

Section 5

GEOGRAPHY AND ENVIRONMENT

This section relates to land and water areas, physical geography, climate, air and water quality, noise, and other geographic and environmental measurements of Hawaii. Most statistics on land use and ownership, however, appear in section 6.

The State consists of eight major islands and 124 minor islands with a total land area of 6,425 square miles and a general coastline of 750 miles. Honolulu is 214 miles from Hilo, 1,367 miles from Kure Atoll (the westernmost end of the State), 2,397 miles from San Francisco, and 4,829 miles from Washington, D.C. The highest peak in the State is Mauna Kea, 13,796 feet above sea level; the longest stream is Kaukonahua Stream, Oahu, 33 miles in length; the biggest lake is Halalii, on Niihau, 841 acres; and the highest named waterfall is Kahiwa, Molokai, a 1,750-foot cascade. Various measures of air pollution, such as suspended particulate matter, indicate that Honolulu is one of the cleanest cities in the nation. There is also relatively little water pollution: 35 major beaches surveyed in 1983 were found to have fecal coliform levels per 100 ml. ranging from 2.0 to 121.1, and all 35 were within EPA standards. More than 1,100 species, subspecies, and varieties of native flora were endangered, threatened, or extinct, according to a 1977 survey. Climatically, Hawaii is marked by remarkably balmy temperatures and wide variations in rainfall. The all-time temperature range at Honolulu International Airport, for example, was from 53° to 92°F. Average precipitation, however, ranges from less than 10 inches at Kawaihae and the summit of Mauna Kea to 451 inches atop Waialeale. The longest volcanic eruption in Island history lasted 867 days, the worst earthquake attained 7.5 on the Richter scale, and the highest tsunami wave reached 56 feet. Water withdrawn for use in 1980 averaged 2.9 billion gallons per day, compared with 2.8 billion in 1975 and 2.7 billion in 1970. Among 31 neighborhoods on Oahu, median noise levels in 1981-1982 ranged from 37 decibels (in Mililani) to 57 decibels (in Pawaa).

Important sources of data include the U.S. Geological Survey, National Ocean Survey, National Weather Service, U.S. Bureau of the Census Geography Division, the Division of Water and Land Development of the State Department of Land and Natural Resources, the State Department of Health, and the University of Hawaii Institute of Geophysics. Detailed information is given in Atlas of Hawaii, published by the University Press of Hawaii in 1983. National data are reported in Statistical Abstract of the United States: 1984, Section 7.

Table 157.-- GREAT CIRCLE DISTANCES BETWEEN HONOLULU INTERNATIONAL AIRPORT AND SPECIFIED PLACES

Place	Distance from Honolulu	
	Statute miles	Kilometers
Hawaiian Islands:		
Cape Kumukahi, Hawaii	236	380
Hilo, Hawaii	214	344
Ka Lae (South Cape), Hawaii	221	356
Kailua, Kona, Hawaii	168	270
Kahului, Maui	98	158
Lanai Airport	72	116
Molokai Airport	54	87
Lihue, Kauai	103	166
Puuwai, Niihau	152	245
Nihoa	283	455
Necker Island	520	837
French Frigate Shoals	556	895
Gardner Pinnacles	688	1,107
Maro Reef	851	1,369
Laysan Island	936	1,506
Lisianski Island	1,065	1,714
Pearl and Hermes Atoll	1,208	1,944
Midway Islands	1,309	2,106
Kure Atoll	1,367	2,200
Other Pacific locations:		
Apra Harbor, Guam	3,806	6,124
Auckland, New Zealand	4,393	7,068
Avarua, Rarotonga	2,950	4,750
Funafuti, Tuvalu	2,550	4,106
Hong Kong	5,541	8,915
Johnston Atoll	820	1,319
Kingman Reef	1,073	1,726
Kiritimati (Christmas Island), Kiribati	1,344	2,163
Kolonia, Ponape	3,087	4,967
Koror, Palau	4,593	7,390
Kwajalein, Marshall Islands	2,443	3,931
Majuro, Marshall Islands	2,271	3,654
Manila, Philippines	5,293	8,516
Nuku'alofa, Tongatapu	3,165	5,096
Nuku Hiva, Marquesas Islands	2,400	3,864
Pago Pago, American Samoa	2,606	4,193

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Table 157.-- GREAT CIRCLE DISTANCES BETWEEN HONOLULU INTERNATIONAL AIRPORT AND SPECIFIED PLACES -- Con.

Place	Distance from Honolulu	
	Statute miles	Kilometers
Other Pacific locations, con.:		
Palmyra Atoll	1,101	1,772
Papeete, Tahiti	2,741	4,410
Saipan, Northern Mariana Islands	3,704	5,960
Suva, Fiji	3,159	5,083
Sydney (Port Jackson), Australia	5,070	8,158
Tokyo, Japan	3,847	6,190
Wake Island	2,294	3,691
North and South America:		
Anchorage, Alaska	2,781	4,475
Cape Horn, Chile	7,457	11,998
Chicago, Illinois	4,179	6,724
Cristobal, Canal Zone	5,214	8,389
Lima, Peru	5,950	9,580
Los Angeles, California	2,557	4,114
Miami, Florida	4,856	7,813
New York, New York	4,959	7,979
Portland, Oregon	2,595	4,175
San Diego, California	2,610	4,199
San Francisco, California	2,397	3,857
Seattle, Washington	2,679	4,311
Vancouver, B.C.	2,709	4,359
Victoria, B.C.	2,668	4,293
Tijuana, Mexico	2,616	4,209
Washington, D.C.	4,829	7,770
London, England	7,226	11,627
Bombay, India	8,010	12,888
Ghanzi, Botswana 1/	12,417	19,979
Equator, due south of Honolulu	1,470	2,367
North Pole	4,740	7,631
South Pole	7,660	12,333

1/ Ghanzi, Botswana, is Honolulu's antipode, that is, the point precisely opposite to it on the globe.

Source follows next table.

Table 158.-- GREAT CIRCLE DISTANCES FROM HILO AND KURE ATOLL

Places	Great circle distance	
	Statute miles	Kilometers
Hilo to --		
Honolulu, Oahu	214	344
Los Angeles, California	2,447	3,937
San Francisco, California	2,315	3,725
Kure Atoll to --		
Cape Kumukahi, Puna, Hawaii <u>1/</u>	1,523	2,451
Honolulu, Oahu	1,367	2,200
Log Point, Elliot Key, Florida <u>2/</u>	5,852	9,416
Tokyo, Japan	2,486	4,000
West Quoddy Head, Maine	5,788	9,313

1/ Cape Kumukahi and Kure Atoll are the points farthest apart in the Hawaiian Archipelago and State of Hawaii.

2/ Log Point and Kure Atoll are the points farthest apart in the fifty states.

Source: U. S. Department of the Interior, Geological Survey, Elevations and Distances in the United States (1970), and distance computations prepared for the Department of Planning and Economic Development.

Table 159.-- WIDTHS AND DEPTHS OF CHANNELS

Channel <u>1/</u>	Width <u>2/</u>		Depth <u>3/</u>	
	Statute miles	Kilometers	Feet	Meters
Alenuihaha	29.6	47.6	6,810	2,076
Alalakeiki	6.7	10.8	822	251
Kealaikahiki	17.8	28.6	1,086	331
Auau	9.5	15.3	252	77
Kalohi	9.2	14.8	540	165
Pailolo	8.8	14.2	846	258
Kaiwi	25.8	41.5	2,202	671
Kauai	72.1	116.0	10,890	3,319
Kaulakahi	17.2	27.7	3,570	1,088
Niihau-Kaula	21.5	34.6	5,364	1,635
Niihau-Nihoa	133.9	215.5	14,550	4,435
Nihoa-Necker I.	179.6	289.0	12,600	3,840
Necker I.-French Frigate Shoals	100.3	161.4	12,780	3,895
French Frigate Shoals-Gardner Pinnacles ..	137.0	220.5	11,448	3,489
Gardner Pinnacles-Marou Reef	155.5	250.3	12,300	3,749
Marou Reef-Laysan I.	65.9	106.1	8,280	2,524
Laysan I.-Lisianski I.	137.4	221.1	16,830	5,130
Lisianski I.-Pearl and Hermes Atoll	162.6	261.7	17,400	5,304
Pearl and Hermes Atoll-Midway Islands	86.9	139.9	15,840	4,828
Midway Islands-Kure Atoll	57.1	91.9	12,960	3,950

1/ Listed in geographic order, from east to west. The channels between major islands were measured between the following points:

Alenuihaha: Upolu Pt., Hawaii, to Puhilele Pt., Maui;
 Alalakeiki: Lae o ka Ule, Kahoolawe, to Nukuele Pt., Maui;
 Kealaikahiki: Makaalae, Kahoolawe, to Kamaiki Pt., Lanai;
 Auau: Kikoa Pt., Lanai, to Lahaina, Maui;
 Kalohi: Wahie Pt., Lanai, to Kamalo, Molokai;
 Pailolo: Lipoa Pt., Maui, to Pohakuloa, Molokai;
 Kaiwi: Ilio Pt., Molokai, to Makapuu Pt., Oahu;
 Kauai: Kaena Pt., Oahu, to Kamilo Pt., Kauai;
 Kaulakahi: Mana Pt., Kauai, to Kaunuopou, Niihau.

