United States Geological Survey
Programs in Hawaii

Fact Sheet

The USGS provides maps, reports, and information to help others meet their needs to manage, develop, and protect America's water, energy, mineral, and land resources. We help find natural resources needed to build tomorrow, and supply scientific understanding needed to help minimize or mitigate the effects of natural hazards and environmental damage caused by human activities. The results of our efforts touch the daily lives of almost every American.

The State of Hawaii consists of 132 islands, shoals, and reefs. The major Hawaiian islands, in terms of both population and land area, are the volcanically derived mountain ranges of Hawaii, Maui, Oahu, Kauai, Molokai, and Lanai.

Volcano Hazards

Four volcanoes in the Hawaiian Islands have erupted in the last 200 years. Of these, Kilauea and Mauna Loa have erupted repeatedly in this century, and the 12-year long eruption at Kilauea Volcano continues (fig. 1). The current eruption at Kilauea and possible future eruptions at Kilauea, Mauna Loa, Hualalai, and Haleakala Volcanoes would threaten communities in the state and would disrupt transportation and distribution of vital services, including water, power, and communications. Losses of life and property from future eruptions can be minimized through effective land-use planning and timely warnings of volcanic activity. The U.S. Geological Survey (USGS), in cooperation with the National Park Service, the Hawaii State and County Civil Defense Offices, and the Hawaii State and County Planning Offices, is working to mitigate hazards from future volcanic eruptions in Hawaii. The USGS is studying the frequency, size, and type of past eruptions. This information has been used to construct hazard zone maps that guide land-use planners and insurance analysis.

Figure 1. Location of volcanoes on the island of Hawaii.

The USGS maintains the Hawaiian Volcano Observatory (HVO), which is adjacent to the Thomas Jagger Museum on the rim of Kilauea Caldera. The HVO was placed under the direction of the USGS in 1948. The main functions of the HVO are monitoring the underground movement of magma, volcanic and earthquake–hazard assessment, and research to develop a better understanding of volcanic and earthquake processes to be able to forecast future activity accurately.

Earthquake Hazards

Earthquakes in Hawaii pose a significant threat to humans and could potentially cause large economic losses on all the islands. The island of Hawaii is one of the more seismically active places on Earth. On average, there is a magnitude 6 or greater earthquake in Hawaii every 9 years. Some of these earthquakes generate tsunamis that can cause extensive damage in coastal zones. Investigations of the causes of Hawaiian earthquakes draw on technical developments that have been supported by the USGS National Earthquake Hazards Reduction Program and share resources with the USGS Volcano Hazards Program. The USGS cooperates with the University of Hawaii, the University of Wisconsin, and Stanford University to determine the frequency of occurrence, characteristics, and origins of damaging earthquakes in Hawaii.

Index of Subjects

To reduce the effects of earthquakes, planners and engineers need quantitative information about the level of risk in specific areas. The USGS maintains and operates a dense seismic network in Hawaii which is used to define long-term earthquake-hazard trends in Hawaii, as well as to locate damaging earthquakes and to provide location information to public officials to facilitate rapid and appropriate response. The USGS cooperates with and provides information to the Hawaii State Earthquake Advisory Board which develops structural engineering standards. Studies are underway to characterize effects of local site conditions on earthquake ground motions and to prepare a probabilistic ground motion map of the island of Hawaii.

Water Supply for Domestic Needs

As a result of its isolated island status, the sole source of freshwater for the State is rainfall. The prevailing moisture-laden tradewinds that move from northeast to southwest and the topography significantly affect the distribution of rainfall. Annual rainfall in excess of 200 inches is common on the windward sides of the

mountains whereas leeward areas are arid to semiarid. Streamflow in windward areas generally is perennial and that of leeward areas is mostly intermittent. Streamflow is perennial at higher mountain elevations, however. Runoff is distributed in a large number of small streams.

A critical issue in the Hawaiian islands is a reliable supply of freshwater. Most existing and proposed development is ground water in the drier areas leeward of the islands. Although streamflow and ground water are generally abundant in Hawaii, most islands are withdrawing water at the rates near the estimated yield of aquifers near the populated areas in which most growth is occurring. The USGS, in cooperation with State and local agencies, is conducting studies to quantify the availability of ground water in five of the six major islands of Hawaii. As part of these studies, the USGS has undertaken an exploratory drilling program on Hawaii, Oahu, and Kauai.

