The aquifer is adjacent to the North Canadian River and underlies approximately 1,036 km^2. It consists of alluvium, low terrace deposits, and high terrace deposits which range from 0 to about 30.5 m in thickness, with an average thickness of about 12.2 m. A thin layer of wind-blown dune sand covers much of the aquifer.

The average saturated thickness of the aquifer is approximately 7.6 m. Recharge to the aquifer is from precipitation and averages about 25 mm/yr. Discharge occurs as base-flow to the North Canadian River and as pumpage for irrigation, public-supply, industry, and domestic use.

A steady-state model of the ground-water system has been completed and work is in progress on projections of future conditions.

WESTERN REGION

Assessments of the hydrologic effects of the cataclysmic eruption of Mount St. Helens on May 18, 1980, have been the most visible activities in the western region, dominating work in the Washington district. Flooding has been the major hazard, and water-quality deterioration a secondary concern, in the months following the blast. The Water Resources Division data program, designed to measure sediment transport, flow, and water quality, has addressed these concerns.

The May 18 blast produced devastating mudflows on most streams draining the mountain and significantly altered the hydrologic processes and characteristics of the drainage basins surrounding the mountain. The direct drainage to the North Fork Toutle River valley was reduced by more than 50 percent. The blast materials blocked the tributary inflow of six streams in the North Fork Toutle River valley (Studebaker, Castle, South Fork, Castle, Jackson, Coldwater, and South Coldwater Creeks), forming natural dams of eruptive debris as much as 80 m high. All but three of the lakes on the debris pile have been breached; Spirit, South Fork Castle, and Coldwater Lakes are continuing to fill, and because of their ultimate possible sizes, they continue to be flood hazards to citizens and property located downstream.

Water quality was affected dramatically in the aftermath of the eruption. Within days of the eruption, concentrations of total iron, manganese, and aluminum increased 100 to 500 times over pre-eruption levels in the Toutle and Cowlitz River basins. These levels of concentration persist.

The interest and concern about volcanic activity of Mount St. Helens has given momentum to studies of other volcanoes and their associated hazards in the western region. The initial work is being carried out in cooperation with the Geologic Division, and it focuses on assessing potential flooding and mudflows, changes in water quality, and disruption of water supplies associated with a variety of eruptive and noneruptive scenarios. The areas of immediate interest include Mount Spurr, Mount Rainer, Mount Hood, Three Sisters (including Broken Top Mountain), Mount Shasta, and Mount Lassen.

In other areas of study, each of the western region states has prepared a 5-year water-use summary. A renewed emphasis on and high Division priority for the cooperative water-use programs reflects the generally increased competition for water. With the addition of Nevada to the cooperative water-use program in February, there is now a program in every state in the region.

Several geothermal projects in the western region are showing results:

- Geopressured geothermal waters exist in California within the miogeosynclinal Great Valley and eugeosynclinal Franciscan sequences in the Coast Ranges and on the west side of the Central Valley. Recent studies by Y. K. Kharaka, M. S. Lico, and W. W. Carothers show that the water salinities in the geopressured zones are generally less than 20,000 mg/L dissolved solids. Lower water salinities in California compared to the Gulf Coast geopressured geothermal waters result in a higher content of dissolved gasses and fewer environment problems.
- A study of the hydrothermal system in southern Grass Valley, about 30 to 50 km south of Winnemucca, Nev., by A. H. Welch, M. L. Sorey, and F. H. Olmsted, indicates that thermal fluids probably circulate to depths of at least 3 km and are derived from precipitation in the region. Numerical modeling suggests that if the present discharge of thermal water, which occurs at Leach Hot Springs, is limited by the hydraulic conductivity of the discharge-conduit system, a deep aquifer might be sufficiently permeable to permit exploitation for electric-power generation. However, if the flow of thermal water is limited by low hydraulic conductivity in the deep aquifer, the potential for exploitation is not large.
- Estimates of pore pressure and temperature gradients in vapor-dominated geothermal reservoirs have been made using a finite-difference fissure-block model developed by A. F. Moench and R. P. Denlinger. These estimates are being used to calculate changes in effective stress in the vicinity of a boiling front in order to account for earthquake activity at the Geysers, Calif.
- Steam-flow experiments in porous materials conducted in the laboratory at various temperatures by W. N. Herkelrath have been successfully simulated

with a finite-difference model that incorporates effects of steam absorption.

