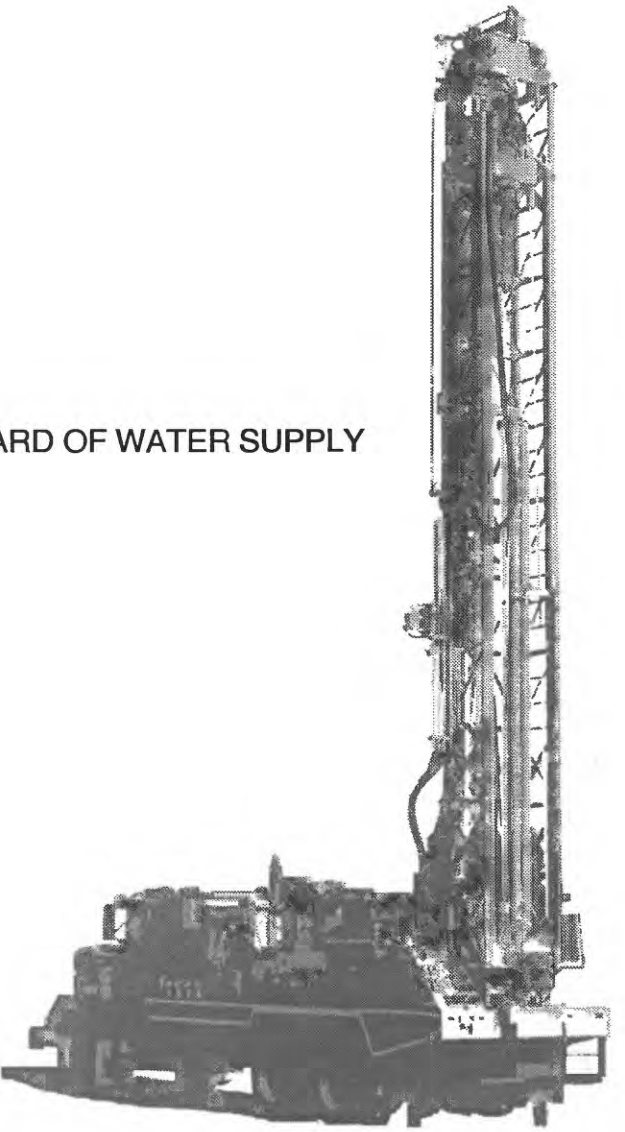
DRILLING, CONSTRUCTION, AND CALIPER-LOG DATA FOR WELL 3-3505-26, OPAEULA EXPLORATORY WELL, OAHU, HAWAII

U.S. GEOLOGICAL SURVEY

Open-File Report 96-429



Prepared in cooperation with the

CITY AND COUNTY OF HONOLULU BOARD OF WATER SUPPLY

U.S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
Gordon P. Eaton, Director

For sale by the
U.S. Geological Survey
Branch of Information Services
Box 25286
Denver, CO 80225-0286

For additional information write to:
District Chief
U.S. Geological Survey
677 Ala Moana Blvd., Suite 415
Honolulu, HI 96813

CONTENTS

FIGURES

TABLES

Conversion Factors

Multiply	By	To obtain
foot (ft)	0.3048	meter
mile (mi)	1.609	kilometer
inch (in.)	25.4	millimeter

Elevations in this report are referenced relative to mean sea level.

Drilling, Construction, and Caliper-Log Data for Well 3-3505-26, Opaeula Exploratory Well, Oahu, Hawaii

By Todd K. Presley and Delwyn S. Oki

Abstract

The Opaeula exploratory well (State well number 3-3505-26) was drilled about 1.2 miles east-southeast of the town of Haleiwa. The well is located on agricultural land in the Waialua ground-water area. The well was drilled at an elevation of about 287 feet above mean sea level and penetrates about 75 feet into a basalt aquifer. Well-construction data, logs of drilling notes, geologic descriptions for the samples, and caliper-log data are presented for the well. The well is one of 12 exploratory wells drilled in the north-central Oahu area between July 1993 and May 1994 in cooperation with the Honolulu Board of Water Supply.

INTRODUCTION

Because of water-supply concerns associated with population increase on the island of Oahu, the Honolulu Board of Water Supply, in cooperation with the U.S. Geological Survey (USGS), conducted a study to assess the availability of ground water in north-central Oahu. This study included drilling 12 exploratory and monitoring wells between July 1993 and May 1994.

This report presents drilling data for the Opaeula exploratory well (State well number 3-3505-26). The well is located about 1.4 miles northeast of Weed Circle and about 1.2 miles east-southeast of the town of Haleiwa (figs. 1 and 2). The purpose of the Opaeula exploratory well is to increase spatial coverage of water-levels in the Waialua ground-water area (Rosenau and others, 1971; Dale, 1978; Hunt, in press) and to provide a water-level observation well for monitoring.

