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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.

Table 5.01-- GREAT CIRCLE DISTANCE BETWEEN SPECIFIED PLACES

Places	Statute miles	Nautical miles	Kilometers
Distances from Daniel K. Inouye 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

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

Places	Statute miles	Nautical miles	Kilometers
Distances from Daniel K. Inouye International 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		
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		
Daniel K. Inouye 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 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 COUNTY AND ISLAND

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
County				
Hawaii	266	428	313	504
Maui, including Kalawao	210	338	343	552
Honolulu	137	220	234	377
Kauai	137	220	162	261
Island 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	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				
Hoomaluhia	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 2019

[As of December 31, 2019. Four volcanoes have erupted in historical times: Haleakala, last active in 1460; Hualalai, last active in 1801; Mauna Loa, last active in 1984; Kilauea, last active in 2018]

Volcano and date of outbreak	Duration (days)	Location 1/	Elevation of main vent (meters)	Area covered by lava flows (km2)	Volume of lava and/or ash erupted (km3)
Mauna Loa					
1950: June 1	23	S, SWR	3,840-2,380	112.0	0.3760
1975: July 5	<1	S	3,900	13.5	0.0300
1984: March 25	22	S, NER	4,030-2,870	48.0	0.2200
Kilauea					
1969: Feb. 22	6	ER	930-870	6.0	0.0161
May 24	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	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	<1	C	1,100	1.0	0.0102
Dec. 31	<1	SWR	1,080	7.5	0.0143
1975: Nov. 29	<1	C	1,080-1,060	0.3	0.0002
1977: Sept. 13	18	ER	620-480	7.8	0.0329
1979: Nov. 16	1	ER	980-960	0.3	0.0006
1982: April 30	<1	C	1,080	0.3	0.0005
Sept. 25	<1	C	1,080	0.8	0.0030
1983: Jan. 3	12,893	ER	900	272.8	4.4000
2008: March 19	3,710	C	1,035	0.4	(2/)
2018: May 3	126	LER	200	35.5	1.0550

1/ C, summit caldera; ER, east rift zone; NER, northeast rift zone; S, summit area; SWR, southwest rift zone; LER, lower east 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/ Halemaumau Overlook Crater contained a lava lake with an area of 41,000 square meters, and total erupted mass of ash ejecta was 2.9x10^6 kg.

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 2019

[As of December 31, 2019. Includes all earthquakes with magnitudes of 6.2 or greater]

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 2019 -- 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
2018: May 4	12:32 PM	Kalapana, Hawaii	6.9

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/>; and records.

Table 5.21-- EARTHQUAKES WITH INTENSITIES OF V OR GREATER ON OAHU: 1859 TO 2019

[As of December 31, 2019]

Date (HST)	Epicentral location	Magnitude	Oahu average intensity (Modified Mercalli Scale 1/)
1861: Dec. 5	Molokai-Lanai vicinity (?)	5.9	Mid V
Dec. 15	Molokai-Lanai vicinity (?)	5.6	Lower V - mid V
1868: Apr. 2	SE coast of Hawaii	7.9	Upper IV - lower V
Apr. 4	Maui group vicinity (?)	6.5	Lower V
1870: Aug. 7	Near Molokai	6.4	V
1871: Feb. 19	S coast of Lanai	6.8	Upper VI - lower VII
1881: Sep. 30	Maui vicinity	6.4	IV - V
1887: Jan. 13	Oahu vicinity	5.3	V
1895: Dec. 8	Oahu vicinity (?)	6.8	Mid V
1896: Sep. 13	Maui vicinity (?)	6.6	IV - V
1926: Mar. 19	N of Kohala, Hawaii	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	5.2	Mid VI
1973: Apr. 26	Honomu, Hawaii	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	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:

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.

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; and records

Table 5.22-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE: 1812 TO 2019

Date	Place of observation	Source	Maximum height in Hawaii		Deaths in Hawaii	Damage in Hawaii
			Meters	Feet		
1812: Dec. 21 1/	Hookena, Hawaii	California	3.0	10	-	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
1854: Jan. 27	Hilo, Hawaii	Alaska	2.4	8	-	(NA)
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	4.5	15	-	Houses, bridges destroyed
1868: Oct. 2	Kahaualea, Hawaii	Hawaii	6.1	20	-	(NA)
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	Alaska 3/	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	15.7	52	-	Houses destroyed on Maui, railroad washed out on Oahu
1906: Aug. 17	Maalaea, Maui	Chile	3.5	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	3.3	11	-	Boathouses, walls destroyed in Kona
1946: April 1	Waikolu Valley, Molokai	Aleutian Islands	16.5	54	159	$26,000,000
1952: Nov. 4	Kaena, Oahu	Kamchatka	10.4	34	-	$1,000,000

Continued on next page.

Table 5.22-- TSUNAMIS WITH RUN-UP OF 2 METERS (6.6 FEET) OR MORE: 1812 TO 2019-- Con.

Date	Place of observation	Source	Maximum height in Hawaii		Deaths in Hawaii	Damage in Hawaii
			Meters	Feet		
1957: March 9	Wainiha Bay, Kauai	Aleutian Islands	16.2	53	-	$5,000,000
1960: May 22	Hilo, Hawaii	Chile	10.7	35	61	$23,000,000
1964: March 27	Waimea Bay, Oahu	Alaska	4.9	16	-	$68,000
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.

