

# HAWAII GROUND WATER CONDITIONS

## Ground Water Importance

The State of Hawai`i consists of 132 islands, reefs and shoals that extend more than 1,500 miles across the central Pacific Ocean. In 2000, a resident population of 1.2 million people inhabited the eight major islands. Ground water is a crucial resource that provides over 90% of the fresh drinking water for its island residents. Ground water is also used for commercial, agricultural, recreational, industrial and thermoelectric power activities.

On the island of O`ahu, 92% of the water supply comes from underground aquifers fed by rainfall. Water stored in high-level dikes provides the remainder of the island's water supply. Although rainfall and groundwater are generally abundant in Hawai`i, a critical issue is a reliable supply of fresh water. Most islands are withdrawing ground water at rates close to the estimated yield of the aquifers, and many new developments are being proposed in the drier, leeward- side of the islands.

## Where Is It?

The eight major islands were originally formed by one or more volcanoes and contain extensive and productive volcanic rock aquifers. Volcanic rock aquifers are the most important source of ground water in Hawai`i. Large bodies of freshwater (freshwater lens) usually float on saltwater and are separated by a transition zone of brackish water. The freshwater lens may be overlain and confined by an impermeable layer of caprock near the shoreline. The caprock tends to impede the discharge of freshwater into the sea and helps to build up a thick freshwater lens that may exhibit artesian pressure.

Dike-impounded water is also an important source of water on some islands. Dikes are near-vertical walls of impermeable rock that form water-holding compartments within the mountains. Dikes can impound water to great heights. For example, on O`ahu dike-impounded waters are 1,600 feet above sea level, and on the islands of Maui and Kaua`i, up to 3,300 feet above sea level.

## How good is the water?

Precipitation is the source of Hawai`i's fresh ground water. As rainfall infiltrates or percolates through the subsurface, it is naturally filtered. Favorable geologic and hydrologic factors contribute to the high quality of ground water. Geologic factors include the content, structure and extent of Hawai`i's volcanic rock. Hydrologic factors include reliable rainfall, recharge capacity, and recharge rates.

Ground water in developed areas is more susceptible to contaminants from agricultural, industrial and human activities. Chemical contaminants have been found in well water samples in central O`ahu, west Maui, east Kaua`i and east Hawai`i. Herbicides and pesticides associated with the sugarcane and pineapple industries, and leaking fuel and solvents are some of the chemical contaminants. Granular activated carbon filters and aeration systems are being used to treat the volatile organic compounds (VOCs) in contaminated ground water.

Fresh ground water is also susceptible to saltwater intrusion when too much ground water is withdrawn from the freshwater lens. Saltwater can intrude into parts of the aquifer that formerly contained fresh water. The degree of saltwater intrusion depends on the pumping rate, hydraulic properties and the recharge rate of the aquifer. Chloride levels in public drinking water sources range from 14 parts per million (ppm) to 280 ppm with the majority of wells under 100 ppm.

The State Department of Health (DOH) has been publicly reporting existing and historic groundwater contamination.

## **Cost of Contamination**

Since the early 1980's when pesticides were detected in the ground water, millions of dollars have been spent on remedial investigations, soil and ground water remediation, and construction and operation of treatment facilities.

Granular activated carbon (GAC) filtration is very effective in removing volatile organic compounds to below non-detection levels, and the GAC usually lasts up to one year. The Honolulu Board of Water Supply (BWS) has GAC treatment plants at five well stations that treat an average of approximately 25 million gallons per day. Five more new well sites are being constructed. The capital costs of GAC are approximately \$45 million. Approximate annual operating and maintenance cost for the GAC is \$350,000.

## **Efforts to Protect Ground Water**

Three State agencies in Hawai'i are responsible for enforcing protection regulations for Hawai'i's ground water resources and quality: Department of Health (DOH), Department of Land and Natural Resources (DLNR), and Department of Agriculture (DOA).

The DOH has contracted with the Water Resources and Research Center (WRRC) at the University of Hawai'i to assist the DOH in conducting assessments of the State's approximately 450 drinking water sources. The work will implement the State's Source Water Assessment Program (SWAP) plan that the U.S. Environmental Protection Agency (EPA) approved in 1999.

The WRRC team is utilizing MODFLOW, a three-dimensional, computer program for simulating common features in ground water systems developed by the U.S Geological Survey (USGS), to establish zones of capture for public drinking water wells. Several demonstration projects were completed, and a series of public hearings were held in 2001 to discuss the results. So far, almost all of the drinking water sources in the islands have been modeled, and locations of the sources have been determined using Global Positioning System (GPS).

The DOH is nearing finalization of administrative rules for non-point source pollution control. These rules will indirectly but significantly help protect ground water by controlling surface water pollution and preventing cross-contamination between surface and ground water environments. The DOH is also working in conjunction with the U.S. EPA towards closing all large-capacity cesspools by 2005.

Examples of Hawai'i's regulatory programs that focus on ground water protection include:

- Underground Injection Control (UIC)
- Underground Storage Tank (UST)
- Leaking Underground Storage Tank (LUST)
- Hazard Evaluation and Emergency Response (HEER)
- Commission on Water Resources Management (CWRM)
- Pesticides

## **What else is needed?**

Although ground water protection initiatives are underway, program implementation is constrained by personnel turnover, state budgets, and resource limitations. These constraints have occasionally inhibited progress on ground water protection goals and objectives.

The current staffing for the Ground Water Protection Program (GWPP) is two, and outreach activities require contracting or involving people and resources from other programs and agencies. Additional resources and staff would greatly improve the efficiency and effectiveness of ground water protection programs.