Summary of Water-Resources Activities of the U.S. Geological Survey in Oregon: Fiscal Year 1993

Compiled by Douglas B. Lee, Thelma D. Parks, and Steven W. Winkler

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U.S. GEOLOGICAL SURVEY
Open-File Report 93-493

Portland, Oregon
1993

U. S. DEPARTMENT OF THE INTERIOR
BRUCE BABBITT, Secretary

U.S. GEOLOGICAL SURVEY
ROBERT M. HIRSCH, Acting Director

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SUMMARY OF WATER-RESOURCES ACTIVITIES OF THE U.S. GEOLOGICAL SURVEY IN OREGON: FISCAL YEAR 1993

INTRODUCTION

Water-resources related activities of the U.S. Geological Survey in Oregon consist of collecting water-resources data and conducting interpretive hydrologic investigations. The water-resources data and the results of investigations are published or released by the U.S. Geological Survey or by cooperating agencies. This report describes the water-resources investigations in Oregon for the 1993 fiscal year (October 1, 1992 to September 30, 1993).

In 1992, the Oregon, Washington, Idaho, and Alaska Districts combined to form the Pacific Northwest Area. Marvin O. Fretwell is the Area Hydrologist for the Pacific Northwest District Area. The Oregon District office is located in Portland, Oregon. The District Chief is Dennis D. Lynch. The Oregon Office has two field offices located in Portland and Medford. Requests for information should be addressed to:

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MISSION OF THE U.S. GEOLOGICAL SURVEY

The U.S. Geological Survey was established by an act of Congress on March 3, 1879, in order to answer the need for a permanent government agency at the Federal level to conduct, on a continuing, systematic, and scientific basis, investigations of the "geological structure, mineral resources, and products of the national domain." Although a number of laws and executive orders have expanded and modified the scope of the Survey's responsibilities during its 110-year history, the Survey has remained principally a scientific and technical investigation agency, as contrasted with a developmental or regulatory one. Today the Survey is mandated to assess onshore and offshore energy and mineral resources; to provide information for society to mitigate the impact of floods, earthquakes, landslides, volcanoes, and droughts; to monitor the Nation's ground- and surface-water supplies; to study the impact of man on the Nation's water resources; and to provide mapped information on the Nation's landscape and land use. The Survey is the principal source of scientific and technical expertise in the earth sciences within the Department of the Interior and the Federal Government. The Survey's activities span a wide range of earth-science research and services in the fields of geology, hydrology, and cartography, and represent the continuing pursuit of the long-standing scientific missions of the Survey.[1]

MISSION OF THE WATER-RESOURCES DIVISION

The mission of the Water-Resources Division, which supports the mission of the Geological Survey and the U.S. Department of the Interior, is to develop and disseminate scientific knowledge and understanding of the Nation's water resources. The activities carried out by the Water-Resources Division fall into three broad categories: (1) resource assessment; (2) research; and (3) coordinating the activities and cataloging the products of numerous other entities involved in water research, data acquisition, or information transfer[1].

Resource Assessment. Resource assessment consists of:

- Collecting data on the quantity, quality, and use of surface water (rivers, streams, lakes, reservoirs, estuaries, and glaciers); the quantity, and use of ground water (including water in the unsaturated zone); and the quality of precipitation.

- Storing and disseminating these data.

- Interpreting these data and publishing the results of these interpretations. This interpretation involves the inference of hydrologic causes, effects, and probabilities; and the extension, over space and time, of information contained directly in the data.

- Developing and applying new methods of hydrologic data collection, analysis, and interpretation.

- Conducting areal focused interpretive investigations and appraisals at national, regional, state, or local scales. These include characterizations of ground and surface waters, and of precipitation chemistry; evaluation of natural hydrologic hazards; and studies of other water-related topics. Frequently these investigations involve the development, testing, and application of mathematical models capable of quantitatively evaluating the hydrologic consequences of management actions, development plans, or natural phenomena. These

[1]Source: Adapted (and updated December 1984) from U.S. Geological Survey Yearbook for Fiscal Year 1983.

investigations are carried out through specific Federal programs or in cooperation with State and local governments or other Federal agencies. Results are published in technical journals or in State, local, U.S. Geological Survey or other Federal agency publications.

- Reporting to the Nation, on a regular basis, on the overall status of water resources, and on hydrologic events and water-resource issues.

Research. The Division conducts research in a wide variety of scientific disciplines--geochemistry, ecology, geomorphology and sediment transport, water chemistry, ground-water hydrology, and surface-water hydrology--particularly as these disciplines relate to the quantity, flow, and quality of surface water and ground water and to other aspects of the hydrologic cycle. The research is intended to:

- Improve the overall understanding of the pathways, rates of movement, chemical processes, and biological processes in the hydrologic cycle.

- Improve the overall understanding of the hydraulic, chemical, and biological factors, both natural and man caused, which affect the resource.

- Provide new strategies of data collection, analysis, and interpretation, in the light of new knowledge and evolving scientific capabilities.

- Improve methods of predicting the response of hydrologic systems to stresses, whether hydraulic or chemical, and whether of natural or human origin.

