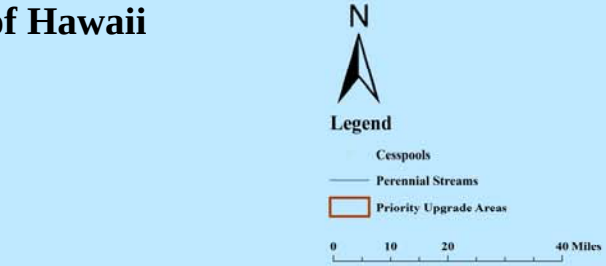
Cesspools and Priority Upgrade Areas in the State of Hawaii

Cesspools in the State of Hawaii

Hawai‘i has nearly 88,000 cesspools that put 53 million gallons of raw sewage into the State’s groundwater and surface waters every day. Cesspools are an antiquated technology for disposal of untreated sewage that have the potential to pollute groundwater which provides over 90% of the drinking water source for the State. Cesspools also present a risk of illness to island residents and a significant harm to streams and coastal resources, including coral reefs.

Island	Housing Units	Number of Cesspools	Cesspool Effluent Discharges (million gallons per day)
Hawai‘i	82,000	49,300	27.3
Kaua‘i	29,800	13,700	9.5
Maui	65,200	12,200	7.9
O‘ahu	336,900	11,300	7.5
Moloka‘i	3,700	1,400	0.8
Total		**87,900**	**53.0**



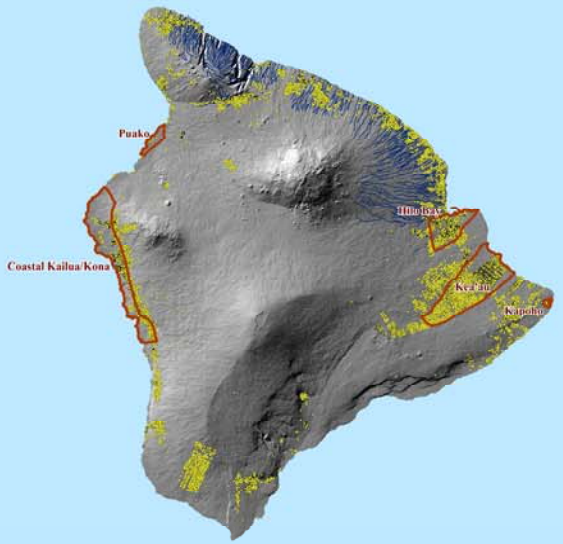
Prioritizing Cesspools for Upgrade or Closure

Two major considerations for prioritizing cesspools for corrective action are the risk the cesspools pose and existing infrastructure such as nearby sewer mains. This report’s prioritization relies upon an analysis 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 coastal waters that may compound the impacts of wastewater in bays and inlets. The DOH proposes that cesspool replacement efforts be focused by geographic area, and prioritized using the following broad categories:

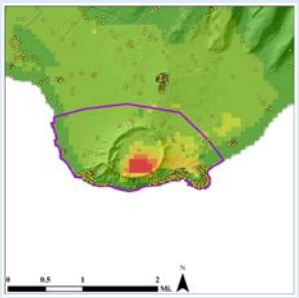
- ***Category 1: Significant Risk of Human Health Impacts, Drinking Water Impacts, or Draining to Sensitive Waters.*** Cesspools in these areas appear to contribute to documented impacts to drinking water or human health, and also appear to impact sensitive streams or coastal waters.
  - Action to address these cesspools represents a significant reduction in risk to public health, and should be achieved as soon as possible using any means available.
- ***Category 2: Potential to Impact Drinking Water***. Cesspools in these areas are within the area of influence of drinking water sources, and have a high potential to impact those sources.
  - DOH should act before 2020 so homeowners can utilize tax credits in upgrading eligible cesspools (sited within 500’ of waters).
  - Action to address these cesspools should be taken simultaneous to or following actions under Category 1.
- ***Category 3: Potential Impacts on Sensitive Waters.*** Cesspools in these areas cumulatively represent an impact to an area that includes sensitive State waters or coastal ecosystems (coral reefs, impaired waterways, waters with endangered species, or other vulnerabilities).
  - DOH should act before 2020 so homeowners can utilize tax credits in upgrading eligible cesspools (sited within 500’ of waters).
  - Action to address these cesspools should be taken simultaneous to or following actions under Category 2.
- ***Category 4: Impacts Not Identified.*** Comprehensive health and environmental risks has not yet been assessed, or the risk of affecting public or environmental health currently appears low.
  - Action to address these cesspools should be taken as possible (if homeowners independently initiate action or if a supporting agency has available funds to target a community or individual home).

