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Section 5

GEOGRAPHY AND ENVIRONMENT

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

Important sources of data include the U.S. Geological Survey, the National Ocean Survey, the National Climatic Data Center, the Division of Water Resource Management of the Hawaii State Department of Land and Natural Resources, the Hawaii State Department of Health, and the University of Hawaii at Manoa, School of Ocean and Earth Science and Technology, Department of Atmospheric Science. Detailed information is given in *Atlas of Hawaii* , 3rd edition, published by the University of Hawaii Press in 1998. National data are reported in the *Statistical Abstract of the United States: 2012* , Section 6.

Table 5.01-- GREAT CIRCLE DISTANCE BETWEEN SPECIFIED PLACES

Places	Statute miles	Nautical miles	Kilometers
DISTANCES FROM HONOLULU INTERNATIONAL AIRPORT			
Hawaiian Islands locations			
Hilo, Hawaii	214	186	344
Kailua, Kona, Hawaii	168	146	270
Kahului, Maui	98	85	158
Lanai Airport	72	63	116
Molokai Airport	54	47	87
Lihue, Kauai	103	90	166
Puuwai, Niihau	152	132	245
Nihoa	283	246	455
Necker Island	520	452	837
French Frigate Shoals	556	483	895
Gardner Pinnacles	688	598	1,107
Maro Reef	851	739	1,369
Laysan Island	936	813	1,506
Lisianski Island	1,065	925	1,714
Pearl and Hermes Atoll	1,208	1,050	1,944
Midway Islands	1,309	1,137	2,106
Kure Atoll	1,367	1,188	2,200
Other Pacific locations			
Apra Harbor, Guam	3,806	3,307	6,124
Auckland, New Zealand	4,393	3,817	7,068
Baker Island	1,900	1,649	3,058
Hong Kong	5,541	4,815	8,915
Howland Island	1,900	1,649	3,058
Jarvis Island	1,560	1,354	2,511
Johnston Atoll	820	713	1,319
Kingman Reef	1,073	932	1,726
Kiritimati (Christmas Island), Kiribati	1,344	1,168	2,163
Majuro, Marshall Islands	2,271	1,973	3,654
Manila, Philippines	5,293	4,599	8,516
Nuku Hiva, Marquesas Islands	2,400	2,086	3,864
Pago Pago, American Samoa	2,606	2,265	4,193
Palmyra Atoll	1,101	957	1,772
Papeete, Tahiti	2,741	2,382	4,410
Suva, Fiji	3,159	2,745	5,083
Sydney (Port Jackson), Australia	5,070	4,406	8,158
Tokyo, Japan	3,847	3,343	6,190
Wake Island	2,294	1,993	3,691

Continued on next page.

Table 5.01-- GREAT CIRCLE DISTANCE BETWEEN SPECIFIED PLACES -- Con.

Places	Statute miles	Nautical miles	Kilometers
DISTANCES FROM HONOLULU INT. AIRPORT--Con.			
North and South American locations			
Anchorage, Alaska	2,781	2,417	4,475
Cape Horn, Chile	7,457	6,480	11,998
Chicago, Illinois	4,179	3,631	6,724
Cristobal, Canal Zone	5,214	4,531	8,389
Los Angeles, California	2,557	2,222	4,114
Miami, Florida	4,856	4,220	7,813
New York, New York	4,959	4,309	7,979
Portland, Oregon	2,595	2,255	4,175
San Diego, California	2,610	2,268	4,199
San Francisco, California	2,397	2,083	3,857
Seattle, Washington	2,679	2,328	4,311
Vancouver, B.C.	2,709	2,354	4,359
Tijuana, Mexico	2,616	2,273	4,209
Washington, D.C.	4,829	4,196	7,770
London, England	7,226	6,279	11,627
Bombay, India	8,010	6,960	12,888
Ghanzi, Botswana 1/	12,417	10,790	19,979
Equator, due south of Honolulu	1,470	1,277	2,367
North Pole	4,740	4,119	7,631
OTHER DISTANCES			
Hilo to --			
Los Angeles, California	2,447	2,126	3,937
San Francisco, California	2,315	2,012	3,725
Kure Atoll to --			
Cape Kumukahi, Puna, Hawaii 2/	1,523	1,323	2,451
Log Point, Elliot Key, Florida 3/	5,852	5,085	9,416
Tokyo, Japan	2,486	2,160	4,000
West Quoddy Head, Maine	5,788	5,030	9,313

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

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

3/ Log Point and Kure Atoll are the points farthest apart in the 50 states.

Source: U.S. Geological Survey, *Elevations and Distances in the United States* (1980), pp. 22-23, and records; and E. H. Bryan, Jr., *American Polynesia and the Hawaiian Chain* (1942), pp. 38, 42, and 134.

Table 5.02-- LATITUDE AND LONGITUDE OF SELECTED PLACES

Island and place	Latitude (North)	Longitude (West)
Hawaii		
Hilo (International Airport)	19°43'	155°04'
Cape Kumukahi	19°31'	154°49'
Ka Lae	18°56'	155°41'
Keahole Point	19°44'	156°04'
Upolu Point	20°16'	155°51'
Geographic center of State (off Maui)	20°15'	156°20'
Maui		
Wailuku	20°53'	156°30'
Kahului (Airport)	20°54'	156°26'
Hana	20°45'	155°59'
Cape Hanamanioa	20°35'	156°25'
Lahaina	20°52'	156°41'
Kahoolawe		
Puu Moaulanui	20°34'	156°34'
Lanai		
Airport	20°48'	156°57'
Molokai		
Kaunakakai	21°05'	157°02'
Laau Point	21°06'	157°19'
Cape Halawa	21°10'	156°43'
Oahu		
Honolulu: International Airport	21°20'	157°55'
Aloha Tower	21°19'	157°52'
Kaena Point	21°35'	158°17'
Kahuku Point	21°43'	157°59'
Makapuu Point	21°19'	157°39'
Diamond Head	21°16'	157°49'
Kauai		
Lihue (Kauai Airport)	21°59'	159°21'
Mana	22°02'	159°46'
Kilauea Point	22°14'	159°24'
Niihau		
Puuwai	21°54'	160°12'
Kure Atoll	28°25'	178°22'

Source: U.S. Board on Geographic Names, *Gazetteer No. 24, Hawaiian Islands* (1956); U.S. Geological Survey, *Elevations and Distances in the United States* (1980), pp. 17 and 22-23; U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary with Comparative Data, 1984* for Hilo, Kahului, Honolulu, and Lihue; Bernice P. Bishop Museum, records; and Hawaii State Department of Accounting and General Services, Survey Division and records.

Table 5.03-- TIME DIFFERENCE BETWEEN HONOLULU AND SELECTED CITIES

[Standard time]

City	Country	Day	Hour	Time difference
Honolulu	United States	Same	9:00 a.m.	-
Anchorage	United States	Same	10:00 a.m.	+1
Vancouver	Canada	Same	11:00 a.m.	+2
Los Angeles	United States	Same	11:00 a.m.	+2
Las Vegas	United States	Same	11:00 a.m.	+2
Denver	United States	Same	12:00 p.m.	+3
Houston	United States	Same	1:00 p.m.	+4
Winnipeg	Canada	Same	1:00 p.m.	+4
Chicago	United States	Same	1:00 p.m.	+4
Atlanta	United States	Same	2:00 p.m.	+5
Miami	United States	Same	2:00 p.m.	+5
Toronto	Canada	Same	2:00 p.m.	+5
Lima	Peru	Same	2:00 p.m.	+5
New York City	United States	Same	2:00 p.m.	+5
Santiago	Chile	Same	3:00 p.m.	+6
Buenos Aires	Argentina	Same	4:00 p.m.	+7
Sao Paulo	Brazil	Same	4:00 p.m.	+7
London	United Kingdom	Same	7:00 p.m.	+10
Madrid	Spain	Same	8:00 p.m.	+11
Paris	France	Same	8:00 p.m.	+11
Frankfurt	Germany	Same	8:00 p.m.	+11
Rome	Italy	Same	8:00 p.m.	+11
Johannesburg	South Africa	Same	9:00 p.m.	+12
Jerusalem	Israel	Same	9:00 p.m.	+12
Moscow	Russia	Same	10:00 p.m.	+13
Baghdad	Iraq	Same	10:00 p.m.	+13
Kabul	Afghanistan	Same	11:30 p.m.	+14.5
Calcutta	India	Next	12:30 a.m.	+15.5
Bangkok	Thailand	Next	2:00 a.m.	+17
Singapore	Singapore	Next	3:00 a.m.	+18
Hong Kong	China	Next	3:00 a.m.	+18
Beijing	China	Next	3:00 a.m.	+18
Manila	Philippines	Next	3:00 a.m.	+18
Taipei	Taiwan	Next	3:00 a.m.	+18
Seoul	Korea	Next	4:00 a.m.	+19
Tokyo	Japan	Next	4:00 a.m.	+19
Sydney	Australia	Next	5:00 a.m.	+20
Auckland	New Zealand	Next	7:00 a.m.	+22

Source: 2009 HYP Media Finance LLC., *The Official Hawaiian Telcom White Pages O'ahu 2009,* pp. 20-23, and "Time Zone Converter" at <http://www.timezoneconverter.com/cgi-bin/tzc.tzc> accessed November 26, 2008.

Table 5.04-- WIDTH AND DEPTH OF CHANNELS

Channel 1/	Width 2/		Depth 3/	
	Statute miles	Kilometers	Feet	Meters
Alenuihaha (Hawaii-Maui)	29.6	47.6	6,810	2,076
Alalakeiki (Kahoolawe-Maui)	6.7	10.8	822	251
Kealaikahiki (Kahoolawe-Lanai)	17.8	28.6	1,086	331
Auau (Lanai-Maui)	9.5	15.3	252	77
Kalohi (Lanai-Molokai)	9.2	14.8	540	165
Pailolo (Maui-Molokai)	8.8	14.2	846	258
Kaiwi (Molokai-Oahu)	25.8	41.5	2,202	671
Kauai (Oahu-Kauai)	72.1	116.0	10,890	3,319
Kaulakahi (Kauai-Niihau)	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-Maro Reef	155.5	250.3	12,300	3,749
Maro 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; and

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, Geography and Map Division, Bernice P. Bishop Museum, in November 1980.

Table 5.05-- GENERAL COASTLINE AND TIDAL SHORELINE OF COUNTIES AND ISLANDS

County and island	General coastline 1/		Tidal shoreline 3/	
	Statute miles	Kilometers 2/	Statute miles	Kilometers 2/
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 4/				
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 5/	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/ 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.

3/ 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.

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 5.06-- HAWAIIAN COASTAL WATERS, BY ISLAND: 2006 TO 2014

[Coastal waters means all waters surrounding the islands of the State from the coast of any island to a point three miles seaward from the coast, and in the case of streams, rivers, and drainage ditches, to a point three miles seaward from their point of discharge into the sea and includes those brackish waters, freshwaters and saltwaters that are subject to the ebb and flow of the tide. (HAR §11-54-1 & HRS §342D-1). Hawaii State Department of Health, Clean Water Branch assessed coastal waters for the following conventional pollutants: enterococci, total nitrogen, nitrates+nitrite, ammonia, total phosphorus, turbidity, and chlorophylla]

Island	Number of coastal waters 1/	Number of impaired 2/	Percentage of total impaired coastal waters	Island percentage of total impaired coastal waters
2006				
State total	522	210	40.2	100.0
Kauai	81	28	34.6	13.3
Oahu	176	68	38.6	32.4
Molokai	37	3	8.1	1.4
Lanai	17	6	35.3	2.9
Maui	122	72	59.0	34.3
Hawaii	89	33	37.1	15.7
2008-2010				
State total	522	207	39.7	100.0
Kauai	81	26	32.1	12.6
Oahu	176	65	36.9	31.4
Molokai	37	3	8.1	1.4
Lanai	17	8	47.1	3.9
Maui	122	72	59.0	34.8
Hawaii	89	33	37.1	15.9
2012				
State total	575	228	39.7	100.0
Kauai	88	26	29.5	11.4
Oahu	194	73	37.6	32.0
Molokai	36	3	8.3	1.3
Lanai	17	7	41.2	3.1
Maui	130	76	58.5	33.3
Hawaii	110	43	39.1	18.9

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Table 5.06-- HAWAIIAN COASTAL WATERS, BY ISLAND: 2006 TO 2014 -- Con.

Island	Number of coastal waters 1/	Number of impaired 2/	Percentage of total impaired coastal waters	Island percentage of total impaired coastal waters
2014				
State total	577	266	46.1	100.0
Kauai	88	39	44.3	14.7
Oahu	196	78	39.8	29.3
Molokai	36	3	8.3	1.1
Lanai	17	7	41.2	2.6
Maui	130	77	59.2	28.9
Hawaii	110	62	56.4	23.3

1/ Number of coastal waters is based on the total number of scopes of assessments in the integrated reports.
2/ Impaired coastal waters for one of more conventional pollutants.
Source: Hawaii State Department of Health, Clean Water Branch, records.