2/ Width measured in statute miles between designated points on National Ocean Survey and Coast and Geodetic Survey charts. Width in kilometers calculated from miles (1 mile = 1.60934 km.).

3/ Depths given are the deepest soundings noted at or near the line joining the two designated points, on National Ocean Survey and Coast and Geodetic Survey charts. Depths measured in fathoms and converted to feet and meters (1 fathom = 6 feet = 1.8288 meters).

Source: Compiled by Lee S. Motteler, Pacific Scientific Information Center, Bernice P. Bishop Museum, in November 1980.

Table 160.-- GENERAL COASTLINE AND TIDAL SHORELINE OF COUNTIES AND ISLANDS

County and island	General coastline <u>1/</u>		Tidal shoreline <u>2/</u>	
	Statute miles	Kilo-meters <u>3/</u>	Statute miles	Kilo-meters <u>3/</u>
State total	750	1,207	1,052	1,693
Counties:				
Hawaii	266	428	313	504
Maui, including Kalawao	210	338	343	552
Honolulu	137	220	234	377
Kauai	137	220	162	261
Islands: <u>4/</u>				
Hawaii	266	428	313	504
Maui	120	193	149	240
Kahoolawe	29	47	36	58
Lanai	47	76	52	84
Molokai	88	142	106	171
Oahu	112	180	209	336
Kauai	90	145	110	177
Niihau	45	72	50	80
Kaula	2	3	2	3
Northwestern Hawaiian Islands <u>5/</u> ..	25	40	25	40
Nihoa	3	5	3	5
Necker Island	2	3	2	3
French Frigate Shoals	6	10	6	10
Laysan Island	6	10	6	10
Lisianski Island	3	5	3	5
Kure Atoll	5	8	5	8

1/ Figures are lengths of general outline of seacoast. Data for the four islands of Maui County are not consistent with the reported county total.

2/ Shoreline of outer coast, offshore islands, bays, rivers, and creeks is included to the head of tidewater or to a point where tidal waters narrow to a width of 100 feet.

3/ Derived from data expressed in statute miles; independently rounded and accordingly may not add exactly to indicated totals and subtotals.
1 mi. = 1.609 km.

4/ Data are not available for five minor islands: Molokini, Lehua, Gardner Pinnacles, Maro Reef, and Pearl and Hermes Atoll.

5/ Excludes the Midway Islands, which are part of the Hawaiian Archipelago but not legally part of the State of Hawaii. Midway has a general coastline of 20 miles and a tidal shoreline of 33 miles.

Source: U.S. Department of Commerce, National Ocean Survey, The Coastline of the United States (1975) and records.

Table 161.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1982

County or island	Square miles		
	Total	Land <u>2/</u>	Inland water <u>3/</u>
State total	6,470.8	6,425.2	45.6
Counties: <u>4/</u>			
Hawaii	4,035.2	4,034.2	1.0
Maui	1,171.0	1,161.6	9.4
Kalawao	14.3	13.3	1.0
Honolulu	620.5	596.3	24.2
Kauai	629.8	619.8	10.0
Islands: <u>4/</u>			
Hawaii	4,035.2	4,034.2	1.0
Maui <u>5/</u>	734.5	728.6	5.9
Kahoolawe	45.9	45.0	0.9
Lanai	141.2	140.4	0.8
Molokai	263.7	260.9	2.8
Oahu	617.6	593.6	24.0
Kauai	558.2	549.4	8.8
Niihau and Lehua	71.1	70.0	1.1
Kaula	0.4	0.4	-
Northwestern Hawaiian Islands <u>6/</u>	2.910	2.690	0.220
Nihoa	0.238	0.238	-
Necker Island	0.105	0.105	-
French Frigate Shoals	0.081	0.081	-
Gardner Pinnacles	0.011	0.011	-
Maro Reef	Awash	Awash	Awash
Laysan Island	1.454	1.234	0.220
Lisianski Island	0.586	0.586	-
Pearl and Hermes Atoll	0.106	0.106	-
Kure Atoll	0.329	0.329	-

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Table 161.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1982 -- Con.

County or island	Square kilometers <u>1/</u>		Acres <u>1/</u>	
	Total	Land <u>2/</u>	Total	Land <u>2/</u>
State total	16,759.3	16,641.2	4,141,312	4,112,128
Counties: <u>4/</u>				
Hawaii	10,451.1	10,448.5	2,582,528	2,581,888
Maui	3,032.9	3,008.5	749,440	743,424
Kalawao	37.0	34.4	9,152	8,512
Honolulu	1,607.1	1,544.4	397,120	381,632
Kauai	1,631.2	1,605.3	403,072	396,672
Islands: <u>4/</u>				
Hawaii	10,451.1	10,448.5	2,582,528	2,581,888
Maui <u>5/</u>	1,902.3	1,887.1	470,080	466,304
Kahoolawe	118.9	116.5	29,376	28,800
Lanai	365.7	363.6	90,368	89,856
Molokai	683.0	675.7	168,768	166,976
Oahu	1,599.6	1,537.4	395,264	379,904
Kauai	1,445.7	1,422.9	357,248	351,616
Niihau and Lehua	184.1	181.3	45,504	44,800
Kaula	1.0	1.0	256	256
Northwestern Hawaiian Islands <u>6/</u>	7.5	7.0	1,862	1,722
Nihoa	0.6	0.6	152	152
Necker Island	0.3	0.3	67	67
French Frigate Shoals	0.2	0.2	52	52
Gardner Pinnacles	0.0	0.0	7	7
Maro Reef	Awash	Awash	Awash	Awash
Laysan Island	3.8	3.2	931	790
Lisianski Island	1.5	1.5	375	375
Pearl and Hermes Atoll	0.3	0.3	68	68
Kure Atoll	0.9	0.9	211	211

Footnotes and source on next page.

Table 161.-- LAND AND WATER AREA OF COUNTIES AND ISLANDS: 1982 -- Con.

1/ Areas in square kilometers and acres were calculated directly from the figures shown for square miles; these equivalents were independently rounded, and hence may not add exactly to the indicated totals and subtotals. 1 square mile = 640 acres = 2.58999 square kilometers.

2/ Dry land and land temporarily or partially covered by water, as marshland, swamps, etc.; streams and canals under one-eighth statute mile wide; and lakes, reservoirs, and ponds under 40 acres of area.

3/ Permanent inland water surface, such as lakes, reservoirs, and ponds having 40 acres or more of area; streams, sloughs, estuaries, and canals one-eighth statute mile or more in width; deeply indented embayments and sounds, and other coastal waters behind or sheltered by headlands or islands separated by less than 1 nautical mile of water, and islands having less than 40 acres of area.

4/ Because of rounding, island figures may not add to county figures.

5/ Molokini, offshore of Maui, not measured; other sources give the area of Molokini as 18.6 acres (0.03 square miles or 0.075 square kilometers).

6/ Exclusive of the Midway Islands, which are part of the Hawaiian Archipelago but not legally part of the State of Hawaii.

Source: Unpublished data supplied by the Geography Division, U.S. Bureau of the Census, May 5, 1983, as cited in the Hawaii State Department of Planning and Economic Development, Remeasurements of the Area of Hawaii, 1982 (Statistical Memorandum 83-6, May 18, 1983).

Table 162.-- MAJOR AND MINOR ISLANDS IN THE HAWAIIAN ARCHIPELAGO

Classification	Number of islands		Land area (square miles)
	Total	Inhabited, 1980 <u>1/</u>	
All named islands	137	15	6,427.0
Major islands	8	7	6,419.4
Named minor islands <u>2/</u>	129	8	7.6
Offshore of major islands	96	4	2.6
Northwestern Hawaiian Islands <u>3/</u>	33	4	4.9
Part of State	28	3	2.9
Not part of State (Midway Islands)	5	1	2.0

1/ For populations, see present volume, table 5.

2/ For individual data, see DPED Report GN-6, pp. 3-7.

3/ The 33 islets are in 10 clusters.

Source: Hawaii State Department of Planning and Economic Development, Geographic Names Approved, Second Quarter 1969 (Report GN-6, July 8, 1969), p. 8; data for Midway Islands supplied by Lee S. Motteler, Bishop Museum.