Cesspool effluent poses significant threats to human health and sensitive ecosystems. Cesspool wastewater is untreated and contains pathogens, bacteria and viruses that may spread disease. Additionally, cesspool effluent contains nutrients, like nitrogen and phosphorous, that can disrupt the sensitive ecosystems of Hawai‘i, including harming nearshore coral reefs. Individual cesspools have the potential to impact the environment, and, where many are located in close proximity, the cumulative impact on the environment and human health increases.
The adverse impact from cesspools is cumulative, so the relative risk and priority attached to upgrading is identified by area rather than by identifying individual cesspools. Priorities given in this report are subject to change as additional information is incorporated into DOH analyses in the future. The following 13 areas are currently priorities:

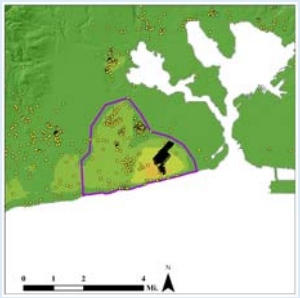
Name	Category	Area (Square Miles)	Cesspools (Quantity)	Effluent Discharge (million gallons per day)	Nitrogen Flux (kilograms per day)	Phosphorus Flux (kilograms per day)
Upcountry Area of Maui	1	72	7,400	4.4	980	280
Kahalu‘u Area of O‘ahu	1	8.4	740	0.44	110	30
Kea‘au Area of Hawai‘i Island	2	91	9,300	4.9	970	270
Kapaa/Wailua Area of Kaua‘i	2	36	2,900	2.2	430	120
Poipu/Koloa Area of Kaua‘i	2	27	3,600	2.6	550	150
Hilo Bay Area, Hawai‘i Island	3	31	8,700	5.6	1,300	340
Coastal Kailua/Kona Area, Hawai‘i Island	3	79	6,500	3.9	550	150
Puako Area of, Hawai‘i Island	3	0.6	150	0.09	17	4.9
Kapoho Area of, Hawai‘i Island	3	1.4	220	0.12	25	6.9
Hanalei Area of Kaua‘i	3	4.3	270	0.13	24	6.8
Diamond Head Area of O‘ahu	3	2.0	240	0.17	35	10
Ewa Area of O‘ahu	3	7.6	1,100	0.71	160	45
Waialua Area of O‘ahu	3	3.3	1,080	0.79	170	49
Waimanalo Area of O‘ahu	3	16.2	536	80.2	80	22



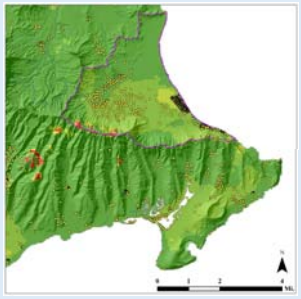
Cesspools Priority Upgrade Areas in the State of Hawaii



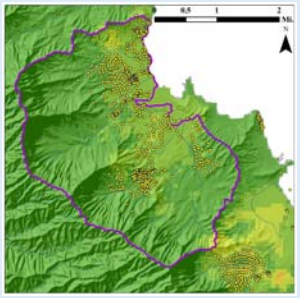
Diamond Head Area of O'ahu – This is an area where cesspools are installed in bare rock very near the shoreline. This is also an area that is frequented by swimmers and surfers, bringing the ocean users in direct contact with cesspool contaminated marine water. Research done by the University of Hawaii showed that the groundwater discharge to the ocean at this location was significantly elevated in nutrients relative to a similar location not affected by cesspools (Richardson et al., 2017). The cesspools in the Diamond Head area of O'ahu that are near existing sewer infrastructure, possibly facilitating cesspool closure by connecting to the municipal sewage collection system.