- Near Mount Hood, Ore., a program funded by the Department of Energy, Division of Geothermal Energy, to drill geothermal observation wells was continued by J. H. Robison. The wells penetrated andesitic lavas and debris. They range in depth from 220 to 1,220 m, and show temperature gradients as high as 84° C/km. An attempt to obtain geothermal fluid from the deepest well was suspended because of weather; the test will be resumed in 1981.

Regional aquifer studies are continuing or beginning in all the western region states except Alaska. Landsat imagery is becoming a more important tool for analyzing the effects of seasonal changes on hydrologic systems, for estimating irrigated acreage, and for predicting changes in land use.

USGS scientists, in cooperation with the National Oceanographic and Atmospheric Administration (NOAA) and other State and Federal agencies, continued to study the hydrodynamics, water chemistry and ecology of the San Francisco Bay estuarine system. The purpose of these continuing studies is to provide information to legislators, planners, and coastal zone managers so that the valuable system can be manipulated positively and profitably.

Other trends in the western region water resources studies include work on improved network design for both streamflow and water-quality measurements, more attention to flood hazards, and additional studies concerned with ground-water quality and the impacts of contamination. Recent water-quality studies emphasize the significant role of nonpoint sources of pollution. Digital models of aquifer systems, as well as flood runoff, continue to be a requested part of the cooperative program as tools for hydrologic interpretation and innovative water management.

MULTISTATE STUDIES

In March 1980, water levels were measured in about 1,600 wells in southern Idaho and eastern Oregon as part of the Snake River Plain RASA study. Repeat measurements were made in about 800 wells in August 1980, near the peak of the irrigation season. G. F. Lindholm reports that these are the most comprehensive water-level data ever collected for the Snake River Plain and will be used to calibrate regional ground-water flow models that are now in process. Sixty-five wells were added to the observation well network on the Plain.

Data from the Water and Power Resources Service and the Pacific Northwest Regional Basin Commission were used to compile a map of 1979 irrigated acreage. The map shows that about 1.1×10^{10} m^2 were irrigated on the Snake River Plain in 1979, about one-fourth of which were supplied by ground water. A cooperative agreement was made with the Idaho Department of Water Resources to determine 1980 irrigated acreage using Landsat data. Pumpage for irrigation from ground- and surface-water sources is being estimated from power company records. Preliminary estimates are that about 5,500 wells and 400 Snake River pumping plants withdraw water for irrigation within the study area.

Seepage losses from diversion canals are highly variable, but may be as high as 40 percent. Major spring flows were measured every other month to determine seasonal variations in ground-water discharge.

ALASKA

Geohydrology of the Fairbanks North Star Borough

The geohydrologic study of the Fairbanks North Star Borough is a continuing cooperative program designed to provide basic hydrologic information for land-use planning.

In 1980, A. P. Krumhardt published an atlas report on arsenic, nitrate, iron, and hardness in well water in the southwest part of Fairbanks. Collection of similar data continued in other upland areas, primarily along Chena Hot Springs Road.

Increasing pressure to subdivide lots into smaller parcels in the lowlands southeast of town initiated a study of water quality and ground-water-flow direction in these areas. The major concern was that closely spaced, deeply buried private septic systems might contaminate the aquifer which, in many places, lies less than 4.6 m below land surface. Data from approximately eleven newly constructed shallow (1.5 to 6.1 m deep) wells and from six existing observation wells are being used in this study. The first of four planned water-quality sampling sets was completed during FY 1980. Iron, ranging from 0.48 to 57 mg/L, was the only constituent found to exceed limits set by the EPA.