Table 163.-- MAJOR SUMMITS

[Elevation of the highest point on each island
and other important peaks]

Island and mountain	Elevation	
	Feet	Meters
Hawaii:		
Mauna Kea 1/	13,796	4,205
Mauna Loa 1/	13,679	4,169
Hualalai	8,271	2,521
Kaunu o Kaleiioohie 2/	5,480	1,670
Kilauea (Uwekahuna)	4,093	1,248
Kilauea (Halemaumau Rim)	3,660	1,116
Kahoolawe:		
Puu Moaulanui 3/	1,483	452
Puu Moaulaiki	1,434	437
Molokini	160	49
Maui:		
Haleakala (Red Hill)	10,023	3,055
Haleakala (Kaupo Gap)	8,201	2,500
Puu Kukui	5,788	1,764
Iao Needle	2,250	686
Lanai:		
Lanaihale	3,370	1,027
Molokai:		
Kamakou	4,961	1,512
Olokui	4,606	1,404
Kaunuohua	4,535	1,382
Kalaupapa Lookout	1,600	488
Mauna Loa (Kukui)	1,430	436
Oahu:		
Kaala	4,017	1,224
Puu Kalena	3,504	1,068
Konahuanui 4/	3,150	960
Tantalus	2,013	614
Olomana	1,643	501
Koko Crater (Kohelepelepe) ...	1,208	368
Nuuanu Pali Lookout	1,186	361
Diamond Head	760	232
Koko Head	642	196
Punchbowl	500	152

Continued on next page.

Table 163.-- MAJOR SUMMITS -- Con.

Island and mountain	Elevation	
	Feet	Meters
Kauai:		
Kawaikini	5,243	1,598
Waialeale	5,148	1,569
Namolokama Mountain	4,421	1,348
Kalalau Lookout	4,120	1,256
Hauptu	2,297	700
Sleeping Giant (Nonou)	1,241	378
Niihau:		
Paniau	1,281	390
Lehua	699	213
Kaūla	550	168
Nihoa:		
Millers Peak	910	277
Necker Island:		
Summit Hill	277	84
French Frigate Shoals:		
La Perouse Pinnacles	135	41
Gardner Pinnacles	190	58
Maro Reef	Awash	Awash
Laysan Island	35	11
Lisianski Island	20	6
Pearl and Hermes Atoll	10	3
Midway Islands <u>5/</u>	12	4
Kure Atoll	20	6
Kingman Reef <u>5/</u>	3	1
Palmyra Atoll <u>5/</u>	6	2
Johnston Atoll: <u>5/</u>		
Sand Island	15	5

1/ The adjacent ocean floor has an average depth of 2,800 fathoms and a maximum depth of 3,045 fathoms. Thus, Mauna Kea and Mauna Loa rise respectively 30,596 feet and 30,479 feet above their submarine bases as calculated from average depths, and respectively 32,066 and 31,499 feet above as calculated from maximum depths. So measured, Mauna Kea and Mauna Loa are the world's tallest mountains.

2/ Kohala on earlier maps.

3/ Lua Makika on earlier maps.

4/ Two distinct peaks. The lower one has an elevation of 3,105 feet.

5/ Not part of the State of Hawaii.

Source on next page.

Table 163.-- MAJOR SUMMITS -- Con.

Source: U.S. National Cartographic Information Center, data provided October 11, 1978; U.S. Geological Survey topographic maps; E. D. Baldwin, 1883 Molokini figure on Hawaiian Government Survey Reg. Map No. 1276; National Geodetic Survey 1969 figure for Kaala, provided by U.S. Geological Survey, Honolulu office, July 23, 1984; U.S.S. Tanager survey, 1923 (for Pearl and Hermes Atoll); A. B. Amerson, Jr., and P. C. Shelton, The Natural History of Johnston Atoll (The Smithsonian Institution, Dec. 1976). Data compiled with assistance of Lee S. Motteler, Geography and Map Division, Bernice P. Bishop Museum.

Table 164.-- LAND AND WATER AREA WITHIN THE FISHERY CONSERVATION ZONE

[Land and water area within the 200 nautical mile Fishery Conservation Zone surrounding the Hawaiian Archipelago]

Category	Square nautical miles	Square statute miles	Square kilometers
Total	634,023	839,623	2,174,626
Land area	4,852	6,425	16,641
Water area	629,171	833,198	2,157,985

Source: Charles E. Harrington, Chief Geographer, Marine Surveys and Maps, National Ocean Survey, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, information supplied September 15, 1978.

Table 165.-- MAJOR STREAMS, BY ISLANDS

Island	Feature or stream	Length or ave. discharge
Longest water feature (miles):		
Hawaii	Wailuku River	32.0
Maui	Kalialinui-Waiale Gulch	18.0
Kahoolawe	Ahupu Gulch	4.0
Lanai	Maunalei-Waialala Gulch	12.9
Molokai	Wailau-Pulena Stream	6.5
Oahu	Kaukonahua Stream (So. Fork)	33.0
Kauai	Waimea River-Poomau Stream .	19.5
Niihau	Keanaulii-Puniopo Valley ...	5.9
Largest perennial stream (miles): ^{1/}		
Hawaii	Wailuku River	22.7
Maui	Palikea Stream	7.8
Molokai	Wailau-Pulena Stream	6.5
Oahu	Kaukonahua Stream	30.0
Kauai	Waimea River	19.7
Streams with greatest average discharge (million gal./day):		
Hawaii	Wailuku River	185
Maui	Iao Stream	54
Molokai	Wailau Stream	30
Oahu	Waikele Stream	25
Kauai	Hanalei River	140

^{1/} Estimated on basis of drainage area rather than stream runoff. Other major streams include Wailoa River, Hawaii (1/2-mile long); Honokohau Stream (9.4 miles long) and Iao Stream (5), both on Maui; Halawa Stream (6.4), Waikolu Stream (4.7), and Pelekunu (2.3), all on Molokai; Waikele Stream (15.3), Kipapa Stream (12.8), Waiakakalaua Stream (11.8), Nuuanu Stream (4), and Ala Wai Canal (1.9), all on Oahu; and the Makaweli River (15.1), Wainiha River (13.8), Hanapepe River (13.3), and Wailua River (11.8), all on Kauai.

Source: Longest water feature from U.S. Geological Survey, records; other data from Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 166.-- MAJOR NAMED WATERFALLS, BY ISLANDS

[Includes the largest named waterfall on each major island, either in height or average discharge; all other named falls 250 feet high or over; and well-known smaller falls. Many unnamed falls have sheer drops of 200 feet or more]

Island	Waterfall	Height (feet)		Horizontal distance (feet)	Average discharge (million gal./day)
		Sheer drop	Cascade		
Hawaii ..	Kaluahine .....	...	620	400	...
	Akaka	442	...	...	...
	Waiilikahi	320	...	...	6.6
	Hiilawe (3 falls) .....	...	300	200	...
	Rainbow	80	...	...	303.5
Maui	Honokohau .....	...	1,120	500	25.2
	Waihiimalu .....	...	400	150	...
	Waimoku .....	...	40	50	37.1
Molokai .	Kahiwa .....	...	1,750	1,000	...
	Papalaua .....	...	1,200	500	...
	Wailele .....	...	500	150	...
	Haloku .....	...	500	200	...
	Hipuapua .....	...	500	300	...
	Olupena .....	...	300	150	...
	Moaula .....	...	250	200	19.7
Oahu	Kaliuwaa (Sacred) ^{1/} .	80	1,520	3,000	...
	Waihee (Waimea)	40	...	...	6.8
	Manoa .....	...	200	250	2.4
Kauai ...	Waipoo (2 falls) .....	...	800	600	...
	Awini .....	...	480	500	...
	Hinalele	280	...	...	...
	Kapakanui	280	...	...	...
	Manawaiopuna	280	...	...	...
	Wailua	80	...	...	...
	Opaekaa	40	...	...	...
	Puwainui	20	...	...	90.9

^{1/} Sheer drop refers to northernmost fall of a cascade of six falls.

Source: U.S. Geological Survey, records; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 167.-- LAKES

[Data shown for the largest natural or man-made lake on each island, and other lakes of interest. At the present time there are no natural lakes on Oahu and Kauai, and no lakes of any type on Kahoolawe and Lanai. Excludes shoreline fish ponds and areas filled only during floods. The largest intermittent lake in the State is Halalii Lake, Niihau, with a maximum area of 840.7 acres]

Island	Name	Category	Maximum depth (feet)	Elevation (feet)	Area (acres)	Shoreline (miles)
Hawaii ..	Waiakea Pond	Natural	(NA)	Sea level	27	2
	Lake Waiiau ^{1/} ...	Natural	10	13,020	2	0.2
Maui	Kanaha Pond	Natural	(NA)	Sea level	41	2
	Violet Lake	Natural	(NA)	5,020	1	0.1
Kahoolawe	.....	...	...	...	...	...
Lanai ...	.....	...	...	...	...	...
Molokai .	Meyer Lake	Natural	5	2,021	6	1
Oahu	Wahiawa Reservoir	Man-made	85	842	302	11
	Salt Lake ^{2/}	Natural	(NA)	Sea level	273	2
Kauai ...	Waita Reservoir .	Man-made	23	241	424	3
Niihau ..	Halulu Lake	Natural	(NA)	Sea level	182	3

NA Not available.

^{1/} Highest lake in the State and third highest in the United States.

^{2/} Data refer to 1964. Since that time, Salt Lake has been mostly filled and is no longer considered a lake.