Regional Setting

The study area is located in north-central Oahu between the crests of the Koolau Range and the Waianae Range (fig. 1). Previous studies (Rosenau and others, 1971; Dale, 1978; Hunt, in press) that describe the physical and geological aspects of the study area are summarized here. The mountain ranges are the eroded remnants of two shield volcanoes. The Mokuleia and Waialua ground-water areas are separated by low-permeability paleosols and saprolite of the Waianae Volcano that lie below the geologic contact between the Waianae and Koolau Volcanoes. The Waialua and Kawailoa ground-water areas are separated by alluvium and weathered basalt in and beneath Anahulu Gulch. Seaward flow of ground water in the Mokuleia and Waialua ground-water areas is impeded by a coastal confining unit that is composed of marine and terrestrial sediment known locally as "caprock." The caprock creates a confined artesian condition at low elevations near the shore. Further inland however, the aquifer is unconfined.

Water levels in the Waialua and Kawailoa ground-water areas are about 12 ft and 4 ft above mean sea level, respectively. Water levels in the Mokuleia ground-water area are about 20 ft. Withdrawal from the Waialua, Kawailoa and Mokuleia ground-water areas is primarily for sugarcane irrigation, although there are also several municipal wells and numerous small capacity private wells. Natural ground-water discharge occurs at springs and by subsurface flow through the caprock to the ocean (Rosenau and others, 1971).

Acknowledgments

The USGS gratefully acknowledges the Waialua Sugar Company for their assistance in identifying and

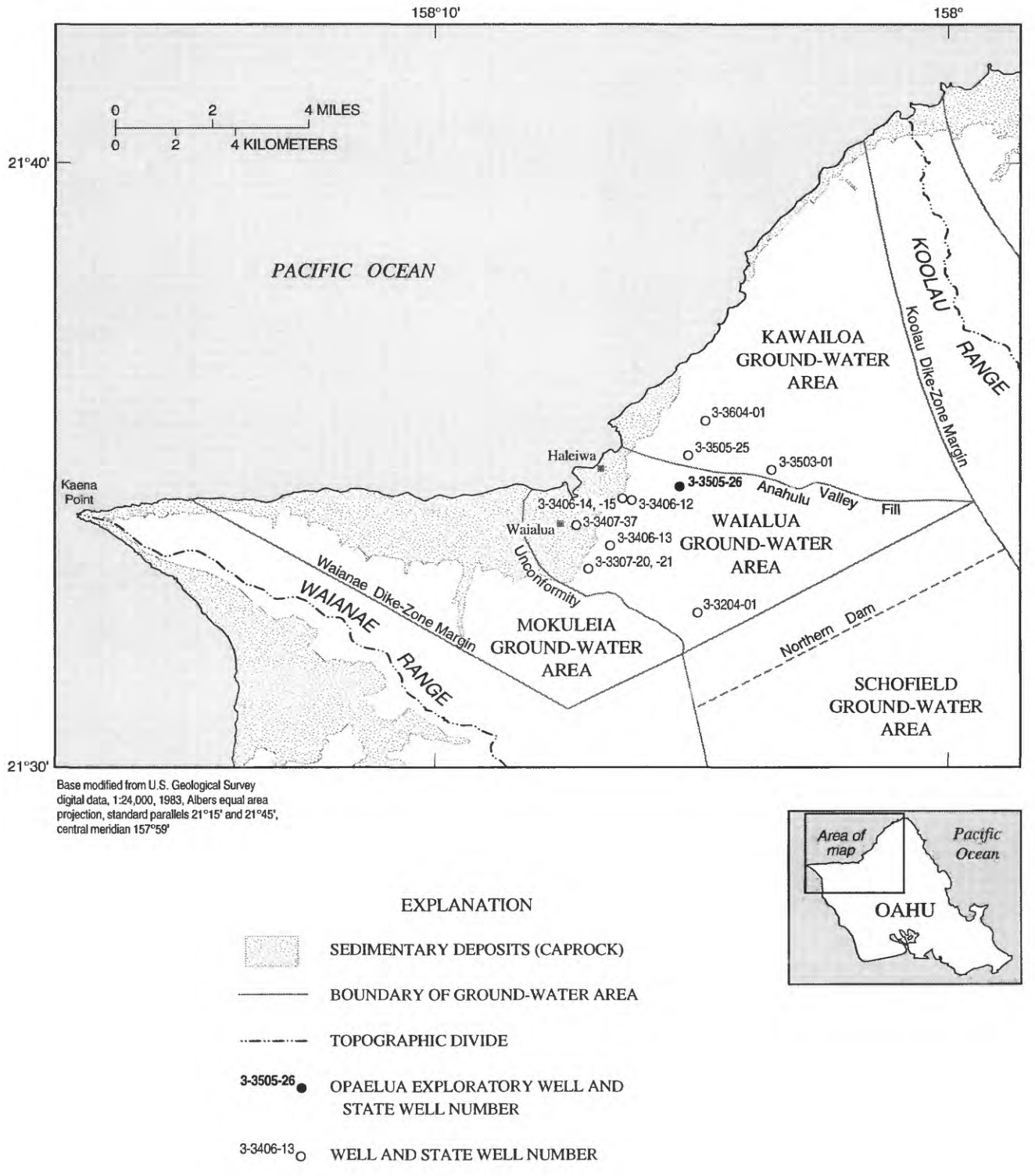


Figure 1. Ground-water areas of north-central Oahu (modified from Hunt, in press) and wells drilled during the study, Hawaii.