Coordinating the Activities and Cataloging the Products of Other Entities Involved in Water Research, Data Acquisition, or Information Transfer. This function has four major components:

- The coordination of water-data acquisition activities of Federal agencies (as mandated by Office of Management and Budget Circular A-67).

- The acquisition of water-use data and development of State and national water-use data bases in cooperation with State governments.

- The operation of water-information exchanges and centers, which provide all interested parties with indexing and access to many sources of water data and information.

- The administration of extramural water-resources research, technology, development, academic training, and information-transfer programs mandated by the Water Resources Research Act of 1984 (Public Law 98-424). The Act mandates research oriented to the environmental values associated with the resource. The research promoted by the Act involves many disciplines and activities other than those required in the assessment, research, and coordinating functions of the Water-Resources Division.[2]

COOPERATING AGENCIES

In Oregon, some of the water-resources data-collection activities and interpretive hydrologic investigations of the Water-Resources Division are conducted in cooperation with Federal, State, and local agencies. Agencies cooperating with the U.S. Geological Survey during fiscal year 1993 are:

City of Eugene City of Portland Bureau of Environmental Services
Douglas County, Oregon
Intergovernmental Resource Center (Clark and Skamania Counties)
Jackson County
Lane County Council of Governments
Oregon Department of Environmental Quality
Oregon Water Resources Department
Oregon State Health Division
Unified Sewerage Agency
U.S. Department of Energy Bonneville Power Administration
U.S. Department of the Interior
Bureau of Land Management
Bureau of Reclamation
Fish and Wildlife Service

COLLECTION OF WATER-RESOURCES DATA

Hydrologic-data stations are maintained at selected locations throughout Oregon and constitute the major water-resources data network in the State for obtaining records on stream discharge and stage, reservoir and lake storage, ground-water levels, well and spring discharge, and the quality of surface and ground water (table 1; fig. 1, at back of report). Every year some new stations are added and other stations are terminated; thus, the U.S. Geological Survey has both a current and a historical file of hydrologic data. Most water-resources data are stored in the U.S. Geological Survey's National Water Information System (NWIS) data base and are available on request to water planners and others involved in making decisions affecting Oregon's water resources. These data can be retrieved in machine-readable form or in the form of computer-printed tables, statistical summaries, and digital plots. Local assistance in the acquisition of services or products from NWIS can be obtained by contacting the District Chief in Portland, Oregon.

Surface-water Data

Surface-water discharge (streamflow), stage (water level) and water-quality data are collected for general hydrologic purposes, such as assessment of water resources, areal analysis, determination of long- term trends, research and special studies, or for management and operational purposes. Data-collection platforms (DCPs), used for the transmission of satellite-telemetered river-stage information, have been installed at several sites throughout the State. Satellite- telemetry Real-time data acquisition of the information is essential to many agencies for operating reservoirs, predicting river stage and flood conditions, and optimizing the use of water resources.

[2]Source: Mission statement by the Chief Hydrologist, September 18, 1984.

Table 1. Water-resources data-collection stations in operation in Oregon during fiscal year 1993, by station classification

Station classification	Number of stations
Streamflow:	
Continuous (daily) record	190
Partial (seasonal) record	4
Peak flow, crest-stage gage	1
Real-time stage and discharge	40
River Stage (only):	8
Lakes and reservoirs:	
Continuous (daily) record	25
Month-end contents	9
Water quality:	
Periodic chemical quality	11
Daily quality monitoring	40
Ground water:	
Elevations (monthly observations)	38
Meteorological:	
Daily precipitation quantity and quality	2

Satellite-telemetered data are received directly from the U.S. Geological Survey ground-receiver site located in Tacoma, Washington and processed at the Portland, Oregon office. In addition to satellite telemetry, data for several field sites are acquired using existing telephone lines. After computer processing, these data are made available to other agencies.

Periodic water-quality data (common ions, nutrients, and (or) trace metals) are obtained at 11 of the surface-water stations listed in table 1. Nine of these stations are part of a U.S. Geological Survey nationwide network known as NASQAN (National Stream Quality Accounting Network) and two are part of the nationwide Benchmark network, that provides data used in the evaluation of long-term trends in stream quality.

Daily water-quality monitoring is being conducted at one site for water temperature, specific conductance, pH, and dissolved oxygen. Thirteen sites are being monitored for water temperature and turbidity, and an additional 26 sites are being monitored for water temperature and (or) specific conductance. Automatic instruments measure the characteristic of interest continuously during the day, enabling the information, such as the daily maximum, minimum, and mean values to be summarized for the day.

Information from water-quality stations is used to monitor the quality of surface-water in Oregon. The frequency of sample collection can range from daily for some of the physical data to annual for pesticide or radiochemical data. In addition to the water-quality data collected at the aforementioned stations, a variety of information is collected at miscellaneous sites as part of interpretive hydrologic studies. This information also is available from the U.S. Geological Survey files.