Water-Resources Investigations in the Kenai Peninsula Borough

In 1980, five independent studies of water resources were underway in the Kenai Peninsula Borough. All the studies were part of the USGS' ongoing cooperative program with the Borough. G. I. Nelson (1981) reported that the Fourth of July Creek alluvial fan near Seward contains an unconfined alluvial aquifer that yields water adequate for drinking-water supplies. However, flooding on the fan and a high potential for pollution of the aquifer may be constraints to development.

Studies by Nelson at Soldotna and Nikiski indicate that wells tapping the confined glaciofluvial aquifers were able to supply the 1980 pumping demands without increased drawdown of the area's ground-water levels.

In their study of ground water in part of the lower Kenai Peninsula, Nelson and P. R. Johnson found that the more permeable of the area's shallow aquifers underlie poorly drained lands and are little utilized. Most residential and commercial development has occurred on well-drained moraines where deep wells are usually completed in sandstone. Results of a surface-water study of the lower Kenai Peninsula by D. R. Scully and C. S. Savard showed that, in general, precipitation, peak discharges, low-flow discharge, and unit runoff decrease to the north.

Geohydrology of Anchorage

A multi-phase water-resources program was ongoing during 1980 under joint funding agreements between the USGS and the Municipality of Anchorage. A network of sites provided data on streamflow in major streams, water-level data in wells finished in the water table and in the confined aquifers, and lake levels throughout the Anchorage area. D. J. Cowing found that lake levels were at or near record high levels. The high lake and water-table levels reflected high precipitation during 1979 and 1980 and reduced pumping from two Municipal wells.

A study was begun in 1980 to provide information on water-quality characteristics of three Anchorage streams, and to assess the impact of urban and suburban runoff on water quality. As part of this study, Campbell Creek was intensively sampled during periods of snowmelt in upper and lower parts of the basin, as well as during baseflow conditions and at other times. Cowing reported that the quality of water in the upper Campbell Creek basin is excellent. However, lowland runoff, especially from Little Campbell Creek basin, contributes significant levels of pollutants to the stream system, particularly during periods of low flow and snowmelt.

Hydrologic studies for land-use planning were underway during 1980 in the Potter Creek area in the south part of the Anchorage area, and in the Peters Creek–Eklutna area to the north. Data collection for the Potter creek study was essentially completed in 1980, and a report is being prepared by R. P. Emanuel and D. J. Cowing. Sixty-six well logs from the Potter Creek study area were entered into the System 2000 data base during 1980; 114 well logs now constitute the data base for the Potter Creek area. Emanuel and Cowing reported that more wells tap bedrock than tap sedimentary units in the Potter Creek. The average bedrock well in that area was more than 61-m deep and yielded 0.28 L/s; in contrast, the average well tapping sedimentary units was less than 30.5 m deep and yielded 0.47 L/s. Bedrock crops out over about 30 percent of the Potter Creek study area. About 120 well logs have been obtained from the Peters Creek–Eklutna area. When these are entered into the System 2000 data base, information on about 480 well logs from that area will be available.

An assessment of the ground-water system in Eagle River valley was begun by L. L. Dearborn in 1980. Resistivity and seismic soundings were made along two lines across the middle reach of Eagle River in September 1979, and the analytical results have been published (Dearborn and Schaefer, 1980). Depth to bedrock along the two sounding lines was reported to exceed 107 m. A recent preliminary geologic map of the middle reach of Eagle River (Schmoll Dobrovolny, and Gardner, 1980) will aid in assessing the ground-water resources in that area.