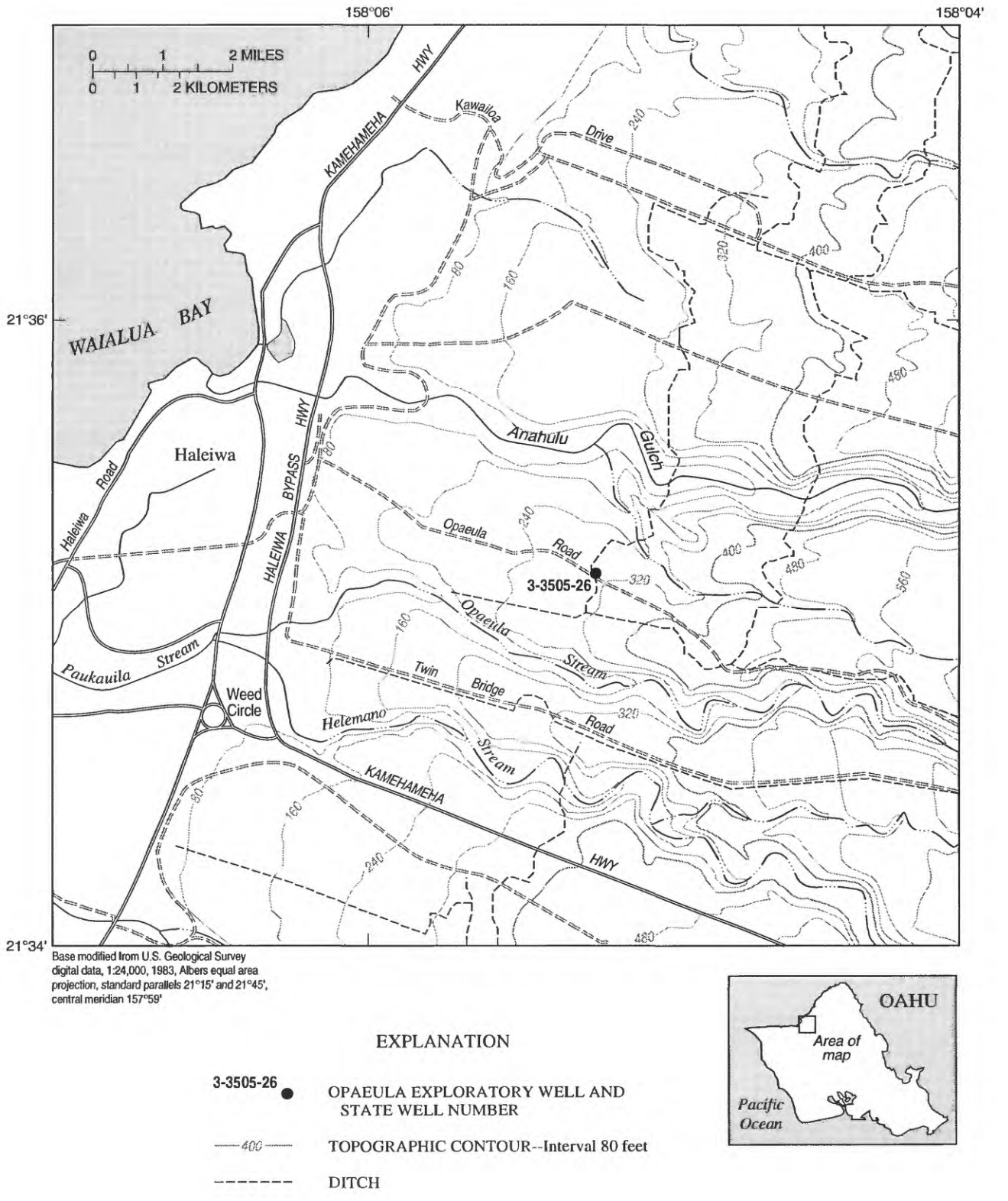


Figure 2. Location of Opaeula exploratory well, Oahu, Hawaii.

preparing the drill site. The USGS also thanks the Bernice Pauahi Bishop Estate for permission to drill on their land.

DRILLING, CONSTRUCTION, AND CALIPER-LOG DATA

The Opaeula exploratory well (State well number 3-3505-26) is located across a cane hauling road (Opaeula Road) from an agricultural water-filter system, about 1.4 mi northeast of Weed Circle. Well-construction data is provided in table 1 and construction details are shown in figure 3.