Table 5.07-- 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]

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

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

Table 5.08-- HAWAIIAN PERENNIAL STREAMS, BY ISLAND: 2006 TO 2014

[Perennial means fresh waters flowing year-round in all or part of natural channels, portions of which may be modified by humans. Flow in perennial streams may vary seasonally. Perennial streams may be subdivided into longitudinal zones, based on elevation and gradient: (1) headwater zone (elevation above 800 m (2600 ft) or gradient above 30 percent or both); (2) mid-zone (elevation between 50-800 m (165-2600 ft), or gradient between 5 and and 30 percent or both); and (3) terminal zone (elevation below 50 m (165 ft) or gradient below 5 percent or both). Perennial streams may be either continuous or interrupted. Continuous perennial streams discharge continuously to the ocean in their natural state, and contain water in the entire length of the stream channel year-round. Interrupted perennial streams usually flow perennially in their upper reaches but only seasonally in parts of their middle or lower reaches, due to either downward seepage of surface flow (naturally interrupted) or to man-made water diversions (artificially interrupted) (HAR §11-54-1). Hawaii State Department of Health Clean Water Branch assessed coastal waters for the following conventional pollutants: enterococci, total nitrogen, nitrate+nitrite, ammonia, total phosphorus, turbidity, and chlorophyll a]

Island	Total number of streams 1/	Number of impaired 2/	Percentage of total impaired streams	Island percentage of total impaired streams
2006				
State total	168	91	54.2	100.0
Kauai	29	20	69.0	22.0
Oahu	50	44	88.0	48.4
Molokai	6	1	16.7	1.1
Lanai	-	-	0.0	0.0
Maui	48	10	20.8	11.0
Hawaii	35	16	45.7	17.6
2008-2010				
State total	168	92	54.8	100.0
Kauai	29	20	69.0	21.7
Oahu	50	44	88.0	47.8
Molokai	6	1	16.7	1.1
Lanai	-	-	0.0	0.0
Maui	48	11	22.9	12.0
Hawaii	35	16	45.7	17.4

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Table 5.08-- HAWAIIAN PERENNIAL STREAMS, BY ISLAND: 2006 TO 2014 -- Con.

Island	Total number of streams 1/	Number of impaired 2/	Percentage of total impaired streams	Island percentage of total impaired streams
2012				
State total	168	91	54.2	100.0
Kauai	29	20	69.0	22.0
Oahu	50	43	86.0	47.3
Molokai	6	1	16.7	1.1
Lanai	-	-	0.0	0.0
Maui	48	11	22.9	12.1
Hawaii	35	16	45.7	17.6
2014				
State total	169	92	54.4	100.0
Kauai	30	21	70.0	22.8
Oahu	50	43	86.0	46.7
Molokai	6	1	16.7	1.1
Lanai	-	-	0.0	0.0
Maui	48	11	22.9	12.0
Hawaii	35	16	45.7	17.4

1/ Number of streams is based on individual stream not wet/dry season.
2/ Impaired streams for one of more conventional pollutants.
Source: Hawaii State Department of Health, Clean Water Branch, records.

Table 5.09-- LAND AREA, BY COUNTY: 2010

Measurement unit and type of area	State total	Hawaii	Maui	Kalawao	Honolulu	Kauai
Square miles	6,422.6	4,028.4	1,161.5	12.0	600.7	620.0
Square kilometers	16,634.5	10,433.6	3,008.3	31.1	1,555.9	1,605.7

Source: U.S. Census Bureau, 2010 Census Redistricting Data (Public Law 94-171) Summary File (February 2011); and calculations by the Hawaii State Department of Business, Economic Development & Tourism, Hawaii State Data Center.

Table 5.10-- LAND AREA, BY ISLAND: 2010

Island	Square miles	Square kilometers
State total	6,422.63	16,634.53
Hawaii	4,028.42	10,433.55
Maui	771.99	1,999.45
Molokini	0.036	0.093
Kahoolawe	44.6	115.5
Lanai	141.07	365.36
Molokai	260.46	674.58
Oahu	597.64	1,547.88
Kauai	552.35	1,430.59
Niihau	67.60	175.09
Lehua	0.444	1.149
Kaula	0.247	0.640
Northwestern Hawaiian Islands 1/	3.100	8.030
Nihoa	0.271	0.701
Necker Island	0.071	0.183
French Frigate Shoals	0.096	0.249
Gardner Pinnacles	0.009	0.024
Maro Reef	Awash	Awash
Laysan Island	1.588	4.114
Lisianski Island	0.601	1.556
Pearl and Hermes Atoll	0.139	0.359
Kure Atoll	0.333	0.862

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

Source: U.S. Census Bureau, 2010 Census Redistricting Data (P.L. 94-171) Summary File (February 2011), and calculations by the Hawaii State Department of Business, Economic Development & Tourism, Office of Planning and the Hawaii State Data Center, and unpublished records.

Table 5.11-- MAJOR AND MINOR ISLANDS IN THE HAWAIIAN ARCHIPELAGO

Classification	Number of islands		Land area (square miles)
	Total	Inhabited, 1990 1/	
All named islands	137	12	6,427.0
Major islands	8	7	6,419.4
Named minor islands 2/	129	5	7.6
Offshore of major islands	96	3	2.6
Northwestern Hawaiian Islands 3/	33	2	4.9
Part of State	28	1	2.9
Not part of State (Midway Islands)	5	1	2.0

1/ For populations, see present volume, table 1.05.

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

3/ Includes individual islets in the 10 Northwestern Hawaiian Islands.

Source: Hawaii State Department of Planning and Economic Development, *Geographic Names Approved, Second Quarter 1969* (Report GN-6, July 8, 1969), p. 8; *Data Book 1986,* table 152.

Table 5.12-- AREA AND DEPTH OF SELECTED CRATERS

Island and crater	Area (acres)	Maximum depth (feet)
Hawaii		
Kilauea Caldera	2,319	476
Mokuaweoweo Crater 1/	2,221	572
Maui		
Haleakala Crater 2/	12,575	3,028
Oahu		
Diamond Head Crater	255	562
Koko Crater	133	968
Punchbowl Crater	62	140

1/ Data exclude North and South Pits.

2/ Data exclude Koolau and Kaupo Gaps.

Source: Measured from U.S. Geological Survey maps by the Hawaii State Department of Business, Economic Development & Tourism.

Table 5.13-- ELEVATION OF MAJOR SUMMITS

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

Island and summit	Feet	Meters
Hawaii		
Mauna Kea 1/	13,796	4,205
Mauna Loa	13,679	4,169
Hualalai	8,271	2,521
Kaumu o Kaleihoohie	5,480	1,670
Kilauea (Uwekahuna)	4,093	1,248
Kilauea (Halemaumau Rim)	3,660	1,116
Kahoolawe		
Puu Moaulanui	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	3,366	1,026
Molokai		
Kamakou	4,961	1,512
Olokui	4,606	1,404
Kalaupapa Lookout	1,600	488
Mauna Loa (Kukui)	1,430	436
Oahu		
Kaala	4,003	1,220
Puu Kalena	3,504	1,068
Konahuanui	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 5.13-- ELEVATION OF MAJOR SUMMITS -- Con.

Island and summit	Feet	Meters
Kauai		
Kawaikini	5,243	1,598
Waialeale	5,148	1,569
Kalalau Lookout	4,120	1,256
Haupu	2,297	700
Sleeping Giant (Nonou)	1,241	378
Niihau		
Paniau	1,250	381
Lehua	699	213
Kaula	548	167
Nihoa		
Millers Peak	903	275
Necker Island		
Summit Hill	276	84
French Frigate Shoals		
La Perouse Pinnacles	120	37
Gardner Pinnacles	190	58
Maro Reef	Awash	Awash
Laysan Island	40	12
Lisianski Island	40	12
Pearl and Hermes Atoll	10	3
Midway Islands	12	4
Kure Atoll	20	6

1/ According to the *1995 Guinness Book of Records* (p. 147), "The world's tallest mountain measured from its submarine base (3,280 fathoms) in the Hawaiian Trough to its peak is Mauna Kea... with a combined height of 33,480 ft., of which 13,796 ft. are above sea level."

Source: Hawaii State Department of Accounting and General Services, Survey Division, data provided April 21, 1992; U.S. National Cartographic Information Center, data provided October 11, 1978; U.S. Geological Survey topographic maps, 1981-1984; Hawaiian Government Survey (for Nihoa and Molokini); and U.S.S. Tanager survey, 1923 (for Necker Island, French Frigate Shoals, Laysan, Lisianski, Pearl and Hermes Atoll and Kure Atoll).

Table 5.14-- MAJOR NAMED WATERFALLS, BY ISLAND

Island	Waterfall	Height (feet)		Horizontal distance (feet)
		Sheer drop	Cascade	
Hawaii	Kaluahine	(NA)	620	400
	Akaka	442	(NA)	(NA)
	Waiilikahi	320	(NA)	6
Maui	Honokohau	(NA)	1,120	500
	Waihiumalu	(NA)	400	150
Molokai	Kahiwa	(NA)	1,750	1,000
	Papalaua	(NA)	1,200	500
	Wailele	(NA)	500	150
Oahu	Kaliuwaa (Sacred)	1/ 80	1,520	3,000
Kauai	Waipoo (2 falls)	(NA)	800	600
	Awini	(NA)	480	500
	Hinalele	280	(NA)	(NA)
	Wailua	200	(NA)	(NA)

NA Not available.

1/ Refers to the northernmost fall of a cascade of six falls.

Source: U.S. Geological Survey, records; Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, records; and "Tall Falls", *The Honolulu Advertiser,* June 25, 1995, pp. A17 and A20.

Table 5.15-- MAJOR STREAMS, BY ISLAND

Island	Feature or stream	Length or average 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	180
Maui	Waihee River	50
Molokai	Wailau Stream	30
Oahu	Waikele Stream	2/ 26
Kauai	Hanalei River	129

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.

2/ Most of discharge is from nearby groundwater outflow.

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

Table 5.16-- LAKES AND LAKE-LIKE WATERS, BY ISLAND

Island and lake	Type	Elevation (feet)	Area 1/ (acres)	Maximum depth (feet)
Hawaii				
Green Lake	Lake	3	2	20
Lake Waiau 2/	Lake	13,020	2	10
Waiakea Pond	Tidal pond	(3/)	27	7
Maui				
Kanaha Pond	Marsh	(3/)	41	3
Kealia Pond	Marsh	(3/)	500	(NA)
Waieleele	Pond	6,690	0.5	21
Molokai				
Kauhako	Pool	(3/)	0.9	814
Kualapuu Reservoir	Reservoir	821	100	50
Meyer Lake	Impoundment	2,021	6-10	5
Oahu				
Ho'omaluhia	Reservoir	202	90	90
Kaelepulu Pond	Lake	(3/)	198	(NA)
Kawainui Marsh	Marsh	(3/)	1,000	(NA)
Wahiawa Reservoir	Reservoir	842	302	85
Kauai				
Nomilu Fishpond	Pond	(3/)	20	66
Waita Reservoir	Reservoir	241	424	23
Niihau				
Halalii Lake	Playa	(3/)	841-865	(NA)
Halulu Lake	Playa	(3/)	182-371	(NA)
Laysan				
Laysan Lagoon	Closed lagoon	(3/)	161	16

NA Not available.

1/ Ranges shown for Meyer Lake, Halalii Lake, and Halulu Lake reflect differences in estimates between sources.

2/ Highest lake in the State and third highest in the United States.

3/ Sea level.

Source: J.A. Maciolek, *Lakes and Lake-like Waters of the Hawaiian Archipelago* (Bernice P. Bishop Museum, Occasional Papers, Vol. XXV, No. 1, April 30, 1982); and Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, May 18,1994.

Table 5.17-- LENGTH AND WIDTH OF SELECTED BEACHES

[Includes the longest white sand beach on each inhabited island, plus other important beaches]

Island and beach	Length (miles)	Width 1/ (feet)
Hawaii		
Hapuna	0.5+	200+
Maui		
Spreckelsville	2+	(NA)
Kaanapali	1.5	60-80
Lanai		
Polihua	1.5+	(NA)
Molokai		
Papohaku	2+	300
Oahu		
Waikiki	2	(NA)
Waimanalo	3.5-4.5	(NA)
Sunset	2-3+	200
Kauai		
Polihale to Kekaha	15	300
Polihale	3	300
Niihau		
Keawanui	3.5	175

NA Not available.

1/ Summer averages. Many beaches in Hawaii are seasonally reduced in width by winter storms.

Source: Hawaii State Department of Planning and Economic Development, *Hawaii's Shoreline* (1965), pp. 33, 47, 55, 62, 68, and 100; John R. K. Clark, *Beaches of the Big Island* (1985), p. 132, *The Beaches of Maui County* (1980), pp. 10, 62, 84-85, and 114, *The Beaches of O'ahu* (1977), pp. 45, 125, and 177, and *Beaches of Kaua'i and Ni'ihau* (1990), pp. 48-49 and 84.

Table 5.18-- MISCELLANEOUS GEOGRAPHIC STATISTICS, BY ISLAND

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
State total	(X)	(X)	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	65.0
Niihau	8	6	3	2.4	100.0

	Percent of area with elevation			Percent of area with slope	
Island	Less than 500 feet	2,000 feet or more	Approximate mean altitude (feet)	Less than 10 percent	20 percent or more
State total	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	0.0	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	0.0	530	68.0	12.5

X Not applicable.

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 Records* (1995 edition, p. 154) as "the highest sea cliffs in the world."

