WORKING TOGETHER FOR CLEAN WATER

A guide to help Nonprofit Organizations and Community Groups prepare to transition from cesspools to improved residential wastewater infrastructure

Snorkelers swimming with a Green sea turtle (*Chelonia mydas*) in Kahaluʻu Bay on Hawaiʻi Island

Photo taken by Vlad & Marina Butsky

CORAL REEF ALLIANCE

Hawaii Division of Aquatic Resources

CLEAN WATER FOR REEFS

About the Coral Reef Alliance (CORAL)

Founded in 1994, CORAL is a world-renowned conservation organization with a bold mission to save the world's coral reefs. Despite recent declines in coral reef health, research shows that corals can adapt to changing conditions. To promote their ability to adapt, CORAL works to reduce local threats to reefs. We take a holistic, integrated approach throughout all marine and coastal ecosystems, the surrounding watersheds, and the communities that depend on them. We specialize in uniting diverse stakeholders and partners to adopt practices and behaviors that help restore and protect coral reef ecosystems.

CORAL has more than a decade of experience working in Hawai'i. Our work in the Main Hawaiian Islands focuses on our Clean Water for Reefs initiative, with an emphasis on preventing land-based pollution both from stormwater runoff and sewage from entering the ocean. We work collaboratively with communities, nonprofits and government to reduce direct threats to reefs in ways that provide long-term benefits to people and wildlife.

On Hawai'i Island, CORAL has worked with the Puakō community since 2014 to help residents develop and implement a plan to transition from cesspools to adequate wastewater treatment. Now CORAL is advising the state government on its transition plan as a member of the Cesspool Conversion Working Group and Hawai'i County as a member of the County Wastewater Advisory Committee.

In West Maui, our work focuses on restoring the natural function of a watershed to filter stormwater and absorb nutrients, sediments and other chemicals. At the shoreline, we provide guidance to resort property owners, the tourism industry and Maui County on how to implement reef-friendly landscape design and make use of reclaimed water. Further inland, we pilot stream restoration techniques that combine modern technology with native vegetation and traditional Hawaiian agricultural practices.

For more information on our work, our values, and our staff, please visit coral.org

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Glossary

Aerobic (or Advanced) Treatment Unit - A container of various configurations that provides for aerobic degradation or decomposition of wastewater constituents by bringing the wastewater into direct contact with air by some mechanical means.

Blackwater - Wastewater that originates from toilets, dishwashers, and food preparation sinks. Blackwater can contain feces, urine, water and toilet paper. Blackwater is distinguished from greywater, which comes from household use other than toilets.

Capital investment strategy - A strategy designed to secure capital (initial) costs to upgrade outdated wastewater infrastructure.

Centralized Wastewater Treatment Facility (CWTF) - A wastewater treatment facility for collection, treatment, and discharge to surface water or reuse of wastewater from a relatively large number of homes, businesses, and industries. Not necessarily at or near the source of waste generation.

Cesspool– A substandard method for disposing of wastewater, without treating it. Cesspools are generally holes in the ground lined with brick or concrete blocks where household waste is discharged. Cesspools release raw, untreated sewage (as distinguished from **effluent**) into the ground and groundwater.

Cesspool transition plan – A strategy to upgrade cesspools to improved wastewater infrastructure.

Cluster Treatment System - a type of **Decentralized Wastewater Treatment System** which collects and treats wastewater from two or more dwellings or buildings with multiple owners and conveys it to a treatment and dispersal system located on a suitable site near the dwellings or buildings.

Coral reef - a wave-resistant oceanic structure resulting from cementation processes and the skeletal construction of coral animals and other calcium carbonate-secreting organisms.

Coral bleaching - The process in which a coral polyp, under environmental stress, expels its symbiotic zooxanthellae from its body. The affected coral colony appears whitened.

Decentralized Wastewater Treatment and Disposal System - Wastewater treatment system for collection, treatment, and subsurface soil dispersal or reuse of wastewater from individual homes, clusters of homes, isolated communities, industries, or institutional facilities, at or near the source of waste generation.

Effluent - The liquid that comes out of a wastewater treatment system after completion of any treatment process. Septic tanks and ATUs release effluent, but cesspools do not, since no treatment takes place for cesspools.

Enterococcus - Bacteria normally found in feces. Two types, *Enterococcus fecalis* and *Enterococcus fecium*, cause human disease, most commonly in the form of urinary tract and wound infections. Often used by researchers as a fecal indicator bacteria -- an indicator of sewage pollution.

Endemic species - A species whose distribution is restricted to a particular area

Greywater – Wastewater that comes from sources other than toilets and food preparation sinks, such as such as showers, bathtubs, hand-washing sinks, and clothes-washing machines.

Groundwater - water located underground in the zone of saturation that moves freely to points of discharge (e.g., springs) and withdrawal (e.g., wells and tunnels). It includes water which comes from artesian and non-artesian sources, as well as the subflow of streams and underground streams.

Individual Wastewater Systems (IWS) – a type of **Decentralized Wastewater Treatment System;** one which relies on natural processes and/or mechanical components to collect, treat, and/or disperse or reclaim wastewater from a single dwelling or building, at or near the source of waste generation. Cesspools, septic tanks, and ATUs are all considered to be Individual Wastewater Systems.

Influent - Wastewater that enters a wastewater treatment plant.

Injection well – A well into which subsurface disposal of fluid or fluids occur or is intended to occur by means of injection.

Leach field (also known as a **drain field) -** An area of soil that serves as the physical location where final treatment and dispersal of effluent (or wastewater) occurs; effluent is usually distributed into a leach field using one or more perforated pipe laterals in gravel-filled trenches buried below the ground surface. Regulations dictate the size of a leach field based on the percolation rate of the soils and depths to seasonally high groundwater, bedrock, or other limiting conditions.

Nutrient - Any substance assimilated by organisms that promotes growth. Examples include nitrate, phosphates, and silicates.

Package Treatment Plant – A type of **Decentralized Wastewater Treatment System,** where treatment units are preassembled in a factory, mounted, transported to the site, and virtually ready to operate.

Pathogen - Any agent, especially a microorganism, capable of causing disease.

Runoff – Flow of water along the surface of the ground or other natural or manmade surfaces, including but not limited to pedestrian walkways, streets, playground surfaces, and grassy slopes.

Sewage / raw sewage – Any urine, feces, and the water carrying human wastes. See also: **Blackwater.**

Special Management Area (SMA) – In Hawai‘i, an area close to the shoreline, where development is subject to special controls by the State Office of Planning, for the purposes of protecting coastal resources.

Wastewater - The mixture of used water and human waste carried away by drains and sewers. Wastewater includes blackwater, greywater, and industrial water.

Water pollution - A general term signifying the introduction into water of microorganisms, chemicals, wastes, or sewage which render the water unfit for its intended use.