ARIZONA

Organic quality of natural waters in Arizona

The role of natural organic matter in the Yuma Desalting Test Facility near Yuma, Ariz., was studied by R. L. Malcolm. This test facility, which is operated by the Water and Power Resources Service, is a pilot plant that uses reverse osmosis, a type of membrane-filtration technique, to remove salt from the Colorado River. Because of a treaty with Mexico, the United States agreed to maintain a fixed degree of salinity of the Colorado River as it enters Mexico. The purpose of the desalting plant is to meet this treaty agreement by removing salt from the Colorado River.

This study measured how natural organic substances, humic substances from the decomposition of plant and soil organic matter, fouled or plugged the membrane used in this plant. It was found that the fouling was caused by clay rather than organic matter, and the natural organic matter was brominated by chlorine and bromide ions present in the water. Chlorination is part of the purification process. These problems could be alleviated by altering the chlorination procedure to lower the level of brominated-organic substances and improving filtration procedures to remove clay-sized particles before they enter the reverse-osmosis membrane.

CALIFORNIA

Water-quality assessment of Cache Creek

An assessment of water quality in Cache Creek was made to compile and summarize all known water-quality data in the Cache Creek basin, to identify beneficial uses and water-quality criteria as defined by the California Regional Water Quality Control Board, and to define any existing or potential impairments of water quality which would diminish its beneficial use. The assessment indicated that high suspended-sediment loads and high boron concentrations were the major water-quality problems in Cache Creek. These constituents are probably of natural origin.

HAWAII

Ground-water status of Lahaina, Maui

The Lahaina District, Island of Maui, is typical of coastal areas where little or no coastal sediment impedes the flow of freshwater to the ocean. Water levels range from about 1 m above sea level to a maximum of about 2.4 m, 4.8 km inland. W. R. Souza found that ground-water levels have not changed significantly since the 1930's. However, seasonal fluctuations may occur and declines of 0.3 to 0.6 m have been observed during dry years and during heavy pumping. The major land use is agriculture, with about 14.2 km^2 of pineapple and 39.7 km^2 of irrigated sugarcane. Total water use in the Lahaina district is about 4.38 m^3/s. Ground water supplies about half this use. Souza (1981) estimated the recoverable ground-water supply at about 2.19 m^3/s during an average rainfall year. This draft is possible because of the effective recycling of large quantities of irrigation water to the ground-water system. Samples for water-quality analyses were taken at selected wells during February 1979 and February 1980. Data from these analyses were compared with previous studies. Long-term pumping for sugarcane irrigation has affected the quality of ground water over most of the Lahaina District. Major sources of pollution are from irrigation-water return and the intrusion of saline water.

Dike-impounded reservoirs in Oahu

Ground-water reservoirs impounded by volcanic dikes constitute important reservoirs of high-quality water on the Island of Oahu. In a recently concluded study, K. J. Takasaki and J. F. Mink explained that these dike-impounded reservoirs have high hydraulic heads and are isolated from saline water. The most important and productive of these reservoirs occur in the Koolau Range, where the top of the impounded water ranges to an altitude of 305 m. The storage above sea level of these reservoirs was estimated by the investigators to be about 2.10×10^9 m^3. In the Waianae Range, the top of the impounded water ranges to an altitude of about 610 m and the estimated storage above sea level is about 0.38×10^9 m^3. Water-development tunnels have, by breaching dike controls, reduced storage by at least 0.19×10^9 m^3 in the Koolau Range and by about 0.02×10^9 m^3 in the Waianae Range. A significant part of the storage thus reduced by each of the tunnels could be restored by bulkheading the dike or dikes that impound the most water.