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

Table 5.19-- VOLCANIC ERUPTIONS: MAUNA LOA 1950 TO 1984, KILAUEA 1969 TO 2016

[As of December 31, 2016. Four volcanoes have erupted in historical times: Haleakala, last active in 1460; Hualalai, last active in 1801; Mauna Loa, last active in 1984; Kilauea, still active]

Volcano and date of outbreak	Repose period since previous eruption (months)	Duration (days)	Location 1/	Altitude of main vent (meters)	Area covered (km2)	Volume (km3)
Mauna Loa						
1950: June 1	17.0	23	S, SWR	3,840-2,380	112.0	0.3760
1975: July 5	301.0	<1	S	3,900	13.5	0.0300
1984: March 25	104.6	22	S, NER	4,030-2,870	48.0	0.2200
Kilauea						
1969: Feb. 22	4.0	6	ER	930-870	6.0	0.0161
May 24	2.0	874	ER	940	50.0	0.1850
1971: Aug. 14	-	<1	C	1,100-1,080	3.1	0.0091
Sept. 24	-	5	C, SWR	1,120-820	3.9	0.0077
1972: Feb. 3	4.3	900	ER	940	46.0	0.1620
1973: May 5	-	<1	ER	1,000-980	0.3	0.0012
Nov. 10	-	30	ER	980-870	1.0	0.0027
1974: July 19	-	3	C, ER	1,080-980	3.1	0.0066
Sept. 19	2.0	<1	C	1,100	1.0	0.0102
Dec. 31	3.4	<1	SWR	1,080	7.5	0.0143
1975: Nov. 29	11.0	<1	C	1,080-1,060	0.3	0.0002
1977: Sept. 13	21.5	18	ER	620-480	7.8	0.0329
1979: Nov. 16	26.3	1	ER	980-960	0.3	0.0006
1982: April 30	29.5	<1	C	1,080	0.3	0.0005
Sept. 25	4.8	<1	C	1,080	0.8	0.0030
1983: Jan. 3	3.3	2/ 12,416	ER	900	2/ 144.0	2/ 4.4
2008: March 19	-	2/ 3,209	C	1,080	(3/)	3/ 0.0006

1/ C, summit caldera; ER, east rift zone; NER northeast rift zone; S, summit area; SWR, southwest rift zone. All historic Mauna Loa eruptions began as summit eruptions, and then either remained in the summit or migrated down one of the rift zones.

2/ Revised from previous *Data Book.*

3/ Kīlauea summit vent opening is 195 m by 255 m. Volume of tephra erupted 2008-2016 is about 3,000 cubic meters. Volume of lava that overflowed the summit vent in April-May 2015 is estimated at 625,000 cubic meters.

Source: Gordon A. Macdonald, Agatin T. Abbott, and Frank L. Peterson, *Volcanoes in the Sea: The Geology of Hawaii,* 2nd ed. (1986), pp. 80-81; U.S. Geological Survey, Hawaiian Volcano Observatory <http://hvo.wr.usgs.gov/kilauea/history/historytable.html> and records.

Table 5.20-- EARTHQUAKES OF MAGNITUDE 6.2 OR GREATER: 1823 TO 2016

[As of December 31, 2016. Includes all earthquakes with magnitudes of 6.2 or greater. For the 2016 *Data Book* this table has been redesigned and updated referencing various different sources]

Date and time (HST)		Location	Magnitude
1823: June 1	10:00 PM	Kaimu, Hawaii	7.0
1825: January 6	11:30 PM	Kona, Hawaii	6.2
1832: January 10	6:00 PM	Kilauea, south flank, Hawaii	6.2
1841: April 7	11:45 PM	Kilauea, south flank, Hawaii	6.5
1849: July 15	4:05 AM	Hilea, Hawaii	6.2
1852: March 31	4:15 PM	Kaoiki, Hawaii	6.2
1865: March 3	12:45 AM	West Hawaii, deep	6.5
1868: March 28	1:28 PM	Hilea, Hawaii	7.0
April 2	4:00 PM	Hilea, Hawaii	7.9
April 3	1:45 AM	Hilea, Hawaii	6.2
April 4	12:30 AM	West Hawaii, deep	6.5
May 24	12:00 AM	Kilauea, south flank, Hawaii	6.2
1870: March 21	8:30 PM	South Hawaii	6.2
August 7	4:13 AM	Molokai	6.4
1871: February 19	10:15 PM	Lanai	6.8
1877: May 31	4:20 AM	Kilauea, caldera deep, Hawaii	6.3
1880: September 23	3:15 PM	Kaoiki, Hawaii	6.6
1881: September 30	4:53 AM	Mauna Kea, deep, Hawaii	6.4
1887: January 23	11:30 PM	Hilea, Hawaii	6.5
1890: August 6	11:10 PM	Kilauea, south flank, Hawaii	6.5
1894: December 3	3:30 AM	Molokai, deep	6.4
1895: January 22	10:00 PM	Molokai	6.5
December 8	11:04 PM	Kona offshore, Hawaii	6.8
1896: September 13	4:59 AM	East Maui	6.6
1905: May 3	4:07 PM	Kilauea, south flank, Hawaii	6.2
1908: September 20	8:15 PM	Kilauea, south flank, Hawaii	6.7
1915: March 28	8:26 AM	Kaoiki, Hawaii	6.4
1918: November 1	11:33 PM	Kaoiki, Hawaii	6.4
1927: March 20	4:52 AM	Mauna Kea, offshore deep, Hawaii	6.8
1929: September 25	6:20 PM	Hualalai, Hawaii	6.2
October 5	9:22 PM	Hualalai, Hawaii	6.5
1938: January 22	10:03 PM	Maui	6.8
1950: May 29	3:17 PM	Kona, Hawaii	6.3
1951: April 22	2:52 PM	Kilauea, caldera deep, Hawaii	6.2
August 21	12:57 AM	Kona, Hawaii	6.9
1952: March 29	11:59 PM	Kilauea, south flank, Hawaii	6.2
1954: March 30	8:42 AM	Kalapana, Hawaii	6.5
1962: June 27	6:27 PM	Kaoiki, Hawaii	6.2
1973: April 26	10:26 AM	Honomu, Hawaii	6.2

Continued on next page.

Table 5.20-- EARTHQUAKES OF MAGNITUDE 6.2 OR GREATER: 1823 TO 2016 -- Con.

Date and time (HST)		Location	Magnitude
1975: November 29	4:47 AM	Kalapana, Hawaii	7.7
1983: November 16	6:13 AM	Kaoiki, Hawaii	6.7
1989: June 25	5:27 PM	Kalapana, Hawaii	6.2
2006: October 15	7:07 AM	Kiholo Bay, Hawaii	6.7

Source: Klein, F.C. and T.L. Wright (2000), "Catalog of Hawaiian Earthquakes, 1823-1959", U.S. Geological Survey Professional Paper 1623, 98 pp; Klein, F.C., et al. (2001), *Seismic Hazard in Hawaii: High Rate of Large Earthquakes and Probabilistic Ground-Motion Maps*, Bulletin of the Seismological Society of America, Vol. 91, No. 3, pp. 479-498; Wyss, M. and R.Y. Koyanagi (1992), *Isoseismal maps, macroseismic epicenters, and estimated magnitudes of historical earthquakes in the Hawaiian Islands*, U.S. Geological Survey Bulletin 2006, 93 pp; U.S. Geological Survey, Hawaiian Volcano Observatory, Seismic Catalog; <https://earthquake.usgs.gov/earthquakes/>.

Table 5.21-- EARTHQUAKES WITH INTENSITIES OF V OR GREATER ON OAHU: 1859 TO 2016

[As of December 31, 2016]

Date (HST)	Epicentral location	Magnitude	Oahu average intensity (Modified Mercalli Scale 1/)
1861: Dec. 5	Molokai-Lanai vicinity (?)	2/ 5.9	Mid V
Dec. 15	Molokai-Lanai vicinity (?)	2/ 5.6	Lower V - mid V
1868: Apr. 2	SE coast of Hawaii	2/ 7.9	Upper IV - lower V
Apr. 4	Maui group vicinity (?)	2/ 6.5	Lower V
1870: Aug. 7	Near Molokai	2/ 6.4	V
1871: Feb. 19	S coast of Lanai	2/ 6.8	Upper VI - lower VII
1881: Sep. 30	Maui vicinity	2/ 6.4	IV - V
1887: Jan. 13	Oahu vicinity	2/ 5.3	V
1895: Dec. 8	Oahu vicinity (?)	2/ 6.8	Mid V
1896: Sep. 13	Maui vicinity (?)	6.6	IV - V
1926: Mar. 19	N of Kohala, Hawaii	2/ 5.5	Upper IV - lower V
1929: Oct. 5	Hualalei	6.5	Lower V
1938: Jan. 22	N of Maui	6.8	Upper V - lower VI
1940: June 16	N of Hawaii	6.0	IV - V
1948: June 28	S coast of Oahu	2/ 5.2	Mid VI
1973: Apr. 26	Honomu, Hawaii 2/	6.2	Mid V
1975: Nov. 29	Kalapana, Hawaii	7.2	V
1981: Mar. 5	Kalohi Channel	5.0	Mid V
2006: Oct.15	Kiholo Bay, Hawaii 2/	6.7	V

1/ Modified Mercalli Scale of 1931, 1956 abridged version further simplified. This scale, which extends from I to XII, reads in part:

2/ Revised from previous *Data Book.*

IV. Hanging objects swing. Vibration like passing of heavy trucks or sensation of a jolt. Standing autos rock. Windows, dishes, doors rattle. Crockery clashes. In the upper part of range wooden construction creaks.

V. Felt outdoors; direction estimated. Sleepers wakened. Liquids distributed, some spilled. Small unstable objects displaced or upset. Doors, shutters, pictures swing. Pendulum clocks stop.

VI. Felt by all. Many frightened, run outdoors. Persons walk unsteadily. Windows, dishes, glassware broken. Knickknacks, books thrown off shelves, pictures off walls. Furniture moved, overturned. Weak plaster and masonry cracked. Small bells ring. Trees, bushes noticeably shaken.

VII. Difficulty in standing. Noticed by drivers of autos. Hanging objects quiver. Furniture broken. Damage to weak masonry. Weak chimneys broken at roof line. Fall of plaster, loose bricks, etc. Some cracks in ordinary masonry. Waves on ponds. Small slides on sand and gravel banks. Large bells ring. Irrigation ditches damaged.

Continued on next page.

Table 5.21-- EARTHQUAKES WITH INTENSITIES OF V OR GREATER ON OAHU: 1859 TO 2016 -- Con.

Source: Cox, D.C. (1986a), *Earthquakes Felt on Oahu, Hawaii and Their Intensities* , Environmental Center Special Report, Vol. 38, University of Hawaii, 120 pp.; Cox, D.C. (1986b), *The Oahu Earthquake of June 1948, Associated Shocks, and the Hypothetical Diamond Head Fault* , Environmental Center Special Report, Vol. 36, University of Hawaii, 32 pp.; Cox, D.C. (1987), *Earthquake Experience in Honolulu* , Hawaiian Journal of History, Vol. 21, pp 98-109; Klein, F.C. and T.L. Wright (2000), *Catalog of Hawaiian Earthquakes, 1823-1959* , U.S. Geological Survey Professional Paper 1623, 98 pp.; Wyss, M. and R.Y. Koyanagi (1992), *Isoseismal maps, macroseismic epicenters, and estimated magnitudes of historical earthquakes in the Hawaiian Islands* , U.S. Geological Survey Bulletin 2006, 93 pp.; U.S. Geological Survey, Hawaiian Volcano Observatory, Seismic Catalog; and U.S. Geological Survey, National Earthquake Information Center, ShakeMap.

Table 5.22-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE: 1812 TO 2016

Date	Place of observation	Source	Maximum height in Hawaii		Deaths in Hawaii	Damage in Hawaii
			Meters	Feet		
1812: Dec. 21 1/	Hookena, Hawaii	California	2.5	8	-	Hut flooded
1819: April 12	W. Hawaii	Chile	2.0	7	-	Houses destroyed
1837: Nov. 7	Hilo, Hawaii	Chile	6.0	20	16	100 houses destroyed
1841: May 17	Hilo,Hawaii	Kamchatka	4.6	15	-	Unknown
1860: Dec. 1	Maliko Bay, Maui	N. Pacific 2/	3.6	12	-	Houses, wharf destroyed
1868: April 2	Keauhou Landing, Hawaii	Ka'u	13.7	45	47	Severe in Puna and Ka'u
1868: Aug. 13	Hilo, Hawaii	Chile	4.6	15	-	Houses, bridges destroyed
1869: Aug. 24	S.E. Puna	S. Pacific 2/	8.2	27	-	Houses destroyed, roads washed out
1877: May 10	Hilo, Hawaii	Chile	4.8	16	5	Severe in Hilo
1878: Jan. 10	Maliko Bay, Maui	N. Molokai 2/	3.6	12	-	Scattered flooding, N. Maui, N. Oahu
1896: June 15	Keauhou, Hawaii	Japan	5.5	18	-	Houses, wharfs, stores destroyed
1903: Nov. 29	Pelekunu,Molokai	N. Molokai	4.5	15	-	Houses destroyed on Maui, railroad washed out on Oahu
1906: Aug. 17	Maalaea, Maui	Chile	3.6	12	-	Piers damaged
1919: Oct. 2	Hoopuloa, Hawaii	S. Kona	4.3	14	-	Wharf damaged, car swept away
1922: Nov. 11	Hilo, Hawaii	Chile	2.1	7	-	Fishing boats swept away
1923: Feb. 3	Hilo, Hawaii	Kamchatka	6.1	20	1	$1,500,000
1933: March 2	Keauhou, Hawaii	Japan	3.2	10	-	Boathouses, walls destroyed in Kona
1946: April 1	Waikolu Valley, Molokai	Aleutian Islands	16.4	54	159	$26,000,000
1952: Nov. 4	Kaena, Oahu	Kamchatka	9.1	30	-	$1,000,000
1957: March 9	Haena,Kauai	Aleutian Islands	16.1	53	-	$5,000,000
1960: May 22	Hilo, Hawaii	Chile	10.5	34	61	$23,000,000
1964: March 27	Waimea Bay, Oahu	Alaska	4.9	16	-	$68,000

Continued on next page.

