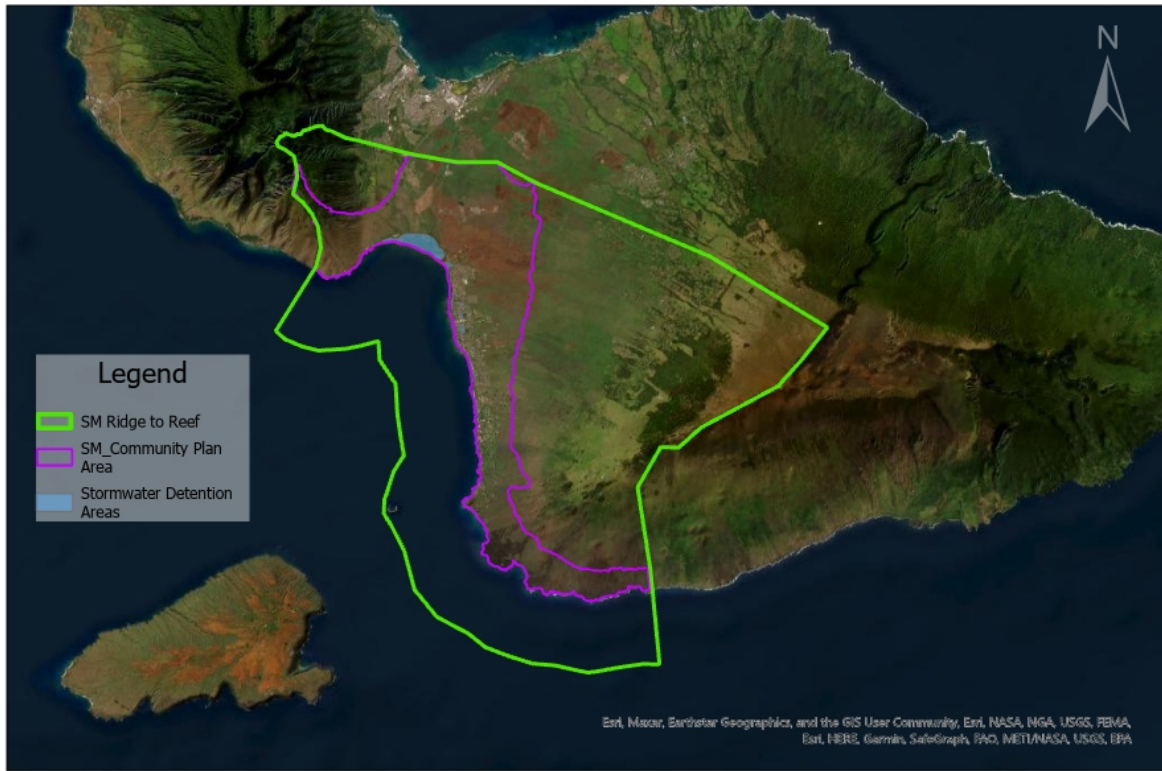
That is a lot to take care of!



The South Maui Community Plan Area is Unique in the following ways:

11. **Endangered species**, Wetlands, and a multitude of Specialized habitats.
12. We are a **Leeward Watershed**, so water is harder to come by, what water we have is precious to the natural systems and habitats that need it.
13. We need to be **water-smart**, and environmentally aware.
14. Our activities are **doing harm to our environment** every day, and we need to create a better system for sustainability and environmental responsibility.
15. Our Mokus are rich with cultural history and **archaeological treasures** which we need to preserve for future archaeology.
16. Every inch of our land has been walked by countless generations before us.
17. Our dunes and caves and shorelines have **many burial sites with Iwi Kupuna**.

18. The land where we stay has been caretaken by Hawaiians **deep into history**, and handed down for us to watch over and **malama for the future**.
19. We need to care for this place, and make it better than we found it, so that it can be enjoyed for **seven generations to come**, and more.
20. We need to ensure that we **do not use up all the resources** in our lifetimes.
21. We must ensure that there are **resources for the future** generations. The keiki of today will need room for their families to grow, and they need a **healthy environment** to live in.
22. We need to leave them a **Clean aquifer and Clean ocean water**.
23. A **healthy reef**, and ocean with plenty of fish.
24. We need to leave open spaces, and **natural areas for recreation**, and spiritual healing, for **cultural connection**, and to support the habitats for all the living things that call South Maui their home.
25. BUT we are **using up our resources** faster than ever and there will be nothing left for future generations unless we show some discipline now.
26. Maui Island needs a **carrying capacity study**.
27. South Maui is totally **water dependent**, and is over reliant on external water sources.
28. **We should NOT be building** at the rate we are, because it is unwise and unsustainable.
29. We need better **food security** in South Maui, we need farms that actually grow food that we can eat here on Maui and not have to bring in from outside.
30. Ranchlands should remain in **agriculture or forestry**.
31. Ranchlands **should NOT be converted** into giant housing estates.
32. We need to stop the **conversion of Agricultural lands** into Housing, or gentleman estates.
33. We need to support smaller farmers **who actually want to farm** the land.
34. We need to be taking better care of the existing resident population, and **make living conditions safer and healthier** for them.



South Maui Community Plan Area

Goals of the Maui County CIP (Capital Improvement program):

- To protect the public safety of all people living in and visiting our islands.
- To plan for, develop and manage a sustainable domestic water supply.
- To strengthen and build communities that includes affordable housing, public transportation systems and beautiful parks and recreation facilities.
- To provide for public infrastructure.

South Maui's Population faces several immediate threats to Health and Safety:

Lack of essential infrastructure such as roads and stormwater drainage. And mismanaged sewage systems that contaminate the aquifer and nearshore waters. This affects all people who swim in the ocean and catch fish and other seafood products such as shellfish, crustaceans, limu, uni, etc. And the constant dangers from flooding.