The Opaeula exploratory well was drilled using an air-rotary system with flush-jointed 4 1/2-in. diameter drill pipe. Drilling foam and polymer were injected into the air-circulation system to assist the removal of drill cuttings and to stabilize the hole. The elevation of the ground surface in the area of the drill site is about 287 ft above mean sea level. A 10-in. diameter hole was drilled to an elevation of 229 ft and cased with 59 ft of 6 5/8-in. outside-diameter steel casing. The annular space was grouted with cement to provide a surface seal. A 6 1/4-in. diameter tri-cone tungsten-carbide button bit was then used to drill to an elevation of -65 ft. After the total depth was reached, a Well Reconnaissance logging unit was used to record a caliper log of the well. The well was cased with 4 1/2-in. outside-diameter flush-jointed PVC casing. PVC screen with 0.02-in. horizontal slots was installed below an elevation of 15 ft.

Samples of the materials expelled by the circulation system while drilling were collected every 5 ft. Between the depths of 150 to 200 ft, and beyond the depth of 235 ft, the circulation was completely absorbed and no sample was recovered. The geologic log (geologic descriptions of the recovered samples from drilling) is presented in table 2, and the driller's log (driller's observations while drilling) is presented in table 3. From the surface, the bore penetrated about 20 ft of red clay, 30 ft of slightly weathered basalt, and 185 ft of unweathered basalt.

The caliper log (fig. 4) shows many hole enlargements where the caliper arms extend as much as 22 in. between the elevations of 80 to -20 ft. The caliper tool has three 16-in. spring-loaded arms that are extended when the tool is at the bottom of the hole. As the tool is raised, the logging unit records the extension of the arms as they drag against the walls of the bore. The caliper extension is an indication of hole diameter and wall smoothness, but the instrument does not measure these attributes directly. The maximum extension for the caliper tool is 32 in.

Table 1. Construction data for Opaeula exploratory well, Oahu, Hawaii.
[Elevation datum is mean sea level; in., inch; ft, foot; od, outside diameter]

Well name	Opaeula exploratory well
State well number	3-3505-26
Latitude and longitude	21°35'11"N, 158°05'14"W
Hawaii tax map key number	6-2-10-1
Landowner	Bernice Pauahi Bishop Estate
Leaseholder	Waialua Sugar Company
Well completed	October 4, 1993
Working days to complete	10 days
Driller	Fred Thibedeau, USGS
Surface hole diameter	10 in.
Bottom of surface casing elevation	229 ft
Surface casing diameter and type	6 5/8-in. od steel, 0.188-in. thick wall
Final hole diameter	6 1/4 in.
Bottom of well elevation	-65 ft
Open interval elevations	229 ft to -65 ft
Screened interval elevations	15 ft to -65 ft
Inner casing diameter and type	4 1/2-in. od PVC, flush-jointed
Screen type	4 1/2-in. od PVC, flush-jointed, 0.02-in. horizontal slots
Reference mark elevation (bolt)	287.22 ft
Top of casing measuring point elevation	288.08 ft (top of aluminum well-cap bracket, NW side)
Water level and date of measurement	10.52 ft, February 15, 1995