Table 5.22-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE: 1812 TO 2016--Con.

Date	Place of observation	Source	Maximum height in Hawaii		Deaths in Hawaii	Damage in Hawaii
			Meters	Feet		
1975: Nov. 29	Keauhou Landing, Hawaii	S. Puna	14.3	47	2	$1,500,000
2011: March 11	Kealakekua Bay, Hawaii	Japan	5.4	18	-	(NA)

NA Not available.

1/ Earliest tsunami for which definite information exists.

2/ Probable source.

Source: George Pararas-Carayannis, *Catalog of Tsunamis in the Hawaiian Islands* (U.S. Coast and 'Geodetic Survey, May 1969); 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); Doak C. Cox, *Tsunami Casualties and Mortality in Hawaii* (University of Hawaii, Environment Center, June 1987), *p. 39;* James F. Lander and Patricia A. Lockridge, *United States Tsunamis (Including United States Possessions) 1690-1988*, Publication 41-2, National Geophysical Data Center, August 1989, pp.17-77; U.S. Geological Survey, Hawaiian Volcano Observatory, records; Pacific Tsunami Warning Center, records; and National Oceanic and Atmospheric Administration, National Geophysical Data Center, Tsunami Runup database <http://www.ngdc.noaa.gov/nndc/struts/form?t=101650&s=167&d=166> accessed June 21, 2017.

Table 5.23-- MAJOR DAMS

[Includes all dams whose maximum storage equals or exceeds 600 acre-ft.]

Dam name	Nearest city	Purpose	Year completed	Height (ft.)	Length (ft.)	Drainage area (sq. miles)	Maximum storage (acre-ft.)
Waita Reservoir	Koloa, Kauai	Irrigation	1906	23	3,250	3.36	9,900
Wahiawa Dam	Wahiawa, Oahu	Irrigation	1906	88	660	16.70	9,200
Kualapuu Reservoir	Kualapuu, Molokai	Irrigation, water supply	1969	57	7,100	0.21	5,082
Kaneohe Dam	Kaneohe, Oahu	Flood control, recreation	1980	83	2,200	2.45	4,500
Nuuanu Dam No. 4	Honolulu, Oahu	Flood control, recreation	1910	66	2,120	1.40	3,600
Alexander	Kalaheo, Kauai	Hydroelectric, irrigation	1931	112	600	2.86	2,540
Puukapu Dam	Waimea, Hawaii	Flood control	1965	12	4,340	3.05	1,450
Kaloko Reservoir	Kilauea, Kauai	Irrigation	1890	27	915	0.12	1,400
Wailua Reservoir	Wailua, Kauai	Irrigation	1920	40	1,080	0.88	1,223
Kapaia Reservoir	Kapaia, Kauai	Irrigation	1910	50	1,050	2.51	1,114
Ku Tree Reservoir	Wahiawa, Oahu	Other	1925	97	550	0.83	1,085
Papuaa Reservoir	Omao, Kauai	Irrigation	1914	43	2,000	1.75	921
Puu Lua Reservoir	Kekaha, Kauai	Fish & wildlife pond, other	1925	105	640	0.08	888
Upper Helemano Reservoir	Waialua, Oahu	Irrigation	1912	46	530	0.45	700
Aepoeha Reservoir	Kukuila, Kauai	Irrigation	1913	42	600	0.81	670

Source: Hawaii State Department of Land & Natural Resources, Engineering Division, Flood Control & Dam Safety Section, records and Dam Inventory System, Hawaii State Department of Land & Natural Resources <http://132.160.239.52/daminventory/> accessed on June 21, 2017.

Table 5.24-- FRESH WATER USE, BY TYPE, BY COUNTY: 2010

[Million gallons per day]

Use	State total	Hawaii	Honolulu	Kalawao	Kauai	Maui
Total	1,273.77	134.68	799.23	0.01	61.77	278.08
Ground water	473.57	109.48	188.00	0.01	18.31	157.77
Public supply	258.07	42.29	162.98	0.01	13.22	39.57
Domestic	1.85	-	0.83	-	0.75	0.27
Industrial	4.63	-	4.61	-	-	0.02
Irrigation	100.94	10.10	15.21	-	-	75.63
Livestock	0.63	-	0.16	-	0.18	0.29
Aquaculture	2.14	1.46	0.68	-	-	-
Mining	1.40	0.69	0.50	-	0.12	0.09
Thermoelectric	103.91	54.94	3.03	-	4.04	41.90
Surface water	800.20	25.20	611.23	-	43.46	120.31
Public supply	15.80	2.82	-	-	2.02	10.96
Domestic	6.17	6.17	-	-	-	-
Industrial	-	-	-	-	-	-
Irrigation	222.52	13.53	58.36	-	41.44	109.19
Livestock	1.20	1.20	-	-	-	-
Aquaculture	2.40	1.48	0.87	-	-	0.05
Mining	0.11	-	-	-	-	0.11
Thermoelectric	552.00	-	552.00	-	-	-

Source: U.S. Geological Survey, Water Resources, *Water Use in the United States, Estimated Use of Water in the United States County-Level Data for 2010* <http://water.usgs.gov/watuse/data/2010/> accessed June 18, 2015.

Table 5.25-- WATER SERVICES AND CONSUMPTION, FOR COUNTY WATERWORKS: 2014 TO 2016

[Services as of June 30; consumption during the year ending June 30]

Geographic area	Number of services			Consumption (million gallons)		
	2014	2015	2016	2014	2015	2016
State total	276,526	281,004	272,404	76,722	73,247	73,921
City and County of Honolulu	176,518	180,472	171,336	51,794	48,347	48,433
Honolulu District 1/	67,404	66,240	63,206	35,323	28,837	28,700
Rest of Oahu	109,114	114,232	108,130	16,471	19,510	19,733
Hawaii County	42,378	42,759	43,117	9,080	9,196	9,655
Kauai County	21,590	21,669	21,740	3,997	4,020	4,048
Maui County	36,040	36,104	36,211	11,851	11,684	11,785
Maui	34,373	34,439	34,552	11,592	11,427	11,523
Molokai	1,667	1,665	1,659	259	257	262

1/ Maunalua to Moanalua.

Source: Data compiled by Hawaii State Department of Business, Economic Development & Tourism from City and County of Honolulu Board of Water Supply, County of Hawaii Department of Water Supply, County of Kauai Department of Water, and County of Maui Department of Water Supply.

Table 5.26-- WATER WITHDRAWALS BY SOURCE AND MAJOR USE, FOR HAWAII AND THE UNITED STATES: 2010

[Withdrawal signifies water physically withdrawn from a source. Includes fresh and saline water]

Subject	U.S. 1/	Hawaii
Water withdrawals, total, millions of gallons per day	355,000	1,270
Source, percent		
Ground water	22.4	37.2
Surface water	77.6	62.8
Selected major uses, percent		
Public supply	11.9	21.5
Domestic	1.0	0.6
Irrigation	32.5	25.4
Livestock	0.6	0.1
Aquaculture	2.7	0.4
Industrial	4.5	0.4
Mining	1.5	0.1
Thermoelectric power	45.4	51.5

1/ Includes Puerto Rico and Virgin Islands.

Source: U.S. Geological Survey, *Estimated Use of Water in the United States in 2010* , Circular 1405 table 1 <http://pubs.usgs.gov/circ/1405/pdf/circ1405.pdf> accessed June 12, 2015 and calculations by Hawaii State Department of Business, Economic Development & Tourism.

Table 5.27-- TOP 25 WATER USERS ON OAHU: MAY 2015 TO APRIL 2016

[Estimated monthly average]

Rank	User	Gallons (1,000)
1	Marine Corps Base Hawaii	65,282
2	Chevron USA Inc	33,170
3	Honolulu International Airport Maintenance - 2980 Aolele	20,087
4	Hilton Hotels Corporation	16,408
5	Sand Island Treratment Plant	15,966
6	Honolulu International Airport Maintenance - 530 Paiea	13,764
7	GGP Ala Moana LLC	12,539
8	Disney Vacation Resort & Spa Ko Olina	11,327
9	Sheraton Waikiki Hotel	11,284
10	University of Hawaii - 2566 Dole	11,187
11	Ala Moana Beach Park	10,224
12	United Laundry Service	10,131
13	Dole Food Co Hawaii - Waialua Sugar Interconnection	9,850
14	Bellows Air Force Station	9,115
15	Hilton Hotels Corporation	8,869
16	Kailua Treatment Plant	8,765
17	Central Regional Park	8,450
18	Hawaiian Cement	8,241
19	Halawa Medium Security Facility	7,201
20	Hale Koa Hotel Ilima Tower	7,016
21	Marriott Vacation Club International	6,450
22	University of Hawaii - 2444 Dole	6,418
23	Honolulu Zoo	6,337
24	Hale Koa Hotel Maile Tower	6,294
25	Ala Wai Golf Course	6,266

Source: Honolulu Board of Water Supply, records.

Table 5.28-- WASTEWATER TREATMENT PLANT OPERATION AND COMPLIANCE: 1994 TO 2015

Year	Total plants	Plants inspected	Plants rated unsatisfactory	In compliance (percent)
1994	(NA)	135	33	(NA)
1995	(NA)	163	35	(NA)
1996	(NA)	103	23	(NA)
1997	(NA)	176	45	(NA)
1998	(NA)	169	41	(NA)
1999	(NA)	164	35	(NA)
2000	(NA)	113	38	(NA)
2001	(NA)	144	35	(NA)
2002	(NA)	106	29	(NA)
2003	(NA)	100	20	(NA)
2004	(NA)	57	17	(NA)
2005	(NA)	41	8	(NA)
2006	180	93	14	92
2007	180	102	33	82
2008	180	34	15	92
2009	180	119	38	79
2010	180	114	13	93
2011	180	62	17	91
2012	190	58	13	93
2013	190	58	16	92
2014	190	82	30	84
2015	191	71	35	82

NA Not available.

Source: Hawaii State Department of Health, *Indicators of Environmental Quality Report* (annual); Hawaii State Department of Health, *Environmental Health Management Report* (annual); and Hawaii State Department of Health, Wastewater Branch, records.

Table 5.29-- WASTEWATER RECYCLED: 1994 TO 2015

[In million gallons per day]

Year	Total wastewater treated	Wastewater reused	Percent Reused
1994	150	10.50	7.00
1995	150	11.10	7.40
1996	150	12.30	8.19
1997	150	15.60	10.40
1998	150	17.00	11.33
1999	150	19.50	13.00
2000	150	20.20	13.47
2001	150	19.90	13.27
2002	150	24.00	16.00
2003	150	23.50	15.67
2004	150	23.50	15.67
2005	150	23.50	15.67
2006	150	24.60	16.40
2007	150	24.40	16.27
2008	150	23.91	15.94
2009	150	23.91	15.94
2010	145	22.98	15.85
2011	141	19.64	13.93
2012	141	21.14	14.99
2013	133	21.12	15.88
2014	134	22.00	16.42
2015	134	21.18	15.81

Source: Hawaii State Department of Health, *Indicators of Environmental Quality Report* (annual); Hawaii State Department of Health, *Environmental Health Management Report* (annual); and Hawaii State Department of Health, Wastewater Branch, records.

Table 5.30-- HAZARDOUS WASTE SITES, THREATS AND CONTAMINANTS ON OAHU

[Sites on the National Priorities List for the Superfund Program]

Sites with threats and contaminants	Location	Final listing 1/	Deletion
Del Monte Corp. (Oahu Plantation) 2/	Kunia	12/16/94	3/ (NA)
Naval Computer & Telecommunications Area 4/	Pearl Harbor	5/31/94	(NA)
Pearl Harbor Naval Complex 5/	Pearl Harbor	10/14/92	(NA)
Schofield Barracks (U.S. Army) 6/	Wahiawa	8/30/90	8/30/00

NA Not available.

1/ After the proposed listing, site was added on this date to the National Priorities List.

2/ Soil and shallow groundwater at the site have been contaminated with the fumigants EDB, DBCP and DCP, the solvents TCP and benzene and the pesticide lindane. Deep groundwater is contaminated with EDB, DBCP and TCP. People who touch or ingest contaminated groundwater or soil could be at risk.

3/ Partial deletion, EPA delisted the Poamoho section of the Site from NPL list on January 13, 2004.

4/ The Navy's Installation Restoration Program (IRP) is addressing the sites at NCTAMS EASTPAC. The sites are primarily land disposal areas that are no longer in use and PCB transformer sites. Soil contamination depends on the site but generally the chemicals of concern are PCBs, volatile organics, semi-volatile organics and metals.

5/ Soil, groundwater and sediment are contaminated with metals, organic compounds and petroleum hydrocarbons. There is a potential human health and ecological risk with contact or accidental ingestion with the contaminated media.

6/ Groundwater contain trichloroethylene (TCE). The Army has installed treatment systems to remove TCE from the water prior to any use.

Source: U.S. Environmental Protection Agency, *National Priorities List Sites in Hawaii* <https://www.epa.gov/cleanups/cleanups-my-community> accessed July 3, 2017.