3/ Revised from previous *Data Book.*

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 February 6, 2020.

Table 5.23-- MAJOR DAMS AS OF DECEMBER 31, 2019

[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	98	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 February 6, 2020.

Table 5.24-- FRESH WATER USE, BY TYPE AND BY COUNTY: 2015

[Million gallons per day. Data source was revised in 2018, but Hawaii data were not affected]

Use	State total	Hawaii	Honolulu	Kalawao	Kauai	Maui
Total	682.95	89.89	258.11	0.01	43.35	291.59
Ground water	338.47	60.09	186.38	0.01	16.71	75.28
Public supply	252.31	37.38	168.78	0.01	13.67	32.47
Domestic	0.66	-	-	-	0.54	0.12
Industrial	0.24	0.21	-	-	0.03	-
Irrigation	73.80	14.47	15.09	-	1.88	42.36
Livestock	0.51	-	0.11	-	0.20	0.20
Aquaculture	8.58	6.21	1.92	-	0.34	0.11
Mining	0.89	0.34	0.48	-	0.05	0.02
Thermoelectric	1.48	1.48	-	-	-	-
Surface water	344.48	29.80	71.73	-	26.64	216.31
Public supply	14.61	2.32	-	-	2.67	9.62
Domestic	7.44	7.44	-	-	-	-
Industrial	-	-	-	-	-	-
Irrigation	311.26	12.19	68.65	-	23.97	206.45
Livestock	1.10	1.10	-	-	-	-
Aquaculture	10.04	6.75	3.08	-	-	0.21
Mining	0.03	-	-	-	-	0.03
Thermoelectric	-	-	-	-	-	-

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 2015* <https://www.sciencebase.gov/catalog/item/5af3311be4b0da30c1b245d8> accessed April 24, 2020.

Table 5.25-- WATER SERVICES AND CONSUMPTION, FOR COUNTY WATERWORKS: 2017 TO 2019

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

Geographic area	Number of services			Consumption (million gallons)		
	2017	2018	2019	2017	2018	2019
State total	273,215	273,969	275,498	73,197	72,193	72,369
City and County of Honolulu	171,780	172,156	172,872	47,848	47,494	47,515
Honolulu District 1/	63,437	63,496	63,612	28,360	28,478	28,001
Rest of Oahu	108,343	108,660	109,260	19,488	19,016	19,514
Hawaii County	43,352	43,391	43,711	9,701	8,935	9,259
Kauai County	21,718	21,807	22,196	4,025	4,015	3,921
Maui County	36,365	36,615	36,719	11,623	11,749	11,674
Maui	34,690	34,933	35,028	11,375	11,508	11,449
Molokai	1,675	1,682	1,691	248	241	225

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 Maui County Department of Water Supply records.

Table 5.26-- WATER WITHDRAWALS BY SOURCE AND MAJOR USE, FOR HAWAII AND THE UNITED STATES: 2015

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

Subject	Hawaii	U.S. 1/
Water withdrawals, total (millions of gallons per day)	1,060	322,000
Source (percent)		
Ground water	33.8	26.3
Surface water	66.2	73.7
Selected major uses (percent)		
Public supply	25.2	12.1
Domestic	0.8	1.0
Irrigation	36.3	36.7
Livestock	0.2	0.6
Aquaculture	1.8	2.3
Industrial	0.0	4.6
Mining	0.1	1.2
Thermoelectric power	35.7	41.3

1/ Includes Puerto Rico and the Virgin Islands.

Source: U.S. Geological Survey, *Estimated Use of Water in the United States in 2015* , Circular 1441 table 1 and table 2A <https://pubs.usgs.gov/circ/1441/circ1441.pdf> accessed May 24, 2019 and calculations by Hawaii State Department of Business, Economic Development & Tourism.

Table 5.27-- TOP 25 WATER USERS ON OAHU: MAY 2017 TO APRIL 2018

[Estimated monthly average]

Rank	User	Gallons (1,000)
1	Marine Corps Base Hawaii	64,356
2	Hilton Hawaiian Village Lessee LLC	18,683
3	Honolulu International Airport Maintenance - 530 Paiea	15,108
4	Honolulu International Airport Maintenance - 2980 Aolele	14,377
5	Disney Vacation Resort & Spa Ko Olina	13,246
6	GGP Ala Moana LLC	12,024
7	United Laundry Service	10,958
8	Sheraton Hotels Hawaii	10,854
9	University of Hawaii - 2566 Dole	10,694
10	Sand Island Treatment Plant	9,702
11	YHB Hawaii Kai LLC (Hawaii Kai Golf Course)	8,565
12	MWR Barbers Point Golf Course	8,429
13	Central Regional Park	8,366
14	Dole Food Company Hawaii - Waialua Sugar Interconnection	7,556
15	Honolulu Zoo	7,311
16	University of Hawaii - 2444 Dole	7,033
17	Hale Koa Hotel Maile Tower	6,975
18	Marriott International Inc.	6,932
19	Hyatt Regency Waikiki	6,921
20	Hawaii MVCC LLC (Makaha Valley Country Club)	6,802
21	Hale Koa Hotel Ilima Tower	6,538
22	Ala Moana Beach Park	6,143
23	Ala Wai Golf Course	6,097
24	Halawa Medium Security Facility	6,089
25	Hawaiian Cement	5,477

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 2016

[In million gallons per day. Reuse amount for 2015 onward is based on operator reports which provide more accurate figures because they account for declines in use due to rainy periods, off-spec water, and equipment malfunctions]

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	16.30	12.10
2016	134	17.20	12.80

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: 2020

[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/	Wahiawa	5/31/94	(NA)
Pearl Harbor Naval Complex 5/	Pearl Harbor	10/14/92	(NA)

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.