Acronyms

ATUs: Advanced or Aerobic Treatment Unit

CORAL: Coral Reef Alliance

CWTS: Centralized Wastewater Treatment System

CWA: Federal Clean Water Act

DAR: Hawai‘i Division of Aquatic Resources

DOH: Hawai‘i Department of Health

EPA: United States Environmental Protection Agency

HRWA: Hawai‘i Rural Water Association

IWS: Individual Wastewater Systems

NPDES: National Pollutant Discharge Elimination System

PER: Preliminary Engineering Report

PUC: Public Utility Commission

SMA: Special Management Area

Preface

The early Polynesian settlers of Hawai‘i correlated *wai* (water) with wealth. *Ka wai ola,* literally translates to “the water of life.” Hawaiians believed that all the land and water belong to the gods, and were resources people could not use freely within the *ahupua’a* (watershed). The importance of *wai* was recognized and managed accordingly, while supporting the demand of each *moku* (district).

Our modern world has largely lost sight of this ancient wisdom. Today, wastewater pollution (particularly, raw sewage pollution from cesspools) reaching Hawai‘i’s coastal waters threatens traditional culture and the marine environment, negatively impacting our quality of life. Wastewater contains harmful bacteria and pathogens that can make people sick. It also contains high levels of nutrients and chemicals that harm our treasured coral reefs and, in turn, threaten Hawai‘i’s major source of income: tourism.

The good news is that communities, nonprofit organization, and government are banding together to transition to clean water by replacing outdated cesspools that pollute our *wai* and *kai* (ocean).

This guide is the first resource as part of a **Clean Water Toolkit** developed by the Coral Reef Alliance (CORAL), with support from the Hawai‘i Division of Aquatic Resources (DAR). Nonprofit organizations and Community Groups interested in transitioning away from cesspools to improved wastewater treatment can use this guide as a resource.

In this guide, you will learn about the wastewater landscape in Hawai‘i and gain an understanding of the process for transitioning, including: why cesspool transition is important to the health of your family and the environment, what you need to know about the problem and potential solutions, what the state of Hawai‘i is currently doing to act, and important questions and considerations to help your community move forward.

The purpose of this guide is to provide a high-level “lay of the land” for cesspool transition. The better informed you are, the smoother the transition and the more likely it is that you will find a locally appropriate solution.

Part I. Sewage Pollution: A Threat to Hawai‘i’s Community, Environment, and Economy

In the water set by Kane and Kanaloa
Water springing forth, water to drink
Water to empower, water to bring life
Let it thrive, indeed!

from The Kumulipo: A Hawaiian Creation Chant, translated by Puakea Nogelmeier

Sewage pollution from outdated cesspools is a significant problem in Hawai‘i. Across the state, approximately 88,000 cesspools release 53 million gallons of raw sewage into groundwater and surface water every day, allowing high levels of nutrients, pathogens and harmful chemicals to enter drinking water and the marine environment. Hawai‘i Island alone has approximately 50,000 cesspools releasing 27.3 million gallons of raw sewage per day.[1]

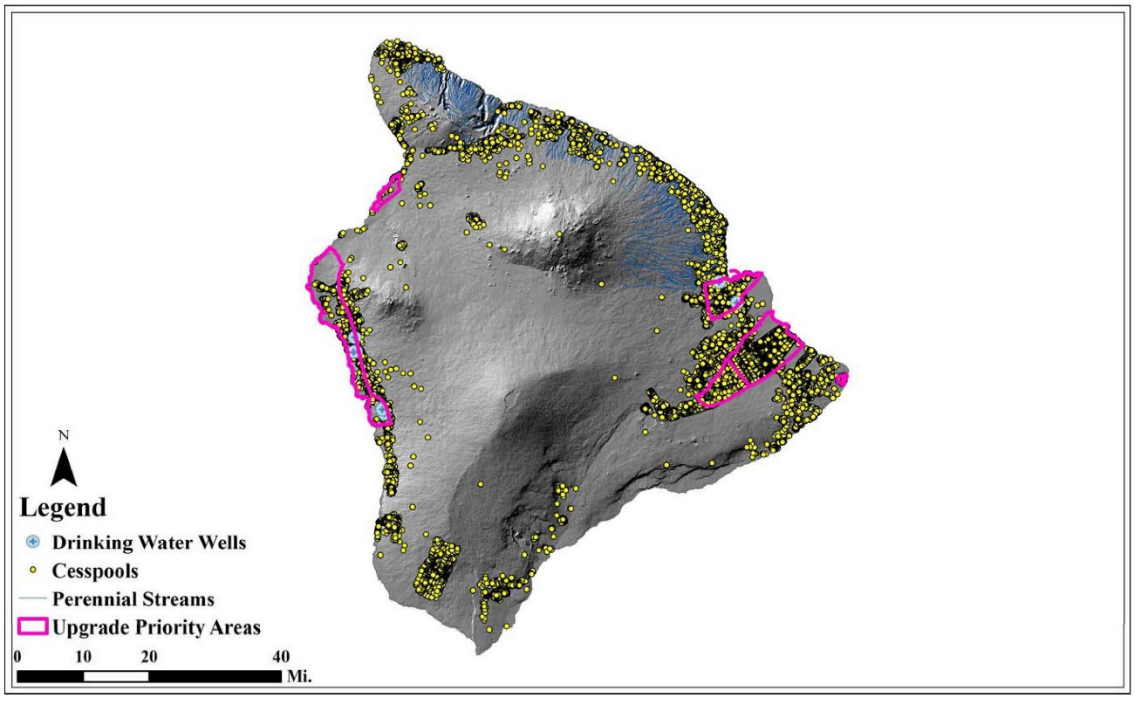

Figure 1. Map of Hawai‘i Island with: Hawai‘i cesspool locations, priority areas for upgrade, potentially affected drinking water sources, and perennial streams. Map taken from the DOH Report to the Twenty-Ninth Legislature Relating to Cesspools and Priorities for Replacement.[1]

[1] https://health.hawaii.gov/opppd/files/2017/12/Act-125-HB1244-HD1-SD3-CD1-29th-Legislature-Cesspool-Report.pdf

Our health is at risk

We need clean water to thrive - physically, spiritually, and culturally. Hawai‘i relies on groundwater as the source of 90 percent of its drinking water[1]. Sewage in groundwater is polluting drinking water and putting people at risk of disease from polluted drinking water.

For example, in the Puna District of Hawai‘i Island, one of the fastest growing communities in Hawai‘i, many residents rely on privately owned drinking wells for domestic water. However, there are an estimated 9,300 cesspools in the area releasing sewage and contaminating the community's groundwater and drinking wells. The Hawai‘i Department of Health (DOH) found that 25 percent of the domestic wells sampled in this area tested positive for *Enterococcus*, a fecal (i.e., sewage) indicator bacteria[1].

