SUBSURFACE AND SURFACE WASTE-DISPOSAL PRACTICE ON ISLAND OF HAWAII

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The island of Hawaii, the largest in the State, has an area of 4,030 square miles (10,044 square kilometers) or more than 60 percent of the total area of 6,435 square miles (16,667 square kilometers) in the Hawaiian Islands. Population in 1970 was about 63,500, of which 42 percent or 26,400 was that of the city of Hilo. Sugar and ranching are the main industries, with macadamia nut and flower cultivation rapidly growing in importance. The growing of coffee has been steadily declining. Future economic growth of the island, as in the rest of the Hawaiian Islands, is probably tied to the rapidly-increasing tourist industry.

The geology and ground-water resources of the island were discussed in some detail by Stearns and Macdonald (1946). The island was built by lavas from five volcanoes, namely, Mauna Kea, Mauna Loa, Hualalai, Kohala, and Kilauea. The lavas of Mauna Loa interfinger with the lavas of Kilauea, Hualalai, and Mauna Kea. The lavas of Mauna Kea interfinger with the latest lavas of the Kohala volcano. There have been no eruptions of the Kohala and Mauna Kea volcanoes during historic time. Hualalai last erupted in 1801, and Mauna Loa in 1950. Kilauea is presently active. The bulk of each volcanic dome is composed largely of permeable thin-bedded basaltic lava flows. A veneer of andesite lavas covers much of Mauna Kea, and one of andesite and trachyte flows covers part of the Kohala Mountain. Volcanic-ash deposits, several feet thick in places, crop out in about 450 square miles (1,166 square kilometers) of the northern, northeastern, and southeastern parts of the island. Most of the ash, however, has been buried by later lava flows. The buried ash deposits, intercalated in permeable lava flows, act as perching members for important high-altitude perched-water bodies in much of the northeastern and southeastern parts of the island.

The absence of perennial streams indicates the highly pervious nature of the surface rocks. Some streams flow perennially in their wet upper reaches but lose their water to the rocks well before reaching the sea.

There is little evidence of extensive coastal-plain sedimentation and of deep erosion except on the northeastern slopes of Kohala Mountain and Mauna Kea. Sedimentary materials, as a result, are sparse and scattered. They include alluvium, talus, dune and beach deposits, and glacial deposits on Mauna Kea. A geologic map of the island was not prepared because the bulk of the rocks is volcanic.

Waste is injected into the subsurface in at least 22 sites. Except for three sites in the Hilo area, all are along the west coast, where they are utilized for the disposal of sewage. Solid and liquid wastes from sugarcane mills are disposed of on the surface in four locations. In addition, there are at least 13 solid-waste dumps. The subsurface and surface disposal sites are shown on figure 1, sheet 4. Owing to the limited volume of sedimentary material, the volcanic aquifer receives most of the waste. Owing also to the highly pervious nature of the surface rocks, wastes injected into the subsurface and the leachate from wastes on the surface would percolate quickly to underlying water bodies. The lines of equal chloride content of ground water in volcanic rock are drawn wherever data permit.

The occurrence of ground water on the island is typified in the cross section drawn through the Hualalai and Mauna Loa volcanic domes (fig. 2, sheet 4). Sites 14 and 18 in the northwest and site 24 in the south are near the coasts across which the cross section is drawn.

The sewered areas, inhabited areas not sewered but serviced by cesspools, and areas in sugarcane cultivation are shown on figure 3, sheet 4. The third map (fig. 4, sheet 4) shows the areas sewered in 1972 and the tributary areas for the sewer facilities proposed for the year 1990. The data on figure 4 are extracted from a consultant's report prepared in 1970 by Sunn, Low, Tom, and Hara, Inc. Also shown on figure 4 and listed in table 2 are the waste-disposal sites that were pending in 1972.

The injection well for heated water at the Hilo Electric Co. is shown in figure 5. A photograph of site 21, the Keauhou sewage treatment plant, is shown in figure 6.