Meteorological Data

Two stations located in Oregon are part of the nationwide National Atmospheric Deposition Program/National Trends Network (NADP/NTN) program to monitor long-term precipitation-quality changes. Composite samples are collected weekly by observers who record precipitation amounts, measure pH and specific conductance of the composite sample, and submit the sample to the laboratory for chemical analyses.

INTERPRETIVE HYDROLOGIC INVESTIGATIONS

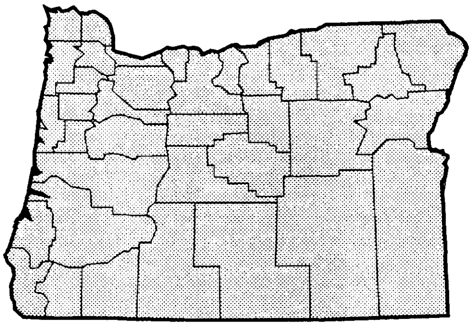
Twenty interpretive hydrologic investigations are being conducted in Oregon during fiscal year 1993 in cooperation with 14 Federal, State, and local agencies. Hydrologic investigations are being conducted that will provide information to answer hydrologic questions specific to the State's needs, as well as questions addressing statewide, multistate, and nationwide hydrologic problems. A summary of each investigation, including problem, objectives, approach, progress, and plans follows.

PROJECT TITLE: Oregon Water-use Program

PROJECT NUMBER: OR-007

STUDY LOCATION: Statewide

COOPERATING AGENCY: Oregon Water Resources Department, Oregon State Health Division, and Jackson County



PROJECT CHIEF: Tyson Broad

PROJECT DURATION Ongoing, beginning in October 1978

PROBLEM: The ever-increasing rate of utilization and competition for water resources requires current water-use information, which is vital for determining future water availability in critical areas and for making sound resource- management decisions. The need for the information is particularly acute during the periods of drought experienced by many Oregon counties. A viable water-use data-collection program is necessary to complement the ongoing water-supply data program, and provides the statistics necessary for developing a comprehensive picture of statewide water resources.

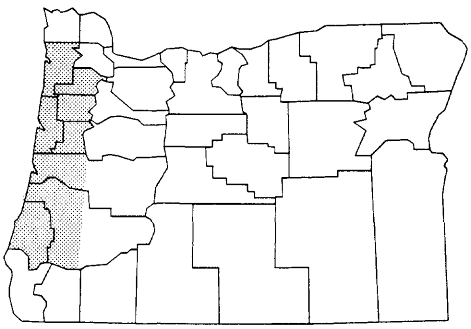
OBJECTIVES: The objective of the project is to provide water-use information for the optimum utilization and management of the nation's water resources, and to develop and operate systems to handle the data. Beneficiaries of the program are the people of the United States and the State of Oregon. The program includes collection, storage, and dissemination of historic and current water-use data required to complement information on availability and quality of water resources. Database systems are being developed to be capable of responding to the needs of local users, the USGS, and other Federal agencies.

APPROACH: Where available, withdrawal and return information for water users is obtained. These site-specific data are stored in a database, which facilitates aggregation and retrieval of information by county or river basin. Site-specific data are combined with water-use data estimated from areal information, to obtain total water-use estimates for a county or basin. Examples of the types of information collected are "number of irrigated acres," or "number of livestock in a county."

PROGRESS: Drafts of the Oregon Water-use and Willamette Valley ground-water pumpage reports have been completed and are in the process of review.

PLANS FOR FY 1993: Data collected for the State-wide water-use and RASA will be entered into the Oregon site-specific water-use database; the methodology used to collect this information will be documented. Reports on Oregon water-use and Willamette Valley ground-water pumpage will be completed. To support ground-water studies in Jackson and Deschutes Counties, efforts will be made to determine water use in these two areas.

PROJECT TITLE: Determining Effects of Land-Use Changes on Hydrology Using Rainfall-Runoff Modeling



PROJECT NUMBER: OR-152

STUDY LOCATION: Oregon Coast Mountain Range

COOPERATING AGENCY: U.S. Bureau of Land Management

PROJECT CHIEF: John C. Risley

PROJECT DURATION: Complete

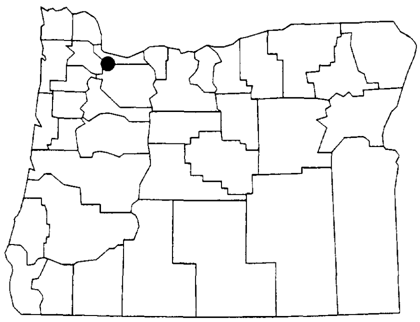
PROBLEM: The Bureau of Land Management (BLM) had no verified method capable of identifying changes in streamflow caused by forest management practices in the Oregon Coast Range. There was a need to determine if a computer model was adequately sensitive to define streamflow changes caused by these activities. Valid streamflow simulations for peak flows, mean flows, and low-flows needed to be defined for use in comprehensive planning.