Table 5.31-- TOXIC CHEMICAL RELEASES IN 2015 AND HAZARDOUS WASTE GENERATED, SHIPPED, AND RECEIVED IN 2015

Category	Unit
Number of TRI facilities in Hawaii in 2015	32
Toxic chemical releases in 2015 1/	2,569,578
On-site releases	2,400,698
Air emissions	1,562,956
Water emissions	621,767
Land emissions	215,976
Off-site releases, transfers to disposal	168,480
Hazardous waste generators, shippers, and receivers 2015	
Number of generators	100
Number of shippers	99
Number of receivers	1
Hazardous waste generated, shipped, and received 2015 2/	
Generated	484,603
Shipped	925
Received	82

1/ In pounds.

2/ In tons. Covers hazardous wastes regulated under the Resource Conservation and Recovery Act (RCRA) of 1976 as amended.

Source: United States Environmental Protection Agency, Toxic Release Inventory Program, *TRI Explorer Fact Sheet, Summary of TRI Information for Hawaii* <http://iaspub.epa.gov/triexplorer/tri_factsheet_search.searchfactsheet> accessed June 21, 2017; United States Environmental Protection Agency, *The National Biennial RCRA Hazardous Waste Report: 2015 Edition* <https://rcrainfo.epa.gov/rcrainfoweb/action/modules/br/summary/view> accessed June 21, 2017.

Table 5.32-- SOLID WASTE RECYCLED IN HAWAII: 2001 TO 2015

[Fiscal year ending June 30. In tons]

Year	Generated	Disposed	Diverted	Percent diverted
2001	1,794,496	1,441,000	353,496	19.7
2002	1,971,336	1,478,668	492,668	25.0
2003	2,115,313	1,489,974	625,339	29.6
2004	2,140,648	1,517,915	622,733	29.1
2005	2,116,724	1,427,904	688,820	32.5
2006	2,227,124	1,425,752	801,373	36.0
2007	2,526,134	1,733,889	792,245	31.4
2008	2,617,350	1,778,009	839,341	32.1
2009	2,532,370	1,629,397	902,973	35.7
2010	1,636,298	988,444	647,854	39.6
2011	1,786,343	1,159,027	627,316	35.1
2012	1/ 1,593,887	1,147,194	1/ 608,857	1/ 2/ 34.7
2013	2,471,320	1,566,642	904,678	38.1
2014	2,300,696	1/ 1,455,078	1/ 845,618	1/ 36.8
2015	2,417,650	1,377,611	3/ 1,040,039	1/ 43.0

1/ Maui County data currently incomplete or unavailable.

2/ Revised from previous *Data Book.*

3/ Maui and Hawaii Counties data currently incomplete.

Source: Hawaii State Department of Health, *Environmental Health Management Plan* (annual); and Hawaii State Department of Health, Solid & Hazardous Waste Branch, records.

Table 5.33-- DEPOSIT BEVERAGE CONTAINER REDEMPTION RATE: 2006 TO 2016

[Fiscal year ending June 30. In millions of beverage containers]

Year	Beverage container sold	Beverage container redeemed	Redemption rate (percent)
2006	930	1/ 629	1/ 67.6
2007	936	1/ 633	1/ 67.6
2008	1/ 948	1/ 682	71.9
2009	1/ 896	705	1/ 78.7
2010	1/ 902	686	76.1
2011	907	1/ 687	1/ 75.7
2012	907	697	76.8
2013	912	684	75.0
2014	934	678	72.6
2015	959	648	67.6
2016	949	635	66.9

1/ Revised from previous *Data Book.*

Source: Hawaii State Department of Health, *Environmental Health Management Report* (annual); and Hawaii State Department of Health, Solid & Hazardous Waste Branch, records.

Table 5.34-- WATER QUALITY AT PUBLIC BEACHES, BY ISLAND: 2013 AND 2014

Island	Number of locations	Number of samples	Enterococci density 1/			
			Lowest 2/	Highest 3/	Number over 4/	Mean 5/
2013						
State total	129	3,056	10.0	510.4	5	13.5
Hawaii	34	995	10.0	25.0	-	12.6
Hilo Shoreline	9	263	11.0	19.6	-	15.1
Kona Shoreline	25	732	10.0	25.0	-	11.8
Maui	62	1,062	10.0	510.4	2	12.2
Lanai	-	-	(X)	(X)	(X)	(X)
Molokai	-	-	(X)	(X)	(X)	(X)
Oahu	13	185	10.0	25.5	-	11.9
Kauai	20	814	10.3	118.6	3	16.9
2014						
State total	148	3,183	10.0	58.8	3	13.4
Hawaii	34	700	10.0	54.4	1	14.3
Hilo Shoreline	10	253	10.0	25.6	-	16.4
Kona Shoreline	24	447	10.0	54.4	1	13.2
Maui	62	790	10.0	17.4	-	12.4
Lanai	-	-	(X)	(X)	(X)	(X)
Molokai	-	-	(X)	(X)	(X)	(X)
Oahu	27	917	10.0	16.9	-	12.0
Kauai	25	776	10.0	58.8	2	15.8

X Not applicable.

1/ Geometric mean, number per 100 ml. The geometric mean standard for Enterococci density was 35 per 100 ml. in 2013 and 35 per 100 ml. in 2014.

2/ The lowest reported average value for 2013 was shared by 11 beaches, one of which was Sans Souci Beach, on the island of Oahu. The lowest reported average value for 2014 was shared by 11 beaches, one of which was Keoniloa Bay, on the island of Kauai (stations with >=5 sampling events).

3/ The highest average value in 2013 was reported for End of Weke Road, on the island of Kauai. The highest average value in 2014 was reported for End of Weke Road on the island of Kauai.

4/ Refers to number of samples over the geometric mean standard for Enterococci density which was 35 per 100 ml. in 2013 and 35 per 100 ml. in 2014 (stations with >=5 sampling events).

5/ Not weighted by number of samples.

Source: Hawaii State Department of Health, Clean Water Branch, records.

Table 5.35-- WATER QUALITY AT SELECTED PUBLIC BEACHES: 2013 AND 2014

Island and beach	Number of samples		Enterococci density 1/	
	2013	2014	2013	2014
Hawaii	995	700	12.6	14.3
Hilo Shoreline	263	253	15.1	16.4
Hilo Bay (Canoe Beach)	28	28	12.3	17.4
Honolii Cove (Ocean)	28	28	15.5	25.6
Kona Shoreline	732	447	12.6	13.2
Anaehoomalu Bay	85	53	10.8	11.5
Kahaluu Beach Park	85	54	12.3	17.8
Spencer Beach Park	18	8	19.6	22.8
Maui	1,062	790	12.3	12.4
Hukilau Hotel shoreline	83	66	12.1	15.5
Kamaole Beach #1	91	69	11.8	10.7
Kihei (south)	90	70	12.6	11.4
Spreckelsville Beach	80	67	11.4	11.0
Wailea Beach	81	65	10.4	10.2
Oahu	185	917	11.9	12.0
Ala Moana Park (center)	20	53	10.7	12.5
Hanauma Bay	9	44	11.7	10.2
Kailua Beach Park	9	44	12.7	11.5
Kuhio Beach	19	52	15.9	16.7
Makaha Beach	(X)	28	(X)	10.0
Sunset Beach	(X)	29	(X)	15.3
Waimea Beach	(X)	44	(X)	11.9
Kauai	814	776	16.9	17.7
Hanapepe Salt Pond	76	75	11.4	11.6
Kalapaki Beach (middle)	75	75	16.5	17.5
Kekaha (Oomano Point)	(X)	(X)	(X)	(X)
Lydgate Park (wading pool)	74	75	12.0	14.1
Poipu Beach Pavilion	76	75	11.0	10.7

X Not applicable.

1/ Geometric mean, number per 100 ml. The geometric mean standard for Enterococci density was 35 per 100 ml. in 2013 and 35 per 100 ml. in 2014.

Source: Hawaii State Department of Health, Clean Water Branch, records.

Table 5.36-- TOTAL DAYS PER YEAR OF SHORELINE POSTINGS: 2006 TO 2013

[For fiscal year ending June 30, unless otherwise specified. These numbers represent sign postings for sewage-related events along coastal shorelines, but do not reflect postings of warning signs on streams, lakes and other inland waters, such as the Ala Wai Canal. Other agencies may also post other shoreline warning signs. These numbers exclude 'brown water advisories' which are general media releases anticipating or responding to heavy storm water runoff and are not accompanied by actual sign postings]

Year	Days 1/	Year	Days 1/	Year	Days 1/
2006 2/	368	2009	310	2012	15
2007 2/	151	2010	403	2013	136
2008 2/	159	2011	529		

1/ Total days may include same-day postings of separate posting events, therefore the total may exceed 365 days.
2/ Data for 2008 and earlier are calendar year data.
Source: Hawaii State Department of Health, Clean Water Branch, records.

Table 5.37-- REFUSE AND SEWAGE STATISTICS FOR OAHU: 2004 TO 2016

[Fiscal year ending June 30]

Year	Tons of municipal solid waste delivered 1/			Sewage treated 2/ (millions of gallons)
	Total	City and County refuse vehicles	Other vehicles	
2004	933,028	350,298	582,730	44,472
2005	952,703	368,288	584,415	40,975
2006	937,726	363,233	574,493	42,275
2007	909,587	433,962	475,625	38,345
2008	883,365	447,972	435,393	39,217
2009	824,633	377,562	447,071	38,018
2010	777,069	326,201	450,868	38,549
2011	778,158	306,939	471,219	38,307
2012	746,368	285,153	461,215	36,517
2013	748,227	289,203	459,024	36,318
2014	764,726	302,732	461,994	38,448
2015	769,183	307,069	462,114	38,447
2016	793,793	311,172	482,621	41,136

Year	Sewage pumped 2/ (millions of gallons)	Miles of sewers 2/	City and County pump stations	City and County treatment plants
2004	50,969	2,212	65	8
2005	44,476	2,268	66	8
2006	44,168	2,268	66	8
2007	43,388	3/ 2,105	67	9
2008	49,538	2,105	67	9
2009	50,093	2,105	69	9
2010	47,051	2,105	72	9
2011	48,679	2,226	72	9
2012	45,778	2,226	72	9
2013	47,922	2,016	72	9
2014	(NA)	2,019	72	9
2015	(NA)	2,023	72	9
2016	(NA)	2,024	72	9

NA Not available.

1/ Excludes small landfill controlled by armed forces.

2/ Data limited to system maintained by the City and County of Honolulu, Department of Environmental Services.

3/ GIS editing for more accurate dimensions resulted in a reduction of lateral length.

Source: City and County of Honolulu, Department of Environmental Services, records.

Table 5.38-- AIR QUALITY IN DOWNTOWN HONOLULU: 1988 TO 2016

[Annual arithmetic means, in micrograms per cubic meter ($\mu g/m^3$), for particulate matter 10 microns or less in diameter (PM_{10}) and in parts per million (ppm) for carbon monoxide (CO). Sampling is conducted about 46 feet above ground on the roof of the State Health Department building (Kinau Hale), 1250 Punchbowl Street, Honolulu, Hawaii]

Year	PM_{10} ($\mu g/m^3$) 1/	CO (ppm) 2/	Year	PM_{10} ($\mu g/m^3$) 1/	CO (ppm) 2/
1988	-	1.7	2003	15	0.6
1989	-	1.8	2004	13	0.6
1990	-	1.5	2005 3/	14	0.6
1991	-	1.7	2006 4/	13	0.4
1992	-	1.6	2007	14	0.5
1993	13	1.8	2008	14	0.5
1994	14	0.8	2009	13	0.4
1995	14	0.8	2010	12	0.4
1996	14	0.8	2011	12	0.4
1997	8	0.8	2012	12	0.4
1998	9	0.8	2013	11	0.4
1999	14	0.6	2014	13	0.4
2000	14	0.7	2015	11	5/ 0.5
2001	16	0.6	2016	13	0.6
2002	15	0.6			

1/ The State Ambient Air Standard for PM_{10} annual average is 50 $\mu g/m^3$. The Federal standard was revoked by the U.S. Environmental Protection Agency effective December 17, 2006.

2/ There is no annual standard for CO.

3/ Represents data until July 14, 2005, when the monitoring station was closed for roof repairs.

4/ Represents data from August 5, 2006, after completion of roof repairs.

5/ Revised from previous *Data Book.*

Source: Hawaii State Department of Health, Environmental Management Division, Clean Air Branch, records.

Table 5.39-- AIR QUALITY AT SPECIFIED LOCATIONS: 2016

Sampling station	PM_{10} ($\mu g/m^3$) 1/			Sulfur dioxide (ppm) 2/		
	Annual range 24-hr		Annual arithmetic average	Annual range 1-hr		Annual arithmetic average
	Minimum	Maximum		Minimum	Maximum	
Oahu						
Downtown Honolulu	4	32	13	0.000	0.009	0.000
Pearl City	5	41	20	(X)	(X)	(X)
Kapolei	3	34	14	0.000	0.014	0.000

X Not applicable.

1/ Particulate matter up to 10 microns in diameter. The State and Federal Ambient Air Standard for 24-hr PM10 is 150 $\mu g/m^3$.

2/ The State Ambient Air Standard for 24-hr SO_2 is 0.14 ppm. Federal standard for SO_2 is now a 1 hour average not to exceed 75 ppb (0.075 ppm).

Source: Hawaii State Department of Health, Environmental Management Division, Clean Air Branch, records.