Source: U.S. Environmental Protection Agency, *National Priorities List Sites in Hawaii* <https://www.epa.gov/superfund/national-priorities-list-npl-sites-state#HI> accessed May 13, 2020.

Table 5.31-- TOXIC CHEMICAL RELEASES IN 2018 AND HAZARDOUS WASTE GENERATED, SHIPPED, AND RECEIVED IN 2017

Category	Unit
Number of TRI facilities in Hawaii in 2018	31
Toxic chemical releases in 2018 1/	2,943,092
On-site releases	2,720,735
Air emissions	1,826,598
Water emissions	749,919
Land emissions	144,218
Off-site releases, transfers to disposal	222,357
Hazardous waste generators, shippers, and receivers 2017	
Number of generators	108
Number of shippers	107
Number of receivers	1
Hazardous waste generated, shipped, and received 2017 2/	
Generated	499,156
Shipped	675
Received	30

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 May 29, 2020; United States Environmental Protection Agency, *The National Biennial RCRA Hazardous Waste Report: 2017 Edition* <https://rcrainfo.epa.gov/rcrainfoweb/action/modules/br/summary/view> accessed May 29, 2020.

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/ 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	2/ 1,040,039	1/ 43.0

1/ Maui County data currently incomplete or unavailable.

2/ Maui and Hawaii counties data are 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	629	67.6
2007	936	633	67.6
2008	948	682	71.9
2009	896	705	78.7
2010	902	686	76.1
2011	907	687	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

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: 2018 TO 2019

[Starting in Data Book 2019, only includes data from regularly monitored beaches and stations with 10 or more sampling events. Therefore, data from previous editions of the Data Book are not comparable. Data from 2018 was revised to reflect this change.

Island	Number of locations	Number of samples	Enterococci density 1/			
			Lowest 2/	Highest 3/	Number over 4/	Mean 5/
2018						
State total	53	1,987	2.4	11.3	-	3.9
Hawaii	10	200	3.1	11.3	-	6.0
Hilo Shoreline	5	117	3.7	11.3	-	5.9
Kona Shoreline	5	83	3.1	9.0	-	6.2
Maui	16	656	2.5	8.4	-	3.9
Lanai	-	-	(X)	(X)	(X)	(X)
Molokai	-	-	(X)	(X)	(X)	(X)
Oahu	22	942	2.4	7.3	-	3.9
Kauai	5	189	2.8	6.5	-	4.4
2019						
State total	53	2,279	2.4	9.9	-	3.8
Hawaii	10	408	2.9	9.5	-	4.4
Hilo Shoreline	5	157	3.6	9.5	-	6.5
Kona Shoreline	5	251	2.9	4.4	-	3.4
Maui	16	506	2.4	8.2	-	3.5
Lanai	-	-	(X)	(X)	(X)	(X)
Molokai	-	-	(X)	(X)	(X)	(X)
Oahu	22	1,120	2.4	6.9	-	3.7
Kauai	5	245	2.8	9.9	-	4.9

X Not applicable.

1/ Geometric mean, number per 100 ml. The geometric mean standard for Enterococci density was 35 per 100 ml. in 2018 and 2019.

2/ The lowest reported average value for 2018 was reported for White Plains Beach Park, on the island of Oahu. The lowest reported average value for 2019 was shared by 2 beaches, one of which was Makapuu on the island of Oahu.

3/ The highest average value in 2018 was reported for Honolii Cove (Ocean), on the Hilo side of the island of Hawaii. The highest average value for 2019 was reported by Kalapaki Beach Park 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 2018 and 2019.

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: 2018 AND 2019

[Starting in Data Book 2019, only includes data from regularly monitored beaches and stations with 10 or more sampling events. Therefore, data from previous editions of the *Data Book* are not comparable. Data are categorized by STORET Station ID. STORET (Storage and Retrieval for Water Quality Data) is a repository of ambient Water Quality Data]