OBJECTIVES: The project had three major objectives: (1) Develop and refine a model as a predictive tool for assessing effects of forest management practices on streamflow, (2) Calibrate a mathematical computer mode, the "Precipitation-Runoff Model System" (PRMS), that would simulate streamflow and other water-budget fluxes from inputs of precipitation and temperature for 11 small forested watersheds, and (3) Determine regionalized model parameters to enable hydrologic simulation for other gaged and ungaged basins.

APPROACH: Hourly and daily streamflow were retrieved from the National Water Data Storage and Retrieval System (WATSTORE) and entered on UNIX workstations. Hourly and daily precipitation and temperature data files were assembled. Geographic Information Systems (GIS) were utilized to develop hydrologic response units (HRUs) for each basin. The entire flow distribution of 11 basins was calibrated; calibrations were performed on approximately one-half of the data set, with the remainder being used for verification. A subsequent sensitivity analysis was performed to identify land-use change and predictability.

PROGRESS: The project has been completed, and three Water-Resources investigations (WRI) reports will be published. Two reports have received Director's approval: (1) Calibration and use of a rainfall-runoff model for simulating effects of forest management on streamflow in the East Fork Lobster Creek basin, Oregon Coast Range-- Lenore Y. Nakama and John C. Risley; and (2) Preliminary modeling results of Oregon Coastal Basins using Precipitation-Runoff Modeling System (PRMS)--Roderick L. Allen and Antonius Laenen. The third WRI report has been submitted for technical review and for approval to publish.

PROJECT TITLE:	Surface-Water-Quality Assessment of the Johnson Creek Basin, Oregon
PROJECT NUMBER:	OR-153
STUDY LOCATION:	Multnomah County, northwestern Oregon
COOPERATING AGENCY:	City of Portland, Bureau of Environmental Services
PROJECT CHIEF:	Thomas K. Edwards
PROJECT DURATION:	Complete, except for report



PROBLEM: Johnson Creek flows from a predominantly rural headwater area through the densely-populated urban areas of Gresham, Portland, and Milwaukie, Oregon. Johnson Creek is a receiving tributary for urban, light-industrial, and agricultural runoff throughout its length, and has contact potential for a large segment of Portland's Population. As a consequence, the occurrence of poor water-quality conditions in Johnson Creek would be regarded as a public health concern. The City of Portland needed data to define water-quality conditions in Johnson Creek and to evaluate the effects of industries adjacent to the creek.

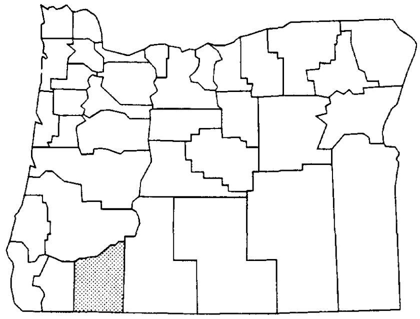
OBJECTIVES: Streambed sediment and water samples were analyzed for trace and organic compounds listed on the EPA's (Environmental Protection Agency) priority pollutants list. The data supplemented existing water- quality for Johnson Creek, and was used to evaluate temporal and spatial water-quality conditions. A "program plan" for further definitive sampling was provided to the city and was used to evaluate the efficiency of in-site improvements and alternative methods of improving water quality.

APPROACH: Bed material was collected during summer low flow, and field reconnaissance inspections defined areas of potential water-quality problems. Water and bed-material samples were collected at three locations along the main stem of Johnson Creek. A detailed proposal and sampling plan was written, intended to evaluate the efficiency of water- quality-improving alternative structures. Fixed-location continuous- recording gages were used to supplement flow data and record water- quality constituents, in addition to information obtained from the periodic collection of field data.

PROGRESS: Two reports were approved for publication by the Director: (1) "Water-Quality and Flow data for the Johnson Creek Basin, Oregon, April 1988 to January 1990," by T.K. Edwards (OFR 92-73), and (2) "Preliminary evaluation of water-quality conditions of Johnson Creek, Oregon," by T.K Edwards and D.A. Curtiss (WRIR 92-41356).

PLANS FOR FY 1993: An interpretive report by T.K. Edwards (WRIR 92) will be published when approved.

PROJECT TITLE: Evaluation of Ground-water Resources of Jackson County, Oregon



PROJECT NUMBER: OR-156

STUDY LOCATION: Jackson County, southwestern Oregon

COOPERATING AGENCY: Jackson County

PROJECT CHIEF: Leonard L. Orzol

PROJECT DURATION: Ongoing since January 1989

PROBLEM: Jackson County is one of the fastest growing areas in Oregon, and the county is predicting the influx of 100,000 new residents by the year 2000. Many small (2 to 10 acres) ranches have been developed, for which ground water is the principal source of domestic water. Continued growth and development depends in part upon the continued availability and potability of Jackson County's ground-water resources. Two major ground-water problems presently exist: (1) poor ground-water quality, and (2) inadequate ground-water supply. An additional problem is the lack of data and information regarding the distribution and source of contaminants or harmful trace elements. Well density is high and increasing in parts of the county; and some locations experience deep, narrow cones of depression during the annual dry season. Data are needed to determine if the aquifers fully recover during the winter recharge season, and to ascertain whether or not long-term water-level declines occur.