South Maui's long-term threats to health, safety, and sustainability:

South Maui has a vulnerable water supply. South Maui is being overdeveloped beyond the carrying capacity of available water, land, and infrastructure. We have heard from DPW Director Jordan Molina that there is no money for drainage plans. And we have heard from the County that there is no money for the North-South Collector road, and there is almost no money coming in for South Maui infrastructure improvements, let alone for missing infrastructure, and maintenance. There are no plans to create more shoreline access and new beach parks to match the growing population. Instead we are squeezing more and more people into our already health-challenged, flood-prone, and infrastructure-poor neighborhoods.

Maui County Floodplain Manager (CFM):

According to Diego Sanchez-Gomez, his job as County Floodplain Manager (CFM) is to make sure that building applications comply with the FEMA requirements. But the CFM does not take any initiatives in flood mitigation, or deny any building applications. The CFM position is a paper pusher who does not manage the floodplain at all. We need people actually managing the floodplain who are actively improving the flood plain, by denying building applications in the flood zones, and requiring greater setbacks from streams and gulches. And by denying designs that increase flooding.

Deny Designs and Developments that Increase Flooding:

The CFM, the Planning Department, and the Planning Commission must deny all developments that increase flooding. For example, developments that raise the grade, cover streams, culvertize gulches, or encroach on gulches. And by not allowing any more building in flood zones, floodways, drainageways, and wetlands.

Floodplain Mismanagement, Wailani Villages:

One prime example of floodplain mismanagement is at the Hoonani Subdivision, (aka "Wailani Villages") in Waipuiani Gulch, Kihei. Its SMA permits were repeatedly extended by the Planning Department/Planning Commission for over 19 years despite the fact

that the current Drainage capacity is less than 10% of the Q100 storm. There is only about 392 CFS at the County-owned Drainageway directly above the property, and approx 350 CFS at the Culvert on South Kihei Road below the property. The Q100 storm volume in Waipuilani Gulch is forecast to be around 8,900 CFS. By contrast the Waipuilani Gulch Bridge at Pi'ilani Highway is Built for 220,000 CFS, and we have seen flooding almost reach the road deck there.

Waipuilani Gulch Improvements (Waipuilani District):

The Final Kihei Drainage Master Plan (2022) is misleading. The Final-Kihei-DMP-2022 says that the Waiuilani Gulch at Hoonani needs a "Trapezoidal channel 25 feet wide by 5 foot high with a capacity of around 392 cfs - 515 cfs". But that is predicated on the assumption that 8,719 cfs of Waipuilani gulch's water has been diverted into Kulanihakoi Gulch. Only then would the conditions meet these expectations of 392-515 cfs in the gulch. That is a giant assumption and that is unlikely to ever happen. Please Note, The current conditions existing in the Gulch are still 8,089 CFS for a Q100 storm at the Piilani bridge, and Q100 at stream mouth is 9,275 cfs.

The Waipuilani Gulch at Hoonani needs to be Widened to 100 feet with 15-foot floodwalls:

According to the Amanda Cording EAA (Environmental Alternatives Analysis) Report, without a major diversion (of Waipuilan into Kulanihakoi) the gulch/drainageway in this area needs to be widened to 100ft wide with floodwalls 15 feet high on either side. The Q100 stormwater is expected to have a flood depth of 13 ft which could totally submerge the entire proposed Wailani Village subdivision under the current drainage conditions. To widen the gulch sufficiently, the report recommends demolishing a row of housing alongside the gulch. To accommodate the flood levels, a 70-foot wide culvert would need to be installed underneath SKR (which is 7 times the current culvert width).

Kulanihakoi and Waipuilani Gulches converge on the floodplain:

According to the FKDMP, "The FIRM shows the area from approximately 1,300 feet mauka of South Kihei Road to the ocean is inundated by both the Kulanihakoi Gulch and Waipuilani Gulch floodplain".

How did this situation occur?

The planning department continues to allow more building before commensurate infrastructure is available. For example, many building applications refer to future road conditions Example, "after the collector road has been completed". Or "after sidewalks have been installed on South Kihei Road", or other infrastructure has been put in place. The County has also been delaying work on the Kihei drainage system since at least 1980 when these flooding problems were also identified in a previous flood study.

South Maui is dangerous Cul-de-Sac:

South Maui is often left with a single lane in and out. Whenever there is roadwork, a water main break, a fire, or a traffic accident, South Maui's (Kihei/Wailea) two roads become one. Frequent Flooding on South Kihei Road can close the road, and makes it impassable for days at a time. Frequent traffic accidents on Piilani Highway often close off traffic in one direction, causing all traffic to be diverted onto SKR. Traffic regularly slows to a crawl, and there are often near-gridlock conditions on one or both roads. This is the situation now for the current level of population.

South Maui traffic is going to get worse:

As our population increases there will be more cars on the road, and there are many more homes being built for mainlanders, and more vacation homes, and new hotels being built that will increase traffic and road use. Each developer gives the planning department a traffic study that shows that their project's contribution to traffic will be "negligible", But what about the cumulative impacts? Traffic is bad already and it is going to get worse. Traffic jams are becoming a safety hazard, because they slow down emergency vehicles, increase ambulance and transport time to hospitals, and reduce

the ability to evacuate in a natural disaster. Example, a large locally-generated Tsunami from Molokai or Big Island could arrive in South Maui in 10-20 minutes, and you would have no way to properly evacuate the population above Piilani Highway (the edge of the large tsunami evacuation zone).