Island and beach 1/	STORET	Number of samples		Enterococci density 1/	
		2018	2019	2018	2019
Hawaii					
Hilo Shoreline	0011XX	2/ 117	157	5.9	6.5
Hilo Bay (Canoe Beach)	001138	21	28	4.8	7.8
Honolii Cove (Ocean)	001110	18	27	11.3	9.5
Keaukaha Beach - 4 Miles	001114	26	34	3.7	6.9
Onekahakaha Beach County Park	001126	26	34	3.9	3.6
Richardson Ocean Center	001136	26	34	10.6	7.1
Kona Shoreline	0012XX	2/ 83	251	2/ 6.2	3.4
Anaehoomalu Bay	001236	16	50	2/ 6.3	2.9
Kahaluu Beach County Park	001203	17	51	2/ 8.0	4.2
Kailua Bay	001205	17	50	3.1	2.9
Kamakaokahonu	001208	17	50	6.5	4.4
Puako	001222	16	50	9.0	3.0
Maui					
Airport (Kahekili) Beach	000695	47	37	3.2	3.6
Baldwin Park	000689	44	33	4.9	2.9
Cove Park	000703	39	35	6.1	3.6
Fleming Beach (North)	000674	39	38	4.0	3.0
Hanakaoo	000693	50	43	8.4	4.7
Hookipa Beach Park	000688	41	30	3.1	2.5
Hukilau Hotel Shoreline	000654	36	27	3.5	2.4
Kamaole Beach 1	000681	44	14	3.3	8.2
Kamaole Beach 2 (Ili'iliholo Beach)	000682	39	32	3.5	3.6
Kamaole Beach 3	000683	40	41	2.8	3.0
Kanaha Beach County Park	000677	38	10	3.0	4.3
Launiupoko	000694	40	32	3.3	3.2
Makena Beach Shoreline	000661	32	27	2.5	3.1
Sheraton Kaanapali Shoreline	000666	36	45	3.8	2.6
Teen Challange (Mile 14)	000697	47	42	5.8	3.8
Wailea Beach	000691	44	40	3.7	4.7
Oahu					
Ala Moana Lagoon	000222	50	51	3.0	3.2
Ala Moana Beach County Park, Center	000153	49	52	3.6	3.4
Ala Moana Beach County Park, DH	000154	49	54	3.2	3.1
Chun's Reef	000218	33	49	2.7	3.6
Haleiwa Alii Beach County Park	000247	35	48	3.6	2.9

Continued on next page.

Table 5.35-- WATER QUALITY AT SELECTED PUBLIC BEACHES: 2018 AND 2019 -- Con.

Island and beach 1/	STORET	Number of samples		Enterococci density 1/	
		2018	2019	2018	2019
Oahu (con.)					
Hanauma Bay	000201	45	43	6.6	6.9
Ihilani Kohola	000252	43	49	4.1	3.6
Kahanamoku Beach	000155	48	53	5.2	5.6
Kailua Beach County Park	000193	44	56	5.7	4.9
Kuhio Beach Park	000161	49	56	5.8	6.7
Lanikai	000194	51	55	7.3	3.9
Makaha Beach County Park	000185	43	49	3.1	2.6
Makapuu Beach County Park	000216	42	52	3.3	2.4
Moana Beach, Waikiki	000238	50	51	4.4	4.1
Nanakuli Beach County Park	000187	38	52	2.9	2.7
Pokai Bay Beach County Park	000224	43	53	4.2	5.1
Sandy Beach County Park	000200	45	52	3.1	2.6
Sans Souci St Rec Area	000228	49	52	3.1	3.7
Sunset Beach	000225	31	45	2.7	3.3
Waimanalo Beach County Park	000197	44	53	5.2	2.9
Waimea Beach	000172	24	45	3.4	4.0
White Plains Beach	000236	37	50	2.4	2.8
Kauai					
Hanalei Bay Pavilion	000805	34	50	4.3	4.6
Hanapepe Salt Pond	000808	45	49	2.8	2.8
Kalapaki Beach Park	000809	35	49	6.5	9.9
Lydgate Park	000825	26	47	4.8	4.9
Poipu Beach Pavilion	000819	49	50	4.9	4.4

1/ Geometric mean, number per 100 ml. The geometric mean standard for Enterococci density was 35 per 100 ml. in 2018 and 2019.

2/ Revised from previous *Data Book.*

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: 2006 TO 2019

[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	
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	38,498
2015	769,183	307,069	462,114	38,448
2016	793,793	311,172	482,621	41,136
2017	(NA)	(NA)	(NA)	42,678
2018	(NA)	(NA)	(NA)	41,593
2019	(NA)	(NA)	(NA)	40,179

Year	Average wastewater treated per day (millions of gallons)	Miles of sewers 2/	City and County pump stations	City and County treatment plants
2006	(NA)	2,268	66	8
2007	(NA)	3/ 2,105	67	9
2008	(NA)	2,105	67	9
2009	(NA)	2,105	69	9
2010	105	2,105	72	9
2011	105	2,226	72	9
2012	100	2,226	72	9
2013	100	2,016	72	9
2014	105	2,019	72	9
2015	105	2,023	72	9
2016	113	2,024	72	9
2017	117	(NA)	(NA)	(NA)
2018	114	(NA)	(NA)	(NA)
2019	110	(NA)	(NA)	(NA)

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 2019

[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	2004	13	0.6
1989	-	1.8	2005 3/	14	0.6
1990	-	1.5	2006 4/	13	0.4
1991	-	1.7	2007	14	0.5
1992	-	1.6	2008	14	0.5
1993	13	1.8	2009	13	0.4
1994	14	0.8	2010	12	0.4
1995	14	0.8	2011	12	0.4
1996	14	0.8	2012	12	0.4
1997	8	0.8	2013	11	0.4
1998	9	0.8	2014	13	0.4
1999	14	0.6	2015	11	0.5
2000	14	0.7	2016	13	0.6
2001	16	0.6	2017	11	0.5
2002	15	0.6	2018	12	0.4
2003	15	0.6	2019	11	0.4

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.