IDAHO

Water quality of the Spokane River

During 1980, H. R. Seitz determined several water-quality characteristics at different flows in the Spokane River between Coeur d'Alene Lake and Post Falls Dam. Velocities in the reach ranged from about 0.61 m/s in June to less than about 0.03 m/s in August and November. Concentrations of nutrients were generally low. An increase in concentration of total ammonia nitrogen was observed in the reach below the outfall from the Coeur d'Alene sewage treatment plant. Dissolved oxygen concentrations were generally within limits established by the Idaho Department of Health and Welfare, Division of Environment. However, at the bottom of several deep stream cross sections, the concentrations were below established limits. Water temperatures ranged from 3°C in March to 20°C in August. With a few exceptions, pH was neutral to slightly basic. Specific conductance was generally less than 75μmhos/cm. Concentrations of selected trace metals were within Idaho water-quality standards.

Ground-water-quality assessment of the eastern Snake River basin

In a study relating 1979 ground-water quality to the hydrogeologic and cultural environments, D. J. Parliman reported that water quality and well construction data for a total of 165 wells were collected in eight eastern Idaho counties in the Snake River basin. Major water-yielding geologic units in these counties include alluvium, basalts, and silicic volcanic rocks of Quaternary, Tertiary, and Cretaceous age, and undifferentiated rocks of pre-Cretaceous age (basement complex). Recharge to aquifers is principally from precipitation in adjacent mountains and infiltration of surface water in valley lowlands and plains. Infiltration of irrigation water and seepage losses from canals, ditches, lakes, and reservoirs are also important sources of aquifer recharge. The most productive aquifers occur in alluvium, basalts, and silicic volcanics geologic units. Ground-water-quality assessment is based on analyses of water from 165 wells sampled in 1979 and 176 wells sampled prior to 1979. Ground water in all aquifers generally contains calcium, magnesium, and bicarbonate plus carbonate ions and is suitable for most uses. Variations in ground-water composition are most directly related to proximity to sources of recharge and effects of land-use practices such as irrigated acreage, drain wells, landfills and garbage dumps, urban and municipal development, and agricultural wastes.

NEVADA

Water resources of a growing urban area near Reno

Within the 75-km² Cold Spring Valley, ephemeral streamflow and ground water move toward the White Lake playa and adjacent areas, where the water is dissipated by evaporation and transpiration. The estimated system yield for the basin, 1.6 hm³/yr, is based on the assumption that all natural ground-water discharge (0.6 hm³/yr) and about two-thirds of the average stream inflow to White Lake can be captured, according to A. S. Van Denburgh (written commun.). Recycling of water during use, and attendent percolation, would permit a sustained withdrawal significantly greater than the system yield, but also would utimately require water treatment to counter deterioration of quality caused by recycling. As of late 1979, domestic and public-supply withdrawals for the basin-wide population of about 2,000, dependent solely on ground water, totalled about 0.3 hm³/yr, of which about 0.06 hm³/yr was consumed by evapotranspiration, with the remainder returned to the ground-water reservoir by percolation. Irrigation of pasture lands (total, about 50 ha) consumed an estimated 0.2 hm³/yr of streamflow and 0.02 hm³/yr of well water. During 1975–79, ground-water levels declined slightly (0.3–1.2 m) throughout most of the valley, but no local net decline of alarming magnitude related to ground-water has as yet been detected.

Ground-water aquifers near Fallon

Aquifers near Fallon, Nev., can be divided into four interdependent subsystems on the basis of hydrologic characteristics, according to P. A. Glancy (1981). In decreasing order of present use, they are (1) a hydraulically complex, shallow, unconsolidated sedimentary aquifer containing water of variable chemical character; (2) a highly permeable deeper basalt aquifer containing nearly homogeneous, moderately fresh water; (3) an intermediate-depth, unconsolidated sedimentary aquifer locally containing large quantities of freshwater; (4) and a deep sedimentary aquifer that probably contains saline water.