Source: Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 168.-- MISCELLANEOUS GEOGRAPHIC STATISTICS, BY ISLANDS

Island	Extreme length (miles)	Extreme width (miles)	Miles of sea cliffs with heights 1,000 ft. or more ^{1/}	Miles from coast of most remote point	Percent of area within 5 miles of coast
The State ..	...	...	33	28.5	48.6
Hawaii	93	76	4	28.5	30.0
Maui	48	26	-	10.6	76.1
Kahoolawe	11	6	-	2.4	100.0
Lanai	18	13	1	5.2	100.0
Molokai	38	10	14	3.9	100.0
Oahu	44	30	-	10.6	79.0
Kauai	33	25	11	10.8	67.0
Niihau	18	6	3	2.4	100.0
Island	Percent of area with elevation --		Approximate mean altitude (feet)	Percent of area with slope --	
	Less than 500 feet	2,000 feet or more		Less than 10 percent	20 percent or more
The State ..	20.8	50.9	3,030	63.5	17.0
Hawaii	12.0	68.4	3,950	76.0	4.0
Maui	24.9	41.4	2,390	38.5	36.0
Kahoolawe	38.9	0	600	60.0	9.0
Lanai	24.8	6.3	1,140	61.0	16.0
Molokai	37.3	17.8	1,150	53.0	26.0
Oahu	45.3	4.6	860	42.5	45.5
Kauai	35.6	24.0	1,380	33.5	50.5
Niihau	78.2	0	530	68.0	12.5

^{1/} According to Lee S. Motteler, Geography and Map Division, Bernice P. Bishop Museum, the sea cliffs along the northeastern coast of Molokai between Umilehi Point and Puukaoku Point drop 3,250 feet at an average slope of 58 degrees. These cliffs have been described by the Guinness Book of World Records (1984 edition, p. 108) as "the highest sea cliffs yet pinpointed anywhere in the world."

Source: Hawaii State Department of Planning and Economic Development, Hawai'i, the Natural Environment (1974), p. 19; U.S. Geological Survey, Elevations and Distances in the United States (1978), pp. 4-5.

Table 169.-- VOLCANIC ERUPTIONS: 1969 TO 1984

[Complete through June 30, 1984. Four volcanoes have erupted in historical times: Haleakala, last active around 1790; Hualalai, last active in 1800-1801; and Kilauea and Mauna Loa, both active during the past decade and included in this table]

Volcano and date of outbreak	Repose period since previous eruption (months)	Duration (days)	Location ^{1/}	Elevation (feet)	Area (square miles)	Volume (1,000 cubic yards)
Mauna Loa:						
1975: July 5	301	<1	S	13,000	5.2	35,000
1984: March 25 ..	104	22	S, ER	13,200-9,400	11±	230,000
Kilauea:						
1969: Feb. 22 ...	4.0	6	ER	3,100-2,900	2.3	22,000
May 24	2.0	867	ER	3,150	19.3	242,000
1971: Aug. 14 ...	-	<1	C	3,660-3,600	0.8	12,400
Sept. 24 ..	-	5	C, SWR	3,740-2,730	1.5	10,500
1972: Feb. 4	4.3	455	ER	3,150	13.5	163,800
1973: May 5	-	<1	ER	3,340-3,250	0.1	1,600
Nov. 10 ...	-	30	ER	3,250-2,900	0.4	3,700
Dec. 12 ...	0.1	203	ER	3,150	3.1	39,300
1974: July 19 ...	-	3	C, ER	3,600-3,520	1.2	9,000
Sept. 19 ..	2.0	<1	C	3,680	0.4	14,000
Dec. 31 ...	3.4	<1	C	3,600	2.9	19,600
1975: Nov. 29 ...	11.0	<1	C	3,600-3,520	0.1	300
1977: Sept. 13 ..	21.5	18	ER	2,080-1,600	3.0	45,000
1979: Nov. 16 ...	26.3	1	ER	3,270-3,200	0.1	800
1982: April 30 ..	29.5	<1	C	3,630	0.1	260
Sept. 25 ..	4.9	<1	C	3,620	0.3	3,900
1983: Jan. 3	3.3	545	ER	2,560-2,120	(NA)	168,000

NA Not available.

^{1/} C, caldera; ER, east rift; S, summit; SWR, southwest rift.

^{2/} Less than 100 square feet.

Source: Gordon A. Macdonald and Douglass H. Hubbard, Volcanoes of the National Parks in Hawaii, 8th edition (Hawaii Natural History Association, 1982), pp. 10, 19, 34, and 58, as updated by the staff of the Hawaiian Volcano Observatory through June 30, 1984.

Table 170.-- EARTHQUAKES OF MAGNITUDE 5 OR GREATER: 1974 TO 1984

[Complete to March 31, 1984]

Date	Location	Magnitude (Richter Scale)
1974: Nov. 30	Hawaii	5.5-6.0
1975: Jan. 1, 2:41 AM ...	Near Pahala, Hawaii	5.1
Jan. 1, 3:20 AM ...	Mauna Loa, Hawaii	5.1
Jan. 2	Near Pahala, Hawaii	5.6
Jan. 5	Mauna Loa, Hawaii	5.1
Nov. 29, 3:35 AM ..	Puna, Hawaii	5.7
Nov. 29, 4:47 AM ..	Puna, Hawaii	7.2
1977: Jan. 22	100 miles S. of Kauai	5.0
1979: March 29	40 miles S.W. of Oahu	5.5
Sept. 21	Puna, Hawaii	5.5
1981: March 5	Molokai area	5.0
Nov. 10	Kilauea, Hawaii	5.3
1982: Jan. 21, 11:52 AM .	Mauna Loa, Hawaii	5.5
Jan. 21, 12:29 PM .	Mauna Loa, Hawaii	5.5
May 14	Off Kawaihae, Hawaii	5.0
1983: Nov. 16	S.E. flank of Mauna Loa ..	6.3-6.6

Source: Hawaii Institute of Geophysics, records; U.S. Geological Survey, National Earthquake Information Service. Data provided by Professor Augustine S. Furumoto, Hawaii Institute of Geophysics, University of Hawaii, May 9, 1984.

Table 171.-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE:
1924 TO 1984

[Correct to March 31, 1984]

Date	Maximum height in Hawaii		Deaths in Hawaii	Damage in Hawaii (dollars)
	Meters	Feet		
1924: May 30	5 (?)	16 (?)	-	Great locally
1933: March 2	2.9	9.5	-	Some
1946: April 1	17.0	55.8	159	26,000,000
1952: Nov. 4	6.1	20.0	-	1,000,000
1957: March 9	16.0	52.5	-	5,000,000
1960: May 22	10.5	34.5	61	23,000,000
1964: March 27	4.8	15.7	-	67,590
1975: Nov. 29	14.6	48.0	2	1,500,000

Source: George Pararas-Carayannis, Catalog of Tsunamis in the Hawaiian Islands (U.S. Coast and Geodetic Survey, May 1969); Robert C. Schmitt, "Catastrophic Mortality in Hawaii," The Hawaiian Journal of History, Vol. III (1969), pp. 66-86; Harold G. Loomis, The Tsunami of November 29, 1975 in Hawaii (Hawaii Institute of Geophysics, December 1975), pp. 1 and 10; D.C. Cox and J. Morgan, Local Tsunamis and Possible Local Tsunamis in Hawaii (Hawaii Institute of Geophysics, Report HIG 77-14, November 1977); Hawaii Institute of Geophysics, records.

Table 172.-- MAJOR DAMS: 1984

Name	Location	Height (ft.)	Length (ft.)	Volume of water impounded (acre ft.)
Wahiawa Dam ...	Wahiawa, Oahu	98	460	7,671
Waita	Koloa, Kauai	28	3,250	6,500
Kualapuu	Kualapuu, Molokai .	58	7,100	4,265
Alexander Dam .	Kalaheo, Kauai	119	600	2,500
Nuuanu No. 4 ..	Honolulu, Oahu	73	1,730	1,420

Source: Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 173.-- WATER USE, BY TYPE, BY ISLANDS: 1980

[Millions of gallons per year]

Type of water and use	State total	Hawaii	Maui	Lanai
Agricultural:				
Ground water	136,510	1,720	47,300	330
Surface water	237,950	3,630	129,130	-
Recycled water	32,970	50	9,730	-
Commercial:				
Ground water	2,770	1,470	-	-
Domestic:				
Ground water	71,770	2,280	3,830	140
Surface water	3,880	130	3,500	-
Hydroelectric:				
Surface water	74,190	22,840	14,620	-
Industrial, thermoelectric:				
Ground water	31,520	24,740	-	-
Surface water	2,170	-	-	-
Seawater <u>1/</u>	447,810	3,140	14,820	-
Industrial, other uses:				
Ground water	18,680	2,030	2,810	-
Surface water	11,220	4,080	2,910	-
Recycled water	4,130	1,900	160	-

Continued on next page.

Table 173.-- WATER USE, BY TYPE, BY ISLANDS: 1980 -- Con.