Public health is also at risk while swimming or recreating in waters adjacent to cesspools, due to the risk of contracting diseases from wastewater contamination. When polluted groundwater reaches the shoreline, families and tourists recreating in the ocean become exposed to pathogens and bacteria that can cause skin, urinary, blood, and abdominal infections, such as gastroenteritis, Hepatitis A, conjunctivitis, salmonellosis, and even cholera. Where concentrations of 35CFU/100mL of *Enterococcus* are present, recreational water users have a 3.6 percent chance of contracting gastroenteritis. Children and the elderly are particularly susceptible to these infections[2].

Of most concern are coastal waters adjacent to residential communities where cesspools are used. However, cesspools that are further *mauka* (towards the mountain) can also pollute groundwater, affecting nearby drinking water and downstream coastal waters. On Hawai‘i's volcanic islands, groundwater weaves its way *makai* (towards the ocean) via complex networks of underground lava tubes, dykes, and channels towards the porous shoreline.

Hawai‘i's environment is at risk

Sewage and wastewater pollution severely harms coral reefs and their ability to provide sustainable livelihoods, shoreline protection, and other benefits and services. Hawai‘i's reefs are particularly special. They have some of the highest marine endemism recorded anywhere on earth and contain about 85 percent of the United States' coral reefs. They are a source of food for families and they

[2] https://coral.org/wordpress/wp-content/uploads/2016/01/Puako-UHH-TNC-2015-3V-revised-ab2.compressed.pdf

contribute $800 million to the economy each year through the tourism industry[3]. Coral reefs also serve as a natural barrier that protects people and coastal buildings from storm surges and floods. The United States Geology Survey calculated the economic value of shoreline protection in Hawai‘i from coral reefs to be worth $900 million[4]. By threatening coral reefs, sewage and wastewater pollution threatens our entire island culture.

For example, Hilo and Kona, two of the biggest cities on Hawai‘i Island, are rife with cesspools that threaten our nearshore environment. There are 8,700 cesspools discharging to the streams and groundwater that flow into Hilo Bay and 6,500 cesspools in Kona contributing to the degradation of coral reefs in west Hawai‘i.

Raw sewage – and even treated wastewater – contains high levels of nitrogen and phosphorous. These nutrients upset the delicate balance of coral reef ecosystems in favor of fast-growing invasive algae, which smother corals, block their access to sunlight, and promote coral disease[5].

Wastewater pollution also reduces the ability of corals to withstand climate change-related impacts, such as coral bleaching[6] and ocean acidification[7], both of which are becoming increasingly prevalent in Hawai‘i. Recent studies indicate that the best conservation action to help reefs and marine life persist or recover from climate change is to reduce other major threats[8].

Raw sewage contains hundreds of different compounds, the most common of which are: inorganic nutrients, pathogens, endocrine disrupters, suspended solids, sediments, heavy metals, and other toxins that all harm coral reefs[9]. In Hawai‘i, sunscreen chemicals like Oxybenzone are in high concentrations in our wastewater because they wash off our bodies in the shower or get excreted

[3] http://www.hawaii.edu/ssri/cron/files/econ_brochure.pdf
[4] https://pubs.usgs.gov/of/2019/1027/ofr20191027.pdf
[5] https://coral.org/wordpress/wp-content/uploads/2014/09/FINAL-for-PCA-Sewage-and-Porites-growth-anomalies.pdf
[6] https://link.springer.com/article/10.1007/s00227-019-3538-9
[7] https://royalsocietypublishing.org/doi/full/10.1098/rspb.2017.2718; https://www.sciencedaily.com/releases/2018/06/180606093736.htm
[8] https://health.hawaii.gov/opppd/files/2017/12/Act-125-HB1244-HD1-SD3-CD1-29th-Legislature-Cesspool-Report.pdf; https://www.nature.com/articles/s41558-019-0518-5.epdf?author_access_token=P8wTmOVZpLkKcslba2guA9RgN0jAjWel9jnR3ZoTv0MfsDpsr-XFeaym1-pv8WErp3wvwWdkVHp-xxQar4ROnGw5GpCATCYx5cv3yLdU3H0Yd0zwLASpSOCiN5WSFidDI_GNaKqZ7ZiaG4o1CQ6xdw%3D%3D
[9] https://coral.org/wordpress/wp-content/uploads/2014/09/Wear-Vega-Thurber-2015.pdf

through urine. Scientists recently discovered that these commonly-used chemical suncreens can make corals more susceptible to bleaching[10].

Because of these impacts, scientists and conservation practitioners are urging us to reduce water pollution to save coral reefs.

To secure Hawai'i's future, human health and environmental impacts must both be considered when transitioning away from cesspools.

[10] https://haereticus-lab.org/about-us/scientific-publications/

Part II: How Wastewater is Managed in Hawai‘i

This section provides a broad overview of the technical landscape of sewage and wastewater management in Hawai‘i, as it stands today. Understanding appropriate sewage and wastewater treatment systems and treatment level of discharged effluent is essential to developing an adequate solution for mitigating impacts to humans and the environment. While this guide does not cover wastewater management systems in great detail, it provides a valuable baseline understanding to assist you in your transition away from cesspools.

Wastewater is generated from many daily activities, such as washing clothes and dishes, preparing food, taking a bath or shower, washing your hands, and using the toilet. Raw sewage is generated when you use the toilet and is mixed with other types of wastewater before entering a wastewater system.

In the United States, residential communities manage their wastewater in two primary ways: with a decentralized system at or near the source of waste generation, or with a centralized system using pipes to convey waste to a centralized location. According to the 2004 EPA Clean Watersheds Needs Survey[11], 61.9 percent are served by a **Centralized Wastewater Treatment System**, while 38.1 percent of Hawai`i residents are served by **Decentralized Wastewater Treatment and Disposal Systems**.

In the sections below, we describe these systems in greater detail. It's worth noting that new innovations in wastewater treatment technology evolve every day. As these technologies advance, the Hawai‘i DOH Wastewater Branch reviews them for acceptable use in the state of Hawai‘i. The applicability of each technology option should be weighed based upon the risk to humans, impacts on the environment, and impacts on economic health.

Centralized Wastewater Treatment Systems (CWTS)

Centralized Wastewater Treatment Systems (CWTS) are systems which collect wastewater from homes, businesses, and industries and transport it via a network of pipes and pump stations to a treatment plant for processing. As permitted by the National Pollutant Discharge Elimination System (NPDES), after the treated water (effluent) leaves the centralized wastewater treatment

[11] https://www.epa.gov/cwns

system, it is released into local waterways where it is recycled for any number of purposes, such as supplying drinking water, irrigating crops, and sustaining aquatic life.