Studies and test-drilling that have led to the discovery and quantification of developable ground-water resources have been completed in the North Kohala and Kona areas of the island of Hawaii and in south-central Oahu. Similar studies are currently underway for West Maui, northern central Oahu, Lanai, and the southeast side of Kauai.

Effects of Ground-Water Development on Streamflow

Large quantities of water are diverted from many streams on the wet, windward sides of the Hawaiian islands for agricultural irrigation. There is considerable public pressure to restore diverted water, however, and to maintain natural conditions in streams where diversions do not presently exist. As a result of these and other issues, existing streamflow in Hawaii is protected by the State Water Code. The known ground-water resources in the drier and more populated areas of the island have largely been developed, and pressure to develop ground-water resources in the wet windward areas where perennial streams exist has mounted. Concerns therefore arise because the relation between ground water and surface water and the effect of development of ground water on nearby streams is not well understood.

Currently (1995) the USGS in cooperation with the State Commission on Water Resource Management and the Maui County Board of Water Supply is conducting a study of the relation between ground water and surface water on the windward side of Eastern Maui. Results of the study will help determine if future water needs for Maui can be met through development of ground water in northeastern Maui. Study conclusions also will have implications for development of ground-water sources of water in Kauai, Hawaii, and Molokai.

Giant Marine Landslides Around the Hawaiian Islands

Recent studies by USGS have identified more than 15 giant landslides surrounding the Hawaiian islands. The slides are among the largest known on Earth, and most occurred within the past 4 million years. The youngest is thought to be only 100,000 years old, and there is evidence that large blocks of land on the island of Hawaii are beginning to slide. Each slide generated large earthquakes and resulted in huge land losses to the islands and in large waves that have carried rocks and sediments as high as 1,000 feet above sea level. Such giant Hawaiian landslides have potential for enormous losses of life, property, and resources. In Hawaii much of the existing land and seafloor topography owes its origin to these landslides, and as such understanding the landslides is crucial to the understanding and evaluation of nearly most of the Hawaiian habitats and resources.

Landslide Hazards

The Honolulu area is vulnerable to fast moving, fluid landslides called debris flows. On New Year's Eve, 1987–88, for example, intense rainfall triggered more than 400 debris flows that, together with accompanying flooding and slow-moving landslides, accounted for an estimated $34 million in damages. The USGS responded initially by briefing emergency officials on the several landslide processes that had produced the baffling array of damage. A cooperative investigation was then arranged with the City and County of Honolulu to determine the rainfall conditions capable of triggering debris flows and to identify areas of potential hazard. Identification of when and where debris flows can be expected provides the information needed for warnings, which can save lives during intense rainstorms, and for reduction of damage through avoidance of hazardous areas or construction of mitigation structures.

National Mapping Program

Among the most popular and versatile products of the USGS are its topographic maps at the scale of 1:24,000 (one inch on the map represents 2,000 feet on the ground). These maps depict basic natural and cultural features of the landscape, such as lakes and streams, highways and railroads, boundaries, and geographic names. Contour lines are used to depict the elevation and shape of terrain. The state of Hawaii is covered by 124 maps at this scale, which is found to be useful for civil engineering, land-use planning, natural resource monitoring, and other technical applications. These maps have long been favorites with the general public for outdoor uses, including hiking, camping, exploring, and back-country fishing expeditions.

The USGS, in cooperation with the Hawaii Office of State Planning, is improving the quality of computerized (digital) elevation data coverage. The data are currently used for accurate watershed delineation in coastal zone management studies.

Through its Earth Resources Observation Systems (EROS) Data Center near Sioux Falls, South Dakota, the USGS distributes a variety of aerial photographs and satellite image data products that cover the entire State. Mapping photographs of some sites go back about 40 years.