Type of water and use	Molokai	Oahu	Kauai	Niihau
Agricultural:				
Ground water	140	70,360	16,650	10
Surface water	990	16,170	88,030	-
Recycled water	-	3,350	19,840	-
Commercial:				
Ground water	-	410	890	-
Domestic:				
Ground water	270	63,250	1,990	10
Surface water	80	-	170	-
Hydroelectric:				
Surface water	-	-	36,730	-
Industrial, thermoelectric:				
Ground water	10	4,880	1,890	-
Surface water	-	-	2,170	-
Seawater <u>1/</u>	-	425,900	3,950	-
Industrial, other uses:				
Ground water	-	7,340	6,500	-
Surface water	30	-	4,200	-
Recycled water	-	200	1,870	-

1/ Includes water from wells near the seacoast.

Source: Data compiled by U.S. Geological Survey, cited in Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, Water Use in Hawaii, 1980 (Report No. R-79, 1984).

Table 174.-- POLLUTION ABATEMENT COSTS AND EXPENDITURES: 1982

[Unless otherwise specified, in millions of dollars]

Subject	State total	Oahu
Total pollution abatement capital expenditures	1.7	(NA)
Air	0.4	(NA)
Water	0.6	(NA)
Solid waste	0.6	(NA)
Gross annual cost of pollution abatement	12.6	6.1
Payments to government units	1.2	0.9
Operating costs	11.4	5.2
Air	3.1	2.1
Water	4.0	2.0
Solid waste	4.3	1.1
Cost recovered	0.9	0.7
Air	0.3	0.1
Water	0.6	0.6
Solid waste	-	-
Quantities of pollutants removed (1,000 short tons):		
Air:		
Particulates	45.1	(D)
Sulfur dioxides	6.7	6.7
Water:		
Total suspended solid	1,355.5	(D)
Biochemical oxygen demand	0.6	0.4
Other water pollutants	0.2	(D)
Solid waste	1,770.6	159.3

D Withheld to avoid disclosing operations of individual companies.

NA Not available.

Source: U.S. Bureau of the Census, "Pollution Abatement Costs and Expenditures, 1982," Current Industrial Reports, MA-200(82)-1 (February 1984), pp. 26, 41, 43, 56, 58, 71, and 73.

Table 175.-- WATER QUALITY AT SPECIFIED PUBLIC BEACHES: 1980 TO 1983

Island and beach	Number of samples, 1983	Fecal coliform density 1/ (geometric mean, MPN/100 ml)			
		1980	1981	1982	1983
Hawaii (Hilo side):					
Exit of Ice Pond	11	41.6	178.3	27.3	27.5
Leileiwi Beach Park	25	195.5	219.3	222.6	121.1
Onekahakaha	11	13.5	8.2	17.3	6.4
Puhi Bay No. 3	8	9.1	30.4	18.1	12.6
Hawaii (Kona side):					
Hapuna Beach	6	16.2	19.5	33.0	15.2
Kahaluu Beach	6	2.5	2.0	2.3	6.4
Kealakekua Bay (off curio stand) .	6	2.5	2.3	2.3	3.9
Kealakekua Bay (off canoe landing)	6	2.8	2.4	2.3	4.4
Magic Sands Beach	6	3.6	2.4	8.0	3.4
Puako Beach Lots (middle)	6	16.7	9.0	29.6	21.4
Puako Beach Lots (far end)	6	35.8	18.6	74.0	21.2
Spencer Beach Park	6	7.8	29.5	14.6	4.7
Maui:					
Hukilau Hotel shoreline	12	3.3	2.0	2.9	3.3
Kahului Breakwater	-	2.1	2.0	3.1	...
Wailuku Breakwater	-	4.2	2.8	3.4	...
Maui Sheraton	12	...	2.0	2.7	2.3
Oahu:					
Ala Moana Park (ewa)	21	5.1	5.6	11.0	6.8
Ala Moana Park (center)	12	3.1	4.1	4.9	2.0
Ala Moana Park (diamond head)	12	7.9	5.4	5.8	6.2
Elks Club Beach	12	5.9	4.0	4.9	4.0
Ewa Beach	11	4.3	6.3	5.5	4.4
Ft. DeRussy Beach	12	7.2	5.2	18.5	5.6
Gray's Beach	21	5.7	5.7	6.0	5.7
Hanauma Bay	24	5.1	8.1	13.0	6.8
Kahana Park Beach	12	35.9	43.6	62.2	24.0
Kahanamoku Beach	12	8.9	4.5	3.3	3.4
Kahanamoku Lagoon (diamond head) .	22	127.3	79.8	38.5	23.3
Kailua Bay outfall shoreline	12	8.8	2.3	5.3	2.0
Kailua Beach Park	12	13.2	3.7	5.7	3.1
Kokokahi Pier	14	60.6	25.6	48.5	29.8
Kuhio Beach	14	37.3	5.2	23.9	9.7
Public Bath Beach	21	4.6	3.6	3.3	2.5
Tavern Beach	13	17.9	3.5	7.3	4.4
Sand Island Pt. No. 3	12	8.9	4.4	2.7	2.9

Continued on next page.

Table 175.-- WATER QUALITY AT SPECIFIED PUBLIC BEACHES: 1980 TO 1983 - Con.

Island and beach	Number of samples, 1983	Fecal coliform density 1/ (geometric mean, MPN/100 ml)			
		1980	1981	1982	1983
Kauai:					
Brennecke Beach	5	2.7	2.0	2.0	4.1
Hanalei Bay Landing	5	30.6	16.7	60.1	86.0
Poipu Beach	5	2.3	2.7	2.5	2.0

MPN Most probable number.

1/ The geometric mean standard for fecal coliform density is 200 per 100 ml.

Source: Hawaii State Department of Health, Pollution Investigation and Enforcement Branch, data supplied May 2, 1984.

Table 176.-- WATER SERVICES AND CONSUMPTION, FOR COUNTY WATERWORKS: 1982 AND 1983

Geographic area	Number of services, June 30		Consumption 1/ (millions of gallons)	
	1982	1983	1982	1983
State total	179,648	181,980	56,719	59,724
City and County of Honolulu ..	126,400	127,540	42,646	44,535
Honolulu 2/	58,159	58,173	24,317	25,658
Rest of Oahu	68,241	69,367	18,329	18,877
Hawaii County	23,682	24,218	4,753	5,066
Kauai County	10,823	11,049	2,805	3,240
Maui County	18,743	19,173	6,515	6,883
Maui	17,607	18,007	6,235	6,592
Molokai	1,136	1,166	280	292

1/ Year ended June 30.

2/ Maunaloa to Moanalua.

Source: Honolulu Board of Water Supply, Annual Report and Statistical Summary for 1981-1982 and 1982-1983; Hawaii County Department of Water Supply, records; Kauai Department of Water, records; Maui Department of Water Supply, records.

Table 177.-- AIR QUALITY IN DOWNTOWN HONOLULU:
1973 TO 1983

[Sampling is conducted approximately 46 ft. above ground on the roof of the State Health Department building, 1250 Punchbowl Street, Honolulu, Hawaii]

Year	Annual arithmetic means (ug/m ³)	
	Total suspended particulates	Sulfur oxides
1973	34	7
1974	35	10
1975	40	9
1976	34	23
1977	31	17
1978	29	18
1979	32	22
1980	37	18
1981	40	19
1982	29	11
1983	26	<5
Standards: 1/		
Primary	75	80
Secondary	60	...

1/ Primary and secondary National Ambient air quality standards have been promulgated by the Federal government. Primary standards are designed to prevent adverse effects on public health, while secondary standards are designed to prevent adverse effects on public welfare, including the effects on comfort, visibility, vegetation, animals, aesthetic values, and soiling and deterioration of materials.

Source: Hawaii State Department of Health, Pollution Investigation and Enforcement Branch, data supplied May 2, 1984.

Table 178.-- SOURCES OF AIR POLLUTANT EMISSIONS, BY COUNTIES: 1980

[Percent distributions for the sums of weights of sulfur oxides, particulate matter, carbon monoxide, hydrocarbons, and nitrogen oxide emissions]

Source	State total	Hawaii	Honolulu	Kauai	Maui
All sources	100.0	100.0	100.0	100.0	100.0
Transportation	43.0	38.1	47.4	40.6	35.8
Motor vehicles	40.1	36.2	43.9	35.7	33.1
Aircraft	2.3	1.1	2.9	2.3	1.6
Vessels	0.6	0.8	0.6	2.6	1.1
Fuel combustion in					
stationary sources	29.7	34.9	26.7	32.2	35.3
Steam electric	23.1	19.8	24.6	18.5	22.4
Gas utilities	0.1	(N)	0.1	(N)	(N)
Ag. fuel	6.5	15.1	2.0	13.7	12.9
Industrial process losses ..	14.6	7.7r	20.3	3.2	3.5
Refinery	4.8	(N)	6.5	(N)	(N)
Petroleum storage	0.7	1.1	0.8	(N)	0.5
Metalurgical	0.1	(N)	0.1	(N)	(N)
Mineral products	6.9	3.9	10.8	0.9	1.1
Off-highway const., farms and industries	2.1	2.7	2.1	2.3	1.9
Municipal incinerator	0.9	(N)	1.3	(N)	(N)
Agricultural burning	11.7	19.3	4.3	24.2	25.4

r Revised from Data Book 1983, table 148.