Decentralized Wastewater Treatment and Disposal Systems

Decentralized Wastewater Treatment and Disposal Systems consist of a variety of approaches to collect, treat, and/or disperse or reclaim wastewater, at or near the source of waste generation. These systems function independently by property or community. They store household waste and can provide varying levels of treatment. According to the EPA[12], in the United States, one in four households, amounting to 60 million people, rely on Decentralized Wastewater Treatment and Disposal Systems.

Individual Wastewater Systems (IWS)

There are three primary types of IWS; (1) cesspools; (2) septic tanks; and (3) Aerobic Treatment Units (ATUs), each offering a different level of treatment. Cesspools only dispose but do not treat wastewater, septic tanks provide only provide primary treatment, and ATUs provide secondary levels of treatment. Below we describe these three systems in greater detail.

1. **Cesspools**, also known as cesspits, are essentially holes in the ground lined with brick or concrete blocks where household waste is discharged. They are disposal systems only, not treatment systems. Cesspools lack the ability to filter waste, and the sewage eventually contaminates the surrounding soil and groundwater. For this reason, cesspools are outdated and no longer legally allowed in the United States. In 2016, Hawai‘i became the last state to ban cesspools, 50 years after Rhode Island did so in 1968.

Cesspools collect and dispose of wastewater, but do not actually treat it. They are an outdated and substandard method for wastewater disposal.

[12] https://www.epa.gov/sites/production/files/2015-06/documents/onsite_handbook.pdf

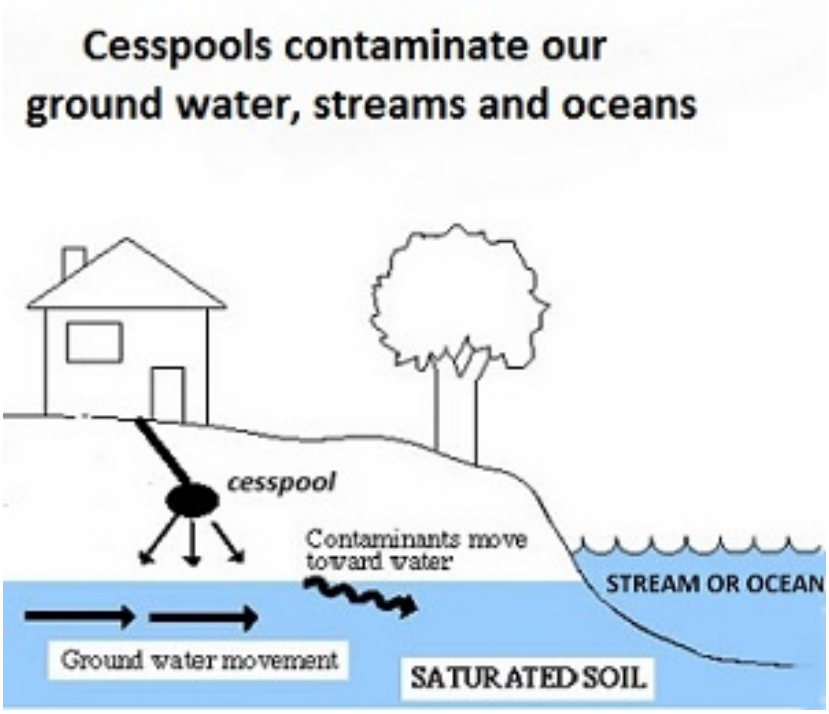

Figure 2. Diagram of how cesspools contaminate groundwater, streams, and oceans. Taken from state of Hawai'i, Department of Health Wastewater Branch website.[13]

2. Septic tanks are slightly more advanced than cesspools. They have four main components: (1) a pipe from the home; (2) a lined septic tank; (3) a leach field; and (4) the soil. This system allows for basic treatment and for sediment (hard waste) to fall out of the waste stream thus removing some of the pathogens and bacteria. This effluent then flows through a leach field (please see section below). When properly designed, constructed, and maintained, a septic system can provide long-term effective treatment of household waste. However, a malfunctioning or poorly designed septic tank can contaminate groundwater and make its way to the ocean. Septic tanks also require proper operation and maintenance to provide an acceptable level of treatment (see Your Septic System is your responsibility!14) The United States EPA urges people to take the following steps for proper septic care:

- Regularly inspect your system and pump your tank as necessary.
- Use water efficiently.
- Don't dispose of household hazardous waste in sinks or toilets.
- Care for your leach field.

[13] https://health.hawaii.gov/wastewater/cesspools/

[14] https://www3.epa.gov/npdes/pubs/homeowner_guide_long.pdf

3. Aerobic (or Advanced) Treatment Units (ATUs) are advanced septic tanks. Unlike a septic system, ATUs have pumps to aerate the chamber. This creates a favorable environment for microbes that digest the sewage. There are many different styles of ATUs that can reduce pathogens and nutrients to varying degrees. ATUs with a functioning leach field can provide a more effective treatment than both cesspools and septic tanks. ATUs can be quite successful at treating wastewater under the right conditions and with proper operation and maintenance by a certified operator.

Understanding leach fields and Hawai‘i’s geology

As described above, septic systems and ATU's provide some level of wastewater treatment, whereas cesspools do not. However, the ability of these systems to sufficiently treat the wastewater is dependent upon additional treatment taking place in a functioning leach field (also known as a drainage field). When designed and installed correctly, leach fields filter the effluent through layers of different soil types. Soil microbes break down the harmful components of the effluent into smaller organic matter that can be recycled into the environment. The filtration of effluent through a leach field acts as a final treatment before discharge, removing most of the contaminants prior to reaching groundwater.

A functioning leach field requires space and soil, so local geology and lot size are the most important factors in determining the efficacy of leach fields. Because Hawai‘i’s shoreline is mostly porous volcanic ground with thin or no soil, in communities directly adjacent to the shoreline, raw sewage from cesspools and treated effluent from other systems are conveyed almost directly to the ocean. Upland communities may also enable poorly treated wastewater to reach the ocean due to Hawai‘i’s complex volcanic geology, consisting of lava tubes, aquifers, and *kumu wais* (underground springs) connecting groundwater from *mauka* (mountain) to *makai*.

Along Hawai‘i’s shorelines, septic systems act more like cesspools

The porous volcanic rock with thin or no soil and high-water table do not provide the conditions necessary for leach fields to function effectively and proper breakdown of harmful substances to occur. Under these conditions, effluent from septic tanks leak into the ground and groundwater without the secondary treatment of a functioning leach field, just like it does with cesspools. From there, polluted groundwater makes its way directly to the ocean.

In Hawai'i, site-specific data are needed to determine the appropriate type of treatment and discharge recommended for each location. The key to achieving optimal performance of Individual Wastewater Systems is a management strategy consisting of site planning, assessments of local site conditions, effective system design, and operation and maintenance.

Other types of Decentralized Wastewater Treatment Systems

Cluster Treatment Systems: When two or more properties are serviced by a single treatment and water dispersal system, it is sometimes referred to as a Cluster Treatment System.