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

Table 5.39-- AIR QUALITY AT SPECIFIED LOCATIONS: 2019

[Data are preliminary]

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	2	35	11	-0.001	0.006	0.000
Pearl City	4	36	14	(X)	(X)	(X)
Kapolei	1	42	12	0.000	0.015	0.001

X Not applicable.

1/ Particulate matter up to 10 microns in diameter. The State and Federal Ambient Air Standard for 24-hr PM_{10} is 150 mg/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 2018

[In pounds. 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]

	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
2016	3,215,150	2,113,719	522,258	197,012	3,199	378,962
2017	3,061,992	2,001,955	593,620	238,073	1,338	227,006
2018	2,943,092	1,826,598	749,919	141,921	2,297	222,357

Source: U.S. Environmental Protection Agency, *Hawaii Report: Toxics Release Inventory* (annual) <https://enviro.epa.gov/triexplorer/tri_factsheet_search.searchfactsheet> accessed May 1, 2020.

Table 5.41-- TOXIC RELEASE INVENTORY CHEMICAL RELEASES: 1988 TO 2018

[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
2016	2,563,310	378,966	2,942,276	5,948,533
2017	2,834,986	227,006	3,061,992	6,572,271
2018	2,720,735	222,357	2,943,091	4,056,189

NA Not available.

Source: United States Environmental Protection Agency, Toxic Release Inventory Program, TRI Explorer <https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools> accessed on April 30, 2020.

Table 5.42 -- RELEASE OF PERSISTENT, BIOACCUMULATIVE AND TOXIC (PBT) CHEMICALS: 2002 TO 2018

[In pounds unless otherwise specified]

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
2016	104,779	493	373	4.00	1.708
2017	120,021	669	67	16.00	1.585
2018	70,427	703	68	17.00	1.586

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.

Source: U.S. Environmental Protection Agency, *Hawaii Report: Toxics Release Inventory* (annual) <https://www.epa.gov/toxics-release-inventory-tri-program/tri-data-and-tools> accessed May 1, 2020.

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 2019

[Average carbon dioxide mixing ratio, parts per million]

Year	Annual average	Year	Annual average	Year	Annual average
1958	1/ 315.17	1979	336.73	2000	369.55
1959	315.83	1980	338.72	2001	371.14
1960	316.75	1981	340.12	2002	373.28
1961	317.49	1982	341.21	2003	375.80
1962	318.30	1983	342.87	2004	377.52
1963	318.83	1984	344.48	2005	379.80
1964	2/ 319.04	1985	345.85	2006	381.90
1965	319.87	1986	347.21	2007	383.79
1966	321.21	1987	348.98	2008	385.60
1967	322.02	1988	351.34	2009	387.43
1968	322.83	1989	352.89	2010	389.90
1969	323.93	1990	354.26	2011	391.65
1970	325.27	1991	355.45	2012	393.85
1971	326.17	1992	356.58	2013	396.52
1972	327.26	1993	357.01	2014	398.65
1973	329.45	1994	358.51	2015	400.83
1974	1/ 329.72	1995	360.62	2016	404.24
1975	3/ 331.14	1996	362.40	2017	406.55
1976	332.04	1997	363.54	2018	408.52
1977	333.79	1998	366.61	2019	411.44
1978	335.35	1999	368.33		

1/ Based on data for 8 months.
2/ Based on data for 9 months.
3/ 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/> accessed July 13, 2020 and records.

Table 5.45-- TEMPERATURES AND PRECIPITATION FOR SELECTED PLACES

[Updated through December 2017]

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	63.5	84.0	51	92	124.73
Hawaii Volcanoes Nat. Park Hdq.	3,971	46.0	72.5	34	87	93.11
Naalehu	800	61.5	84.5	50	96	45.20
Kailua (Kona Airport)	30	69.5	87.5	60	96	23.30
Puako 2/	49	60.0	85.0	52	92	9.01
Waimea (Kamuela) 3/	2,671	49.5	73.5	34	87	31.44
Honokaa	1,080	(NA)	(NA)	(NA)	(NA)	67.35
Mauna Kea summit 4/	13,773	(NA)	(NA)	(NA)	(NA)	5.71
Maui:						
Hana Airport 5/	75	60.0	84.0	50	94	73.42
Haleakala summit 6/	9,964	26.0	62.5	15	73	25.33
Kihei 7/	160	(NA)	(NA)	(NA)	(NA)	12.21
Kahului Airport	51	61.5	86.5	48	97	18.52
Lahaina 8/	40	63.0	86.0	52	97	13.57
Molokai:						
Kaunakakai	12	(NA)	(NA)	(NA)	(NA)	13.10
Molokai Airport	443	59.5	85.5	46	93	23.83
Lanai:						
Lanai City 9/	1,620	55.5	79.5	46	89	33.41