Electrical-resistivity data suggested that the deeply buried basalt aquifer is generally mushroom shaped; characteristically, it overlies the deep sedimentary aquifer and underlies the intermediate aquifer. It is recharged mainly by the freshwater intermediate aquifer, but apparently contains a blend of the freshwater and saline water. In areas of large withdrawals, water from the basalt aquifer exhibits chemical evidence of modern (post-1953) recharge from surface sources. The basalt aquifer is highly transmissive and exhibits a nearly flat potentiometric surface. The shallow sedimentary aquifer is inherently susceptible to pollution, and it contains mainly hard water. The salinity of the shallow ground water is influenced by irrigation-water recharge. Known reserves of freshwater in the intermediate aquifer are expanding with exploration activity. Water from all aquifers contains greater than normal concentrations of dissolved arsenic. Concentrations of arsenic in water from the basalt aquifer, from which the municipal water supply is drawn, are about 0.1 mg/L. Concentrations in the shallow alluvial aquifer are as high as several milligrams per liter in places.

Monitoring network for ground-water quality, Las Vegas Valley

Almost 200 wells and one spring have been selected as preliminary candidates for a monitoring network in Las Vegas Valley, according to A. S. Van Denburgh and others (1981). The wells tap valley-fill sedimentary deposits in three arbitrary depth intervals: (1) the shallow zone, less than about 10 m below the water table, which would be the first to feel the impact of land- and water-use practices; (2) an intermediate zone, about 10 to 60 m below the water table, which is commonly tapped for domestic supplies, and (3) a deep zone, more than 60 m below the water table, which currently yields most of the ground water for public supplies in the valley. Forty-five water-quality characteristics were chosen for monitoring, largely on the basis of drinking-water standards. For each site, the specific array of characteristics and their frequencies of determination (which range from once quarterly to once in 5 years) were based on geographic location and water-yielding zone(s) that were tapped.

Ground-water quality downgradient from copper ore-milling wastes at Weed Heights

Ponds that were used from 1953 until 1978 for disposal of an acid, iron-sulfate-rich brine and an alkaline tailings slurry overlie saturated valley-fill sedimentary deposits. According to H. R. Seitz (written commun.), shallow ground water (1–10 m below land surface) from several test wells closest to the ponds has been contaminated to differing degrees, but comparable water more than about 0.3 km downgradient probably has not. The water-quality data also suggested that the shallow sedimentary deposits through which the waste fluids percolate can deplete several of the more objectionable contaminants, with an effectiveness ranging from moderate to almost complete. Chemical analyses of water from six industrial-supply wells in the same area indicate (1) that deeper ground water (15-140 m below land surface) adjacent to the ponds deteriorated in quality during the period of heavy pumping, which terminated in 1978, and (2) that the chemicals changes may be due to contamination by percolating acid brine, tailings fluid, or both.

Ground water in Kyle and Lee Canyons, Spring Mountains, Clark County

Rocks in the study area consist of Paleozoic limestone and dolomite, along with unconsolidated to consolidated upper Tertiary(?) and Quaternary alluvium that underlies each canyon floor to depths of as much as 100 m or more. Faults and fractures in the carbonate rocks transmit water to the alluvium. The water then moves down each canyon on gradients that range from 40 to 90 meters per kilometer. Highest gradients occur at the mouths of the canyons, a possible indication of changes in permeability of alluvium, changes in inflow or outflow between carbonates and alluvium, or faulted bedrock. Water-level and water-quality data were collected from wells in both canyons during April 1980–March 1981. Water levels in both canyons rose during late spring early summer in response to the spring snowmelt, and declined through late fall. Absolute water-level changes ranged from 12 to 37 m in Kyle Canyon and from 3 to 10 m in Lee Canyon. Water-quality data indicated little or no contamination of ground water by septic systems in either canyon.

OREGON

Delineation of major aquifers in western Oregon

Aquifers in western Oregon have been grouped into seven major units based on geologic and hydrologic similarities, according to W. D. McFarland. Each aquifer unit has a distinct geologic setting. Bedrock formations in the Klamath Mountains, Coast Range, and the Western Cascade Range generally have low hydraulic conductivities ranging from about 3 mm/d to 6.1 m/d.

