

SUBSURFACE AND SURFACE WASTE-DISPOSAL PRACTICE ON KAUAI

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Kauai has an area of 555 square miles (1,437 square kilometers) and is the fourth largest island in the State. The island, abounding in perennial streams, springs, and waterfalls, is lushly vegetated and is popularly known as the "Garden Isle". Its population in 1970 was about 29,500. Unlike most of the other islands, the population of Kauai is less concentrated, and is scattered throughout the island in the communities of Hanalei, Kapaa, Lihue, Koloa, Hanalei, and Waimea. Sugarcane is the main agricultural crop and occupies much of the southeastern and southwestern parts of the island. The growing of sugarcane in the northeastern part of the island was terminated in 1971 and these lands are being used for the growing of sorghum and seed corn, or for grazing. Some pineapple is grown but its cultivation has decreased markedly in recent years. The recent upsurge in population, economic growth, and activity is tied to the rapidly increasing tourist industry.

A description of the geology and ground-water resources of Kauai is included in a report by Macdonald, Davis, and Cox (1960). The island is one of the oldest and its geologic structure is the most complicated of the Hawaiian Islands. It is a large highly-dissected shield volcano. Toward the end of the mountain-building phase, the summit collapsed to form a huge caldera 12 miles (19 kilometers) across in the central part of the shield. Lava, which erupted in the caldera, were ponded, and cooled slowly to form massive dense flows in contrast to the thin-bedded flows of the areas outside the caldera. A smaller caldera was formed simultaneously by collapse around a minor eruptive center in the southeastern part of the shield. Lava also ponded in this caldera. Near the end of the caldera-filling phase, a large graben was formed by the collapse of the southwestern part of the main caldera. Lava erupting in the main caldera spilled out and poured into the graben. The eastern flank of the shield collapsed at about the time the main volcano became extinct, or shortly afterward. The semicircular graben, thus formed in the eastern flank, is deeply buried under post-erosional flows and not easily recognized. A long period of volcanic quiescence and erosion followed, during which time high sea cliffs and deep canyons were formed. After the period of quiescence, post-erosional lava eruptions filled much of the deeply eroded canyons in the eastern half of the island. These later flows are dense and massive, especially where they were ponded in depressions and deep canyons.

Owing to the wide range in permeability from one volcanic formation to another, and even within the same formation, the ground-water hydrology and the geology are the most complicated in the Hawaiian Islands.

There are at least 19 subsurface waste-disposal sites in areas not serviced by sewers. At four of these sites, untreated sewage is disposed of in multiple cesspools. At some others, effluent from small private aerobic treatment plants is injected into the subsurface. At five other disposal sites, treated sewage effluent is discharged to sugarcane irrigation ditches. At the large resort complex near Hanalei, some treated sewage is used for the irrigation of a 27-hole golf course. Wastes from sugar mills are ponded in five locations and used for irrigation and landfill. These sites and other surface-disposal sites, including solid-waste dumps, are shown on the simplified geologic map (fig. 1, sheet 5). Subsurface waste-disposal sites are shown on the same figure.

The geohydrologic cross section, A-A', (fig. 2, sheet 5) is drawn across the buried semicircular graben on the eastern flank of the volcano near Lihue. Massive post-erosional lava flows make up most of the surface outcrops. Owing to the heterogeneous nature of the graben-filling lava flows and the beds of breccia and conglomerate intercalated in them, overall permeability of this formation is generally low. Water levels are generally high and well above sea level, and where water bodies are perched on even less permeable rocks, the water levels differ greatly from place to place. Except for remnant ridges surrounded by post-erosional flows, outcrops of earlier formed thin-bedded basalts are absent in the eastern half of the island. Ground water in the basalts is generally confined, owing to the overburden of post-erosional lavas or sediments of low permeability. Outcrops of sediments are limited in the eastern half of the island, where outcrops of post-erosional lava flows largely compose the present shoreline. In contrast, coastal-plain sedimentary deposits are extensive in the western part, where post-erosional flows are absent.