OBJECTIVES: The objective of the project is to define and document natural and anthropogenic changes in ground-water levels in major aquifers, through selection and monitoring of an observation well network. The basinwide ground-water study begun in the 1970's needs to be completed, in order to understand the regional ground-water flow system. The information and data gathered during preliminary work will be used to design a long-term study, that quantifies ground- and surface-water resources and their water quality.

APPROACH: Maps of 1978 well density were used to select sites for the observation well network. The wells were inventoried, and about 45 were selected for measurement and sampling every two months until March 1990. The new information was used in conjunction with historic data to describe general year-to-year changes in water levels. To assess the regional flow system, the thickness of the alluvial aquifer and general distribution of other aquifer units and their lithologic makeup is mapped. Water table and water-level change maps are prepared. Ground-water quality data are gathered to aid in describing horizontal and vertical distribution of mineralized water in each principal aquifer unit. Data and interpretations were used to write a proposal for future work designed to quantify the ground-water flow system.

PROGRESS: Maps of the thickness, extent, and elevation of the major geological units have been processed into ARC/INFO coverages. Preliminary geologic plates for the map report have been processed and transmitted to the cooperator. All water-level measurements for the monitoring well network have been entered into the GWSI data base for the years 1990 to 1993.

PLANS FOR FY 1993: Plans are to create and review copies of five geologic plates, to be incorporated in a map report. Monitoring of the well-network will continue, with data being entered into the GWSI data base. Additions to water-quality data for Jackson County wells will be made, and a work plan for publishing the water-level and water-quality data will be developed. An preliminary inventory of water use for Jackson County will be assembled; and a GIS database including USGS and other information will be established. A map report with 5 geologic plates will be completed.

PROJECT TITLE: Checking the National Water-Data Exchange Master Water Data Index for errors using the Geographic Information System

PROJECT NUMBER: OR-159

PROJECT CHIEF: Howard E. Harrison

PROJECT DURATION: October 1991 to September 1993

PROBLEM: The National Water Data Exchange (NAWDEX) is an interagency program administered by the USGS since the mid-1970's. References to the availability of data at surface water, ground water, water quality, and meteorological sites throughout the Federal government and cooperating agencies are stored in the NAWDEX Master Water Data Index (MWDI) on the Amdahl mainframe computer at Reston, Virginia. The MWDI was designed for non-interactive query (batch mode); however, there is a lack of quality assurance in the geographic locations of sites, which makes geographic queries of the MWDI impossible.

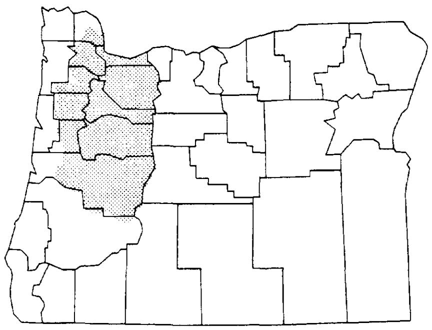
OBJECTIVES: The objectives of this project are to identify geographic and coding errata in the MWDI, and to notify the contributing agencies for applicable changes or amendments.

APPROACH: Programs will be designed for three purposes: (1) to install the MWDI in a Geographic Information System (GIS) using DG workstations; (2) to identify geographic and coding errors using the GIS system, and (3) to produce reports documenting errata from each agency using a relational data base (INFO).

PROGRESS: The entire MWDI was checked for geographic and coding errors. All applicable agencies were notified of the errata with instructions to make corrections. A statistical summary of the errors in the MWDI was given to NAWDEX office.

PLANS FOR FY 1993: Pending completion of errata correction, the MWDI will be rechecked for accuracy and completeness. Programs will be rerun, and a new errata list for the MWDI will be generated. The list will be compared with the previous list, with applicable annotations made to the MWDI. An open-file report documenting the project and its results will be written.

PROJECT TITLE: Streamflow Simulation, Sediment Transport, and Reconnaissance-level Determination of Contaminants in the Main Stem and Major Tributaries of the Willamette River, Oregon



PROJECT NUMBER: OR-160

STUDY LOCATION: Willamette River Basin

COOPERATING AGENCY: Oregon Department of Environmental Quality

PROJECT CHIEF: Antonius Laenen

PROJECT DURATION: October 1991 to September 1993

PROBLEM: The ODEQ (Oregon Department of Environmental Quality) requires recent water-quality data to renew point source permits in the Willamette River basin in 1994. ODEQ must require compliance with EPA's TMDL (total maximum daily load) concentration limits of various chemicals. For example, the limits for dioxin have previously been exceeded at the mouth of the Willamette River. To coordinate studies with the Willamette NAWQA (National Water-Quality Assessment program), ODEQ cooperated with the USGS in a joint-study to provide information for both agencies. USGS provides the hydrodynamic model(s), estimates of sediment transport, and reconnaissance of hydrophobic and hydrophilic contaminants (both metallic and organic).