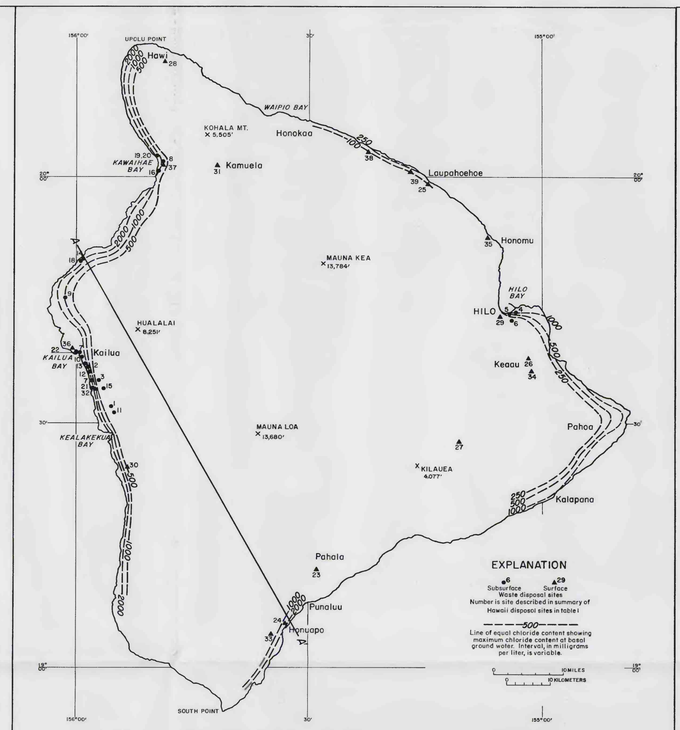

FIGURE 1. MAP OF ISLAND OF HAWAII SHOWING WASTE-DISPOSAL SITES AND CHLORIDE CONTENT OF GROUND WATER IN VOLCANIC BEDROCK.

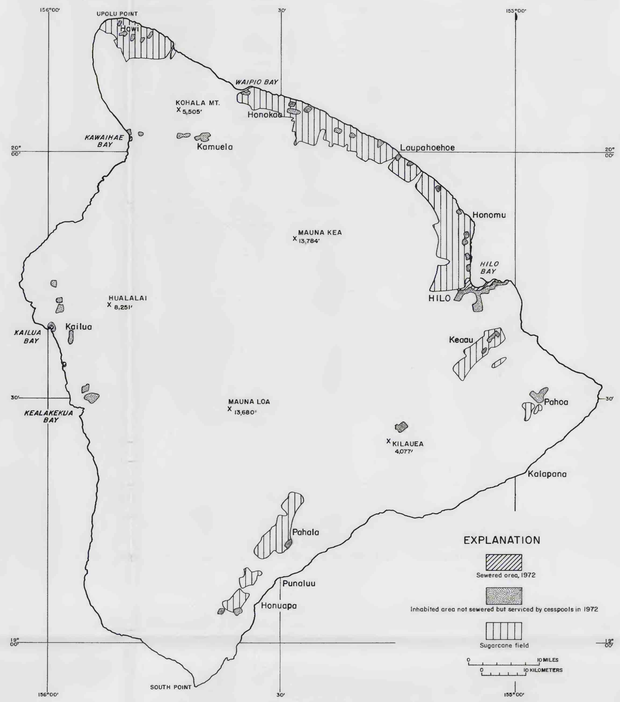

FIGURE 3. MAP OF ISLAND OF HAWAII SHOWING SEWERED AREAS, INHABITED AREAS NOT SEWERED, AND SUGARCANE FIELDS.

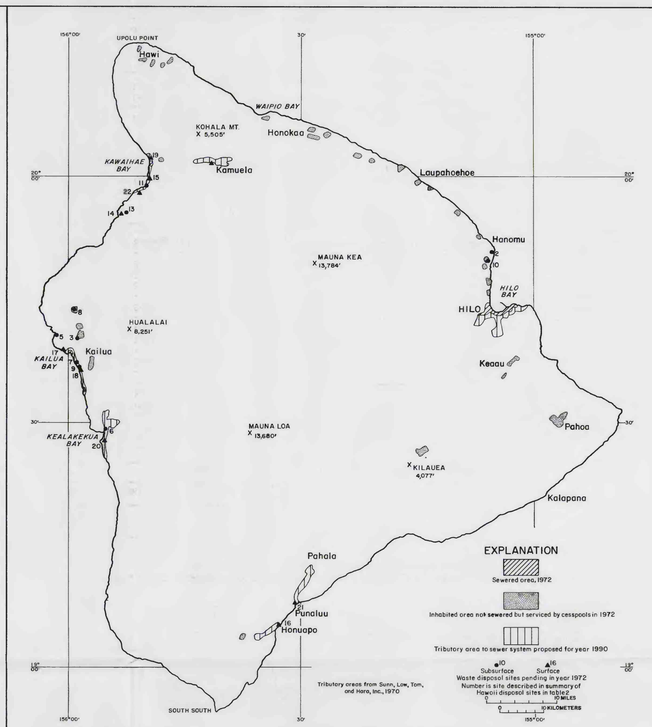

FIGURE 4. MAP OF ISLAND OF HAWAII SHOWING SEWERED AREAS IN 1972, PENDING WASTE-DISPOSAL SITES, AND TRIBUTARY AREAS TO SEWER SYSTEM PROPOSED FOR YEAR 1990.