In the Klamath Mountains, aquifers consisting of saprolite derived from granitic intrusive rocks are more permeable than surrounding bedrock (hydraulic conductivities range from about 1.5 m/d to 6.1 m/d). Water-bearing characteristics of the volcanic-rock aquifers of the High Cascade Range are largely unknown, but probably are highly variable. The most important aquifer unit in western Oregon consists of Tertiary and Quaternary sediments that occur in lowlands and, most extensively, in the Willamette Valley; hydraulic conductivities of permeable zones range from about 6.1 m/d to 1,830 m/d. Geologic formations in western Oregon are capable of supplying potable water to wells for domestic and stock use. However, available data suggest that the Tertiary marine rocks of the Coast Range commonly contain water with more than 10,000 mg/L dissolved solids at depths greater than 610 m.

WASHINGTON

Hydrologic effects of Mount St. Helens eruption

The cataclysmic eruption of Mount St. Helens on May 18, 1980, produced devastating mudflows on most streams draining the mountain and significantly altered the hydrologic characteristics of and processes occurring in the drainage basins surrounding the mountain. More than 2×10^9 m^3 of unconsolidated rock, pumice, sediment, and debris were deposited in the North Fork Toutle River valley, reducing the direct drainage area of the North Fork Toutle by more than 50 percent. In an attempt to trap some of this sediment, the Corps of Engineers constructed two debris-retention structures. During the fall and winter of 1980, both of these structures filled, and the structure on the North Fork was breached within one month.

The blast materials have blocked the tributary inflow of six streams in the North Fork Toutle River valley (Studebaker, Castle, South Fork Castle, Jackson, Coldwater, and South Coldwater Creeks), forming natural dams of eruptive debris as much as 80 m high. All but three of the lakes on the debris pile have been breached; Spirit, South Fork Castle, and Coldwater Lakes are continuing to fill and, because of their ultimate possible size, continue to represent potential flood hazards to citizens and property located downstream. Estimates are that, with normal rainfall, Coldwater and South Castle Creek lakes will fill in late November 1981, with capacities of 123 hm^3 and 31 hm^3, respectively.

The eruption of St. Helens has also had a pronounced impact on water quality. Within days, total concentrations of iron, manganese, and aluminum increased 100 to 500 times and are persisting in the Toutle and Cowlitz River basins over pre-eruption levels. In the ash-affected basins east of St. Helens, the observed river-quality changes were short-lived and, in general, decreased in magnitude with distance from the volcano. In the immediate blast area, plant and soil organic materials were pyrolized; their byproducts have created a number of organic compounds that have contaminated ash, surface water, and stream-bottom material. Many of the contaminants, including fatty acids, phenols, and resin acids, are similar to those found in effluents from the paper and pulp industry.

The North Fork Toutle River mudflow had a peak sediment concentration greater than 1.8×10^6 mg/L or about 85 percent solids by weight. An estimated 145 Mg of sediment was delivered to the Cowlitz River on May 18–19. A total suspended-sediment discharge of 20 Mg was calculated for the Toutle River for the period May 20 to December 31, 1980; 60 percent of the suspended-sediment discharge was delivered during 8 days of fall and winter storms. Peak concentrations of more than

400,000 mg/L occurred in the Toutle River during the peak flow of February 19, 1981, at which time the instantaneous sediment discharge was 18 Mg/d. Peak sediment concentrations in the North Fork Toutle River commonly exceed 300,000 mg/L, while peak sediment concentrations in the South Fork Toutle River generally were less than 100,000 mg/L.

Transport of ash from Mount St. Helens eruption

Volcanic ash from the May 18, 1980, eruption of Mount St. Helens covered much of northern Idaho to depths of up to 50 mm. Rain and snow have subsequently compacted the ash on flat areas and worked it into the soils. Some of the ash has been transported to stream channels and carried downstream. A sediment sample from the streambed of Big Creek near Calder, Idaho, taken in mid-December 1980, consisted of a mixture of ash, sand, and gravel. Most of the ash could pass through a 63 micron sieve. A flood in late December removed much of the ash from the streambed, although ash is still present locally to depths of 3 mm.