OBJECTIVES: The objectives of this project are to: (1) characterize low- flow conditions and simulate streamflows of the main stem and major tributaries of the basin; (2) measure suspended-sediment concentration and calculate loads and yields for nine locations in the basin; and (3) perform reconnaissance sampling of metallic and organic contaminants in the main stem and major tributaries.

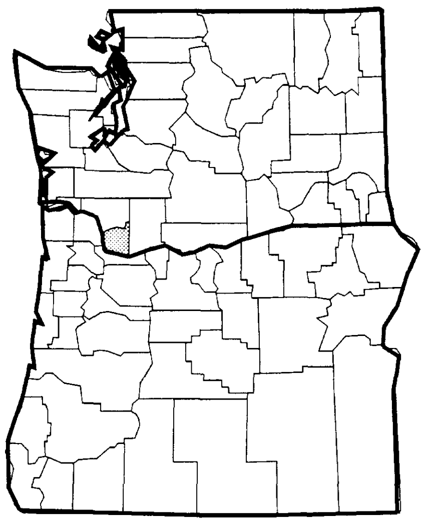
APPROACH: Model streamflow, dye-tracer studies, and miscellaneous low-flow and gain-loss measurements are made in areas where data was scarce or missing. Suspended-sediment samples were collected and analyzed for concentration and size class from 9 locations in the Willamette River and major tributaries during the 1992-93 water year. Total sediment loads and yields were calculated for the 2-year period and the long term, utilizing flow-duration-curve techniques. Water and bed-material samples were collected from 12-14 locations, for hydrophilic and hydrophobic contaminants, sediment size, and organic carbon. These data are used to select constituents for future fate-and-transport studies requiring extensive data collection activities.

PROGRESS: Progress for fiscal year 1992 results fell into the following four categories: (1) Low flows were defined; dye-tracer studies were performed on selected reaches of seven Willamette River tributaries, and on the upper main stem Willamette River. On the Molalla River, a dye-concentration-time curve was defined in the hyporheic zone in the vicinity of Canby, Oregon.

Seepage measurements were made to define gains and losses in the main stem Molalla River and on the Santiam River. Flow needs are to be routed by model to determine gains and losses; (2) Flows were modeled, and stream geometry for the Willamette main stem and major tributaries were defined. Selected data sets of storm and daily hydrographs were prepared as modeling-inflow data. GIS coverages were prepared for coverages of slope, aspect, land use, soils, geology, drainage area, and hydrology for hydrologic response unit delineation and watershed modeling; (3) Suspended-sediment samples were collected and analyzed at selected locations for comparison with 1948-51 COE data; and (4) A reconnaissance-level determination of contaminants was performed, and historical point- and nonpoint-source data from Federal, State and local agencies were analyzed to select sites for bed-sediment and water sampling. Bed-sediment samples were collected from 14 main stem and tributary sites. Water samples for dissolved trace-organic compounds and trace elements were resampled from the main stem and tributary sites in the fall of 1991 to determine dissolved-contaminant concentrations.

PLANS FOR FY 1993: The plans for fiscal year 1993 include: (1) Low flows will be defined, and a WRIR will be prepared documenting time-of-travel as defined by dye-tracer studies. Gain-loss investigation results will be published in the Oregon Annual Data Report. (2) a DAFLOW (diffusion analogy flow mode) model will be calibrated and verified for the Willamette River main stem and major tributaries. The DAFLOW model will be modularized and used in the framework of MHMS (modular hydrologic modeling systems). The Precipitation run-off model system (PRMS) will be used in MHMS to simulate watershed responses to inputs of daily precipitation. (3) Sediment sampling and analysis will provide data comparisons with historic information, to establish new suspended-sediment load versus water-discharge relations. (4) Reconnaissance-level determinations of contaminants obtained by water-sampling will be used to define contaminants of concern for future fate and transport studies.

PROJECT TITLE: Use of a Ground-Water Flow Model with Particle Tracking to Evaluate aquifer Vulnerability, Clark County, Washington



PROJECT NUMBER: PN-351

STUDY LOCATION: Clark County, Washington

COOPERATING AGENCY: Intergovernmental Resource Center of Clark and Skamania Counties, Washington

PROJECT CHIEF: Daniel T. Snyder

PROJECT DURATION: Complete, except for reports

PROBLEM: The Intergovernmental Resource Center (IRC) recognized a need for a method to evaluate land-use scenarios in terms of relative threat to ground-water quality, in order to better protect and manage ground-water resources.

OBJECTIVES: The objective of the project was for the USGS, in cooperation with IRC, to develop a methodology to evaluate aquifer vulnerability for Clark County using a ground-water flow model with particle tracking.