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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:						
Daniel K. Inouye International Airport 10/	7	62.5	86.5	52	95	19.57
Waikiki (Honolulu Zoo)	10	59.5	86.5	43	95	22.55
Manoa (Lyon Arboretum)	500	60.5	82.0	49	92	150.52
Kaneohe (State Hospital)	190	60.5	84.5	50	93	69.53
Kahuku	13	32.0	85.0	32	95	37.84
Wheeler AFB 11/	820	32.0	80.0	32	91	39.96
Upper Wahiawa 12/	1,006	59.5	81.0	42	92	59.81
Kauai:						
Kilauea (town)	390	59.5	82.5	49	93	64.89
Lihue Airport	100	60.0	84.5	50	91	39.75
Poipu (Makahuena Pt.) 6/	52	61.0	85.5	50	96	32.06
Kekaha 13/	10	61.5	85.0	44	95	20.60
Kokee (Kanalohuluhulu)	3,600	32.5	74.0	19	86	62.29
Northwestern Hawaiian Islands:						
Midway 14/	40	55.0	86.5	49	92	40.73

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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/ Data available through 1976. Temperature data are for Mahukona.
3/ Data available through 1980.
4/ Based on incomplete and non-continuous data for 1966-1972.
5/ Data available through 2005.
6/ Data available through 1976.
7/ Temperature data available through 1982, refer to Keawakapu Beach.
8/ Data available through 2001.
9/ Data available through 2008, then restarted since June 2010.
10/ Formerly known as Honolulu International Airport.
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: 2019

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

Subject	Hilo	Kahului	Honolulu	Lihue
Temperatures (°F)				
Normal daily maximum, annual	80.9	77.3	84.4	81.2
Highest daily maximum	94	97	95	91
Month and year of occurrence	Nov 2013	Sep 2019	Aug 2019	Sep 2019
Normal daily minimum, annual	66.8	61.8	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	69.5	77.7	75.8
Normal no. days with maximum 90°F and above	-	(NA)	18.7	0.1
Normal relative humidity (percent), annual				
8 a.m.	80	(NA)	72	77
2 p.m.	68	(NA)	56	66
Percent of possible sunshine, annual	41	(NA)	71	59
Mean no. days (annual) with		(NA)		
Clear	35.5	(NA)	90.0	55.3
Partly cloudy	131.3	(NA)	179.8	183.2
Cloudy	195.3	(NA)	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	17.09	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	40.00
Month and year of occurrence	Nov 2000	Jan 1980	Mar 1958	Aug 2019

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, 2019,* "Normals, Means, and Extremes," for Hilo, Kahului, Honolulu, and Lihue (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed May 13, 2020.

Table 5.47-- MONTHLY AND ANNUAL CLIMATIC DATA FOR DANIEL K. INOUYE INTERNATIONAL AIRPORT: 2019

[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	5.68	(2/)	5.01
July	87.9	74.5	81.2	94	66	0.51	2.71	0.02	2.20
August	88.7	75.1	81.9	95	65	0.56	7.63	(2/)	4.42
September	88.6	74.4	81.5	95	64	0.70	4.48	0.05	2.25
October	86.7	73.4	80.0	94	58	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 DANIEL K. INOUYE INTERNATIONAL AIRPORT: 2019-- 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	39	68	8.1	7.6	7.4
March	73	57	10.1	39	72	7.4	9.3	8.8
April	70	55	11.0	35	70	5.9	9.6	7.5
May	67	54	10.5	31	72	6.7	8.7	5.8
June	66	52	11.8	30	74	6.5	6.2	5.7
July	68	52	12.0	30	76	7.4	5.1	7.1
August	68	52	11.7	33	77	8.0	5.7	5.6
September	70	53	10.1	30	77	7.9	5.7	6.9
October	71	56	9.6	36	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, 2019,* "Normals, Means, and Extremes, Honolulu, HI" (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed May 13, 2020.

Table 5.48-- AVERAGE TEMPERATURE, PERCENT OF POSSIBLE SUNSHINE, AND PRECIPITATION, FOR DANIEL K. INOUYE INTERNATIONAL AIRPORT: 1960 TO 2019

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

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	77.6	69	19.84
1961	77.2	81	14.26	1991	77.7	69	17.94
1962	76.5	71	13.58	1992	77.8	69	19.00
1963	76.7	64	37.91	1993	77.1	69	5.84
1964	77.0	63	20.12	1994	78.8	70	15.59
1965 1/	76.1	74	42.78	1995	79.3	70	13.60
1966 1/	77.6	68	23.18	1996	78.6	70	33.12
1967 1/	77.6	58	34.34	1997	77.8	71	19.99
1968 1/	77.9	63	37.26	1998	77.1	71	4.52
1969 1/	77.4	68	22.50	1999	76.9	71	11.99
1970 1/	78.2	72	15.49	2000	77.6	71	7.10
1971 1/	76.1	70	26.64	2001	78.2	71	9.14
1972	76.2	65	26.94	2002	77.9	71	12.18
1973	77.2	63	14.24	2003	78.5	71	12.69
1974	77.5	61	24.02	2004	78.7	71	39.01
1975	76.2	62	24.39	2005	78.4	71	15.60
1976	76.8	60	12.90	2006	77.1	71	29.45
1977	78.2	68	12.36	2007	78.0	71	11.99
1978	76.8	69	25.05	2008	78.3	71	14.76
1979	77.0	68	16.93	2009	(NA)	71	11.55
1980	77.4	68	26.90	2010	77.5	71	17.40
1981	77.1	68	13.41	2011	78.3	71	15.69
1982	76.9	67	34.92	2012	77.2	71	8.58
1983	77.2	67	5.03	2013	77.1	71	16.18
1984	78.1	67	17.08	2014	78.2	71	20.82
1985	76.9	67	17.38	2015	78.7	71	21.04
1986	78.3	68	13.93	2016	77.9	71	13.16
1987	77.9	68	23.53	2017	78.2	71	22.62
1988	78.5	68	16.47	2018	78.8	71	16.95
1989	77.5	68	27.52	2019	79.3	71	16.61