The second map (fig. 3, sheet 5) shows the areas severed, inhabited areas not severed but serviced by cesspools, and areas in sugarcane cultivation. The areas severed in 1972 and those proposed to be severed by 1980 are shown on figure 4, sheet 5. The data on figure 5 are taken from the County of Kauai General Plans prepared in 1963 by Samp, Low, Tom, and Hara, Inc. The general plans, however, for water, sewerage, and drainage on Kauai are being revised by Samp, Low, Tom, and Hara, Inc. and are scheduled for completion in 1974. Waste-disposal sites which were pending in 1972 are also shown on figure 4.

Photographs of the Eagle County sewage treatment plant and Inhoff tank for the Kauaiki sewer system are shown in figures 5 and 6, respectively. The effluent from the Eagle County plant is used for golf course irrigation and that from the Kauaiki system is used for sugarcane irrigation.

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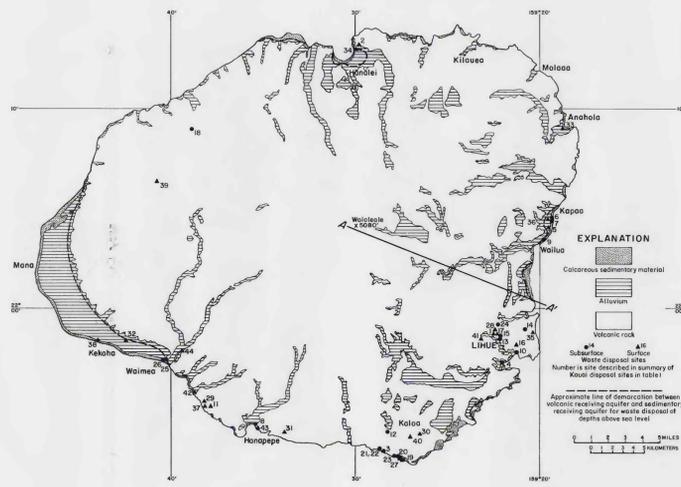


FIGURE 1. MAP OF KAUAI SHOWING GENERALIZED GEOLOGY, WASTE-DISPOSAL SITES, AND PRINCIPAL WASTE-RECEIVING AQUIFERS.

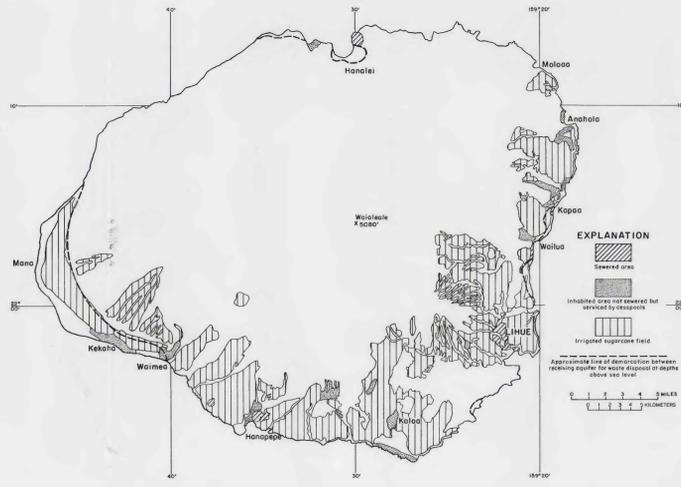


FIGURE 3. MAP OF KAUAI SHOWING SEWERED AREAS, INHABITED AREAS NOT SEWERED, AND SUGARCANE FIELDS.