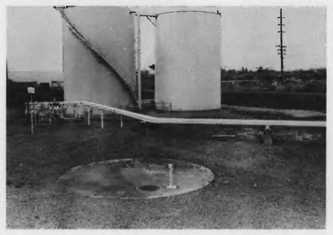

FIGURE 5. PHOTOGRAPH OF SITE 6, INJECTION WELL FOR HEATED WATER AT HILO ELECTRIC CO.

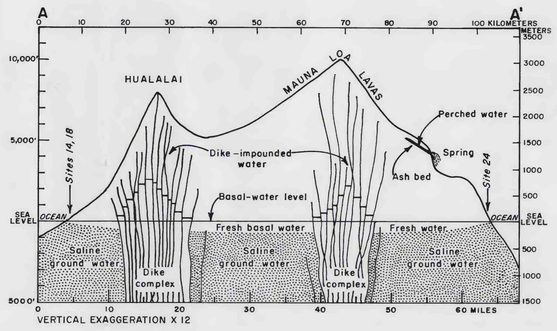

FIGURE 2. GEOHYDROLOGIC SECTION THROUGH HUALALAI AND MAUNA LOA LAVAS NEAR DISPOSAL SITES 14, 18, AND 24 (AFTER STEARNS AND MACDONALD, 1946).

FIGURE 6. PHOTOGRAPH OF SITE 21, KEAUHOU SEWAGE-TREATMENT PLANT

TABLE 1. SUBSURFACE AND SURFACE WASTE DISPOSAL ON ISLAND OF HAWAII AS OF DECEMBER 1972

SITE	NAME	NATURE OF WASTE	TREATMENT	DISPOSAL	GROUND-WATER RESOURCES AFFECTED	REMARKS
1	David Basque c/	Sewage	Septic tank	Seepage pit	Basal ground water in lava flows	Flow 3,000 gpd
2	Casa De Endeko c/	do	Aerobic plant, chlorinated	----do----	----do----	Flow 24,000 gpd
3	Glen Development c/	do	do	Subsurface	----do----	Flow 3,000 gpd
4	Hilo Airport c/	do	Aerobic, cavittete a/	Cesspool	----do----	Flow 3,000 gpd
5	Hilo Electric (Makai plant) b/	Clean-out water	None	Seepage pit	----do----	----------
6	Hilo Electric (Mauka plant) b/	Thermal water	None	----do----	----do----	----------
7	Kahalau Apartments c/	Sewage	Aerobic, cavittete	----do----	Injection wells	Flow 10,000 gpd
8	Kawaihae Village c/	do	----------	----------	----do----	----------
9	Keahole Airport c/	do	Aerobic plant	----do----	----do----	----------
10	Kona Alii Condominium c/	do	----------	Subsurface	----do----	Flow 15,000 gpd
11	Kona Hospital c/	do	Aerobic, cavittete	Cesspool	----do----	----------
12	Kona Magic Sands Condominium c/	do	do	----------	----do----	----------
13	Kona Shores Apartments c/	do	Aerobic plant	Seepage pits	----do----	Flow 7,000 gpd
14	Kona Village Hotel c/	do	Aerobic, cavittete	----do----	----do----	Flow 10,000 gpd
15	Mauka Arms Apartment c/	do	Aerobic plant	Subsurface	----do----	Flow 4,000 gpd
16	Mauna Kea Beach Hotel d/	do	do	Injection well	----do----	----------
17	Pacific Empress Hotel c/	do	Aerobic, cavittete	Seepage pit	----do----	Flow 18,000 gpd
18	Signal Oil (Kaupulehu) c/	do	do	----------	----do----	Flow 4,000 gpd
19	Standard Oil Depot c/	do	do	Seepage pit	----do----	----------
20	Ultramar Chemical Co. c/	do	do	----do----	----do----	----------
	SEWAGE-TREATMENT PLANTS e/					
21	Keauhou	Sewage	Secondary	Injection well	Basal ground water in lava flows	----------
22	Kailua-Kona	do	do	Holding ponds, wells	----do----	Flow 300,000 gpd
	SUGARCANE MILL WASTES d/					
23	Hawaiian Agriculture Co.	Cane-wash water, bagasse	None	Land fill, flooding	Dike-impounded ground water in lava flows	----------
24	Hutchinson Sugar Co.	do	None	----do----	Basal ground water in lava flows	----------
25	Laupahoehoe Sugar Co.	Bagasse	Burning	Land fill	Perched and basal ground water in lava flows	----------
26	Puna Sugar	Cane-wash water, bagasse	None	Land fill, flooding	Basal ground water in lava flows	----------
	SOLID-WASTE DUMPS c/					
27	Glenwood	Leachate from solid waste dump	None, burning	Onsite fill	Basal ground water in lava flows	Domestic waste
28	Hawi	do	do	-----do----	----do----	------Do------
29	Hilo	do	do	-----do----	----do----	------Do------
30	Hookena	do	do	-----do----	----do----	------Do------
31	Kamuela	do	do	-----do----	Dike-impounded water in lava flows	------Do------
32	Keauhou	do	do	-----do----	Basal ground water in lava flows	------Do------
33	Naalehu	do	do	-----do----	----do----	------Do------
34	Olas	do	do	-----do----	----do----	------Do------
35	Honomu	do	do	-----do----	Perched and basal water in lava flows	------Do------
36	Kailua	do	do	-----do----	Basal ground water in lava flows	------Do------
37	Kawaihae	do	do	-----do----	----do----	------Do------
38	Pauulo	do	do	-----do----	Perched and basal water in lava flows	------Do------
39	Ookala	do	do	-----do----	----do----	------Do------