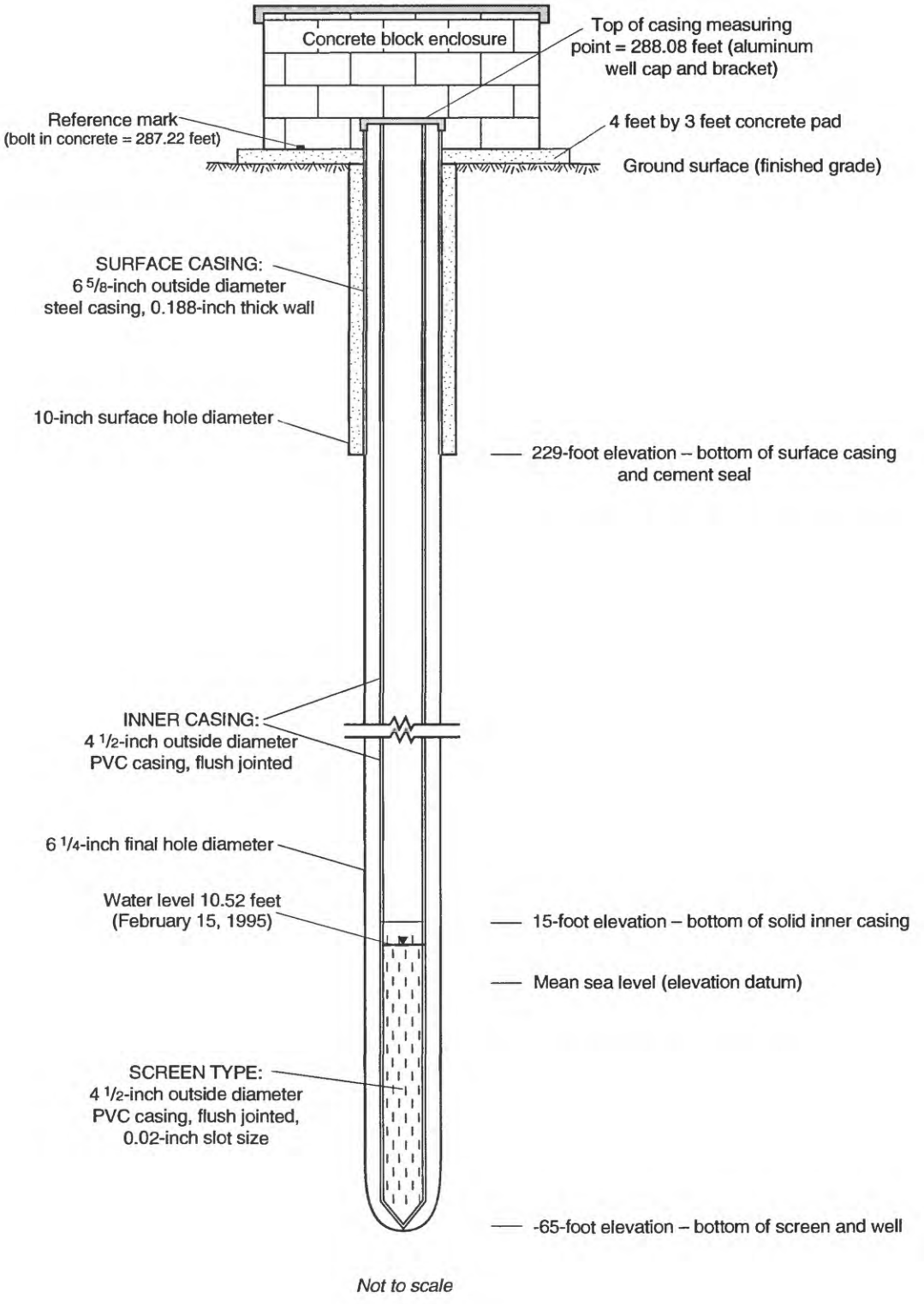


Figure 3. Construction details for Opaeula exploratory well (State well number 3-3505-26), Oahu, Hawaii.