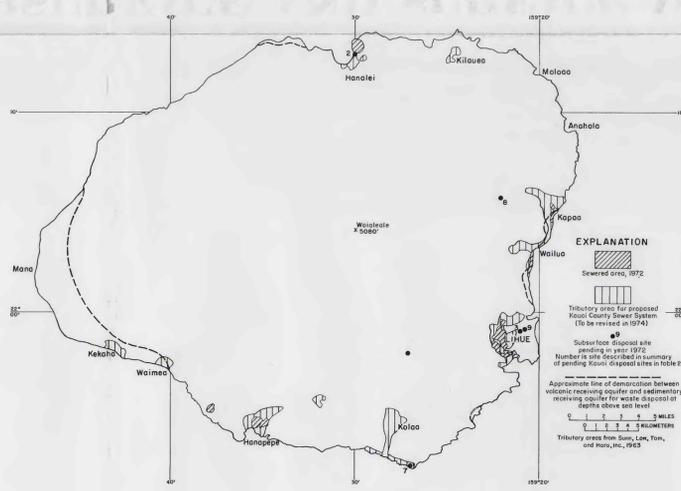


FIGURE 4. MAP OF KAUAI SHOWING SEWERED AREAS IN 1972, PENDING WASTE-DISPOSAL SITES, AND TRIBUTARY AREAS TO SEWER SYSTEM PROPOSED FOR YEAR 1980.

SITE	NAME	NATURE OF WASTE	TREATMENT	DISPOSAL	GROUND-WATER RESOURCES AFFECTED	REMARKS
1	Amfac Communities c/	Sewage	Secondary	Irrigation ditch	Fresh water-table zone in lava flows	
2	Eagle County Development d/	do	do	Golf course irrigation	do	
3	Ilele Nani of Kauai c/	do	do	Sewage pits	Breackish water-table zone in lava flows	Flow 200,000 gpd
4	Ilele Waialeale Hotel c/	do	do	do	Breackish water-table zone in sediments	
5	Hawaii Housing Authority, Kapaa c/	do	do	Leaching field, drying	Fresh to breackish water-table zone in sediments	Overflow to ocean outfall
6	Kapaa Elderly Housing c/	do	None	Cesspools	Breackish water-table zone in sediments	Overflow to ocean outfall
7	Kapaa High School and Hospital c/	do	do	do	do	Overflow to ocean outfall
8	Kauai Electric, Port Allen c/	do	Aerobic, cavittate d/	do	Breackish water-table zone in lava flows	Flow 400 gpd
9	Kauai Sea Apartments c/	do	Secondary	Sewage pits	Breackish water-table zone in sediments	Flow 18,000 gpd
10	Kauai Surf c/	do	do	Irrigation ditch	Breackish water-table zone in lava flows	Flow 100,000 gpd
11	Kauaiki Sewer System d/	do	Inhoff tank	Mill waste ditch	Fresh water-table zone in lava flows	
12	Koloa Gardens c/	do	Secondary	Sewage pit	do	
13	S. H. Kress c/	do	Aerobic, cavittate	do	do	
14	Lihue Airport c/	do	do	do	do	
15	Lihue Health Center c/	do	do	do	do	
16	Lihue Sewage Treatment Plant g/	do	Secondary	Irrigation ditch	do	Flow 500,000 gpd
17	Lihue Shopping Center c/	do	do	do	do	Flow 17,000 gpd
18	150th Aircraft Control Warning b/	do	None	Cesspools	Purched ground water in lava flows	Flow 5,000 gpd
19	Plantation Gardens c/	do	Secondary	Sewage pit	Breackish water-table zone in sediments	
20	Poipu Beach Hotel c/	do	Aerobic, cavittate	Sewage pit	Breackish water-table zone in lava flows	Flow 16,000 gpd
21	Prince Kuhio Apartments c/	do	do	Sewage pits	do	
22	Prince Kuhio Hotel c/	do	Secondary	Sewage pits	Breackish water-table zone in sediments	Flow 60,000 gpd
23	Shorekai-Kauai Hotel c/	do	do	do	do	
24	Tip Top Restaurant c/	do	Aerobic, cavittate	do	Fresh water-table zone in lava flows	
25	Waimea High School and Dispensary c/	do	None	Cesspools	Fresh water-table zone in sediments	Overflow to ocean outfall
26	Waimea Elderly Housing g/	do	Aerobic, cavittate	Sewage pits	Breackish water-table zone in sediments	Overflow to lagoon
27	Weihai Hotel c/	do	do	do	do	
SUGARCANE MILL WASTES d/						
28	Lihue Plantation Mill	Cane wash water	Ponding	Irrigation, land fill	Fresh water-table zone in lava flows	
29	Oleakala Sugar Mill	Cane wash water, sewage	do	do	do	
30	Grove Farm Sugar Mill	Cane wash water	do	do	do	
31	McBryde Sugar Mill	do	do	do	do	
32	Kekaha Sugar Mill	Cane wash water, sewage, piggy waste	do	do	Fresh water-table zone in sediments	
SOLID-WASTE DUMPS e/						
33	Anaehou Bay	Leachate from solid-waste dumps	None, burning	Onsite fill	Fresh to breackish water-table zone in sediments	Domestic waste
34	Hanalei	do	do	do	do	do
35	Hanalei	do	do	do	do	do
36	Kapaa	do	do	do	do	do
37	Kauaiki	do	do	do	do	do
38	Kekaha	do	do	do	do	do
39	Koloa	do	do	do	do	do
40	Koloa	do	do	do	do	do
41	Lihue	do	do	do	do	do
42	Waimea	do	do	do	do	do
43	Fort Allen	do	do	do	do	do
44	Waimea	do	do	do	do	do