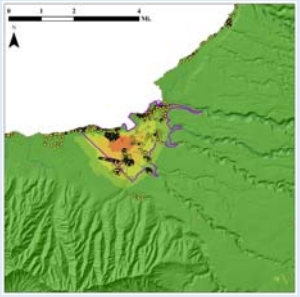
Ewa Area of O'ahu –Parts of the Ewa area of O'ahu still have an abundance of legacy cesspools that are near sewer infrastructure. This concentration of cesspools near the coast and existing sewer infrastructure make these parts of Ewa a priority area for cesspool replacement.



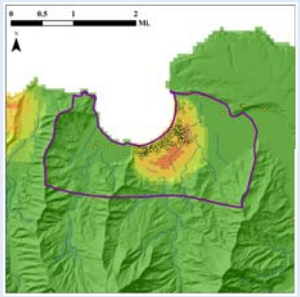
Waimanalo Area of O'ahu – The cluster of cesspools near the shoreline and proximity to existing infrastructure make Waimanalo a priority upgrade area. This is also an area with municipal wastewater injection and upslope agriculture. UH researchers confirmed chemical signatures in the coastal algae community that were consistent with wastewater discharge to the marine environment. The distribution of the wastewater chemical signature showed that cesspools in addition to wastewater injection were contributing the coastal contaminant load. These factors taken together make Waimanalo an attractive location for cesspools replacement.



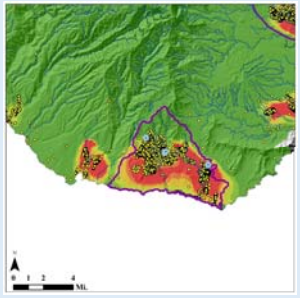
Kahalu'u Area of O'ahu – High bacteria counts in the surface water and incidents of skin infections consistent with sewage contaminated surface waters have been documented following contact with waters in this area. Many of these cesspools are located near perennial streams and are subject to overflow due to the wet climate and shallow depth to groundwater. All wastewater from these cesspools flows to the Kahalu'u Lagoon or to Kaneohe Bay as contaminated stream or groundwater discharge. The waters of the Kahalu'u Lagoon and Kaneohe Bay are sheltered, so there is less exchange with offshore water that could dilute, and thus reduce, the severity of the cesspool contamination. The high density cesspool areas are near existing sewer infrastructure that could be extended, possibly facilitating cesspool closure of nearly 70 percent of these cesspools by connecting to the municipal sewage collection system.



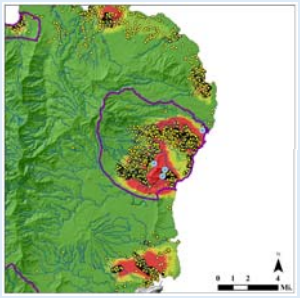
Waialua Area of O'ahu – The Kaiaka and Waialua Bays of north Oahu receive surface water and groundwater containing cesspool, wastewater injection, and agricultural contamination. The streams that flow into Kaiaka and Waialua Bays drain four major watersheds with a combined area of 79.8 square miles. Groundwater modeling indicates that nitrate concentration in groundwater resulting from cesspool and other OSDS leachate approaches the drinking water limit of 10 mg/L. While there are no drinking water sources on this Waialua priority upgrade area, this high nutrient groundwater discharges to the bays. Compounding the coastal pollution from cesspools are 14 wastewater injection wells, and agricultural nutrients where surface water mixed with treated wastewater is applied to the fields. Approximately 10 percent of the 1,080 cesspools in the Waialua area are located with 200 ft of the shoreline, increasing the health risk to swimmers and surfers.