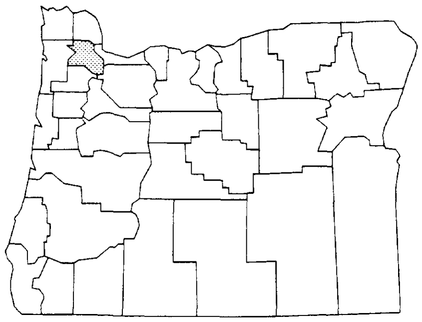
APPROACH: A three-dimensional regional ground-water flow model of the Portland Basin, Oregon, and Washington, constructed using the USGS modular three-dimensional finite-difference ground-water flow model (MODFLOW) for a previous USGS study, was utilized. The model was used to calculate three-dimensional pathlines and travel times, using the USGS particle tracking post-processor (MODPATH) modified to enable data and results to be output in the form of ARC/INFO (a geographic information system) digital maps. This newly modified version of MODPATH, called MODPATH-ARC, enhances the ability to display and analyze results of the particle tracker. The modification permits a versatile use of database, statistical and display capabilities of ARC/INFO, and facilitates the comparison with other types of spatial information.MODPATH was used to individually track six particles from each model grid cell located in Clark County backward in time through the flow model, upgradient to their recharge points. MODPATH-ARC was then utilized to create digital maps of 60,000 recharge points. Chlorofluorocarbon (CFC) age-dating, used to compare with ground-water ages calculated by the particle tracker, showed a 76 percent agreement at 51 wells sampled for CFCs.

PROGRESS: Maps of recharge points derived by particle tracking were used to identify a large number of recharge areas in southern Clark County, which could be adversely affected by land-use activities such as on-site waste- disposal systems, or drywells. ARC/INFO was used to summarize travel times for particles started in a cell and tracked backward to their recharge points, and maps were generated of the age of ground water for each grid cell in the model. Many public-supply wells in Clark County withdraw water, which, in part, may be less than one-hundred years old. Characteristics of the recharge areas were related to the downgradient parts of the ground-water system. Hydrogeologic units were mapped to highlight areas receiving flow from recharge areas characterized by surficial loading from on-site waste-disposal systems or drywells. Comparisons of these maps with maps of public-supply wells in Clark County indicated that a most of the wells in southern Clark County may eventually receive components of water that were recharged in areas of surficial contaminant loading. The results of the project show that a single particle-tracking analysis simulating advective transport can be used to evaluate aquifer vulnerability for current water resources, or to identify sites for future development. The methodology is applicable for any part of a ground-water flow system and is usable at any scale or discretization; it is directly transferable to other areas utilizing MODFLOW to simulate ground-water flow systems.

PLANS FOR FY 1993: The project is complete, and 2 open-file reports will be written pending publication as water-supply papers. One report is about the use of chlorofluorocarbons, and the other report is a project summary. Three journal articles will be written--one jointly with IRC--that will discuss chlorofluorocarbons in age dating, and some of the project conclusions relevant to ground-water scientists and resource managers.

PROJECT TITLE: Water Quality Assessment, Tualatin River Basin

PROJECT NUMBER: PN-356



STUDY LOCATION: Tualatin River Basin, Oregon

COOPERATING AGENCY: Unified Sewerage Agency (USA)

PROJECT CHIEF: Dennis Lynch

PROJECT DURATION: Ongoing, since January 1990

PROBLEM: Continued economic growth within the Tualatin River basin is linked to improving the quality of its water resources. Nutrient inputs from wastewater treatment plants, surface-water runoff from urban, agricultural, and forest lands, and ground-water discharge have led to nuisance growths of planktonic algae in the slow-flowing lower river. Algal growth and inputs of ammonia have led to water-quality problems such as low dissolved oxygen concentrations, excessively high pH, and ammonia toxicity. During algal blooms, chlorophyll-a concentrations often exceed 50 micrograms per liter and pH exceeds 9.0. Following algal blooms, dissolved oxygen concentrations commonly drop below the 6 milligram per liter Oregon State standard. The control of nutrient inputs to the main-stem river is complicated. Whereas wastewater discharges of nutrients during the summer months are currently controlled, concentrations of non-point source nutrients are sufficiently large to support substantial algal blooms. Regulatory agencies and sewerage authorities, in conjunction with foresters and persons concerned with agriculture, are working to lower or eliminate nutrient inputs to the main-stem river. To accomplish this task, sources of nutrients need to be identified to properly target clean-up efforts; acceptable nutrient loads need to be quantified, to define processes needed to eliminate water-quality problems associated with algal growth.

OBJECTIVES: The objectives of the project are to: (1) determine the source, transport, and fate of nutrients in the main-stem Tualatin River; (2) determine relations between nutrient loads in the river, and the growth of algae, low concentrations of dissolved oxygen, and excessively high pH; and (3) calibrate, check, and utilize a water-quality model to assess the response of the main-stem river to various remediation options.