Disposition of mudslide materials from Mount St. Helens

F. P. Haeni reported that 27.2×10^6 m^3 of mudslide material was deposited in the lower Cowlitz and Columbia Rivers, Washington–Oregon, as a result of the May 18, 1980, eruption of Mount St. Helens.

The arrival of this material at the Columbia River during an incoming tidal cycle resulted in the deposition of material that stretched 11.2 km upstream, and 3.2 km downstream from the junction of the Cowlitz River and the Columbia River. The maximum thickness of mudflow material occurred near Coffin Rock where a hole, 42.7 m in depth, was filled with 27.4 m of sediment. Compaction and (or) erosion caused a 3 m depression to form in the surface of the newly deposited material at this location.

The presence of two scour channels, on May 23, 1980, on each side of a 0.99×10^6 m^3 tongue-like delta deposit of very fine sand and silt, indicates that the sediment and water surge on the morning of May 19 initially eroded the lower 0.8 km of the Cowlitz River bed. A minimum of 0.27×10^6 m^3 of material was removed from the Cowlitz River bed and redeposited in the Columbia River.

Preliminary investigation of the water resources of Island County

A preliminary survey of ground-water resources of Island County (Whidbey and Camano Islands) by D. R. Cline and others showed that the pumpage in 1979 was 6.32×10^6 m^3, which was 60 percent greater than in 1963. Although the population has nearly doubled, the quantity pumped in 1979 was not larger because water was imported to supply part of northern Whidbey Island. Public supplies used 66 percent, irrigation 25 percent, and domestic supplies 8 percent of pumpage. About 90 percent of the ground water was pumped from the sea-level aquifer, which is composed of fairly continuous sand and gravel deposits beneath the islands. Locally, one or more water-bearing zones overlie the main aquifer.

Chloride content exceeded 190 mg/L in some areas, mainly northeastern and southern Camano Island and central Whidbey Island.

Water resources of the Yakima Indian Reservation

Present ground-water levels in the lower Satus Creek basin in Washington are so high that some potentially good agricultural lands are of little use because of water logging. A numerical model of the area has been used to estimate the effects on water levels of (1) pumping ground water, (2) reducing the amount of irrigation water used on existing lands in lower Satus Creek basin, and (3) irrigating lands in the Satus uplands. According to E. A. Prych, computations with the model indicate that water levels in some areas would be (1) lowered by up to 3.0 m to 6.1 m by pumping from various numbers of the existing wells, (2) lowered by up to 1.5 m if 10 percent less irrigation water were used on the existing areas in the lower basin, and (3) raised up to 2.7 m or 9.1 m depending on whether 12.1 km^2 or 52.6 km^2 of the Satus upland were irrigated.

Ground-water quality network in Washington

Data from 100 samples collected in the northeastern part of Washington have been evaluated as part of an investigation of the quality of water in the major aquifers in the State. As many as 500 ground-water-quality samples are to be collected from these aquifers.

According to the investigator, J. C. Ebbert, preliminary results indicated that the quality of ground water in the major aquifers of northeastern Washington is suitable for most uses. This evaluation is based on analyses for common ions, nitrates, trace metals, and fecal coliform bacteria. Only a few constituents, chiefly iron and manganese, exceeded EPA primary and secondary drinking water regulations.

SPECIAL WATER-RESOURCE PROGRAMS

DATA COORDINATION, ACQUISTION, AND STORAGE

Office of Water Data Coordination

During FY 1981, progress made in major activities and publications of the Office of Water Data Coordination (OWDC) included the "Index of Water Data Acquisition," "Index to Water Data Activities in the Coal Prov-