The “De facto” Population in South Maui is higher than reported:

The de facto population in South Maui is likely much higher than the current statistics would have you believe. Maui now has over 24,0000 visitor units (mauiNOW.com) and we are building even more Hotels, and TVRs. And although the Maui Island Plan (MIP), set a limit for the number of visitors to not exceed 25% of the resident population. Some estimates suggest that visitors are equal to 41% of the resident population (Dick Mayer). According to census.gov, Maui County's population was 164,221 in 2021. Maui Island's resident population was 150K in 2022, and at least $\frac{1}{3}$ as many visitors giving us a de facto population around 200K. In about 20 years the de facto population on Maui (county) is forecast to increase to around 300K.

Maui's Hidden Population:

But these population figures do not fully account for the thousands of part-time residents in South Maui that own homes and condos here and spend part of their year here when coming from the mainland or Canada. Many couples and families are living here under the radar. They are like a ghost population. This population does not show up as Visitors renting TVR accommodations, and they do not register to vote, get a drivers license, or enroll on the Census. So they are not counted as residents either.

On Maui we have more visitor accommodations per capita than Oahu.

And we are building as many homes for visitors and mainland buyers as we are for local residents. We are also selling off our affordable homes to new residents, while local families are unable to qualify for mortgages. We need to extend the moratorium on Building TVRs, and Visitor accommodations.

Set a Cap on Visitor Accommodations in South Maui:

We need to cap the number of allowable visitor Accommodations in our South Maui Community at 25% of the housing for the resident population or less.

Discourage foreign/mainland ownership of homes and housing speculators:

To do this you need to raise the Sales taxes for homebuyers, and give a credit for full-time residents. You also need to raise the property taxes for homes and condos, and then give a credit for full time residents who actually occupy their homes. There was a recent Bill proposed that would raise the sales tax for Luxury homes from 17% to 75%. That bill didn't pass, but had the right intentions. The sales tax on luxury homes sales should be raised to something like 30%.

Set a maximum carrying capacity for South Maui:

South Maui is a satellite community that is wholly dependent on Wailuku Water. We have limited capacity for more population. Our infrastructure is limited (2 roads, no drainage) and there is only so much room for cars on the road, and only so many houses can be built, before we literally and figuratively drown in our own feces. We need a carrying Capacity Island Wide and for South Maui.

Problems with North Kihei Road (Hwy310):

Much of the road running from Maalaea to North Kihei is built on a sand spit and elevated just a few feet above sea level. This road is expected to suffer greatly from Sea Level Rise (and climate change). This is visible on the PacIOOS SLR Viewer (flooded highways layer). (<https://www.pacioos.hawaii.edu/shoreline/slr-hawaii/>).

Coastal Flood Hazard Zone:

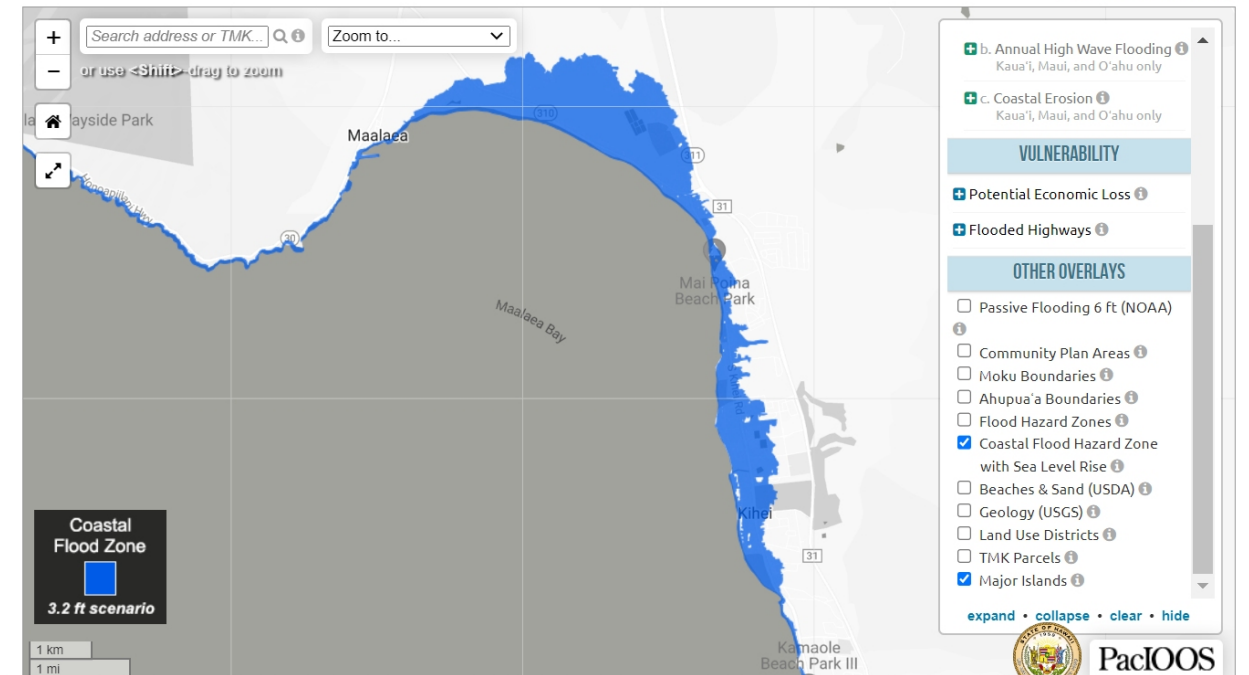
It should be noted that SLR is one factor that will increase the runup of large wave events that will be the first impacts that will damage this and other coastal roadways. We will need to plan for this road to fail sometime in the next few decades. Damage will come from isolated incidents such as large kona storms and large swell events that will

become more frequent over time. (Image below: PacIOOS Viewer, Coastal Flood Hazard Zone with Sea Level Rise)