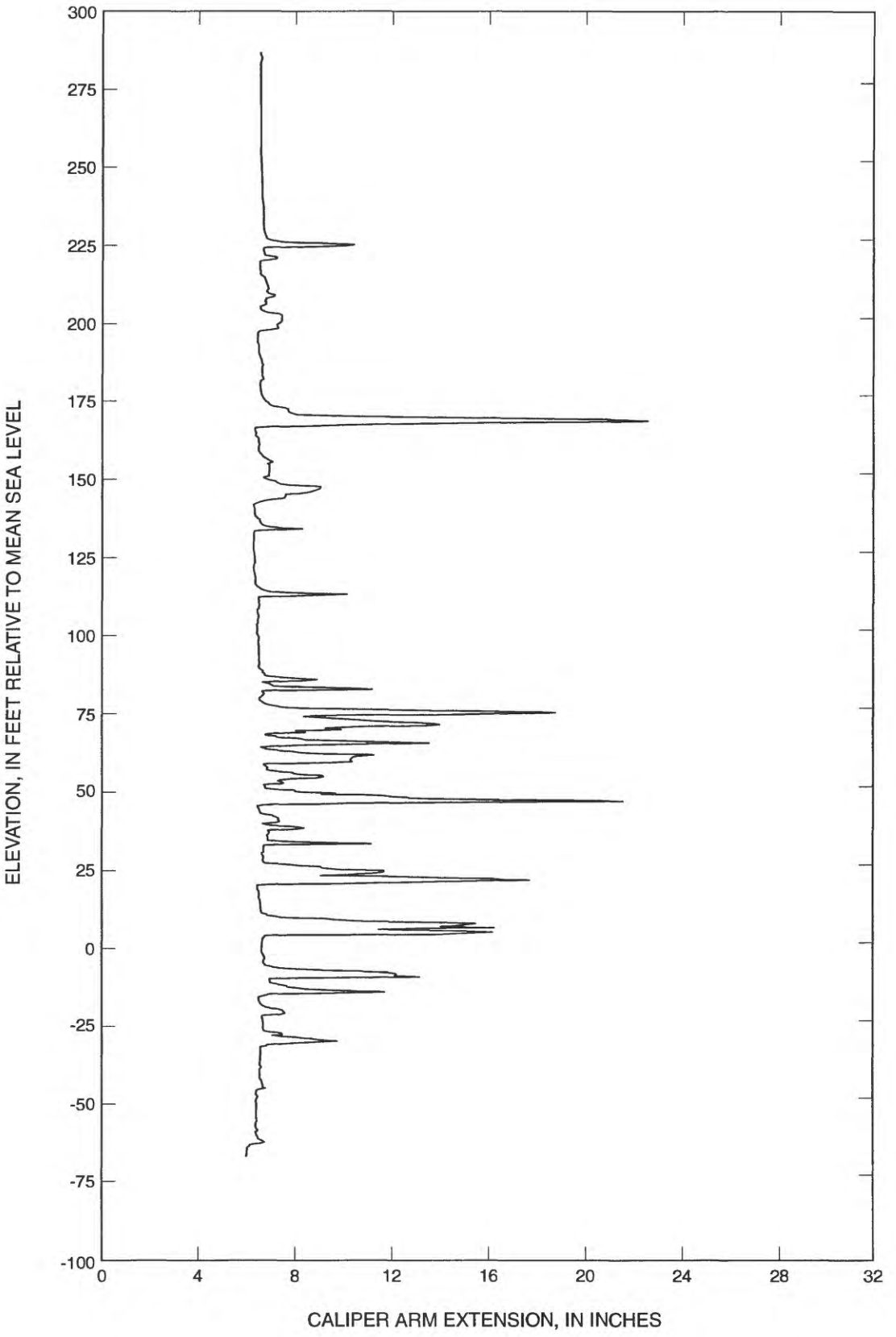


Figure 4. Caliper log for Opaeula exploratory well (State well number 3-3505-26), Oahu, Hawaii.

The measuring point (elevation 288.08 ft) for water-level determination is located on the northwest side of the aluminum well-cap bracket affixed to the top of the 6 5/8-in. outside-diameter steel surface casing. An additional reference mark (elevation 287.22 ft) for the well site is located on the top of a stainless steel bolt emplaced into the concrete pad surrounding the well.

ADDITIONAL INFORMATION

Information for the 12 wells drilled during the north-central Oahu study is listed in table 4. Nine of the wells, including the Opaeula exploratory well (State well number 3-3505-26), were drilled in the Waialua ground-water area, and three wells were drilled north of

Table 2. Geologic log for Opaeula exploratory well (State well number 3-3505-26), Oahu, Hawaii.
[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Sample description	Comments
0 to 5	287 to 282	Red clay	
5 to 10	282 to 277	Red clay	
10 to 15	277 to 272	Red clay	
15 to 20	272 to 267	Red clay grading to reddish-brown clay; grey, weathered basalt	
20 to 25	267 to 262	Grey, medium-hard, nonvesicular, slightly weathered basalt	
25 to 30	262 to 257	Grey, medium-hard, nonvesicular, slightly weathered basalt	
30 to 35	257 to 252	Brownish-grey clay	
35 to 40	252 to 247	Brownish-grey clay	Slightly darker than above
40 to 45	247 to 242	Grey, medium-hard, nonvesicular, slightly weathered basalt	
45 to 50	242 to 237	Grey, aphyric, nonvesicular basalt	
50 to 55	237 to 232	Dark-grey, massive, unweathered basalt; some clinker	
55 to 60	232 to 227	No sample	
60 to 65	227 to 222	Grey, vesicular basalt	
65 to 70	222 to 217	Slightly brownish-grey, slightly weathered basalt	
70 to 75	217 to 212	Medium-grey, hard, vesicular basalt	Small pieces
75 to 80	212 to 207	Grey, hard, vesicular basalt	Same as above but slightly darker, more vesicular
80 to 85	207 to 202	Grey, hard, vesicular basalt	Some oxidation
85 to 90	202 to 197	Grey, hard, vesicular basalt	Some oxidation
90 to 95	197 to 192	Medium-grey basalt	Less vesicular and finer pieces than above
95 to 100	192 to 187	Dark-grey, hard, slightly vesicular basalt	
100 to 105	187 to 182	Reddish-grey, hard, slightly vesicular basalt	
105 to 110	182 to 177	Dark-grey, olivine-phyric, slightly vesicular, unweathered basalt	
110 to 115	177 to 172	Reddish-grey, olivine-phyric, slightly vesicular, unweathered basalt	
115 to 120	172 to 167	Pinkish-grey, olivine-phyric, slightly vesicular, unweathered basalt	
120 to 125	167 to 162	Pinkish-grey, olivine-phyric, slightly vesicular, unweathered basalt	
125 to 130	162 to 157	Grey, slightly vesicular, unweathered basalt	
130 to 135	157 to 152	Pinkish-grey, slightly vesicular, unweathered basalt	
135 to 140	152 to 147	Reddish, dark-grey, slightly vesicular, unweathered basalt	
140 to 145	147 to 142	Reddish, dark-grey, slightly vesicular, unweathered basalt	
145 to 150	142 to 137	Pinkish, dark-grey, slightly vesicular, unweathered basalt	
150 to 200	137 to 87	No sample	
200 to 205	87 to 82	Grey, nonvesicular, unweathered basalt	
205 to 217	82 to 70	No sample	
217 to 225	70 to 62	Pinkish, dark-grey, slightly vesicular, unweathered basalt	
225 to 230	62 to 57	Pinkish, dark-grey, vesicular, unweathered basalt	Some oxidation; larger chunks than above
230 to 235	57 to 52	Pinkish, dark-grey, slightly vesicular, unweathered basalt	Some oxidation