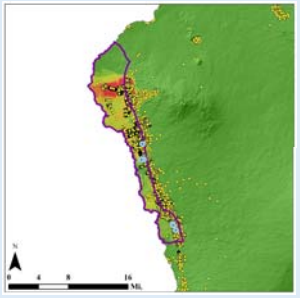
Hanalei Area of Kaua'i – This area has about 270 cesspools in close proximity to the shoreline or the Hanalei River, degrading surface and coastal water quality. The nutrient load from cesspools combined with that from agriculture can provide a significant nutrient load to the Hanalei Bay. Wastewater also reduces the coral's ability to resist disease. Recent occurrence of the Black Band Coral disease in Hanalei Bay (Aeby et al., 2007 and 2012) demonstrates the need to improve the quality of surface and groundwater flowing to Hanalei Bay.



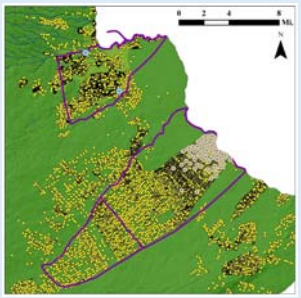
Poipu/Koloa Area of Kaua'i – Similar to the Kapaa/Wailua area, groundwater modeling indicates that OSDS contamination, predominantly from cesspools, has likely elevated the groundwater nitrate concentrations above drinking water limits. This high nitrate groundwater discharges at the coast, placing the coastal reefs at risk. The waters off of Poipu are on the leeward side of the island, reducing the rate at which coastal water turnover can dilute the contamination. The coastal wastewater contamination problem is compounded by injection of wastewater, which in combination with the OSDS/cesspool input results a significantly elevated contaminant load to the marine environment.



Kapaa/Wailua Area of Kaua'i – This watershed has a high cesspool density resulting in a significant cesspool contamination load to the groundwater and the perennial streams in this area. Groundwater modeling indicates that concentrations significantly greater than the Maximum Contaminant Limit (MCL) may be present in the drinking water aquifer. There are five public drinking water wells in this area that can potentially become contaminated by cesspool discharge. This is also an area where an elevated water table results in discharge of groundwater to important streams. The Kapaa and Moikeha Streams, and the Wailua River pass through this area's receiving groundwater that is contaminated by cesspool discharge.

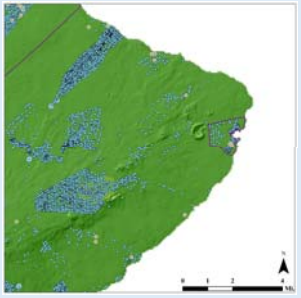


Coastal Kailua/Kona Area of Hawai'i Island – The groundwater in this area discharges to the economically important reefs of West Hawaii. Groundwater modeling indicates that nitrate concentrations in the aquifer from OSDS may exceed 10 mg/L, resulting in a significant nutrient contamination load to the coral reefs of west Hawai'i Island. Wastewater injection further increases the coastal wastewater contaminant load, likely resulting in degradation of coral reefs. A survey of reef health for the leeward coast of Hawaii (Couch et al., 2014) found steep coral declines in multiple locations. Many of the locations with coral decline correlate to high densities of OSDS or points of wastewater injection.

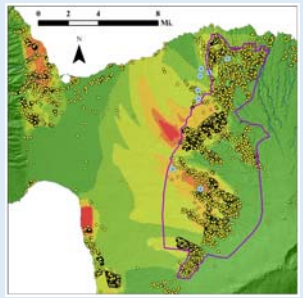


Kea'au Area of Hawai'i Island – About 17 percent of the cesspools in the State are located in 4.3-mile wide corridor along the groundwater flow path on east slope of the Kilauea Volcano. This area of the Puna District is not served by public water so many of the residents rely on privately owned wells for their domestic water needs. Additionally, there is little to no soil cover to mitigate the impact of cesspools or slow the drainage of cesspool effluent to the water table. A UH study found the infiltration travel time from the ground surface to the groundwater could be as short as a fraction of an hour (Novak, 1995). The high density of cesspools and short leachate infiltration time pose a significant health risk in an area where residents rely on domestic wells for drinking water. A DOH investigation found that 25 percent of domestic wells sampled in this area tested positive for wastewater indicator bacteria demonstrating the potential for disease transmission.