Sea Level Rise : State of Hawai'i Sea Level Rise Viewer

An Interactive Mapping Tool in Support of the State of Hawai'i Sea Level Rise Vulnerability and Adaptation Report

[view full-screen map](#)



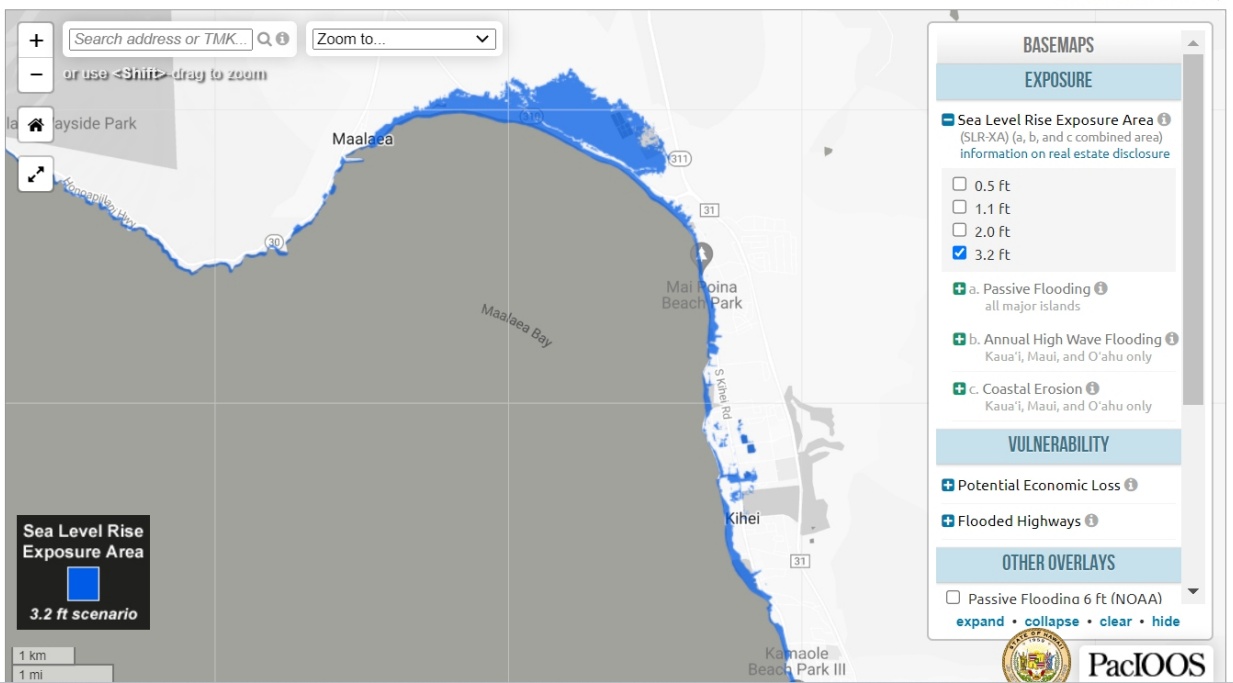
We should use the CFHZ-SLR maps not the SLR-XA maps:

Developers and Planners use the SLR-XA maps to make decisions regarding the effects of Sea Level Rise (SLR). This is such a bad idea that it appears to be intentionally bad.

Planners need to use the “Coastal Flood Hazard Zone with Sea Level Rise Map” instead of the Sea Level Rise Exposure Area (SLRXA) map. (Image below: PacIOOS Viewer, Sea Level Rise Exposure Area)

Sea Level Rise : State of Hawai'i Sea Level Rise Viewer

An Interactive Mapping Tool in Support of the State of Hawai'i Sea Level Rise Vulnerability and Adaptation Report



The impacts of SLR will be felt long before the SLR-XA line reaches your property:

SLR increases the damaging effects of storms, large waves, flooding, and tsunamis. Damaging waves will reach much further inland, and floods will be deeper and recede more slowly, tsunamis will have a greater runup and reach farther inland. Passive flooding will be more frequent also.

The SLR-XA gives people a false sense of security and makes for bad planning decisions:

The SLR-XA is like looking at the water level of the bathtub filled to the brim. That is before you jump in or make any waves. The SLR-XA gives people a false sense of security and makes for bad planning decisions.

Problems with South Kihei Road:

And South Kihei Road is going to keep having issues, and will eventually be cut off in several sections. Eventually South Kihei Road (SKR) will be closed at Isana (North Kihei), because of the effects of Sea Level Rise (SLR). It has been completely swamped by high waves on several occasions and the roadway is being progressively undercut by high waves. South Kihei Road is slumping toward the ocean in many places. The ground under SKR is built on a wetland with saturated soils that are constantly moving.

Iron pipes rusting in brackish groundwater:

Water/Sewer Mains too in iron pipes are constantly breaking down because of the effects of the brackish groundwater that are rusting pipes and making them unreliable and need frequent maintenance and emergency work. This is why SKR is so rough and in need of constant repair.

Utilities along and Under SKR:

All of the utilities and infrastructure under SKR need to be replaced and rethought to counter the effects of Climate Change and SLR. We need to start moving our utilities back from the coastal areas and begin the process of "Shoreline retreat".

Water tables are Rising:

Sea Level Rise doesn't just affect the shoreline. In Kihei, the salt water table extends inland for about a mile. The effect of the tide can be measured far inland. As sea level rises, the water tables rise. This means that the ground will become more saturated, foundations of buildings will become less stable, soils will become damaged by salt water. Chemicals in the soils around buried infrastructure will start to contaminate the aquifer and groundwater, and the coastal waters. For example water tables rising around gas stations, will affect buried tanks and cause contamination to aquifers as the ground around them becomes saturated.