Package Treatment Plants: Smaller communities have the option to install a Package Treatment Plant, where treatment units are preassembled in a factory, mounted, transported to the site, and virtually ready to operate. Package Plants come in many sizes and efficiencies from extended aeration plants, sequencing batch reactors, oxidation ditches, to biological contactors with both physical, chemical and biological processes. When servicing multiple structures or a rural community, a collection system and pumps are needed to convey the influent to the plant. Discharge of effluent is determined by quality of treatment, infrastructure demands, and regulations. Across Hawai'i, you will find many of these privately owned package plants serving individual communities and resort properties.

Water treatment and reuse

Once wastewater reaches an Decentralized or Centralized Wastewater Treatment System, it will undergo primary, secondary, or tertiary treatment:

1. **Primary treatment** consists of temporarily holding the sewage in a quiescent basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.
2. **Secondary treatment** removes dissolved and suspended biological matter. Secondary treatment is typically performed by indigenous, water-borne micro-organisms in a managed habitat
3. **Tertiary treatment** is sometimes defined as anything more than primary and secondary treatment in order to allow ejection into a highly sensitive or fragile ecosystem (estuaries, low-flow rivers, coral reefs...). Treated water is sometimes disinfected chemically or physically (for example, by lagoons and microfiltration) prior to discharge into a stream,

river, bay, lagoon or wetland, or it can be used for the irrigation of a golf course, greenway or park. If it is sufficiently clean, it can also be used for groundwater recharge or agricultural purposes

In Hawai‘i, treatment systems produce three categories of recycled water[15]:

1. **R-3 Water** (Not disinfected, secondary recycled water) – Correlates to Primary treatment. Removes solids by filtration, sedimentation, and chemical coagulation.
2. **R-2 Water** (Disinfected secondary-23 recycled water, which means secondary treatment with disinfection to achieve a median fecal coliform limit of 100 ml based on the last seven days for which analyses have been completed) – Correlates to Secondary treatment. Removes most of the organic matter in the wastewater using biological processes.
3. **R-1 Water** (99.999 percent of bacteria and pathogens are removed) – Correlates to Tertiary treatment. Removes excess organic matter, nitrogen, phosphorus, or toxics.

Achieving the goal of the federal Clean Water Act of ensuring "fishable, swimmable and drinkable waters" requires wastewater treatment to the R-1 or R-2 standard[16]. R-1 water is the highest standard of treatment for wastewater, whereby 99.999 percent of bacteria and pathogens are removed. Some nutrients, however, remain in the treated effluent and if high volumes of R-1 water reach the groundwater and coastline, impact from nutrient pollution can still occur. However, because R-1 is the highest quality water, treatment to this standard provides the most options for effluent reuse, such as irrigating golf courses, food crops, gardens. When the effluent is used for irrigation, vegetation can further filter the water by absorbing remaining nutrients. A full list of uses for recycled water can be found on page 25 of the Hawai‘i Department of Health's Guidelines for the Treatment and Use of Recycled Water[15].

Injection wells

In Hawai‘i, injection wells are sometimes used by private and public wastewater treatment facilities as a method for disposing of the treated effluent into the ground. In Hawai‘i, use of injection wells can lead to nutrient pollution along the coast in cases where the underground place that the effluent is injected into is connected to the ocean, for example, through an underground lava tube. Injection wells are permitted in Hawai‘i, however, their continued use is currently under scrutiny because of the environmental impact of injecting high volumes of nutrient-rich effluent into

[15] http://health.hawaii.gov/wastewater/files/2013/06/reuse-final.pdf
[16] https://www3.epa.gov/npdes/pubs/centralized_brochure.pdf

groundwater systems that are connected to the ocean. Follow the Maui Lahaina Wastewater Reclamation Facility lawsuit[17] for more information.

The key factors in identifying a suitable wastewater treatment technology are geology and an effective management strategy

[17] https://www.hawaiipublicradio.org/post/maui-wastewater-lawsuit-headed-supreme-court#stream/0

Part III: Ownership, Operations and Maintenance

Typically, Individual Wastewater Systems are owned by individuals who are responsible for the operations and maintenance. In Hawai‘i, for the first two years of operations, all homeowners must follow a DOH-mandated maintenance plan for new ATUs to ensure their system is functioning appropriately. After that time period, ensuring proper operations and maintenance is the responsibility of individual homeowners.

Centralized Wastewater Treatment Systems can be owned, operated, and maintained by the following management structures:

1. *Nonprofit organization*: If a community decides to own a centralized facility, they may decide to form a nonprofit entity to take on the management role.
2. *Corporation*: A number of for-profit companies own and/or operate wastewater facilities for communities and resorts. The Hawai‘i Public Utilities Commission (PUC) regulates the rates and services of private utilities; that is, they are not owned by the government.
3. *Municipality*: Utilities owned and operated by the local city or county government.

The capital costs of owning and operating a Centralized Wastewater Treatment System can be extensive and includes not only constructing the treatment facility itself, but also sewering the homes by building a collection system that transports the wastewater to the facility. In Hawai‘i, building the collection system can be expensive, especially when it is necessary to lay pipes in volcanic rock.

Sometimes the owner of a system may hire another company to operate the system. For example, Kohanaiki's wastewater treatment facility is operated by a third party operator. In some cases the collection system may be owned by a different entity than the one which actually owns the treatment facility. An example is the system that treats the wastewater from the Mauna Lani properties in South Kohala, Hawai‘i Island. In this case, Hawai‘i American Water owns and operates the treatment facility, but the separate properties own their collection systems that transport their wastewater to the facility.

The choice of who owns and manages the treatment system directly affects how the cesspool transition is funded, how rates are collected and who will operate the system post-construction. Therefore, considerations around future operation and maintenance will help you determine the steps necessary to take to develop a funding strategy for your cesspool transition. In some cases, one entity might own the construction project, then sell or lease the facility to another entity once it is operational.

The extent of operation and maintenance of a wastewater treatment system is based on the complexity of the system. Some facilities need to be monitored around the clock, while others only need part-time oversight. Operators are responsible for activities such as equipment maintenance, refilling chemical storage, taking water samples, coordinating the disposal of solids and general housekeeping of the site. Hawai'i Rural Water Association (HRWA)[18] are experts in wastewater management and provide technical assistance on sustainable operation and maintenance of wastewater treatment systems. HRWA can help facilitate workshops to clearly outline the roles and responsibilities of ownership and operation and maintenance.

Ownership directly affects how the transition is funded and options for what type of entity can operate the system once it is operational.

[18] http://www.hrwa.net/wastewater-cr.html

Part IV: Developing a Capital Investment Strategy to Fund the Transition

Transitioning from cesspools to improved treatment technology can be costly. But the benefits of clean water, healthy communities, healthy environment and healthy economy cannot be understated.