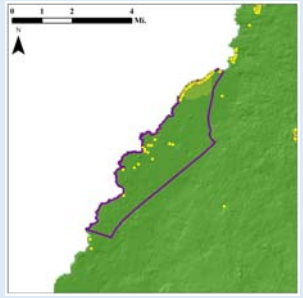
Hilo Bay Area of Hawai'i Island –Hilo Bay is on the windward side of Hawai'i Island resulting large flow of groundwater and surface water into the bay. The bay itself is sheltered from the oceanic waters by a breakwater, reducing the rate of water turnover in the bay. There are nearly 9,000 cesspools discharging to the streams and groundwater that flow into Hilo Bay. This results in a significant wastewater contaminant load to this sheltered body of water. Research by University of Hawai'i at Hilo (Wiegner et al., 2013) shows elevated nutrient and fecal indicator bacteria concentrations in Hilo Bay and in the rivers discharging to this bay.



Kapoho Area of Hawai'i Island – The Kapoho community is fronted by tide pools in the Wai'opae Marine Life Conservation District with only a limited connection to the ocean. This shielding from oceanic waves reduces the water turnover rate making the tides pools and the abundance of coral therein susceptible to degradation due to land based pollution. A study by the University of Hawaii at Hilo (Wiegner et al., 2016) estimated that sewage contributed about 27 percent of the nutrient load to the tide pools reducing the ability the ability of the coral to resist algae overgrowth.



Upcountry Area of Maui– Upcountry Maui – the Makawao, Pukalani, and Kula areas on the western flank of Haleakalā have more than 7,000 cesspools and measured groundwater nitrate concentrations as high as 8.7 mg/L, which is very close to the drinking water MCL of 10 mg/L. DOH conducted an investigation to determine the extent, magnitude and source the of the nitrate contamination in the area. Nearly all of the wells sampled had nitrate concentrations higher than what could be accounted from natural and agricultural sources. Of the 12 wells sampled, 25 percent had nitrate concentrations equal to or greater than 5 mg/L, half of the MCL. The wells sampled are located at the edge or upslope of the major agricultural zones, leaving OSDS as the only logical source of the elevated groundwater nitrate. A groundwater model of OSDS nitrate in the groundwater, validated by the well sampling, indicates it is likely that the MCL for nitrate is exceeded in parts of the drinking water aquifer of east-central Maui. The conclusion of the DOH investigation is that while nitrate in the groundwater captured by the current drinking water sources is significantly less than the MCL, parts of the aquifer are degraded enough by OSDS contamination that water from a well installed in these locations would require expensive treatment to meet drinking water standards.



Puako Area of Hawai'i Island – Puako is a small community in the north of Kailua-Kona. The residents of this community are reliant on OSDS for wastewater disposal. Community concern about the health of the reef and potential adverse impacts from wastewater disposal have prompted scientific and State Agency evaluation of coastal impact from current wastewater disposal practices. The Hawai'i Department of Land and Natural Resources, Division of Aquatic Resources found that the Puako reefs are in dire straits, with coral cover decreasing 35 percent and overgrowth of turf and macroalgae increasing 38 percent in the last 30 years. Research done by the University of Hawaii at Hilo found elevated concentrations of nutrients along the shoreline with chemical signatures consistent with sewage. A tracer dye study verified the hydraulic connection between OSDS and shore line with travel times varying from 13 to 250 feet per day (NOAA, 2017).