Maui County Obligations under the FEMA National Flood Insurance Program (NFIP):

In order to continue to qualify for NFIP Maui County has to meet the requirements for the Community Rating System (CRS) such as,

- Reduce potential flood damage to existing buildings
- Manage development in areas not mapped by the NFIP
- Protect new buildings beyond the minimum NFIP protection level
- Preserve and/or restore natural functions of floodplains

THERE CAN BE NO MORE DEVELOPMENT IN SOUTH MAUI UNTIL
PROPER INFRASTRUCTURE IS PROVIDED.

South Maui is a vulnerable, underserved community with a lack of basic infrastructure:

We have no drinking water, we do not have proper drainage, and we do not have enough roads. And we are dumping our sewage into the ocean where we swim and catch fish.

Make South Maui is a safe and healthy place to live:

We are obligated to make South Maui a safe and healthy place to live, for the current residents, before we expand our population any further.

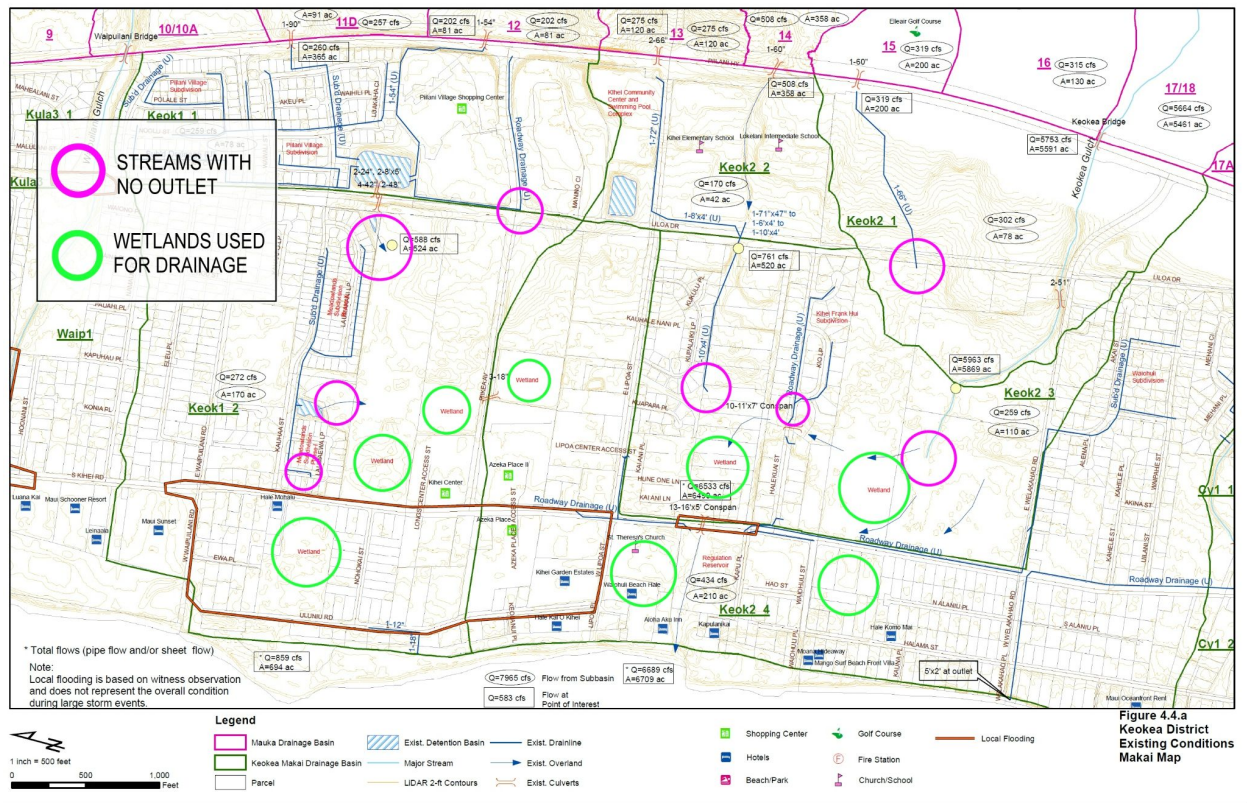
12 Things we need to do before we build any more housing:

1. We need to Complete the Collector Road,
2. We need to repair South Kihei Road.
3. We need to build a Third Road, before any more Housing estates are developed.
4. We need the 14 Stormwater Retention Basins (SRBs). Or the equivalent stormwater holding capacity, in check dams, wetlands, and Stormwater wetlands.
5. We need to Activate (utilize) the Pi'ilani Detention Basin.
6. We need to restore all the remaining Natural wetlands in the South Maui area.
7. We need to create a series of Stormwater Wetlands on the floodplain's remaining open spaces.
8. We need to Stop Wastewater Injection Wells and Cesspools.

9. We need to disinfect 100% of our Sewage.
10. We need to create a Wastewater Wetland at Kihei WTP, and Wailea WTP, and we need better sewage treatment facilities for Maalaea.
11. We need to use R1 water to irrigate a green buffer zone that protects the lower watershed from erosion and stormwater pollution.
12. We need to set up “Potable Water Reuse” to supply drinking water to the expanding South Maui population.

South Maui’s current drainage system relies heavily wetlands on private land:

South Maui’s current drainage system relies heavily on open spaces, gulches, wetlands, and private lands. The drainage plans utilize surface water transport and depend on groundwater infiltration, especially in the leeward lowlands and specifically on the floodplain. In many locations, no outlets for stormwater are provided or available, so stormwater typically pools and is either pumped out or allowed to infiltrate into groundwater. In the diagram below (from the Final Kihei DMP 2022) you can see how the current drainage conditions rely heavily on wetlands to convey and infiltrate the stormwater generated by streams and drainage systems.