NA Not available.

1/ 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 2019,* "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 May 13, 2020.

Table 5.49-- AVERAGE DAILY TEMPERATURE AND DAYS WITH MAXIMUM OF 90° OR HIGHER, FOR DANIEL K. INOUYE INTERNATIONAL AIRPORT: 1971 TO 2019

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	2017	84.7	14
1988	86.1	70	2018	84.7	31
1989	85.2	34	2019	86.1	95
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 2019,* "Meteorological Data, Honolulu" (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed May 14, 2020.

Table 5.50-- CLIMATIC DATA FOR DANIEL K. INOUYE INTERNATIONAL AIRPORT: 2008 TO 2019

Year	Average temperature (°F) 1/			Extreme temp. (°F)		Precipitation (inches)
	Annual	Coolest month	Warmest month	Lowest	Highest	
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
2017	78.2	73.5	81.7	58	91	22.62
2018	78.8	75.0	82.9	63	92	16.95
2019	79.3	72.3	84.3	61	95	16.61

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		
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
2017	64	54	9.7	(NA)	(NA)	72
2018	67	58	10.1	(NA)	(NA)	98
2019	65	54	9.6	(NA)	(NA)	85

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 2019,* "Meteorological Data, Honolulu, HI" (annual) <http://www.ncdc.noaa.gov/IPS/lcd/lcd.html> accessed May 5, 2020.

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	444.0
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	100.0
Lowest annual rainfall of record (inches)	1953	Kawaihae	0.2
Highest annual rainfall of record (inches)	1982	Waialeale	666.0
Highest wind speed of record (m.p.h.)	Sept. 11, 1992	Makahuena Pt. 3/	143.0

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: 2003 TO 2017

[In inches]

Year	Hawaii				Maui		
	Hilo Airport	Lalamilo	Kona Village	Naalehu	Kahului Airport	Kihei	Lahaina
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	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
2017	105.57	1.38	(NA)	35.64	26.10	(NA)	(NA)

Year	Oahu				Kauai		
	Waikiki	University of Hawaii	Nuuanu Res. 4	Kane-ohe	Koloa	Lihue Airport	Princeville
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
2017	21.58	29.95	101.15	60.61	40.23	23.68	72.42

Continued on next page.

Table 5.52-- RAINFALL AT SPECIFIED LOCATIONS: 2003 TO 2017 -- 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.

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 2018

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	1900.0

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: 1995

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: 2020

[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 19	6:24	(NA)	6:35	(NA)
June 20	5:42	(NA)	5:50	(NA)
September 22	6:09	(NA)	6:20	(NA)
December 21	6:50	(NA)	7:05	(NA)
Sunset (p.m.)				
March 19	6:31	(NA)	6:43	(NA)
June 20	7:02	(NA)	7:16	(NA)
September 22	6:16	(NA)	6:27	(NA)
December 21	5:47	(NA)	5:55	(NA)
Daylight (hours, minutes)				
March 19	12, 07	(NA)	12, 08	(NA)
June 20	13, 20	(NA)	13, 26	(NA)
September 22	12, 07	(NA)	12, 07	(NA)
December 21	10, 57	(NA)	10, 50	(NA)

NA Not available.

Source: NOAA Global Monitoring Laboratory, *NOAA Solar Calculator for sunrise, sunset, solar noon and solar position for any place on earth* . Hilo data based on GML data sites. Honolulu data based on U.S. Cities sites. <https://www.esrl.noaa.gov/gmd/grad/solcalc/> accessed July 1, 2020 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: 2021

[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 19	6:24	(NA)	6:35	(NA)
June 20	5:42	(NA)	5:50	(NA)
September 22	6:09	(NA)	6:20	(NA)
December 21	6:50	(NA)	7:05	(NA)
Sunset (p.m.)				
March 19	6:31	(NA)	6:43	(NA)
June 20	7:02	(NA)	7:16	(NA)
September 22	6:16	(NA)	6:27	(NA)
December 21	5:47	(NA)	5:55	(NA)
Daylight (hours, minutes)				
March 19	12, 07	(NA)	12, 08	(NA)
June 20	13, 20	(NA)	13, 26	(NA)
September 22	12, 07	(NA)	12, 07	(NA)
December 21	10, 57	(NA)	10, 50	(NA)

NA Not available.