d/ Small modular aerobic sewage-treatment unit developed by Hanna Enterprises in Hawaii.

b/ - e/ Sources of information: b/ U. S. Geological Survey; c/ State Department of Health; d/ owner; e/ Kauai County.

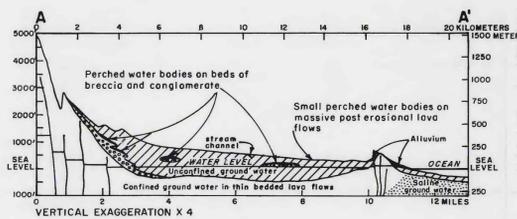


FIGURE 2. GEOHYDROLOGIC SECTION THROUGH BURIED GRABEN NEAR LIHUE (AFTER MACDONALD AND OTHERS, 1960).



FIGURE 5. PHOTOGRAPH OF SITE 2, EAGLE COUNTY SEWAGE-TREATMENT PLANT



FIGURE 6. PHOTOGRAPH OF SITE 11, INHOFF TANK FOR KAUKAIKI SEWER SYSTEM

SITE	NAME	NATURE OF WASTE	TREATMENT	DISPOSAL	GROUND-WATER RESOURCES AFFECTED	REMARKS
1	Community College site c/	Sewage	Aerobic plant recommended		Fresh water-table zone in lava flows	
2	Hanalei Bay Condominium c/	do	Aerobic, cavittate d/	Injection wells	Breackish water-table zone in sediments	Flow 4,000 gpd
3	Hanalei Subdivision c/	do	Aerobic plant recommended	Interim cesspools	Fresh water-table zone in lava flows	Cesspools not approved Location not known
4	Hanalei Elderly Housing (CHSP) c/	do	None	Interim cesspools	do	do
5	Kekaha Gardens Subdivision c/	do	do	do	do	do
6	Poipu Palms c/	do	Aerobic plant, chlorinated	Sewage pits	Breackish water-table zone in lava flows	Sewers recommended
7	Poipu Terrace c/	do	do	do	Fresh water-table zone in lava flows	do
8	Sokei Subdivision c/	do	do	do	do	do
9	Wiliko Homes c/	do	None	Interim cesspools	do	do
10	Leonard Zolopary c/	do	None	Cesspools	do	Location not known

d/ Small modular aerobic sewage-treatment unit developed by Hanna Enterprises in Hawaii.

c/ Source of information: State Department of Health.

HYDROLOGIC CONDITIONS RELATED TO SUBSURFACE AND SURFACE DISPOSAL OF WASTES IN HAWAII