Natural Stormwater Infiltration, Cryptorheic Basins:

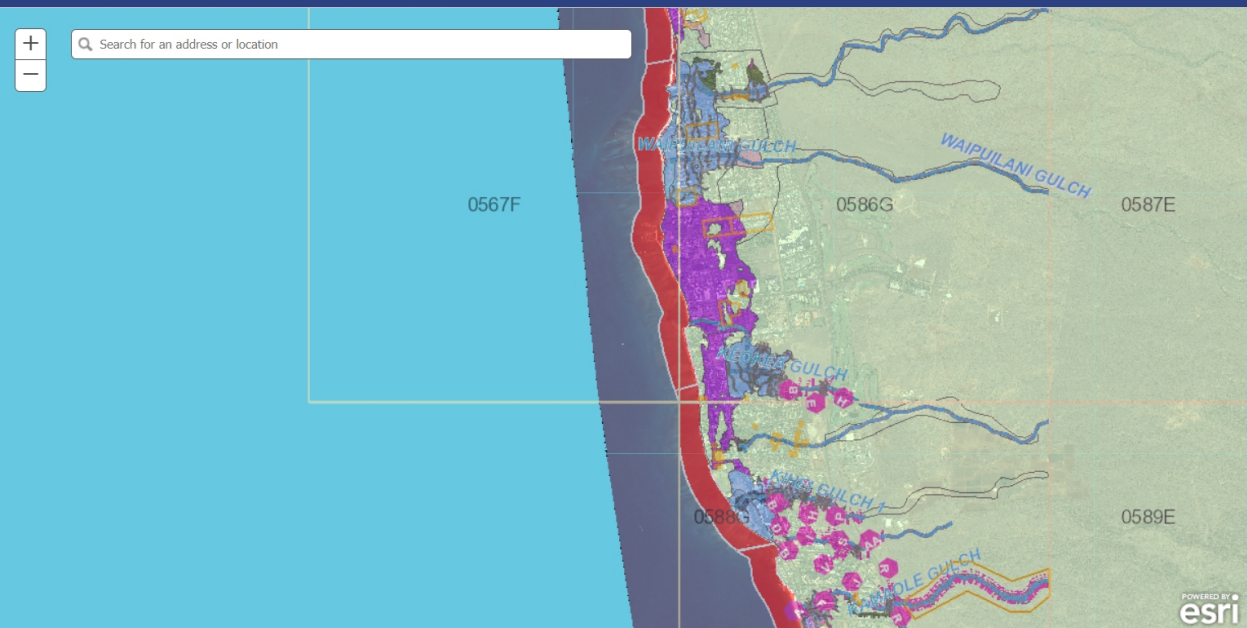
Several large Cryptorheic basins are present in the Kula Kai region that are prime areas for stormwater infiltration. These naturally occurring basins are critical to our current drainage infrastructure. These basins took nature thousands of years to build, but these basins are now being developed rapidly and we are losing many of their beneficial functions.



The Floodplain Flood Zones:

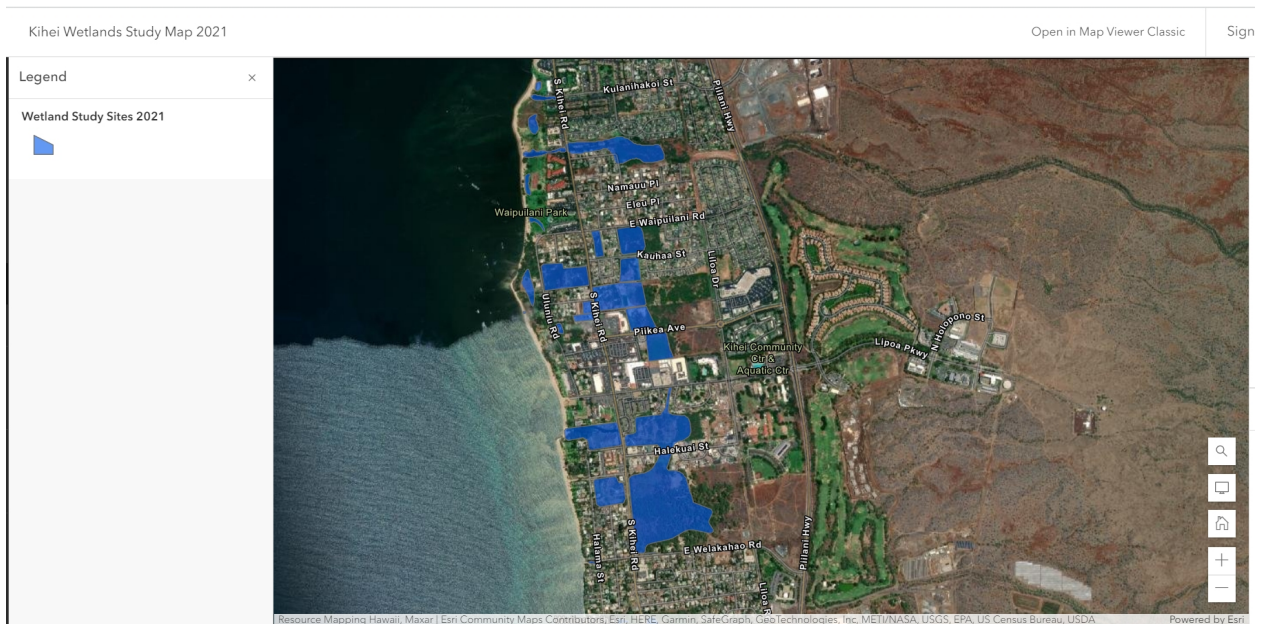
These Basin areas are also the known flood-zones and where the majority of the wetlands occur on the floodplain. These features are the natural drainage systems that we rely on and that we need to preserve. These areas also correspond to the FEMA Flood Zones. (Image, DLNR Flood Hazard Assessment Tool).