Source: NOAA Global Monitoring Laboratory, *NOAA Solar Calculator for sunrise, sunset, solar noon and solar position for any place on earth* . Hilo data based on GML data sites. Honolulu data based on U.S. Cities sites. <https://www.esrl.noaa.gov/gmd/grad/solcalc/> accessed July 1, 2020 and calculations by the Hawaii State Department of Business, Economic Development & Tourism.

Table 5.57-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF SELECTED SPECIES IN THE HONOLULU AREA: 2015 TO 2019

[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	2015	2016	2017	2018	2019
Endemic species 1/					
Apapane	2	26	4	4	18
Hawaiian Duck x Mallard	274	160	279	170	165
Hawaiian Moorhen 2/	23	103	77	26	49
Hawaiian Stilt 2/	129	124	117	119	131
Oahu 'Amakihi	-	7	7	6	64
Oahu 'Elepaio	2	-	1	2	-
Indigenous species 3/					
Black-crowned Night Heron	34	39	51	36	41
Brown Booby	5	8	8	-	6
Great Frigatebird	15	7	78	57	105
Red-footed Booby	1,650	2,050	1,775	850	866
White Tern	3	48	55	48	31
Alien species 4/					
Cattle Egret	193	204	193	206	382
Common Myna	820	1,137	1,294	969	1,381
Common Waxbill	647	1,414	860	1,259	832
House Finch	36	32	89	38	204
House Sparrow	123	258	373	126	236
Japanese White-eye	63	61	104	93	343
Java Sparrow	611	128	262	514	484
Northern Cardinal	19	22	28	12	81
Nutmeg Mannikin	89	57	27	114	27
Red-billed Leiothrix	14	42	50	83	163
Red-crested Cardinal	227	228	250	198	373
Red-vented Bulbul	165	289	278	214	350
Red-whiskered Bulbul	13	37	24	13	115
Rock Dove/Pigeon	283	630	605	215	370
Spotted Dove	161	269	242	164	315
White-rumped Shama	16	20	55	31	76
Yellow-fronted Canary	144	190	97	142	121
Zebra Dove	878	1,826	2,317	1,860	1,649

Continued on next page.

Table 5.57-- HAWAII AUDUBON SOCIETY BIRD COUNTS OF SELECTED SPECIES IN THE HONOLULU AREA: 2015 TO 2019 -- Con.

Species	2015	2016	2017	2018	2019
Visitor species 5/					
Mallard	13	104	10	-	2
Pacific Golden-Plover	231	313	342	339	485
Ruddy Turnstone	245	186	239	424	285
Sanderling	11	1	9	13	14
Wandering Tattler	12	5	15	11	23

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 May 14, 2020.

Table 5.58-- HAWAII AUDUBON SOCIETY BIRD COUNTS IN THE HONOLULU AREA, BY TYPE OF SPECIES: 2008 TO 2019

[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
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
2017	50	5	7	30	8
2018	46	5	8	26	7
2019	1/ 55	7	5	36	7
Year	Number of individuals				
	All species	Endemic	Indigenous	Alien	Visitor
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
2017	10,583	374	2,161	7,430	618
2018	9,037	437	1,150	6,640	810
2019	10,851	877	1,049	8,060	865

1/ Reported total was 53, but after summing total number of species it was found to be 55 individual species.

Source: Audubon's Christmas Bird Count <http://netapp.audubon.org/CBCObservation/> accessed May 14, 2020; Robert L. Pyle, *Checklist of the Birds of Hawaii* <http://www.hawaiiaudubon.com/checklist/checklist2002.pdf> accessed on June 22, 2010; Denis Lepage, *Avibase - Bird Checklists of the World* <https://avibase.bsc-eoc.org/checklist.jsp?region=ushi&list=howardmoore> accessed on May 14, 2020; and calculations by the Department of Business, Economic Development & Tourism.

Table 5.59-- BIRD SPECIES OF HAWAII

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 certainly extinct	33
Endangered (or threatened): on the federal list of endangered species	36

1/ Does not include double counts for cattle egret and eurasian skylark, which 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 May 14, 2020.

Table 5.60-- TREES ALONG STREETS OR IN PARKS UNDER THE JURISDICTION OF THE CITY AND COUNTY OF HONOLULU: 2014 TO 2019

[As of June 30]

Location	2014	2015	2016	2017	2018	2019
Along City and County streets and highways 1/	143,281	143,967	145,184	145,900	146,830	147,417
In City and County parks	95,521	95,978	96,790	97,266	97,886	98,278

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: 2020

[As of July 1, 2020]

Group	Hawaii	United States
Animal species	78	719
Amphibians	-	36
Arachnids	1	12
Birds	36	99
Clams	-	91
Corals	-	7
Crustaceans	3	28
Fishes	-	166
Insects	28	88
Mammals	1	95
Reptiles	4	45
Snails	5	52
Plant species	424	943
Conifers and cycads	-	4
Ferns and allies	23	38
Flowering plants	401	899
Lichens	-	2

Source: U.S. Fish & Wildlife Service, Environmental Conservation Online System (ECOS) <https://ecos.fws.gov/ecp/species-reports> accessed July 1, 2020.