Table 5.40-- RELEASE OF TOXICS: 1999 TO 2015

[In pounds]

Year	Release 1/					
	Total	Air	Water	On-site land	Under-ground injection	Off-site
1999	1,681,101	1,584,809	2,721	38,163	5,070	50,338
2000	1,311,611	1,057,090	1,224	31,833	7,284	214,180
2001	3,108,521	2,379,969	29,770	224,400	2,071	472,311
2002	3,688,240	2,495,256	454,684	228,634	2,241	507,425
2003	3,163,057	2,131,959	364,067	249,267	2,670	415,094
2004	3,170,737	2,358,741	296,415	227,719	6,601	281,261
2005	3,102,730	2,311,635	522,217	89,734	2,736	176,408
2006	3,022,392	2,254,027	358,266	174,678	4,743	230,678
2007	3,015,602	2,266,925	446,948	143,011	2,670	156,048
2008	3,245,524	2,277,988	549,838	169,076	3,471	245,151
2009	2,947,241	2,228,566	222,963	147,530	4,477	343,705
2010	2,495,605	1,739,249	452,359	171,221	2,603	130,173
2011	2,597,069	1,845,550	409,370	124,224	3,722	214,203
2012	2,693,617	1,876,897	435,662	181,039	4,508	195,511
2013	3,023,584	1,727,045	441,572	232,261	1,242	621,465
2014	2,671,773	1,566,921	534,190	401,495	7,036	162,131
2015	2,569,578	1,562,956	621,767	210,030	6,346	168,480

1/ Release is defined as the amount of a toxic chemical released on-site (to air, water, underground injection, landfills, and other land disposal), and the amount transferred off-site for disposal.

Source: U.S. Environmental Protection Agency, *Hawaii Report: Toxics Release Inventory* (annual) <http://iaspub.epa.gov/triexplorer/tri_factsheet.factsheet_forstate?pstate=HI&pyear=2015> accessed July 3, 2017.

Table 5.41-- TOXIC RELEASE INVENTORY CHEMICAL RELEASES: 1988 TO 2015

[In pounds. For all industries and all chemicals]

Year	Total on-site disposal or other releases	Total off-site disposal or other releases	Total on- and off-site disposal or other releases	Total production-related waste managed
1988	2,225,959	164,482	2,390,441	(NA)
1989	2,105,585	20,458	2,126,043	(NA)
1990	844,758	7,209	851,967	(NA)
1991	916,001	12,388	928,389	8,322,961
1992	873,910	163,500	1,037,410	8,348,939
1993	706,345	14,982	721,327	8,259,575
1994	588,489	17,371	605,860	3,133,045
1995	492,923	163,769	656,692	5,401,395
1996	536,272	3,995	540,267	4,185,584
1997	444,040	8,365	452,405	4,118,506
1998	2,026,357	85,903	2,112,260	5,806,154
1999	1,630,843	50,438	1,681,281	5,221,169
2000	1,097,432	176,546	1,273,978	1,782,121
2001	2,950,196	430,325	3,380,521	4,258,038
2002	3,180,814	514,846	3,695,661	4,620,356
2003	2,747,963	419,791	3,167,753	4,023,425
2004	2,889,493	281,224	3,170,718	3,853,008
2005	2,925,433	179,935	3,105,369	4,009,430
2006	2,790,816	230,671	3,021,488	3,679,473
2007	2,859,554	156,023	3,015,577	3,878,790
2008	3,000,373	245,176	3,245,550	4,393,104
2009	2,603,536	343,728	2,947,264	3,734,894
2010	2,365,432	130,212	2,495,644	3,045,978
2011	2,375,076	214,223	2,589,299	3,274,039
2012	2,498,106	195,511	2,693,617	6,633,891
2013	2,402,119	621,465	3,023,584	5,906,320
2014	2,509,642	162,131	2,671,773	5,677,783
2015	2,401,098	168,480	2,569,578	7,059,437

NA Not available.

Source: United States Environmental Protection Agency, Toxic Release Inventory Program, TRI Explorer <http://iaspub.epa.gov/triexplorer/tri_release.chemical> accessed on April 13, 2017.

Table 5.42 -- RELEASE OF PERSISTENT, BIOACCUMULATIVE AND TOXIC (PBT) CHEMICALS: 2002 TO 2015

[In pounds; dioxin and dioxin-like compounds in grams]

Year	Total on- and off-site disposal or other releases 1/				
	Lead and lead compounds	PAC's 2/	Mercury and mercury compounds	Benzo (g,h,i) perylene	Dioxin 3/
2002	91,912	1,407	317	0.95	6.330
2003	106,067	1,533	203	1.18	5.129
2004	131,952	1,786	187	9.84	5.390
2005	46,192	1,683	211	213.00	5.100
2006	90,131	1,467	127	7.00	5.000
2007	84,110	1,271	203	6.00	5.080
2008	91,106	1,288	293	6.00	0.010
2009	107,782	2,276	147	16.00	4.080
2010	93,115	1,328	553	6.00	4.110
2011	74,488	1,798	236	9.00	4.233
2012	101,479	1,627	345	33.00	3.888
2013	134,234	1,361	294	6.00	3.678
2014	214,637	915	131	5.00	1.676
2015	110,410	520	128	32.00	1.649

1/ Release is defined as the amount of a toxic chemical released on-site (to air, water, underground injection, landfills, and other land disposal), and the amount transferred off-site for disposal.

2/ Polycyclic aromatic compounds.

3/ Dioxin and dioxin-like compounds (in grams) unless otherwise specified.

Source: U.S. Environmental Protection Agency, *Hawaii Report: Toxics Release Inventory* (annual) <http://iaspub.epa.gov/triexplorer/tri_release.chemical> accessed July 3, 2017.

Table 5.43-- OIL AND CHEMICAL RELEASES: 2006 TO 2014

Year	Total oil & chemical releases	Oil releases			Chemical releases		
		Total	To land	To water	Total	To land	To water
2006	384	206	(NA)	(NA)	178	(NA)	(NA)
2007	489	289	(NA)	(NA)	200	(NA)	(NA)
2008	305	198	(NA)	(NA)	107	(NA)	(NA)
2009	268	143	56	87	125	63	62
2010	414	218	126	92	196	131	65
2011	371	257	185	72	114	51	63
2012	376	268	203	65	108	70	38
2013	388	256	178	78	132	83	49
2014	366	230	159	71	136	104	32

NA Not available.
Source: Hawaii State Department of Health, Hazard Evaluation and Emergency Response Office, records.

Table 5.44-- ATMOSPHERIC CARBON DIOXIDE MEASUREMENTS AT MAUNA LOA: 1958 TO 2016

[Average carbon dioxide mixing ratio, parts per million]

Year	Annual average	Year	Annual average	Year	Annual average
1958	1/ 315.17	1978	335.35	1998	366.61
1959	315.83	1979	336.73	1999	368.33
1960	316.75	1980	338.72	2000	2/ 369.55
1961	317.49	1981	340.12	2001	2/ 371.14
1962	318.30	1982	341.21	2002	2/ 373.28
1963	318.83	1983	342.87	2003	2/ 375.80
1964	3/ 319.04	1984	344.48	2004	2/ 377.52
1965	319.87	1985	345.85	2005	2/ 379.80
1966	321.21	1986	347.21	2006	2/ 381.90
1967	322.02	1987	348.98	2007	2/ 383.79
1968	322.83	1988	351.34	2008	2/ 385.60
1969	323.93	1989	352.89	2009	2/ 387.43
1970	325.27	1990	354.26	2010	2/ 389.90
1971	326.17	1991	355.45	2011	2/ 391.65
1972	327.26	1992	356.58	2012	2/ 393.85
1973	329.45	1993	357.01	2013	2/ 396.52
1974	1/ 329.72	1994	358.51	2014	2/ 398.65
1975	4/ 331.14	1995	360.62	2015	400.83
1976	332.04	1996	362.40	2016	404.21
1977	333.79	1997	363.54		

1/ Based on data for 8 months.
2/ Revised from previous *Data Book.*
3/ Based on data for 9 months.
4/ Based on data for 11 months.

Source: National Weather Service, Pacific Region, Honolulu (for 1958-1991); Mauna Loa Observatory (for 1992-1999); and U.S. Department of Commerce, National Oceanic & Atmospheric Administration (NOAA), Cooperative Global Air Sampling Network, Global Monitoring Division, Earth Systems Research Laboratory (ESRL) <ftp://aftp.cmdl.noaa.gov/products/trends/co2/co2_annmean_mlo.txt> accessed June 21, 2017 and records.

Table 5.45-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES

[Updated through December 2016]

Island and station	Ground elevation (feet)	Average temperature 1/ (°F)		Extreme temperature of record (°F)		Average annual precipitation (inches)
		Coolest month	Warmest month	Lowest	Highest	
Hawaii:						
Hilo Airport	38	66.4	81.2	53	94	126.61
Hawaii Volcanoes Nat. Park Hdq.	3,971	52.6	69.2	34	2/ 85	106.84
Naalehu	800	65.8	79.4	50	93	47.24
Kona Airport	2/ 30	2/ 66.9	2/ 82.7	2/ 52	2/ 93	2/ 24.00
Puako 3/	49	68.3	83.8	52	2/ 91	10.11
Waimea (Kamuela) 4/	2,671	2/ 53.9	2/ 74.1	2/ 34	2/ 87	2/ 32.68
Honokaa	1,080	(NA)	(NA)	(NA)	(NA)	78.53
Mauna Kea summit 5/	13,773	2/ (NA)	2/ (NA)	2/ (NA)	2/ (NA)	2/ 7.41
Maui:						
Hana Airport 6/	75	67.4	80.8	50	2/ 91	80.48
Haleakala summit 7/	9,964	38.9	54.6	2/ (NA)	2/ 68	38.89
Kihei 8/	160	(NA)	(NA)	(NA)	(NA)	12.84
Kahului Airport	51	67.3	83.8	48	97	18.23
Lahaina 9/	40	66.4	84.9	52	2/ 94	14.63
Molokai:						
Kaunakakai	12	(NA)	(NA)	(NA)	(NA)	13.66
Molokai Airport	443	67.6	81.4	2/ 48	2/ 93	24.96
Lanai:						
Lanai City 10/	1,620	62.4	75.4	2/ 46	2/ 87	34.29

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Table 5.45-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES -- Con.

Island and station	Ground elevation (feet)	Average temperature 1/ (°F)		Extreme temperature of record (°F)		Average annual precipitation (inches)
		Coolest month	Warmest month	Lowest	Highest	
Oahu:						
Honolulu International Airport	7	70.4	84.0	52	95	20.20
Waikiki (Honolulu Zoo)	10	69.2	84.5	2/ 52	2/ 94	23.44
Manoa (Lyon Arboretum)	500	66.6	79.0	49	2/ 92	151.05
Kaneohe (State Hospital)	190	68.8	79.8	2/ 55	2/ 91	76.03
Kahuku	13	68.6	80.9	51	2/ 95	44.11
Wheeler AFB 11/	820	45.6	59.8	25	88	38.46
Upper Wahiawa 12/	1,006	64.4	79.2	2/ 51	2/ 89	67.48
Kauai:						
Kilauea (town)	390	67.1	79.5	2/ 49	2/ 93	67.97
Lihue Airport	100	69.9	81.1	50	91	40.93
Poipu (Makahuena Pt.) 7/	52	69.3	82.6	50	95	36.08
Kekaha 13/	10	64.8	84.8	44	95	21.78
Kokee (Kanalohuluhulu)	3,600	51.1	67.3	2/ 27	2/ 86	2/ 66.07
Northwestern Hawaiian Islands:						
Midway 14/	2/ 40	68.4	76.2	51	92	42.52

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Table 5.45-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES -- Con.

NA Not available.
1/ For some stations, data represent 30-year normals.
2/ Revised from previous *Data Book.*
3/ Data available through 1976. Temperature data are for Mahukona.
4/ Data available through 1980.
5/ Based on incomplete and non-continuous data for 1966-1972.
6/ Data available through 2005.
7/ Data available through 1976.
8/ Temperature data available through 1982, refer to Keawakapu Beach.
9/ Data available through 2001.
10/ Data available through 2008, then restarted since June 2010.
11/ Data available through 1949.
12/ Started on April 1971 used through December 1977, then relocated WSW of Post Office at Wahiawa.
13/ Data available through 2000.
14/ Data available through 1991, not confirmed.

Source: Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, records; and University of Hawaii at Manoa, School of Ocean and Earth Science and Technology, Department of Atmospheric Science, records.