Flood Hazard Assessment Tool



Preserving Wetlands in the Floodplain:

The 2021 County-sponsored Wetlands Study, by HILT and South Maui Save the Wetlands Hui, identified a number of wetlands in the central Kihei area. These wetlands correspond to the KDMP drainage maps as critical to the existing drainage conditions for the area. (Image [Kihei Wetlands Study Sites 2021 ArcGIS online](#))



Buy back the Gulches and Wetlands:

Our drainage systems are heavily reliant on privately owned lands. We need to protect these lands from development, and keep them in our watershed natural infrastructure inventory. We can do that with purchasing land, and/or acquiring conservation easements, etc. This needs to be our top priority. All of the drainage plans to date (KDMP, SMWP, EAA) rely on the continued benefits we are receiving from these lands. And our drainage and flooding issues will worsen rapidly if we lose any more of them.

Restoring and protecting our natural systems for climate resilience:

Restoring function to our natural watershed systems and protecting our existing drainage features such as open spaces and wetlands is vital for our climate resilience, and to our infrastructure stability, and as the basis for future improvements.

Regards,

David Dorn

Wetlands and sand dunes were able to act as flood plain filters:

“Prior to urbanization the coastal lowlands were covered by coastal vegetation, wetlands, sand dunes, and varying low impact agriculture lands, and were able to act as flood plain filters”.

(SOUTHWEST MAUI WATERSHED PLAN, page 281) <https://www.mauiwatershed.org/>

Surface runoff collects into a number of major drainage features (gulches):

“Surface runoff in the planning area collects into a number of major drainage features (gulches) that are considered intermittent streams. There are currently no streams classified as perennial in the planning area. According to the EPA, ephemeral and

intermittent streams provide the same ecological and hydrological functions as perennial streams by moving water, nutrients, and sediment throughout the watershed.” (SOUTHWEST MAUI WATERSHED PLAN, page 31) <https://www.mauiwatershed.org/>

Stream and Gulch Depth in the Hapapa/Wailea watersheds:

“Streams in the Hapapa and Wailea watersheds have steep reaches with deep V-shaped channels, primarily in the upper elevations. In the lower elevations, stream slope decreases and there are wide, shallow stream channels”.

(SOUTHWEST MAUI WATERSHED PLAN, page 32) <https://www.mauiwatershed.org/>

Pollutants are transported via surface or groundwater (SMWP):

“Pollutants such as nutrients, toxic chemicals, pathogens, and sediments originate from a variety of sources within the watershed and potentially threaten both human and environmental health. These pollutants are transported via surface or groundwater throughout the watershed, reducing the quality of water in groundwater, streams, wetlands, estuaries, coastal, and oceanic waters”.

(SOUTHWEST MAUI WATERSHED PLAN, page 15) <https://www.mauiwatershed.org/>

Fertilizers find their way to coastal waters:

“When fertilizers are placed in the soil, they can be transferred to the ocean by both surface water and ground water. During heavy rainfall, stormwater can carry these nutrients from their source to the ocean through gullies, gulches, stormwater drains and other surface water conveyances. In addition, nutrients can be absorbed into the aquifer and make its way to coastal waters through groundwater flow”.

(SOUTHWEST MAUI WATERSHED PLAN, page 83) <https://www.mauiwatershed.org/>

Benefits of Properly Function Streams (SMWP):

“When functioning properly, these streams provide landscape hydrologic connections; stream energy dissipation during high-water flows to reduce erosion and improve water quality; surface and subsurface water storage and exchange; ground-water recharge

and discharge; sediment transport, storage, and deposition to aid in floodplain maintenance and development; nutrient storage and cycling; wildlife habitat and migration corridors; support for vegetation communities to help stabilize stream banks and provide wildlife services; and water supply and water-quality filtering”.

(SOUTHWEST MAUI WATERSHED PLAN, page 32) <https://www.mauiwatershed.org/>

A watershed-scale approach to address overall watershed function (USEPA):

In the rapidly developing areas, land management decisions must employ a watershed-scale approach that addresses overall watershed function and water quality. Ephemeral and intermittent stream systems comprise a large portion of leeward watersheds and contribute to the hydrological, biogeochemical, and ecological health of the watershed. Given their importance and extent, it is concluded that an individual ephemeral or intermittent stream segment should not be examined in isolation. Consideration of the cumulative impacts from anthropogenic uses on these streams is critical in watershed-based assessments and land management decisions to maintain overall watershed health and water quality (USEPA, November 2006).

Protect and Manage Existing Wetlands:

Existing wetlands along the coast of Kihei, Wailea, and Makena should be delineated, protected and restored wherever possible. Like the detention basins discussed above, wetlands have the ability to filter stormwater for sediment, nutrients and pathogens. They are habitat for native flora and fauna. They serve as flood prevention and aquifer recharge locations. Lastly, wetlands represent greenspace within urban communities, offering recreational space and improve the community’s relationship with the natural environment.

(SOUTHWEST MAUI WATERSHED PLAN, page 71) <https://www.mauiwatershed.org/>

Natural Wetlands and Constructed Stormwater Wetlands (EPA):

“Planners should distinguish between using a constructed wetland for stormwater management and diverting stormwater into a natural wetland. They should avoid the

latter: altering the hydrology of a natural wetland can in turn alter and, in many cases, degrade the existing system. In most cases, local regulations also prohibit this practice. In all circumstances, communities should protect natural wetlands from the adverse effects of development, including impacts from increased stormwater discharge. This is especially important because natural wetlands provide stormwater and flood control benefits on a regional scale”.