We will cover this topic in more detail at a later date, as part of our comprehensive **Clean Water Toolkit.** Additionally, one of the goals of the Cesspool Conversion Working Group formed by Act 132 is to determine financing options for transitioning communities. Please refer to Part V for more information on what the government is doing.

In the meantime, you can gain some background on funding options by reviewing the funding overview developed for the Puakō community, as part of CORAL's Clean Water for Reefs Puakō project[19].

[19] https://coralreef.egnyte.com/dl/iSN6n04Gkn/

PART V. Government is Working to Resolve Hawai‘i’s Wastewater Problem

Overview of wastewater treatment policy and regulation

At the **federal level,** the United States’ Environmental Protection Agency’s (EPA) Clean Water Act (CWA) establishes the basic framework for regulating discharge of pollutants into U.S. waters and regulating water quality standards for surface waters.

At the **state level,** the Hawai‘i Department of Health (DOH) Wastewater Branch sets local regulations under the federal standards of wastewater infrastructure for both privately and publicly owned treatment systems. The Wastewater Branch’s mission is to protect public health and the environment. It does so by administering statewide engineering functions relating to water pollution control, municipal and private wastewater treatment works program and the water pollution control revolving fund program.

At the **county level,** wastewater divisions are responsible for the operation and maintenance of the county’s municipal wastewater collection and treatment facilities[20]. To protect shorelines from harm, Hawai‘i has established Special Management Areas (SMAs)[21], which are areas of the island in close proximity to the shoreline that require special controls for shoreline development. Established in 1975, the Hawai‘i State Legislature found that “it is the state policy to preserve, protect, and when possible, to restore the natural resources of the coastal zone of Hawai‘i” *(Hawai‘i Revised Statutes, Chapter 205A, Part II).*[22]

A timeline of government research and legislation on wastewater issues

- **1992:** the Hawai‘i DOH revised its wastewater regulations by designating Critical Wastewater Disposal Areas across the state, prohibiting new cesspools in these regions.
- **2008-2009:** multiple studies on cesspools were conducted across the state.
- **2009:** a new partnership was created to upgrade 20 cesspools in Halalei.
- **2012:** further research identified that 32 percent of Individual Wastewater Systems inspected were either failing or had difficulties that could result in failure.

[20] https://health.hawaii.gov/wastewater/

[21] http://www.hiplanningdept.com/resources-and-references/special-management-area-sma/

[22] https://dlnr.hawaii.gov/occl/files/2013/07/205a.pdf

- **2014:** Cesspools were identified as a significant source of contamination, leading to a DOH proposal to revise the wastewater regulations to require conversion of cesspools to higher level of treatment. However, no new laws were ultimately passed at this time.
- **2015:** In hopes of encouraging a voluntary transition, the state legislature and Governor, with assistance from DOH, enacted Act 120, a tax credit of $10,000 to upgrade cesspools in sensitive areas. During the period of 2015-2017, they received only 47 applications.
- **2016:** Hawai'i banned construction of new cesspools**.**
- **2017:** Hawai'i passed Act 125, which requires the replacement of all cesspools by 2050 and directs the Hawai'i DOH to investigate an effective pathway to transition away from cesspools.
- **2018**: Hawai'i DOH submitted a report[23] to Congress, highlighting the need for more data, identifying a $1.75 billion budget to replace all cesspools to septic systems, a priority list for transition areas, and a need for a transition plan.
- **2018:** Act 132 was signed into law by Governor Ige. As part of Act 132, DOH created a Cesspool Conversion Working Group tasked to develop a long-range comprehensive plan for statewide cesspool conversion in order to meet Act 125's 2050 goal.

Act 125 requires the replacement of all cesspools by 2050 and directs the Hawai'i DOH to investigate an effective pathway to transition away from cesspools.

DOH prioritization of areas for cesspool replacement

DOH identified fourteen communities across the state as priority areas for cesspool replacement. Together, these areas represent approximately half of all inventoried cesspools in the state. DOH identified these priority areas using existing, but limited, data and models based on a combination of risk factors, including: the density of cesspools in an area; soil characteristics; proximity to drinking water sources, streams, and shorelines; other groundwater inputs including agriculture and injected wastewater; and the physical characteristics of nearby coastal waters (e.g., bays and inlets) that may compound the impacts of improperly treated wastewater. In its report[1], DOH proposed that cesspool replacement efforts be addressed in order of priority, based on the following categories:

- Priority 1: Significant Risk of Human Health Impacts, Drinking Water Impacts, or Draining to Sensitive Waters

[23] https://health.hawaii.gov/opppd/files/2017/12/Act-125-HB1244-HD1-SD3-CD1-29th-Legislature-Cesspool-Report.pdf

- Priority 2: Potential to Impact Drinking Water
- Priority 3: Potential Impacts on Sensitive Waters
- Priority 4: Impacts Not Identified

Planning for cesspool replacement

DOH is working with the legislature, counties, homeowners and interest groups to achieve the goal of eliminating cesspools in a financially feasible way. As part of Act 132, of DOH created a Cesspool Conversion Working Group tasked to develop a long-range comprehensive plan for statewide cesspool conversion to meet Hawaii's 2050 goal. Between 2019-2023, the Cesspool Conversion Working Group will develop a comprehensive plan for the conversion of all cesspools by 2050. An interim report will be submitted to the legislature outlining priority areas by December 31st, 2021, and a final report by December 31st, 2023. DOH's website[24] shows the list of Cesspool Conversion Working Group meeting attendees, the agenda, and meeting minutes for each meeting, allowing communities to follow its progress and learn about the process. The final report will outline the plan for transition, which will highlight the local process for implementing the transition and how communities can participate.

Cesspool Conversion Working Group's subgroups

The Cesspool Conversion Working Group has created three specialized subgroups tasked with exploring key aspects of the cesspool transition process. Each subgroup reports back to the larger Working Group.

<u>Subgroup #1: Finance / Capital Investment</u>

The Finance Subgroup is evaluating different possible funding mechanisms. Parameters include eligibility requirements, available funding , funding parameters, challenges, benefits, and considerations like rebates, grants, loans, and tax credits.