Anahulu Gulch in the Kawailoa ground-water area. Water-level time-series data were collected for all of the wells drilled and for numerous other existing wells as part of the overall monitoring effort for the project (unpublished data in files of the USGS, Honolulu). Data were collected using electronic data loggers coupled to shaft encoder-float systems or pressure transducers.

REFERENCES CITED

Dale, R.H., 1978, A ground-water inventory of the Waialua basal-water body, island of Oahu, Hawaii: U.S. Geological Survey Open-File Report 78-24, 71 p.

Hunt, C.D., Jr., in press, Geohydrology of the island of Oahu, Hawaii: U.S. Geological Survey Professional Paper 1412-B.

Rosenau, J.C., Lubke, E.R., and Nakahara, R.H., 1971,Water resources of north-central Oahu, Hawaii: U.S. Geological Survey Water-Supply Paper 1899-D, 40 p.

Table 3. Driller's log for the Opaeula exploratory well (State well number 3-3505-26), Oahu, Hawaii.
[Elevation datum is mean sea level]

Depth below grade (feet)	Elevation (feet)	Description
0 to 18	287 to 269	Saprolite, red
18 to 24	269 to 263	Weathered, grey rock
24 to 29	263 to 258	Hard, grey rock
29 to 31	258 to 256	Weathered, grey rock
31 to 40	256 to 247	Weathered, grey rock, moist
40 to 45	247 to 242	Hard, grey dry rock
45 to 51	242 to 236	Weathered grey dry rock
51 to 57	236 to 230	Grey, moist rock
57 to 60	230 to 227	Hard, grey rock
60 to 63	227 to 224	Soft, grey rock
63 to 64	224 to 223	Hard rock
64 to 67	223 to 220	Soft rock
67 to 68	220 to 219	Firm rock
68 to 80	219 to 207	Soft, voids, grey rock
80 to 82	207 to 205	Hard rock
82 to 90	205 to 197	Very soft rock with voids
90 to 93	197 to 194	Firm rock
93 to 95	194 to 192	Soft rock
95 to 109	192 to 178	Hard rock with fractures
109 to 115	178 to 172	Soft rock with voids
115 to 118	172 to 169	Firm rock
118 to 129	169 to 158	Hard, grey rock
129 to 133	158 to 154	Soft rock with voids, red tint
133 to 151	154 to 136	Hard rock
151 to 152	136 to 135	Void
152 to 156	135 to 131	Soft rock
156 to 171	131 to 116	Hard rock
171 to 173	116 to 114	Soft, sand-like
173 to 182	114 to 105	Firm rock
182 to 205	105 to 82	Hard rock
205 to 208	82 to 79	Medium-hard rock
208 to 212	79 to 75	Firm rock
212 to 216	75 to 71	Soft, sand like
216 to 219	71 to 68	Hard rock
219 to 220	68 to 67	Soft rock
220 to 231	67 to 56	Hard, grey rock
231 to 236	56 to 51	Medium-hard rock, brown
236 to 239	51 to 48	Soft rock
239 to 240	48 to 47	Hard rock
240 to 263	47 to 24	Medium to soft rock
263 to 275	24 to 12	Firm rock
275 to 281	12 to 6	Very soft rock
281 to 286	6 to 1	Hard rock
286 to 291	1 to -4	Hard, solid rock
291 to 292	-4 to -5	Hard, broken rock
292 to 297	-5 to -10	Medium-hard rock
297 to 298	-10 to -11	Soft rock
298 to 335	-11 to -48	Medium to hard rock, fractures
335 to 337	-48 to -50	Soft rock
337 to 343	-50 to -56	Medium rock
343 to 344	-56 to -57	Soft rock
344 to 346	-57 to -59	Medium rock
346 to 347	-59 to -60	Soft rock
347 to 353	-60 to -66	Medium rock
353 to 354	-66 to -67	Soft rock
354 to 355	-67 to -68	Medium rock