(<https://www.epa.gov/system/files/documents/2021-11/bmp-stormwater-wetland.pdf>)

Ephemeral Streams are losing or disappearing streams because water is infiltrated into the aquifer as it flows downstream:

“The streams within the Plan are ephemeral and are considered losing or disappearing streams because water is infiltrated into the aquifer as it flows downstream. This results in generally more water volume upstream than downstream, and is characterized by deep gulches and canyons upstream and relatively small rivulets and stream channels downstream. While the downstream reaches of these streams may not flow for years at a time, and discharges from gulches and gullies into coastal waters are infrequent, when stormwater events do occur, the potential for flash floods, and very large stormwater volumes is possible within this watershed”.

(SOUTHWEST MAUI WATERSHED PLAN, page 159) <https://www.mauiwatershed.org/>

Potable water Reuse:

The process of using treated wastewater for drinking water is called potable water reuse. Potable water reuse provides another option for expanding a region's water resource portfolio. Jan 19, 2023

Potable Water Reuse and Drinking Water | US EPA

Cultural connection to Humpback Whales:

Native Hawaiian culture acknowledges the whale as an ancient being. They have been honored as ‘aumākua which are family or personal gods, deified ancestors who might assume the shape of either animals, plants, or natural phenomena.

Native Hawaiian Culture

The six main styles of Hawaiian fishponds:

The six main styles of fishponds as identified by Kikuchi include: Loko Kuapā, Loko Pu'uone, Loko Wai, Loko I'a Kalo, Loko 'Ume'iki and Kāheka / Hāpunapuna.

(<https://savethewetlands.org/six-main-styles-of-hawaiian-fishponds-peter-t-young/>)

Kihei Population Predictions:

With a 2023 population of 21,585, it is the 13th largest city in Hawaii and the 2160th largest city in the United States. Kihei is currently growing at a rate of 0.25% annually and its population has increased by 0.76% since the most recent census, which recorded a population of 21,423 in 2020.

Population Projections for the County of Maui to 2045:

Maui County Population 2045, 211,500. In 2016, the De Facto population was more than 30 percent higher than resident population in Maui. The de facto population in 2045 is projected to be 293,300.

https://files.hawaii.gov/dbedt/economic/data_reports/2045-long-range-forecast/2045-long-range-forecast.pdf

The goal of the Southwest Maui Watershed Plan to improve water quality:

The goal of this Watershed Plan is to show the ways to improve water quality to enhance all of these uses, and to establish management practices on the land which will support these uses into the future.

(SOUTHWEST MAUI WATERSHED PLAN, page 14) <https://www.mauiwatershed.org/>

Maui Island Plan Kihei-Makena Population Forecast:

According to the 2030 Socio-Economic Forecast, the total population is not expected to increase equally throughout the island; rather, there are specific regions where population growth is more likely to occur at a higher rate than others.

Table 1 - 2: Community Plan Area Population 2000 – 2030

Community Plan Area	2000	2005	2010	2015	2020	2025	2030
West Maui	17,967	19,852	22,156	29,103	31,410	33,743	36,058
Kihei-Mākena	22,870	25,609	27,244	37,850	40,850	43,885	46,896
Wailuku-Kahului	41,503	46,626	54,433	52,343	56,492	60,689	64,853
Makawao-Pukalani-Kula	21,571	23,176	25,198	23,919	25,815	27,732	29,635
Pā'ia-Ha'ikū	11,866	12,210	13,122	11,332	12,230	13,139	14,040
Hāna	1,867	1,998	2,291	2,541	2,743	2,947	3,149
Total Maui Island	117,644	129,471	144,444	157,087	169,540	182,135	194,630

<https://www.mauicounty.gov/1503/Maui-Island-Plan>

The National Flood Insurance Program (NFIP)

The National Flood Insurance Program (NFIP) provides federally backed flood insurance within communities that **enact and enforce floodplain regulations**. Since its inception in 1968, the NFIP has been very successful in helping flood victims get back on their feet.

Maui County NFIP: To qualify for the NFIP, a community adopts and enforces a floodplain management ordinance to regulate development in flood hazard areas. The objectives of the ordinance are to protect human life, protect property from flood damage, and to reduce public cost for flood control, rescue, and relief efforts.

Under the Community Rating System (CRS), communities are rewarded for doing more than the minimum national standards. Under the CRS, the flood insurance premiums of residents and businesses are discounted to reflect their community's work to:

- Reduce potential flood damage to existing buildings
- Manage development in areas not mapped by the NFIP
- Protect new buildings beyond the minimum NFIP protection level
- Preserve and/or restore natural functions of floodplains
- Help Maui residents and insurance agents obtain flood data

Tsunami Evacuation Zone maps do not account for locally generated tsunami:

“These maps do not consider the destructive effects of a locally generated tsunami. If you feel shaking, move inland immediately, well away from the evacuation zone”.

<https://dod.hawaii.gov/hiema/public-resources/tsunami-evacuation-zone/>

REFERENCES:

<https://www.epa.gov/ground-water-and-drinking-water/potable-water-reuse-and-drinking-water>

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<https://en.wikipedia.org/wiki/Maui>

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<https://www.epa.gov/system/files/documents/2021-11/bmp-stormwater-wetland.pdf>

<https://www.mauicounty.gov/1503/Maui-Island-Plan>

<https://www.census.gov/quickfacts/mauicountyhawaii>

<https://tsunami.coast.noaa.gov/>

<https://www.pacioos.hawaii.edu/shoreline/slr-hawaii/>

<https://savethewetlands.org/kihei-maui-wetlands-gis-data-download-page/>