The Finance Subgroup will also review and identify a short-list of the most feasible funding options, research avenues for distributing funds to homeowners, and develop a priority list of eligible recipients. This Subgroup will consider any and all factors inhibiting cesspool conversion, including tax impediments, legislative barriers, and challenges in marketing the benefits of conversion. Members include:

[24] http://health.hawaii.gov/wastewater/ccwg/

- Ted Bohlen: Deputy Attorney General
- Charlene Lani Fernandez: Bank of Hawai‘i
- Ken Hiraki: Hawai‘i Association of Realtors
- Representative Nicole Lowen: House of Representatives
- Mike Montgomery: Environmental Protection Agency, Region 9
- Eric Nakagawa: Chief, County of Maui, Wastewater Division

Subgroup #2: Technology

The Technology Subgroup is identifying existing technologies for onsite systems to replace cesspools at individual residences, encourage research and development of emerging technologies, outline decentralized options, and reference the existing regulatory framework. Members include:

- Stuart Coleman: Surfrider Foundation
- Jason Kagimoto: Chief, Wastewater Division, County of Kauai
- Bill Kucharski: Director, County of Hawai‘i, Department of Environmental Management
- Dr. Darren T. Lerner: Interim Director for the University of Hawai‘i Water Resources Research Center
- Mike Montgomery: Environmental Protection Agency, Region 9
- Erica Perez: Coral Reef Alliance
- Sina Pruder: Wastewater Branch, DOH

Subgroup #3: Research and Prioritization of Communities for Transition

The Prioritization Subgroup is identifying and consolidating data for drinking water, public health, and environment impacts. They are also identifying critical data needs, studying the impacts of different treatments, and reviewing data reporting protocols for guidance on next steps. Members include:

- Bruce Anderson: Director, DOH
- Jason Kagimoto: Chief, Wastewater Division, County of Kauai
- Bill Kucharski: Director, County of Hawai‘i, Department of Environmental Management
- Dr. Darren T. Lerner: Interim Director for the University of Hawai‘i Water Resources Research Center
- Erica Perez: Coral Reef Alliance
- Sina Pruder: Wastewater Branch, DOH
- Dr. Kawika Winter, Manager, He‘eia National Estuarine Research Reserve, Hawai‘i Institute for Marine Biology

PART VI. Prepare for Cesspool Transition by Asking the Right Questions

This section provides information to nonprofit organizations and community groups interested in engaging in a process to transition from cesspools to improved wastewater infrastructure. Regardless of your role in the transition, it is important to understand the basic technical and regulatory framework to help you collaborate successfully with your local government and community.

What follows is a series of considerations in the form of questions to ask yourselves, your community partners, and your local government representatives. You will need to consider baseline questions, technology questions, and finance questions. Note that some answers are dependent on answers associated with other questions. Taken together, the answers to these questions are meant to demystify and help you prepare for the transition away from cesspools.

A **"target community"**, as used in this document, is a community that is concerned about outdated infrastructure and in need of assistance to transition such infrastructure to improved wastewater technology for human and environmental health reasons. We encourage community members to be informed and stay highly engaged in the transition process.

The better informed you are, the easier this transition will be. This guide will give you an understanding of the overall process. Community engagement is of utmost importance.

Baseline Questions

The most important questions to ask as you begin to engage in a wastewater transition process are related to understanding the existing wastewater treatment process and the potential for pollution to reach drinking water or coastal waters. Understanding how engaged the target community wishes to be in the transition process is also key.

Does your target community have cesspools, ATUs, or septic tanks?
The first step in this process is to determine which types of wastewater treatment are operating in the community. Typically, a community will have a mix of different types of systems, but one system may be more predominantly used.

Has your target community been listed under the state of Hawai‘i Prioritization List?

To determine if / how your community has been priorities by the state, see pages 5-6 of the DOH Report to the twenty-ninth legislature relating to cesspools and priorities for replacement[1]. Please note that reprioritization is currently underway by the Cesspool Conversion Working Group (see Section V.

Are your cesspools polluting local groundwater or coastal waters?

First, look at the DOH report that prioritizes communities for transition[1]. If there are no data for your community and you want to find out if your water is polluted, we recommend you contact the DOH Clean Water Branch to determine if there is a plan for the government or the University of Hawai‘i to collect data in your community. If there is not, you may be able to enlist the help of local researchers or citizen science programs:

- Hawai‘i Island: Hawai‘i Wai Ola[25] on Hawai‘i Island,
- Maui: Hui O Ka Wai Ola[26] and Surfrider Foundation[27]
- O‘ahu: Surfrider Foundation[28]
- Kauai: Surfrider Foundation[29]

Is your target community along the shoreline?

As explained earlier in Part II, shorelines along Hawai‘i’s coast tend to be porous because of the volcanic rock. Being situated on porous rock and adjacent to the shoreline means that groundwater containing wastewater or treated effluent will very likely make its way directly to the ocean without filtration. The unique geology and proximity to the shore means that it will not be an ideal location for even more advanced Individual Wastewater Systems like and ATUs.

If this is the case, your community will likely need to consider connecting to a Package Treatment Plant or a Centralized Wastewater Treatment System. To avoid nutrient pollution on coral reefs, facilities along the coastline should consider treating to the highest standard (e.g. R-1) and recycling effluent water away from the shoreline. Another consideration to note is that if your

[25] https://www.hawaiiwaiola.com/
[26] https://www.huiokawaiola.com
[27] https://maui.surfrider.org/
[28] https://oahu.surfrider.org/
[29] https://kauai.surfrider.org/

community is located along the shoreline, it will be in a Special Management Area (SMA)[21], which has strict regulations to avoid water pollution.

Is your target community not along the shoreline?

Even if your target community is not along a shoreline, you may still be on top of porous rock. A certified engineer can be hired to survey your property to identify the percolation rate within the soil. This will give you an understanding of how porous the ground is where you live, and help inform which technologies are suitable for your area, and the type and amount of permitted discharge.

What is the percolation rate of the soil near your target community?

As described earlier, leach fields provide the final treatment of wastewater from more advanced IWS like septic tanks and ATUs. Under ideal conditions, leach fields allow wastewater to undergo treatment as they pass through microbial soil that digests pathogens and absorbs nutrients. The size of the leach field required by DOH depends on the percolation rate of the soil. If the lot sizes in the target community are small, there may not be sufficient space for an adequately sized leach field. For an accurate percolation rate, an engineer can be hired to conduct a survey and determine the correct leach field size requirement.

Is there interest and capacity in the target community to mitigate the community's wastewater impact?

This can be a difficult question to answer. If a community is united around finding a solution, reaching a solution will be easier and more efficient. Regardless, undergoing a wastewater transition will likely require a collaboration of communities, governments and nonprofits working together.

Is it possible for your target community to connect to a nearby Centralized or Decentralized Wastewater System? If so, is the facility public or private?

If there is a Centralized or Decentralized Wastewater System near your community, you will need to contact the owner/users and investigate some details. You will want to consider the viability of having your community connect to this facility and determine if the treatment level and discharge method are appropriate for your needs.

If a municipal public system is available, there are mandates to connect to that system, which don't exist for private systems. All private systems are regulated by the Public Utility Commission (PUC). The PUC protects both the consumer (homeowner), as well as the provider. All changes, upgrades, and add-ons are overseen by the PUC, which means that the county cannot demand an upgrade to treatment, capacity or discharge method.

Are there golf courses, hotels and/or private wastewater treatment facilities near your target community?