Table 4. Construction data for wells drilled during the study, Oahu, Hawaii

State well number	Well name	Latitude	Longitude	Hawaii state tax map key number	Landowner	Well completed	Working days to complete
3-3204-01	Kaheaka exploratory well	21°32'52"	158°04'52"	6-5-01-2	Castle and Cooke Land Company	March 2, 1994	16 days
3-3307-20	Thompson Corner exploratory well I	21°33'41"	158°07'02"	6-5-01-1	Castle and Cooke Land Company	July 9, 1993	14 days
3-3307-21	Thompson Corner exploratory well II	21°33'41"	158°07'02"	6-5-01-1	Castle and Cooke Land Company	August 9, 1993	15 days
3-3406-12	Twin Bridge Road deep monitor well	21°34'56"	158°06'10"	6-4-01-1	Castle and Cooke Land Company	March 9, 1994	27 days
3-3406-13	Kaamooloa exploratory well	21°34'06"	158°06'36"	6-5-01-2	Castle and Cooke Land Company	January 12, 1994	4 days
3-3406-14	Helemano exploratory well I	21°34'58"	158°06'21"	6-2-07-11	Castle and Cooke Land Company	October 15, 1993	11 days
3-3406-15	Helemano exploratory well II	21°34'58"	158°06'21"	6-2-07-11	Castle and Cooke Land Company	November 15, 1993	15 days
3-3407-37	Kiikii exploratory well	21°34'28"	158°07'16"	6-6-23-3	Castle and Cooke Land Company	April 21, 1994	27 days
3-3503-01	North Upper Anahulu exploratory well	21°35'30"	158°03'25"	6-2-09-1	Bishop Estate	May 5, 1994	8 days
3-3505-25	North Lower Anahulu exploratory well	21°35'45"	158°05'04"	6-2-09-1	Bishop Estate	December 23, 1993	7 days
3-3505-26	Opaeula exploratory well	21°35'11"	158°05'14"	6-2-10-1	Bishop Estate	October 4, 1993	10 days
3-3604-01	Kawailoa deep monitor well	21°36'24"	158°04'44"	6-1-05-1	Bishop Estate	January 9, 1994	28 days

Table 4. Construction data for wells drilled during the study, Oahu, Hawaii--Continued

State well number	Well name	Bottom of surface casing elevation (feet)	Surface casing outside diameter (inch)	Hole diameter (inch)	Bottom of well elevation (feet)	Open interval elevations (feet)	Inner casing outside diameter (inch) and type	Screened interval elevations (feet)	Measuring point elevation (feet)	Water level	
										Height above sea level (feet)	Date and time
3-3204-01	Kaheaka exploratory well	643	8 5/8	6 3/4	-55	643 to -55	4 1/2, steel	25 to -55	741.59 (top of casing)	12.44	Jan. 27,1995 17:20
3-3307-20	Thompson Corner exploratory well I	-65	12 5/8	12 1/4	-82	-65 to -82	12 5/8, steel	-65 to -82	99.10 (bolt)	11.32	Aug 5, 1993 15:51
3-3307-21	Thompson Corner exploratory well II	17	8 5/8	7 7/8	-80	17 to -80	4 1/2, PVC	20 to -80	101.40 (top of casing)	11.29	Aug. 5, 1993 15:51
3-3406-12	Twin Bridge Road deep monitor well	9	6 5/8	6 1/4	-596	9 to -596	4 1/2, steel	24 to -596	53.10 (top of casing)	11.10	Feb. 15, 1995 12:09
3-3406-13	Kaamooloa exploratory well	10	6 5/8	6 1/4	-10	10 to -10	4 1/2, PVC	10 to -10	42.35 (top of casing)	11.87	Feb. 13, 1995 14:45
3-3406-14	Helemano exploratory well I	-51	8 5/8	7 7/8	-78.5	-72 to -78.5	4 1/2, PVC	-68.5 to -78.5	13.79 (top of casing)	10.92	Feb. 15, 1995 12:26
3-3406-15	Helemano exploratory well II	-52	8 5/8	7 7/8	-291	-271 to -291	4 1/2, steel	-271 to -291	14.41 (top of casing)	11.15	Feb. 15, 1995 12:28
3-3407-37	Kiikii exploratory well	-115	8 5/8	6 3/4	-135	-125 to -135	4 1/2, steel	-115 to -135	14.68 (top of casing)	11.70	Feb. 13, 1995 13:44
3-3503-01	North Upper Anahulu exploratory well	592	8 5/8	6 3/4	-103	592 to -103	4 1/2, steel	17 to -103	671.74 (top of casing)	7.15	Feb 14, 1995 13:54
3-3505-25	North Lower Anahulu exploratory well	182	8 5/8	7 7/8	-18	182 to -18	4 1/2, PVC	22 to -18	234.24 (top of casing)	4.75	Feb.14, 1995 15:08
3-3505-26	Opaeula exploratory well	229	6 5/8	6 1/4	-65	229 to -65	4 1/2, PVC	15 to -65	288.08 (top of casing)	10.52	Feb. 15, 1995 11:14
3-3604-01	Kawailoa deep monitor well	190	6 5/8	6 1/4	-392	190 to -392	4 1/2, steel	9 to -391	309.01 (top of casing)	4.40	Feb. 14, 1995 14:18