Table 5.46-- CLIMATIC NORMALS, MEANS, AND EXTREMES FOR HILO, KAHULUI, HONOLULU, AND LIHUE AIRPORTS: 2016

[Normals are 30-year averages (1981 - 2010)]

Subject	Hilo	Kahului	Honolulu	Lihue
Temperatures (°F)				
Normal daily maximum, annual	80.9	84.3	84.4	81.2
Highest daily maximum	94	97	95	91
Month and year of occurrence	Nov 2013	Aug 2015	Sep 1994	Oct 2012
Normal daily minimum, annual	66.8	67.4	70.9	70.4
Lowest daily minimum	53	22	53	50
Month and year of occurrence	Feb 1962	Jan 2004	Jan 1998	Jan 1969
Normal dry bulb (temperature of ambient air)				
Coolest	71.2	71.8	73.1	71.6
Month	Feb	Feb	Feb	Feb
Warmest	76.4	79.7	81.9	79.7
Month	Aug	Aug	Aug	Aug
Annual	73.9	75.8	77.7	75.8
Normal no. days with maximum 90°F and above	-	17.0	18.7	0.1
Normal relative humidity (percent), annual				
8 a.m.	80	74	72	77
2 p.m.	68	58	56	66
Percent of possible sunshine, annual	41	67	71	59
Mean no.days (annual) with				
Clear	35.5	130.5	90.0	55.3
Partly cloudy	131.3	145.2	179.8	183.2
Cloudy	195.3	89.5	92.0	123.2
Wind speed (m.p.h.), annual				
Mean	6.7	12.8	10.3	13.3
Maximum 2-minute	39	48	40	48
Month and year of occurrence	Aug 2014	Jan 2004	Jan 2004	Dec 2007
Precipitation (inches)				
Normal, annual	126.72	17.83	17.10	37.05
Maximum monthly	50.82	14.46	20.79	36.13
Month and year of occurrence	Dec 1954	Jan 1980	Mar 1951	Mar 2006
Minimum monthly	0.13	-	0.01	0.08
Month and year of occurrence	Jan 1998	Jun 1957	Dec 2012	Dec 2005
Maximum in 24 hours	27.36	7.01	17.07	11.54
Month and year of occurrence	Nov 2000	Jan 1980	Mar 1958	Dec 1968

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary with Comparative Data, 2016,* "Normals, Means, and Extremes," for Hilo, Kahului, Honolulu, and Lihue (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed July 4, 2017.

Table 5.47-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT: 2016

[Normals are 30-year averages (1981 - 2010)]

Month	Normal temperature (°F)			Extreme temperature (°F)		Precipitation (inches)			
	Daily maximum	Daily minimum	Normal dry bulb 1/	Highest daily maximum	Lowest daily minimum	Normal	Maximum monthly	Minimum monthly	Maximum in 24 hours
January	80.1	66.3	73.2	88	53	2.31	14.74	0.03	6.72
February	80.2	66.1	73.1	88	53	1.99	13.68	0.06	6.88
March	81.2	67.7	74.5	88	55	2.02	20.79	0.01	17.07
April	82.7	69.4	76.1	91	57	0.63	8.92	0.01	4.21
May	84.6	70.9	77.8	93	60	0.62	7.23	0.03	3.44
June	87.0	73.4	80.2	92	65	0.26	2.46	(2/)	2.28
July	87.9	74.5	81.2	94	66	0.51	2.71	0.03	2.20
August	88.7	75.1	81.9	93	65	0.56	7.63	(2/)	4.42
September	88.6	74.4	81.5	95	66	0.70	4.48	0.05	2.25
October	86.7	73.4	80.0	94	61	1.84	11.15	0.07	7.57
November	83.9	71.4	77.6	93	57	2.42	18.79	0.03	9.15
December	81.2	68.3	74.8	89	54	3.24	17.29	0.01	8.25
Annual	84.4	70.9	77.7	95	53	17.10	20.79	0.01	17.07

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Table 5.47-- MONTHLY AND ANNUAL CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT: 2016-- Con.

Month	Relative humidity (percent)		Wind (miles/hour)			Number of days		
						Mean		Normal
	8 a.m.	2 p.m.	Mean speed	Maximum 2-minute speed	Percent of possible sunshine	Clear	Cloudy	Precipi-tation .01 inch or more
January	81	61	8.4	40	65	9.5	8.5	8.5
February	79	59	9.1	37	68	8.1	7.6	7.4
March	73	57	10.2	39	72	7.4	9.3	8.8
April	70	55	11.0	35	70	5.9	9.6	7.5
May	67	54	10.6	30	72	6.7	8.7	5.8
June	66	52	11.9	30	74	6.5	6.2	5.7
July	68	52	11.9	30	76	7.4	5.1	7.1
August	68	52	11.7	31	77	8.0	5.7	5.6
September	70	53	10.2	30	77	7.9	5.7	6.9
October	71	56	9.6	31	71	7.5	8.1	7.6
November	75	59	9.7	35	64	7.2	8.8	8.8
December	79	60	9.3	39	63	7.9	8.7	9.7
Annual	72	56	10.3	40	71	90.0	92.0	89.4

1/ Temperature of the ambient air.

2/ Trace precipitation.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data, 2016*, "Normals, Means, and Extremes, Honolulu, HI" (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed July 4, 2017.

Table 5.48-- AVERAGE TEMPERATURE, PERCENT OF POSSIBLE SUNSHINE, AND PRECIPITATION, FOR HONOLULU INTERNATIONAL AIRPORT: 1960 TO 2016

Year	Average temperature (°F)	Percent of possible sunshine	Precipitation (inches)	Year	Average temperature (°F)	Percent of possible sunshine	Precipitation (inches)
1960	76.7	70	12.07	1990 1/	77.6	69	19.84
1961	77.2	81	14.26	1991 1/	77.7	69	17.94
1962	76.5	71	13.58	1992 1/	77.8	69	19.00
1963	76.7	64	37.91	1993 1/	77.1	69	5.84
1964	77.0	63	20.12	1994 1/	78.8	70	15.59
1965 2/	76.1	74	42.78	1995 1/	79.3	70	13.60
1966 2/	77.6	68	23.18	1996 1/	78.6	70	33.12
1967 2/	77.6	58	34.34	1997 1/	77.8	71	19.99
1968 2/	77.9	63	37.26	1998 1/	77.1	71	4.52
1969 2/	77.4	68	22.50	1999 1/	76.9	71	11.99
1970 2/	78.2	72	15.49	2000 1/	77.6	71	7.10
1971 2/	76.1	70	26.64	2001 1/	78.2	71	9.14
1972	76.2	65	26.94	2002 1/	77.9	71	12.18
1973	77.2	63	14.24	2003 1/	78.5	71	12.69
1974	77.5	61	24.02	2004 1/	78.7	71	39.01
1975	76.2	62	24.39	2005 1/	78.4	71	15.60
1976	76.8	60	12.90	2006 1/	77.1	71	29.45
1977	78.2	68	12.36	2007 1/	78.0	71	11.99
1978	76.8	69	25.05	2008 1/	78.3	71	14.76
1979	77.0	68	16.93	2009 1/	(NA)	71	11.55
1980 1/	77.4	68	26.90	2010 1/	77.5	71	17.40
1981 1/	77.1	68	13.41	2011 1/	78.3	71	15.69
1982 1/	76.9	67	34.92	2012 1/	77.2	71	8.58
1983 1/	77.2	67	5.03	2013 1/	77.1	71	16.18
1984 1/	78.1	67	17.08	2014 1/	78.2	71	20.82
1985 1/	76.9	67	17.38	2015 1/	78.7	71	21.04
1986 1/	78.3	68	13.93	2016 1/	77.9	71	13.16
1987 1/	77.9	68	23.53				
1988 1/	78.5	68	16.47				
1989 1/	77.5	68	27.52				

NA Not available.

1/ From 1980 on, data taken from "Normals, Means, and Extremes, Honolulu, HI" table, and represents a historic average rather than annual data.

2/ Site conditions produced distorted temperature measurements from 1965 to 1971.

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data 2016,* "Average Temperature (°F), Honolulu, HI", "Normals, Means, and Extremes, Honolulu, HI", "Precipitation (inches), Honolulu, HI" (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed July 4, 2017.

Table 5.49-- AVERAGE DAILY TEMPERATURE AND DAYS WITH MAXIMUM OF 90° OR HIGHER, FOR HONOLULU INTERNATIONAL AIRPORT: 1971 TO 2016

Year	Average daily maximum (°F)	Days 90° or higher	Year	Average daily maximum (°F)	Days 90° or higher
1971	82.7	-	2001	84.5	19
1972	83.2	3	2002	84.1	9
1973	84.4	10	2003	84.8	35
1974	85.0	25	2004	84.9	53
1975	83.6	1	2005	84.7	55
1976	84.1	9	2006	83.1	1
1977	85.2	16	2007	84.2	11
1978	84.2	13	2008	84.5	12
1979	84.7	51	2009	(NA)	31
1980	84.6	22	2010	84.0	1
1981	84.6	9	2011	84.6	8
1982	83.5	27	2012	83.4	-
1983	85.1	44	2013	83.6	3
1984	85.5	63	2014	84.4	40
1985	84.6	53	2015	85.0	64
1986	86.2	64	2016	84.1	4
1987	85.7	93			
1988	86.1	70			
1989	85.2	34			
1990	84.0	47			
1991	84.9	35			
1992	85.2	28			
1993	84.5	23			
1994	85.5	85			
1995	86.8	116			
1996	85.8	69			
1997	85.1	50			
1998	83.7	-			
1999	83.2	-			
2000	84.0	4			

NA Not available

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data 2016*, "Meteorological Data, Honolulu" (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed July 4, 2017.

Table 5.50-- CLIMATIC DATA FOR HONOLULU INTERNATIONAL AIRPORT: 2003 TO 2016

Year	Average temperature (°F) 1/			Extreme temp. (°F)		Precipitation (inches)
	Annual	Coolest month	Warmest month	Lowest	Highest	
2003	78.5	72.5	83.2	57	92	12.69
2004	78.7	73.6	82.8	60	92	39.01
2005	78.4	72.7	83.6	58	93	15.60
2006	77.1	72.1	81.2	60	90	29.45
2007	78.0	73.4	82.1	57	91	11.99
2008	78.3	73.6	82.2	62	90	14.76
2009	(NA)	72.5	82.5	58	92	11.55
2010	77.5	73.1	80.7	61	90	17.40
2011	78.3	73.4	81.5	59	90	15.69
2012	77.2	73.9	80.8	60	89	8.58
2013	77.1	72.9	81.2	59	90	16.18
2014	78.2	72.7	82.9	60	93	20.82
2015	78.7	72.3	83.5	57	93	21.04
2016	77.9	74.2	81.5	59	91	13.16

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	Peak gust		
2003	71	56	10.5	(NA)	(NA)	87
2004	75	61	9.7	(NA)	(NA)	122
2005	71	55	10.6	(NA)	(NA)	90
2006	66	58	9.9	(NA)	(NA)	97
2007	63	54	11.1	(NA)	(NA)	83
2008	62	53	10.0	(NA)	(NA)	92
2009	62	54	10.2	(NA)	(NA)	74
2010	63	53	10.1	(NA)	(NA)	88
2011	66	56	10.1	(NA)	(NA)	108
2012	66	57	10.7	(NA)	(NA)	51
2013	65	56	9.4	(NA)	(NA)	83
2014	65	56	8.9	(NA)	(NA)	104
2015	67	58	9.4	(NA)	(NA)	122
2016	66	57	10.2	(NA)	(NA)	97

NA Not available.

1/ Average dry bulb (temperature of the ambient air).

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Local Climatological Data, Annual Summary With Comparative Data 2016,* "Meteorological Data, Honolulu, HI" (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed July 4, 2017.

Table 5.51-- 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 1/	80.8
Lowest average annual rainfall (inches)	…	Kawaihae	8.7
Highest average annual rainfall (inches)	…	Waialeale	444
Single events			
Lowest temperature of record (°F)	Jan. 20, 1970	Mauna Kea summit 2/	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.)	Sept. 11, 1992	Makahuena Pt. 3/	143

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: Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, data provided February 14, 1995.

Table 5.52-- RAINFALL AT SPECIFIED LOCATIONS: 2002 TO 2016

[In inches]

Year	Hawaii				Maui		
	Hilo Airport	Lalamilo	Kona Village	Naalehu	Kahului Airport	Kihei	Lahaina
2002	134.03	18.01	9.70	59.15	15.07	13.33	(NA)
2003	91.38	1/ 12.37	5.66	1/ 25.71	13.83	11.58	(NA)
2004	137.49	29.99	19.97	2/ 47.56	26.17	26.38	(NA)
2005	123.32	15.58	14.90	1/ 25.01	2/ 15.45	10.88	(NA)
2006	122.02	10.61	9.68	1/ 71.26	18.65	16.49	(NA)
2007	106.75	16.39	12.45	42.46	13.06	14.61	(NA)
2008	127.53	7.43	7.74	1/ 48.43	9.55	5.84	(NA)
2009	131.18	2/ 9.41	6.99	4/ 23.20	14.07	7.33	(NA)
2010	63.29	8/ 0.25	5.55	8/ 0.51	9.44	4.68	(NA)
2011	97.66	8/ 0.36	3.29	6/ 11.49	1/ 10.59	7.42	(NA)
2012	90.94	5/ 1.04	1.50	7/ 18.73	5.04	2.17	(NA)
2013	102.24	9/ 0.90	4/ 4.29	1/ 27.02	15.41	1/ 6.76	(NA)
2014	115.24	7/ 11.83	13.64	1/ 52.87	23.25	17.97	(NA)
2015	147.59	8/ 1.66	11/ 9.61	43.20	29.26	1/ 14.22	(NA)
2016	128.43	9/ 0.04	1/ 14.60	41.76	19.00	1/ 14.22	8/ 0.73

Year	Oahu				Kauai		
	Waikiki	University of Hawaii	Nuuanu Res. 4	Kane-ohe	Koloa	Lihue Airport	Princeville
2002	17.26	23.66	106.70	44.16	1/ 40.33	31.92	66.81
2003	23.09	1/ 24.36	111.33	50.75	2/ 31.06	35.78	74.82
2004	40.31	61.89	146.17	81.26	64.89	49.91	93.17
2005	19.26	36.45	1/ 79.09	58.24	4/ 22.35	27.61	79.95
2006	31.84	38.90	89.54	81.28	3/ 60.48	67.03	91.58
2007	27.30	1/ 33.81	1/ 93.06	45.19	43.52	24.37	72.09
2008	15.60	33.79	103.82	41.44	57.56	40.07	78.85
2009	11.56	24.22	1/ 88.12	52.50	1/ 30.99	26.63	82.53
2010	15.60	32.76	83.33	40.91	1/ 43.12	25.94	52.02
2011	23.74	1/ 29.87	93.76	1/ 52.56	3/ 39.64	42.67	83.11
2012	14.25	23.01	5/ 61.22	32.66	(10/)	41.12	73.40
2013	19.25	32.11	112.48	47.44	(10/)	37.15	62.28
2014	21.48	32.83	123.63	52.51	(10/)	30.94	70.73
2015	18.54	3/ 33.70	130.86	1/ 52.45	(10/)	30.07	71.87
2016	11.97	24.80	123.67	1/ 80.30	(10/)	13.39	74.53

Continued on next page.