If so, your community may be able to connect to this facility. You will want to ask the following questions to determine if their system is ideal for connection:

- How does the resort/property treat their wastewater? How many gallons/day are treated?
- Does their private wastewater treatment facility have the capacity to handle new connections from the community? Would they be willing to consider new connections?
- What are the current treatment level and discharge practices of the private treatment facility?
- Is there capability for reuse or purchase of R-1 effluent?
- Are there environmental impacts? If so, where are they originating from? (e.g. golf course? cesspools?)
- What is the hotel's water impact, and can it be modified?

Are homeowners in your target community worried about the legality of their cesspools?

Hawai'i state requires all cesspools to be replaced by 2050. In the meantime, although cesspools are actively contributing to water pollution, the EPA cannot fine homeowners for owning a permitted cesspool. The one exception is when it comes to "large capacity cesspools" that serve more than 20 people per day. These tend to be found in public facilities, restaurants, or hotels.

Technology Questions

Is your target community a good candidate for ATUs?

ATUs are permitted in Hawai'i, per the Department of Health (DOH) Guidelines for the Treatment and Use of Recycled Water[15], but several complex factors impact permitting and whether ATUs are appropriate for wastewater management, such as lot configurations, geology and local hydrologic conditions (e.g. shallow groundwater). For example, if a community has

porous rock, high groundwater and/or proximity to the ocean, ATUs will not be appropriate, as their effluent can still reach the ocean and harm marine life.

Is reuse of ATU effluent allowed in your target community?

Reuse of ATU effluent is allowed in some residential communities[15], but for the same reasons stated above, shoreline communities are not a good candidate for reuse of ATU effluent. Effluent reuse requirements can be found in the DOH Wastewater Hawai'i Administrative Rules 11-62.[30] For additional details, see the Onsite Wastewater Treatment Survey and Assessment.[12]

What potential options are out there for your target community that are superior to cesspools?

Conducting a comprehensive Preliminary Engineering Report (PER) - like the one conducted for the Puakō community[31] - can help identify the best alternatives for treatment. Options to consider include:

- Aerobic Treatment Units (ATUs)
- Connecting to an existing public or private Decentralized Wastewater Treatment System
- Constructing a Decentralized Wastewater Treatment System (e.g. Package Treatment Plant)
- Connecting to an existing public or private Centralized Wastewater Treatment System
- Constructing a new public or private Centralized Wastewater Treatment System

To determine which solution will deliver the best return on investment to the community, you will want to evaluate options against criteria established by a range of multi-sector stakeholders. These criteria may include timeline, permitting, treatment quality, shoreline impacts, initial costs (capital), and ongoing costs (operation and maintenance). A PER will be able to recommend the option with the best return on investment, based upon the weighted criteria.

The state government may be able to assist in conducting a PER; however, they will need to prioritize assessing communities that appear on their Prioritization list[1]. Note that the Cesspool Conversion Working Group may add communities to this list as more water quality data become available. If your community is not listed as a priority community, and you want to move forward with implementing a solution, privately hired, certified engineers can help conduct these types of studies.

[30] https://health.hawaii.gov/opppd/files/2015/06/11-62-Wastewater-Systems.pdf

[31] https://coral.org/wordpress/wp-content/uploads/2017/06/CWFR_Puako_PCACommunity_ExecutiveSummary_Rev051917.pdf

Is there already a plan to transition your target community away from cesspools to an improved wastewater system?

If so, consider partnering with university researchers or citizen science groups to conduct water quality testing before and after the cesspool transition. These data will be helpful to guide and refine the DOH's prioritization list, monitor the overall transition process, and create opportunities for other communities.

Are there malfunctioning Individual Wastewater Systems in the target community?

A malfunctioning septic tank or ATU can contaminate groundwater that might be a source of drinking water. In A Homeowners Guide Septic Systems[32], the EPA advises that "partially treated wastewater which comes into contact with groundwater can result in the pollution of wells, nearby streams, or other bodies of water. Seek immediate assistance from septic system professionals and the local health department if you suspect such a failure."

Are new technologies being developed that are cheaper and more effective than current ATUs and treatment facilities?

A number of organizations and companies are innovating new wastewater technology that may help transform wastewater management by improving treatment and/or reducing costs. One of the many challenges in the wastewater industry is that solutions have been developed with only human health risks in mind. While human health is of critical importance, unless nutrients are prevented from reaching groundwater and the shoreline, the dire risk to marine life health will remain. Additionally, before new technologies can be available in Hawai'i they will need to go through DOH's rigorous testing process.

Finance Questions

Can your target community spread costs over a larger user base?

Spreading capital costs across a larger user base (e.g., connecting nearby communities to your treatment facility) can decrease costs to all users in a private utility system. In public systems (Municipalities) the county Department of Environmental Management (DEM) and finance divisions set wastewater rates. Rates are structured and budgeted by the county.

[32] https://www3.epa.gov/npdes/pubs/homeowner_guide_long.pdf

Do grants exist to help communities with this transition?

There are a number of available grants to support the transition. Typically these are available for lower income communities. This topic will be covered in more detail at a later date, as part of our comprehensive **Clean Water Toolkit.**

How do communities pay for the cost of transitioning to an improved Individual Wastewater Systems?

If transitioning to an improved Individual Wastewater System, such as an ATU, homeowners will typically take full responsibility for both the initial (capital) costs and ongoing maintenance costs. That said, Act 120 established a temporary income tax credit of $10,000 in Hawai'i "for the cost of upgrading or converting a qualified cesspool to a septic tank system or an aerobic treatment unit system, or connecting to a sewer system." If you'd like to know if you qualify for this tax credit, you can consult the state of Hawai'i Department of Health Wastewater Branch website.[33]

How do communities pay for the cost of transitioning to a Centralized or Decentralized Wastewater Treatment System?

If transitioning to connecting to a new or existing Centralized Wastewater or Decentralized Treatment System, the finance mechanism will depend upon a number of factors, including who will own and operate the facility (please refer to Part III). Additionally, one of the goals of the Cesspool Conversion Working Group is to determine financing options for communities in transition. Therefore, more information about options for your community will become available in the future.

How are county-owned facilities funded?

Counties can fund improvement projects by establishing Chapter 12: Improvement Districts[34] and Chapter 32: Community Facilities Districts.[35] These are capital improvement frameworks that offer communities the opportunity to acquire necessary infrastructure upgrades, including new wastewater infrastructure. Under Hawai'i's Chapter 12, government bonds can be used to finance a Centralized Wastewater Treatment System. Under Chapter 12, homeowners within an established improvement district have rates levied on their properties. These funds can then be used to pay for capital and operations costs.

[33] https://health.hawaii.gov/wastewater/home/taxcredit/

[34] https://www.hawaiicounty.gov/home/showdocument?id=28

[35] https://www.hawaiicounty.gov/home/showdocument?id=74