Collection of Hydrologic Data

The USGS, in cooperation with local, State, and Federal agencies collects streamflow, ground-water level, water-quality, water-use, and rainfall data at

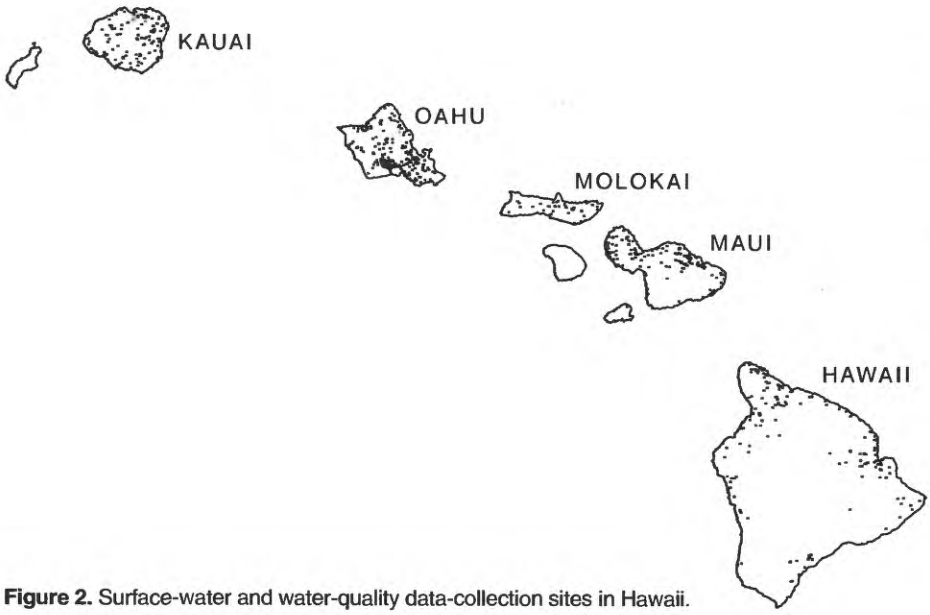

Figure 2. Surface-water and water-quality data-collection sites in Hawaii.

sites throughout the State of Hawaii (fig. 2). These data are used on a regular basis by decisionmakers to guide the management and protection of the freshwater resources. Hydrologic data are used to determine the extent and severity of droughts; to identify flood-prone areas and potential hydrologic hazards; to quantify available freshwater resources; to monitor the effects of human activities on water resources; to test for long-term trends, such as those associated with possible climate change; and to resolve complex legal issues associated with water rights.

Evaluation of Flood Hazards

Flooding on streams in Hawaii is a persistent and often life-threatening hazard. Because intense rainfall of short duration is common, floods can happen at any time, often with little or no warning. Daily rainfall in excess of 10 inches can be expected at least once a year somewhere in the State. The intense rainfall generates extreme flood peaks, which when combined with steep, short streams, come with little or no warning.

Peak streamflow data collected by the USGS are used to estimate the magnitudes and frequencies of floods that can reasonably be expected on streams in the State. These data are used to identify flood-hazard areas and in the design of hydraulic structures, such as bridges, culverts, and flood-control channels. The USGS publishes summaries of the magnitudes of the floods, factors that cause them, and the extent of the damage and areas affected. Ongoing evaluations of flood hazards in Hawaii by the USGS can help save lives and minimize flood damage.

Beach Loss in the Hawaiian Islands

Coastal erosion is a widespread, chronic, and locally severe problem in the Hawaiian Islands. The beaches of Hawaii derive most of their sediment from the surrounding reefs, and factors that affect the growth and health of living reefs, such as deterioration in water quality or severe storms, can have an adverse effect on beach sediment supply. Island beach systems are important because the people of Hawaii have a very strong cultural attachment to the beaches and because tourism in Hawaii is a multi-billion dollar industry that is inextricably linked to the health of the beaches. Loss of beaches through erosion has a very adverse effect on the economy of the State. The USGS, in cooperation with the University of Hawaii, is documenting the magnitude and extent of beach loss and is studying the causes of erosion unique to the Hawaii environment. Results from this program provide information useful to planners, engineers, and resource managers for the development of appropriate management and engineering guidelines.

Effects of Watershed Development on Water Quality

The construction of Interstate Route H–3 represents a profound land-use change to the Haiku, the Kamooalii, and the North Halawa drainage basins. To assess the effects of highway construction in these drainage basins, the USGS, in cooperation with the State of Hawaii Department of Transportation, has been studying the effects of construction on the suspended-sediment transport and water-quality characteristics of streams and on the Waimaluhia flood-control reservoir. This study, which started in 1983, covers the before, during, and after effects of the H–3 highway construction. Information supplied by the USGS can be used to evaluate the effect of erosion mitigation measures, and the rate of sediment accumulation in the reservoir.