Table 5.52-- RAINFALL AT SPECIFIED LOCATIONS: 2002 TO 2016 -- Con.

NA Not available.
1/ Missing 1 day.
2/ Missing 2 days.
3/ Missing 3 days.
4/ Missing 4 days.
5/ Missing 5 days.
6/ Missing 6 days.
7/ Missing 7 days.
8/ Missing 10 days.
9/ Missing 11 days.
10/ Missing 26 or more days.
11/ Revised from previous *Data Book.*

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Climatic Data Center, *Climatological Data, Annual Summary, Hawaii and Pacific* (annual); Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, records; and University of Hawaii at Manoa, School of Ocean and Earth Science and Technology, Department of Atmospheric Science, records.

Table 5.53-- MAJOR HURRICANES: 1950 TO 2016

Hurricane name	Date 1/	Islands most affected	Maximum recorded winds ashore (m.p.h.)		Deaths	Property damage (mil. dol.)
			Sustained	Peak gusts		
Hiki	Aug. 15-17, 1950	Kauai	68	(NA)	1	0.2
Della	Sept. 4, 1957	French Frigate Shoals	82	109	-	Minor
Nina	Dec. 1-2, 1957	Kauai	(NA)	92	1	0.1
Dot	Aug. 6, 1959	Kauai	81	103	-	5.5+
Fico	July 18-20, 1978	Hawaii	(NA)	58+	-	0.2
Iwa	Nov. 23, 1982	Kauai, Oahu	65	117	1	234.0
Estelle	July 22, 1986	Maui, Hawaii	(NA)	55	-	2.0
Iniki	Sept. 11, 1992	Kauai, Oahu	92	143	8	1,900

NA Not available.

1/ Period affecting the Hawaiian Islands.

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; "20-Foot Waves Hit Big Isle As Storm Brushes Coastline", *The Honolulu Advertiser,* July 23, 1986, pp. A1, A2; "Hawaii Hurricanes", *Honolulu Star-Bulletin,* August 4, 1988, p. A-8; Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, records; and University of Hawaii at Manoa, School of Ocean and Earth Science and Technology, Department of Atmospheric Science, records.

Table 5.54-- TRADE WINDS, HIGH SURF, AND TEMPERATURES IN HAWAIIAN WATERS, BY MONTH

Month	Trade wind frequency 1/ (percent)	Expected days of strong trade winds 2/	Highest surf 3/ (average number of days)		Water temperature 4/ (°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
Annual	73	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), pp. 14, 22, 56, and 74; and Hawaii State Department of Land and Natural Resources, Commission on Water Resource Management, data provided February 14, 1995.

Table 5.55-- SUNRISE, SUNSET, AND HOURS OF DAYLIGHT AT SELECTED LOCATIONS, AT BEGINNING OF EACH SEASON: 2017

[Based on Hawaii-Aleutian Standard Time which is 10 hours less than Universal Time Coordinated (UTC), the international standard for civil time]

Subject	Hilo	Kahului	Honolulu	Lihue
Sunrise (a.m.)				
March 20	6:24	6:30	6:35	6:41
June 20	5:42	5:46	5:50	5:55
Sept. 22	6:09	6:15	6:20	6:26
Dec. 21	6:50	6:58	7:05	7:12
Sunset (p.m.)				
March 20	6:32	6:37	6:43	6:49
June 20	7:02	7:10	7:16	7:24
Sept. 22	6:16	6:22	6:27	6:33
Dec. 21	5:47	5:50	5:55	6:00
Daylight (hours, minutes)				
March 20	12, 08	12, 07	12, 08	12, 08
June 20	13, 20	13, 24	13, 26	13, 29
Sept. 22	12, 07	12, 07	12, 07	12, 07
Dec. 21	10, 57	10, 52	10, 50	10, 48

Source: U.S. Naval Observatory, Astronomical Applications Department <http://aa.usno.navy.mil/data/docs/EarthSeasons.php> and <http://aa.usno.navy.mil/data/docs/RS_OneYear.php> accessed June 22, 2017; and calculations by the Hawaii State Department of Business, Economic Development & Tourism.

Table 5.56-- SUNRISE, SUNSET, AND HOURS OF DAYLIGHT AT SELECTED LOCATIONS, AT BEGINNING OF EACH SEASON: 2018

[Based on Hawaii-Aleutian Standard Time which is 10 hours less than Universal Time Coordinated (UTC), the international standard for civil time]

Subject	Hilo	Kahului	Honolulu	Lihue
Sunrise (a.m.)				
March 20	6:24	6:30	6:35	6:41
June 21	5:43	5:46	5:50	5:55
Sept. 22	6:09	6:15	6:20	6:26
Dec. 21	6:50	6:58	7:04	7:12
Sunset (p.m.)				
March 20	6:31	6:37	6:43	6:49
June 21	7:02	7:10	7:16	7:24
Sept. 22	6:16	6:22	6:27	6:33
Dec. 21	5:47	5:50	5:55	6:00
Daylight (hours, minutes)				
March 20	12, 07	12, 07	12, 08	12, 08
June 21	13, 19	13, 24	13, 26	13, 29
Sept. 22	12, 07	12, 07	12, 07	12, 07
Dec. 21	10, 57	10, 52	10, 51	10, 48

Source: U.S. Naval Observatory, Astronomical Applications Department <http://aa.usno.navy.mil/data/docs/EarthSeasons.php> and <http://aa.usno.navy.mil/data/docs/RS_OneYear.php> accessed June 22, 2017; and calculations by the Hawaii State Department of Business, Economic Development & Tourism.

Table 5.57-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF MAJOR SPECIES IN THE HONOLULU AREA: 2012 TO 2016

[Counts are made in late December at various locations between Hawaii Kai and Aiea, and between Waimanalo and Kaneohe. Annual changes reflect differences in numbers of bird counters and counting time in the field, as well as changes in bird populations. Totals by species are also affected by the types of habitats studied]

Species	2012	2013	2014	2015	2016
Endemic species 1/					
'Apapane	8	28	7	2	26
Hawaiian Duck X Mallard	312	188	144	274	160
Hawaiian Moorhen 2/	67	50	31	23	103
Hawaiian Stilt 2/	145	143	103	129	124
Oahu 'Amakihi	8	33	23	-	7
Oahu 'Elepaio	4	7	5	2	-
Indigenous species 3/					
Black-crowned Night Heron	54	41	33	34	39
Brown Booby	3	1	29	5	8
Great Frigatebird	39	25	48	15	7
Red-footed Booby	522	866	1,473	1,650	2,050
White Tern	7	9	5	3	48
Alien species 4/					
Cattle Egret	185	130	212	193	204
Common Myna	814	885	522	820	1,137
Common Waxbill	1,189	337	1,319	647	1,414
House Finch	193	141	73	36	32
House Sparrow	199	162	56	123	258
Japanese White-eye	192	201	260	63	61
Java Sparrow	503	497	623	611	128
Northern Cardinal	52	48	33	19	22
Nutmeg Mannikin	186	14	265	89	57
Red-billed Leiothrix	112	118	131	14	42
Red-crested Cardinal	155	159	95	227	228
Red-vented Bulbul	492	379	363	165	289
Red-whiskered Bulbul	45	72	118	13	37
Rock Dove/Pigeon	464	224	165	283	630
Spotted Dove	292	393	214	161	269
White-rumped Shama	46	60	78	16	20
Yellow-fronted Canary	19	56	6	144	190
Zebra Dove	1,962	1,110	1,303	878	1,826

Continued on next page.

Table 5.57-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF MAJOR SPECIES IN THE HONOLULU AREA: 2012 TO 2016 -- Con.

Species	2012	2013	2014	2015	2016
Visitor species 5/					
Mallard	24	6	3	13	104
Pacific Golden-Plover	518	613	374	231	313
Ruddy Turnstone	322	561	131	245	186
Sanderling	13	13	5	11	1
Wandering Tattler	26	19	18	12	5

1/ Birds peculiar to Hawaii, and found nowhere else.
2/ Endangered species.
3/ Native to Hawaii, but also found elsewhere.
4/ Formerly termed "introduced". Includes accidental escapes from captivity.
5/ Formerly termed "migratory". Includes stragglers and seasonal migrants.
Source: Audubon's Christmas Bird Count <http://netapp.audubon.org/CBCObservation/> accessed June 23, 2017.

Table 5.58-- HAWAII AUDUBON SOCIETY BIRD COUNTS IN THE HONOLULU AREA, BY TYPE OF SPECIES: 2004 TO 2016

[Counts are made in late December of various locations between Hawaii Kai and Aiea, and between Waimanalo and Kaneohe. Annual changes reflect differences in numbers of bird counters and counting time in the field, as well as changes in bird populations. Totals by species are also affected by the types of habitats studied]

Year	Type of species				
	All species	Endemic	Indigenous	Alien	Visitor
2004	56	4	9	31	12
2005	52	5	8	28	11
2006	55	5	13	27	10
2007	47	5	7	26	9
2008	40	3	5	22	10
2009	51	5	11	28	7
2010	46	4	8	27	7
2011	60	5	9	33	13
2012	54	5	7	28	14
2013	50	5	9	27	9
2014	56	5	12	28	11
2015	51	5	8	27	11
2016	48	4	9	28	7
Year	Number of individuals				
	All species	Endemic	Indigenous	Alien	Visitor
2004	11,306	160	1,294	8,243	1,609
2005	7,007	106	1,143	4,673	1,085
2006	7,386	152	620	5,671	943
2007	5,021	149	695	3,445	732
2008	4,110	193	553	2,587	777
2009	6,963	149	656	5,102	1,056
2010	5,475	304	808	3,574	789
2011	11,807	512	1,242	8,985	1,068
2012	9,600	403	837	7,458	902
2013	7,847	353	1,138	5,113	1,243
2014	8,528	271	1,733	5,977	547
2015	7,314	302	1,860	4,640	512
2016	10,406	240	2,381	7,260	525

Source: Audubon's Christmas Bird Count <http://netapp.audubon.org/CBCObservation/> accessed July 4, 2017; Robert L. Pyle, *Checklist of the Birds of Hawaii* <http://www.hawaiiaudubon.com/checklist/checklist2002.pdf> accessed on June 22, 2010; and calculations by the Department of Business, Economic Development & Tourism.

Table 5.59-- BIRD SPECIES OF HAWAII: 2017

Type of species	Number
All species	1/ 338
Resident native: normally does not leave the islands	34
Alien, introduced: resident, does not leave the islands	53
Breeding in Hawaii: most individuals leave Hawaii when not breeding	26
Visitor: breeds elsewhere, occurs in Hawaii when not breeding	194
Extinct: extinct or almost cerrtainly extinct	33
Endangered (or threatened): on the federal list of endangered species	36

1/ Doesn't include double counts for cattle egret and eurasian skylark, that are classified as alien and visitor.

Source: Robert L. Pyle and Peter Pyle, *The Birds of the Hawaiian Islands: Occurrence, History, Distribution, and Status,* Version 2-1 January 2017, Bishop Museum, Hawaii Biological Survey <http://hbs.bishopmuseum.org/birds/rlp-monograph/PrimaryChecklist.htm> accessed on July 4, 2017 and U.S. Fish & Wildlife Service, Environmental Conservation Online System (ECOS) <https://ecos.fws.gov/ecp/species-reports> accessed July 4, 2017.

Table 5.60-- TREES ALONG STREETS OR IN PARKS UNDER THE JURISDICTION OF THE CITY AND COUNTY OF HONOLULU: 2011 to 2016

[As of June 30]

Location	2011	2012	2013	2014	2015	2016
Along City and County streets and highways 1/	139,300	143,400	142,700	143,281	143,967	145,184
In City and County parks	92,900	95,600	95,100	95,521	95,978	96,790

1/ Excludes Federal, State, and private thoroughfares.

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

Table 5.61-- THREATENED AND ENDANGERED SPECIES, FOR HAWAII AND THE UNITED STATES

[As of July 4, 2017]

Group	United States	Hawaii
Animal species	709	77
Amphibians	35	-
Arachnids	12	1
Birds	101	36
Clams	89	-
Corals	6	-
Crustaceans	28	3
Fishes	163	-
Insects	84	27
Mammals	95	1
Reptiles	44	4
Snails	52	5
Plant species	942	424
Conifers and cycads	4	-
Ferns and allies	38	23
Flowering plants	898	401
Lichens	2	-

Source: U.S. Fish & Wildlife Service, Environmental Conservation Online System (ECOS) <https://ecos.fws.gov/ecp/species-reports> accessed July 4, 2017.