N Less than 0.05 percent.

Source: Hawaii State Department of Health, Environmental Permits Branch, information provided May 2, 1984.

Table 179.-- AIR QUALITY AT SPECIFIED LOCATIONS: 1983

[24-hour sampling, in micrograms per cubic meter]

Sampling station	Total suspended particulates			Sulfur dioxide		
	Annual range		Arith- metic average	Annual range		Arith- metic average
	Minimum	Maximum		Minimum	Maximum	
Oahu:						
Barbers Point ...	28	193	54	<5	95	5.2
Downtown Honolulu	14	58	26	<5	16	<5
Kalihi Kai 1/ ...	23	98	43	...	...	...
Pearl City	17	57	30	<5	...	<5
Waikiki 1/	18	59	33	...	5	...
Waimanalo	11	45	23	...	...	...
Maui:						
Kahului	4	163	69	<5	67	5.6
Kihei	12	139	45	...	...	...
Hawaii:						
Hilo	7	50	17	<5	23	<5
Kauai:						
Lihue	18	90	39	<5	<5	<5

1/ SO_x sampling discontinued January 1, 1983.

Source: Hawaii State Department of Health, Pollution Investigation and Enforcement Branch, data supplied May 2, 1984.

Table 180.-- NOISE LEVELS IN SPECIFIED NEIGHBORHOODS ON OAHU: 1981-1982

[Data collected during the latter part of 1981 and throughout 1982, during daylight hours only. Data were obtained from both manual sampling, utilizing on-site noise-level readouts, and automatic sampling, utilizing a community noise analyzer. Differences in noise levels as measured by the two types of sampling result from the inclusion in the automatic samplings of such sources as vehicles traveling near the microphone, barking dogs, or other instantaneous sounds. With manual samplings, these sources are eliminated from the recorded data]

Neighborhood	Noise levels (in decibels) exceeded --					
	Manual sampling			Automatic sampling		
	10 percent of time	50 percent of time	90 percent of time	10 percent of time	50 percent of time	90 percent of time
HONOLULU						
Aina Haina	45.6	42.1	39.5	53.5	46.2	43.2
Aina Koa	48.1	43.1	40.1	52.9	45.8	42.5
Downtown	57	55	54	60	57	55
Hawaii Kai	46.5	41.6	38.9	53.5	46.9	42.9
Kahala	48.0	44.5	42.4	-	-	-
Kaimuki	51.8	44.6	41.7	57.2	47.6	43.3
Kalihi	53.5	49.6	47.4	-	-	-
Kapahulu	47.2	45.0	42.0	-	-	-
Kapalama-Liliha	46.4	45.1	42.5	-	-	-
Kuliouou	48.6	45.9	43.4	52.5	47.9	45.4
Liliha	46	45	43	-	-	-
Makiki	52.7	46.9	45.3	56.5	50.5	48.6
Manoa	45.4	42.6	40.7	51.5	46.0	43.4
Moiliili	53.7	50.2	46.9	60.0	53.4	48.9
Nuuanu	46.6	43.6	40.8	-	-	-
Palolo	49.3	44.6	41.6	65.0	52.4	45.4
Pawaa	59.8	57.1	55.2	60.8	57.1	54.7
Salt Lake	56	52	49	-	56	51
Waikiki	57.8	55.4	54.1	61.6	57.5	55.3
Waialae Iki ...	46.4	43.1	40.6	54.6	44.8	41.7
REST OF OAHU						
Aiea	58	54	52	59	56	54
Halawa	52	46	44	55	50	47
Hauula	53	48	45	56	51	47
Kailua	49.2	45.5	42.9	54.9	49.6	45.2
Kaneohe	43.8	40.9	38.9	49.7	43.5	40.9

Continued on next page.

Table 180.-- NOISE LEVELS IN SPECIFIED NEIGHBORHOODS ON OAHU:
1981-1982 -- Con.

Neighborhood	Noise levels (in decibels) exceeded --					
	Manual sampling			Automatic sampling		
	10 percent of time	50 percent of time	90 percent of time	10 percent of time	50 percent of time	90 percent of time
REST OF OAHU -- Con.						
Mililani	44	37	34	53	46	41
Nanakuli	54	50	47	58	52	48
Pearl City	51	47	45	55	50	48
Wahiawa	47.1	44.7	42.4	51.8	47.3	43.9
Waimanalo	53	50	48	55	51	49
Waipahu	54.1	50.5	47.4	58.8	53.6	50.4

Source: Hawaii State Department of Health, Environmental Protection and Health Services Division, Noise and Radiation Branch, records.

Table 181.-- AVERAGE WATER TEMPERATURES AT WAIKIKI BEACH

[In Fahrenheit degrees]

Month	Morning	Afternoon
March	75	77
August	77	82

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii, 1983.

Table 182.-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES

Island and station	Ground elevation (feet)	Average temperature (°F.)		Extreme temperature of record (°F.)		Average annual precipitation (inches)
		Coolest month	Warmest month	Lowest	Highest	
Hawaii:						
Hilo Airport	27	71.2	75.9	53	94	127.40
Hawaii Volcanoes Nat. Park Hdq. .	3,971	57.6	63.2	37	85	102.81
Kailua	30	72.1	77.3	54	93	25.22
Puako <u>1/</u>	10	73.1	79.8	52	98	9.47
Waimea (Kamuela)	2,670	62.3	66.8	34	90	40.05
Mauna Kea summit <u>2/</u>	13,796	31.3	42.5	11	66	8.08
Maui:						
Hana	120	71.3	76.8	50	90	70.65
Haleakala summit	9,960	42.6	50.0	14	73	50.69
Kihei <u>3/</u>	90	70.9	78.4	49	98	13.79
Kahului Airport	48	71.6	79.0	48	96	18.76
Lahaina	45	71.5	78.0	52	93	15.51
Molokai:						
Kaunakakai	12	...	...	...	...	14.08
Molokai Airport	450	70.2	77.6	48	90	29.21
Lanai:						
Lanai City	1,620	65.8	72.8	46	88	38.44
Oahu:						
Honolulu International Airport ..	7	72.5	80.1	53	93	22.83
Honolulu (Old Federal Bldg.) <u>4/</u> .	12	72.0	78.6	57	88	25.35
Waikiki (Honolulu Zoo)	10	71.9	80.6	51	93	27.32
Manoa (Lyon Arboretum)	500	69.4	75.2	...	...	158.41
Kaneohe MCAS	10	72.9	79.1	58	90	43.88
Kahuku	25	71.6	78.8	49	95	41.10
Wheeler AFB	826	68.2	75.5	52	89	39.85
Waianae	20	72.1	79.7	45	96	20.31

Continued on next page.

Table 182.-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES -- Con.

Island and station	Ground elevation (feet)	Average temperature (°F.)		Extreme temperature of record (°F.)		Average annual precipitation (inches)
		Coollest month	Warmest month	Lowest	Highest	
Kauai:						
Kilauea (town)	315	68.7	75.6	49	94	68.03
Lihue Airport	103	70.2	77.9	50	90	43.92
Poipu (Makahuena Pt.)	52	72.4	79.4	50	93	36.39
Kokee (Kanalohuluhulu)	3,600	54.9	65.5	31	80	72.25
Waialeale	5,075	...	...	...	...	451.00
Northwestern Hawaiian Islands:						
Midway	10	65.0	78.6	52	89	43.60

1/ Temperature data are for Mahukona.

2/ Based on incomplete and non-continuous data for 1966-1972.

3/ Temperature data refer to Puunene Airport.

4/ Temperature sensors were 87 feet above the ground.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service Pacific Region, data supplied March 17, 1976 and May 2, 1977, and National Climatic Data Center, Local Climatological Data, Annual Summary With Comparative Data, 1983 for Hilo, Kahului, Honolulu, and Lihue; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, data supplied September 14, 1984.

Table 183.-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT

Month	Normal temperature (°F)			Extreme temperature (°F) 1/		Precipitation (inches)			
	Daily maximum	Daily minimum	Monthly	Record highest	Record lowest	Normal total	Maximum monthly	Minimum monthly	Maximum in 24 hours
Jan. .	79.9	65.3	72.6	87	53	3.79	14.74	0.32	6.72
Feb. .	80.4	65.3	72.9	87	53	2.72	13.68	0.06	6.88
Mar. .	81.4	67.3	74.4	88	55	3.48	20.79	0.01	17.07
Apr. .	82.7	68.7	75.7	89	59	1.49	8.92	0.01	4.21
May ..	84.8	70.2	77.5	90	62	1.21	7.23	0.05	3.44
June .	86.2	71.9	79.1	91	65	0.49	2.46	T	2.28
July .	87.1	73.1	80.1	91	67	0.54	2.01	0.03	1.03
Aug. .	88.3	73.6	81.0	92	67	0.60	3.08	T	2.35
Sept.	88.2	72.9	80.6	92	66	0.62	2.74	0.05	1.40
Oct. .	86.7	72.2	79.5	93	64	1.88	11.15	0.11	7.57
Nov. .	83.9	69.2	76.6	90	58	3.22	14.72	0.03	9.15
Dec. .	81.4	66.5	74.0	89	54	3.43	12.09	0.06	8.14
Ann. .	84.2	69.7	77.0	93	53	23.47	20.79	T	17.07

Continued on next page.