Use of a Geographic Information System for Water Data Analysis

The USGS has developed a geographic information system (GIS) as a tool for studying water-use and water availability. Cooperative agencies include the Kauai County and the Hawaii County Departments of Water, the State Commission on Water Resource Management, and governmental agencies of the Commonwealth of the Northern Mariana Islands and American Samoa. The GIS data base for water use in Hawaii can be used to calculate surface and ground-water withdrawals from selected areas so that comparisons between current usage and estimated values of sustainable yields of these areas can be made.

Disposal Issues, Offshore Honolulu

The USGS, in cooperation with the U.S. Army Corps of Engineers and the U.S. Environmental Protection Agency, is studying the contaminant composition of dredge-spoil deposits in Mamala Bay located directly offshore Honolulu. The investigation will determine the nature and extent of physical, chemical, and biological effects associated with dumping of dredged material from Pearl and Honolulu Harbors. During 1993 and

1994, USGS scientists used acoustical and optical remote sensors to map the extent of the deposits on the seafloor and collected sediment cores for contaminant-content determination. The USGS has determined that the dredge-spoil deposits extend over an area of about 100 square kilometers, within and beyond the designated sites, and that the deposits have been modified by ocean currents. Sediment samples are being analyzed for toxic heavy metals, pesticides, and organic compounds. Results of the study can be used by Federal agencies concerned with operation and management of the dump sites.

Hydrology of Endangered Species Habitat

Hawaii has more rare and endangered plants and animals than any state in the Nation and their survival often depends upon an understanding of the water resources which is gained by the collection and analysis of hydrologic data. The USGS, in cooperation with the U.S. Fish and Wildlife Service (USFWS), is investigating the water system associated with wetlands at the James Campbell National Wildlife Refuge. This natural wetland, is home to at least four endangered species of birds, including the Hawaiian Stilt and the Coot. Potential water-quality problems exist because water flows into the refuge from numerous surface sources such as storm runoff, sediment-laden streams, agricultural ditches, aquaculture ditches, and tidally driven ocean water. Ground water in the area may be affected by urban development, underground wastewater injection, and seawater intrusion. In addition the refuge lacks a sufficient supply of water during extended dry periods.

USGS scientists plan to identify all sources of water entering the wetlands and quantify and monitor the water quality of the inflows. An elaborate network of recording stream and ditch gages, tide gages, water-level recorders, and rain gages will provide the data needed to accomplish this. In addition, a computer-based model is being constructed to determine the role of ground water in the wetlands and to determine the feasibility of using ground water to meet water requirements when refuge water requirements are not met by surface inflows. The information obtained from the investigation will be used by the USFWS to maintain a viable habitat for migratory waterfowl.

Cooperative Programs

The USGS cooperates with more than 15 State and Federal agencies in Hawaii. Cooperators include county boards of water supply, county public works departments, State natural resource and health agencies, native Hawaiian departments, and other Federal agencies. Cooperative activities include hydrologic and climatologic data collection, compilation, and analysis, interpretive water-availability and water-quality studies, volcanic and earthquake hazard studies, and mapping. When local and State agencies are involved, activities typically are funded on a matching basis. The USGS cooperates with the Hawaii State Commission for Water Resource Management, the Hawaii Department of Health, four County Water Departments, the U.S. Navy and the U.S. Air Force, to name a few.

The USGS provides support to the Water Resources Research Center at the University of Hawaii and the Water and Energy Resources Institute of the Western Pacific at the University of Guam, which conduct programs of research, education, and information and technology transfer.

For more information contact any of the following:

For water information
District Chief
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813
(808) 522-8290

For map information
Chief, Western Mapping Center
345 Middlefield Road, Mail Stop 531
Menlo Park, California 94025
(415) 329-4254

For geologic information
Assistant Chief Geologist
345 Middlefield Road, Mail Stop 919
Menlo Park, California 94025
(415) 329-5101

National Earthquake Information Center
Denver Federal Center, Mail Stop 967
Denver, Colorado 80225
(303) 273-8500

Hawaiian Volcano Observatory
P.O. Box 51
Hawaii National Park, Hawaii 96718
(808) 967-7328

Additional earth science information can be found by accessing the USGS "Home Page" on the World Wide Web at "http://www.usgs.gov".

For more information on all USGS reports and products (including maps, images, and computerized data), call 1-800-USA-MAPS.

U.S. Department of the Interior
U.S. Geological Survey
Fact Sheet FS-011-95