a/ 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/ Hawaii County.

TABLE 2. PENDING SUBSURFACE AND SURFACE WASTE DISPOSAL ON ISLAND OF HAWAII AS OF DECEMBER 1972

SITE	NAME	NATURE OF WASTE	TREATMENT	DISPOSAL	GROUND-WATER RESOURCES AFFECTED	REMARKS
1	Captain Cook Village c/	Sewage	Aerobic plant	----------	Basal ground water in lava flows	Kona, location not available
2	Furferal Plant d/	Thermal water	None	Injection wells	Perched and basal water in lava flows	----------
3	Harbor View PUD c/	Sewage	Aerobic plant	----------	Basal ground water in lava flows	----------
4	Hilo Country Club Estates c/	do	----------	Injection wells	----do----	South Hilo, location not available
5	Honokahau Boat Harbor c/	do	Aerobic, chlorinated	Cesspool	----do----	----------
6	Kealakekua Shopping Center, Village c/	do	Aerobic plant	----------	----do----	Cesspools not approved
7	Kilohana Unit 1-A c/	do	None	Cesspools, temporary	----do----	Approximate location
8	Kona Palisades Estate c/	do	----	----------	----do----	Flow 4,000 gpd
9	Kona Rigger Condominium c/	do	----	----------	----do----	----------
10	Kulaimana Subdivision c/	do	----	----------	Perched and basal water in lava flows	----------
11	Punako Bay Development c/	do	----	----------	Basal ground water in lava flows	Cesspools not approved
12	Queen Liliuokalani Village c/	do	----	----------	----do----	Kailua, location not available
13	Waikoloa Village c/	do	Aerobic plant and septic tanks	----------	----do----	----------
	SEWAGE-TREATMENT PLANTS f/					
14	Boise Cascade	Sewage	Secondary	Irrigation, wells	Basal ground water in lava flows	250,000 gpd plant
15	Hapuna Bay	do	do	----do----	----do----	----------
16	Honuapo	do	do	----do----	----do----	600,000 gpd plant
17	Kailua-Kona (new)	do	do	----do----	----do----	1.5 mgd plant
18	Kamoe Point	do	do	----do----	----do----	800,000 gpd plant
19	Kawaihae	do	do	----do----	----do----	750,000 gpd plant
20	Kealakekua	do	do	----do----	----do----	1.2 mgd plant
21	Punaluu	do	do	----do----	----do----	800,000 gpd plant
22	Signal Oil	do	do	----do----	----do----	500,000 gpd plant
23	Waimea	do	Stabilization pond	Irrigation	Dike-impounded water in lava flows	750,000 gpd plant

c/, d/, f/ Sources of information: c/ State Department of Health; d/ owner; f/ Sunn, Low, Tom, and Hara, Inc., 1970.

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

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