Table 183.-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT -- Con.

Month	Relative humidity (percent) <u>2/</u>		Wind (miles/hour)		Percent of possible sunshine	Mean sky cover, sunrise to sunset <u>3/</u>	Mean number of days		
	8 A.M.	2 P.M.	Mean speed	Fastest mile			Sunrise to sunset		Precip. .01 inch or more
							Clear	Cloudy	
Jan. ...	82	63	9.8	67	61	5.5	9	9	10
Feb. ...	78	60	10.5	63	63	5.7	7	8	9
Mar. ...	73	58	11.6	59	68	5.9	7	10	9
Apr. ...	70	57	12.1	40	66	6.3	6	11	9
May	67	55	12.1	35	68	6.0	6	10	7
June ...	67	53	12.8	39	70	5.7	6	7	6
July ...	68	52	13.6	34	73	5.3	7	5	8
Aug	68	54	13.3	52	74	5.3	8	6	7
Sept. ..	68	52	11.7	36	75	5.2	8	6	7
Oct. ...	69	55	10.9	40	68	5.6	7	8	9
Nov. ...	75	59	10.9	65	61	5.7	7	9	9
Dec. ...	79	62	10.7	59	58	5.6	8	10	10
Ann. ...	72	57	11.7	67	67	5.7	86	99	101

T Trace, an amount too small to measure.

1/ For periods October 1962 through December 1964 and September 1971 through December 1983.

2/ Data for 1963, 1964, and 1972-1983.

3/ Sky cover is expressed in a range of 0 for no clouds or obscuring phenomena to 10 for complete sky cover.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary With Comparative Data, Honolulu, 1983.

Table 184.-- CLIMATIC DATA FOR THE PERIOD OF RECORD

Subject	Date	Place	Magnitude
Long-term averages:			
Lowest monthly average minimum temp. (°F.) ..	February	Mauna Kea summit ..	23.5
Lowest monthly average daily temp. (°F.)	February	Mauna Kea summit ..	31.3
Highest monthly average maximum temp. (°F.) .	September	Kawaihae 1/	91.9
Highest monthly average daily temp. (°F.) ...	September	Kawaihae <u>1</u> /	80.8
Lowest average annual rainfall (inches) .....	.....	Kawaihae	8.7
Highest average annual rainfall (inches) ....	.....	Waialeale	451
Single events:			
Lowest temperature of record (°F.)	Jan. 20, 1970 ...	Mauna Kea summit <u>2</u> /	1.4
Highest temperature of record (°F.)	April 27, 1931 ..	Pahala	100
Lowest annual rainfall of record (inches) ...	1953	Kawaihae	0.2
Highest annual rainfall of record (inches) ..	1982	Waialeale	666
Highest wind speed of record (m.p.h.)	Nov. 23, 1982 ...	Makahuena Pt. <u>3</u> / ..	117

1/ Puukohola Heiau National Historical Site, Kawaihae, Hawaii.

2/ Recorded by Dr. Alfred Woodcock 60 meters inside the Mauna Kea summit cone, at 6:50 a.m. The rim at that time had a temperature of 39° F.

3/ Makahuena Point Coast Guard Station, Poipu, Kauai.

Source: U.S. Department of Commerce, National Weather Service, Pacific Region, data supplied March 14, 1973; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, data supplied September 14, 1984.

Table 185.-- CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT: ANNUALLY,
1973 TO 1983

Year	Average temperature (°F)			Extreme temp. (°F)		Precipitation (inches)
	Annual	Coolest month	Warmest month	Lowest	Highest	
1973 ...	77.2	72.6	81.2	55	91	14.24
1974 ...	77.5	74.0	81.2	58	92	24.02
1975 ...	76.2	72.4	80.1	56	90	24.39
1976 ...	76.8	72.0	80.8	53	91	12.90
1977 ...	78.2	73.7	82.2	59	92	12.36
1978 ...	76.8	72.4	80.5	57	91	25.05
1979 ...	77.0	69.9	81.1	57	93	16.93
1980 ...	77.5	71.9	81.6	56	91	26.90
1981 ...	77.1	73.2	80.7	53	90	13.41
1982 ...	76.9	71.7	81.4	56	92	34.92
1983 ...	77.2	71.3	82.4	53	92	5.03

Year	Relative humidity (percent)		Wind speed (miles/hour)		Percent of possible sunshine	Days with precipitation .01 inch or more
	8 A.M.	2 P.M.	Annual average	Fastest mile		
1973 ...	70	54	12.7	33	63	110
1974 ...	73	58	10.9	34	61	118
1975 ...	72	56	12.2	36	62	82
1976 ...	64	52	11.5	38	60	105
1977 ...	71	55	12.2	37	68	81
1978 ...	74	58	11.9	34	69	90
1979 ...	74	57	11.4	34	68	89
1980 ...	75	59	11.9	35	69	115
1981 ...	76	59	10.7	30	72	97
1982 ...	73	59	10.4	46	56	124
1983 ...	75	52	9.8	23	64	78

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary With Comparative Data, Honolulu, Hawaii (annual).

Table 186.-- CLIMATIC DATA FOR HILO, KAHULUI, HONOLULU, AND LIHUE AIRPORTS

Subject	Hilo	Kahului	Honolulu	Lihue
Normal temperatures (°F.):				
Daily maximum	81.2	83.8	84.2	81.1
Daily minimum	65.9	67.2	69.7	69.3
Monthly: Coolest month	71.2	71.5	72.6	71.3
Warmest month	75.9	79.2	81.0	79.1
Annual	73.6	75.5	77.0	75.2
Extreme temperatures (°F.):				
Record highest	94	96	93	90
Record lowest	53	48	53	50
Normal degree days, base 65°F.:				
Heating	-	-	-	-
Cooling	3,134	3,851	4,389	3,758
Precipitation (inches):				
Normal	128.15	19.84	23.47	44.02
Maximum monthly	50.82	14.46	20.79	22.91
Minimum monthly	0.28	0.00	T	T
Relative humidity (percent):				
8 A.M.	80	75	72	78
2 P.M.	68	57	57	67
Wind speed (m.p.h.):				
Mean	7.1	12.8	11.7	11.8
Fastest mile	30	44	67	73
Percent of possible sunshine	40	69	67	56
Mean number of days:				
Clear	34	127	86	53
Partly cloudy	128	149	180	177
Cloudy	203	89	99	135
Precipitation .01 inch or more .	279	98	101	203

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, Local Climatological Data, Annual Summary with Comparative Data, 1983 for Hilo, Kahului, Honolulu, and Hilo.

Table 187.-- RAINFALL AT SPECIFIED LOCATIONS:
ANNUALLY, 1973 TO 1983

[In inches]

Year	Hawaii			Maui		
	Hilo Airport	Kona Airport	Kona Village	Kahului Airport	Kihei	Lahaina
1973 ...	107.97	12.49	4.17	10.27	5.92	10.13
1974 ...	112.92	35.57	8.10	18.68	14.97	13.01
1975 ...	99.93	20.28	15.64	13.74	10.63	12.19
1976 ...	114.67	17.32	7.04	12.83	8.84	8.86
1977 ...	90.38	14.60	3.40	11.50	7.88	8.28
1978 ...	119.09	18.93	8.68	19.15	9.91	11.97
1979 ...	158.77	...	16.00	26.82	21.32	20.85
1980 ...	127.74	...	16.90	27.87	20.27	22.69
1981 ...	89.91	...	7.02	12.85	9.72	8.13
1982 ...	170.36	...	26.88	34.04	29.11	34.36
1983 ...	68.09	...	8.51	13.05	8.60	9.70
Year	Oahu			Kauai		
	Waikiki	Univ. of Hawaii	Nuuanu Res. 4	Koloa	Lihue Airport	Princeville
1973 ...	18.79	36.42	99.42	66.78	35.27	102.48
1974 ...	24.51	44.62	130.94	86.35	45.60	130.40
1975 ...	25.98	39.25	101.42	49.91	35.52	62.36
1976 ...	13.59	26.83	86.44	62.60	32.83	109.34
1977 ...	15.73	32.83	88.96	52.51	40.34	84.55
1978 ...	27.18	41.56	124.42	70.64	39.11	130.82
1979 ...	26.22	46.74	111.56	55.98	37.09	93.19
1980 ...	28.50	48.52	140.70	78.78	54.64	130.55
1981 ...	19.09	31.71	112.46	66.26	38.14	130.72
1982 ...	39.96	57.98	168.16	96.75	74.40	241.22
1983 ...	9.80	19.77	74.32	50.69	16.40	46.93

Source: U.S. Department of Commerce, National Climatic Data Center, Local Climatological Data, Annual Summary with Comparative Data, 1983 for Hilo, Kahului, and Lihue and Climatological Data Annual Summary, Hawaii and Pacific (annual); U.S. Department of Commerce, National Weather Service, Pacific Region, records; and Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, records.

Table 188.-- TRADE WINDS, HIGH SURF, AND TEMPERATURES IN HAWAIIAN WATERS,
BY MONTHS

Month	Trade wind frequency ^{1/} (percent)	Expected days of strong trade winds ^{2/}	Highest surf ^{3/} (average number of days)		Water temperature (°F.)	
			Flat or 1 foot	6 feet or more	Mean maximum	Mean minimum
Jan. ...	42	9	1	19	74.7	71.1
Feb. ...	55	7	1	16	75.6	70.3
March ..	61	10	1	12	76.5	71.8
April ..	74	10	3	7	77.7	73.0
May	86	7	8	3	79.5	74.7
June ...	91	7	15	-	81.1	77.7
July ...	95	10	16	-	81.1	78.3
Aug. ...	94	7	15	-	81.9	79.2
Sept. ..	83	4	10	2	81.9	78.4
Oct. ...	71	4	1	12	81.1	77.2
Nov. ...	64	8	-	19	79.3	74.5
Dec. ...	57	9	-	20	75.9	71.4
Ann. ...	65	92	71	110	78.6	74.8

^{1/} Mean monthly frequency of trade winds in Hawaiian waters.

^{2/} Expected number of hazardous days in Hawaiian waters due to strong trade winds.

^{3/} Observations at Sunset Beach, Oahu. Annual averages were: flat or 1 foot, 71 days; 2-5 feet, 184 days; 6-10 feet, 71 days; 11-15 feet, 26 days; 16 feet or higher, 13 days.

^{4/} Observations at Kaneohe, Oahu. The mean ranged from 73.0 in January and February to 80.2 in August. Absolute maximums and minimums were respectively 84 (in July, August, and October) and 68 (December and February).

Source: Paul Haraguchi, Weather in Hawaiian Waters (Honolulu: Pacific Weather, Inc., 1979), pages 14, 22, 56, and 74.

Table 189.-- MAJOR HURRICANES: 1950 TO 1984

[Complete to September 16, 1984]

Hurricane name	Date ^{1/}	Islands most affected	Maximum winds ashore (m.p.h.)		Deaths	Property damage (million dollars)
			Sus-tained	Gusts		
Hiki	Aug. 12-16, 1950	Kauai	68	(NA)	1	0.200
Della	Sept. 1-17, 1957	French Frig. Shoals	82	109	-	Minor
Nina	Nov. 29-Dec. 7, 1957	Kauai	92	(NA)	4	1.056
Dot	Aug. 1-8, 1959	Kauai	81	103	-	5.5+
Fico	July 17-28, 1978	Hawaii	(NA)	58+	-	0.188
Iwa	Nov. 19-25, 1982	Kauai, Oahu	65	117	-	234

NA Not available.

^{1/} Total duration, including period outside Hawaiian waters.

Source: Samuel L. Shaw, A History of Tropical Cyclones in the Central North Pacific and the Hawaiian Islands, 1832-1979 (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, September 1981); Hawaii State Department of Defense, Civil Defense Division, Catalogue of Natural and Man-Caused Incidents and Disasters in the Hawaiian Islands (December 1978); The Governor's Ad Hoc Committee on the Economic Impact of Hurricane Iwa, Hurricane Iwa's Economic Impact on Hawaii (January 1983); "The History of Hurricanes in Hawaii," Honolulu Star-Bulletin, July 18, 1983, p. A-5; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, letter dated December 5, 1983.

Table 190.-- TROPICAL CYCLONES IN THE HAWAIIAN ISLANDS
AND CENTRAL NORTH PACIFIC: 1832 TO 1983

Period	Number
1832 to 1899 ^{1/}	6
1900 to 1949 ^{T/}	13
1950 to 1959	17
1960 to 1969	34
1970 to 1979	34
1980 to 1983	18

^{1/} Data prior to 1950 are thought to be seriously incomplete.

Source: Samuel L. Shaw, A History of Tropical Cyclones in the Central North Pacific and the Hawaiian Islands, 1832-1979 (U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Weather Service, September 1981), p. 109; Hawaii State Department of Land and Natural Resources, Division of Water and Land Development, data provided September 14, 1984.

Table 191.-- SUNRISE, SUNSET, AND HOURS OF DAYLIGHT AT HILO, HONOLULU,
AND LIHUE, FOR SELECTED DATES

[Hawaiian Standard Time]

Subject	March 21	June 21	Sept. 23	Dec. 22
Sunrise (A.M.):				
Hilo	6:24	5:42	6:09	6:51
Honolulu	6:35	5:50	6:21	7:05
Lihue	6:41	5:55	6:26	7:12
Sunset (P.M.):				
Hilo	6:32	7:02	6:16	5:47
Honolulu	6:43	7:16	6:27	5:55
Lihue	6:49	7:23	6:33	6:00
Hours of daylight:				
Hilo	12:08	13:20	12:07	10:56
Honolulu	12:08	13:26	12:06	10:50
Lihue	12:08	13:28	12:07	10:48

Source: Nautical Almanac Office, U.S. Naval Observatory, Tables of Sunrise and Sunset, No. 1083 and 1084 and records.

Table 192.-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF THE HONOLULU AREA: 1975 TO 1983

[Counts are made in late December, in a circle, 15 miles in diameter, centered near Nuuanu Pali]

Species <u>1/</u>	1975- 1979 <u>2/</u>	1980	1981	1982 <u>3/</u>	1983 <u>3/</u>
All species:					
Species	54	44	48	45	46
Individual birds ..	15,811	20,226	19,427	16,649	22,279
Endemic species:					
'Apapane	135	147	153	68	106
Hawaiian Coot	35	28	28	62	135
Hawaiian Stilt	128	115	92	77	110
Oahu 'Amakihi	132	152	159	65	140
Indigenous species:					
Great Frigatebird	597	615	366	24	37
Red-footed Booby	1,401	1,132	1,063	425	370
Introduced species:					
Cattle Egret	1,156	1,072	682	331	384
Common Myna	2,241	3,577	2,917	2,790	3,080
House Sparrow	1,155	1,684	1,604	1,489	2,518
Japanese White-eye	1,165	1,003	970	1,121	1,706
Red-vented Bulbul	503	1,174	1,159	1,199	2,195
Spotted Dove	1,091	1,104	1,393	1,052	1,606
Zebra (Barred) Dove	2,216	2,541	3,694	3,442	3,840
Migratory species:					
Lesser Golden-Plover ...	1,138	1,884	1,621	1,402	1,747
Ruddy Turnstone	165	397	361	291	269

1/ Separate data are shown for endemic birds averaging more than 25 individuals in 1975-1979, indigenous birds more than 200, introduced birds more than 500, and migratory species and stragglers more than 100. Endemic birds are those peculiar to a particular region, in this case Hawaii, and therefore found nowhere else in the world; indigenous birds are those native to a given region, in this case Hawaii, but with a total range of distribution encompassing a much wider area. The classification is that in Andrew J. Berger, Hawaiian Birdlife (1972).

2/ Annual averages.

3/ Excluding Moku Manu, previously included. Moku Manu had 4 species and 913 individuals (including 425 Red-footed Boobies and 460 Great Frigatebirds) in 1982, and 4 species and 760 individuals in 1983.

Source: Hawaii Audubon Society, The 'Elepaio (monthly).

Table 193.-- TREES ALONG STREETS OR IN PARKS UNDER THE JURISDICTION OF THE CITY AND COUNTY OF HONOLULU: 1978 TO 1983

[As of June 30]

Year	Along City and County streets and highways <u>1/</u>	In City and County parks
1978	101,021	94,800
1979	104,499	95,600
1980	108,202	95,700
1981	110,975	96,250
1982	113,489	96,296
1983	114,875	96,130

1/ Excludes Federal, State, and private thoroughfares.

Source: City and County of Honolulu, Department of Parks and Recreation, records.

Table 194.-- ENDANGERED, THREATENED, AND EXTINCT SPECIES OF NATIVE HIGHER PLANTS: 1977

Status	Species, subspecies, and varieties	Percent
Total native flora	2,200	100.0
Endangered, threatened, or extinct <u>1/</u> ...	1,113	50.6
Endangered	646	29.4
Threatened	197	8.9
Extinct	270	12.3
Not endangered, threatened, or extinct .	1,087	49.4

1/ For the other 49 States, 2,140 (or 10.7 percent) of all 20,000 native higher plants are endangered, threatened, or extinct.

Source: Edward S. Ayensu and Robert A. DeFilipps, Endangered and Threatened Plants of the United States (Smithsonian Institution and the World Wildlife Fund, Inc., 1978), p. xiii.