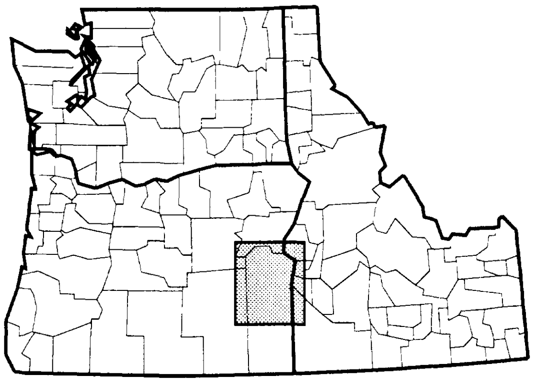
APPROACH: A mixture of fixed-station monitoring and synoptic surveys of smaller tributaries and drains is combined with a ground-water sampling program to assess nutrient-loading to the main-stem Tualatin River. To assess the transport of nutrients, l0 fixed-stations on the main-stem Tualatin are being sampled 1 to 3 times a week during summer months. These data are used to determine if nutrients are transported conservatively in the Tualatin River, or if certain river reaches provide a source or sink for phosphorus or nitrogen. A water-quality model is being developed to quantify the relations between nutrient loadings to the river and the associated water-quality problems in the lower main stem. The modeling requires explicit measurements of algal growth and its relation to (1) nutrient concentrations, (2) algal-settling rates, (3) light conditions, (4) zooplankton grazing, (5) temperature, (6) flow conditions, and (7) vertical mixing patterns. The model is being calibrated with data collected in 1991 and

1992, and will be checked with data collected in 1993. Various river management options will be tested with the model during 1994 to predict their effects on dissolved oxygen, pH, ammonia toxicity, and algal standing crop.

PROGRESS: Field data to determine source, transport, and fate of nutrients were collected in 1991 and 1992. These data, along with other field and laboratory measurements, are being used to calibrate the water-quality model.

PLANS FOR FY 1993: Field and laboratory data necessary to check the water- quality model will be collected. Calibration of the water-quality model will continue.

PROJECT TITLE: Department of Interior Irrigation Drainage Reconnaissance Study of the Owyhee-Vale Irrigation Projects, Oregon and Idaho



PROJECT NUMBER: PN-360

STUDY LOCATION: Eastern Oregon and southwestern Idaho

COOPERATING AGENCIES: U.S. Fish and Wildlife Service; U.S. Bureau of Reclamation

PROJECT CHIEF: Frank A. Rinella

PROJECT DURATION: Complete

PROBLEM: The Owyhee and Vale Irrigation Districts in extreme east-central Oregon and southwest Idaho supply water for the irrigation of agricultural crops; the semiarid climate and high evaporation rates necessitate that about 90 percent of irrigable land receive irrigation water. Water within the districts is used primarily for irrigation of agricultural crops. Ground-water supplies or privately-owned domestic wells supply most of the drinking water in the project areas. Although habitat within the districts is primarily farmland, the Snake River and parts of both irrigation districts provide wintering habitat for bald eagles, and breeding and wintering habitat for migratory waterfowl. The upper reaches of the Malheur River support important resident fisheries. The possible degradation of water quality in the study areas was a concern to agencies monitoring fish and wildlife populations. Several previous investigations have documented widespread elevated concentrations of arsenic, boron, nitrate, selenium, numerous pesticides, PCBs, and other organic contaminants, including dioxins, in the surface and ground waters of this area. A number of these chemicals may also be present in the food chain.

OBJECTIVES: The objective of this reconnaissance investigation was to determine from existing and newly-collected data if irrigation drainwater from the Owyhee and Vale Irrigation Districts have caused, or have significant potential to cause: (1) harmful effects on human health or fish and wildlife, or (2) the impairment of other beneficial water uses.

APPROACH: Water-quality samples at 19 sites were collected during three surveys: (1) prior to the irrigation season (early April), (2) during the irrigation season (July-August), and (3) after the irrigation season (mid-October), when the ground-water contribution is near maximum. Bottom-material samples were collected at all sites during a July-August survey. Biological sampling was done at eighteen sites; several bioassessment techniques were used to evaluate toxic conditions in the study area. Bioassays were made during July or August, when the land was most intensively irrigated and received frequent applications of pesticides. This was the time period when most samples for biota, water, and bottom-material samples were collected.

PROGRESS: The data collection activities are completed, and a water- resources investigation report has been written.

PLANS FOR FY 1993: The report will be approved for publication and printed.

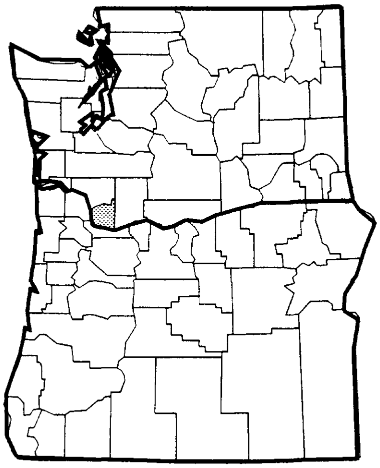
PROJECT TITLE: Ground-water Flow System in Clark County, Washington

PROJECT NUMBER: PN-363

COOPERATING AGENCY: Intergovernmental Resource Center (IRC)

PROJECT CHIEF: Leonard L. Orzol

PROJECT DURATION: Complete, except for report



PROBLEM: In order to provide methods of protecting ground-water resources from contamination, water managers required information on the lateral and vertical extent of zones of contribution to public supply wells. Zone-of-contribution maps were needed by local agencies in Clark County Washington; and a methodology had to be developed to produce the maps, that enable agencies to assign wellhead protection zones to municipal supply wells.

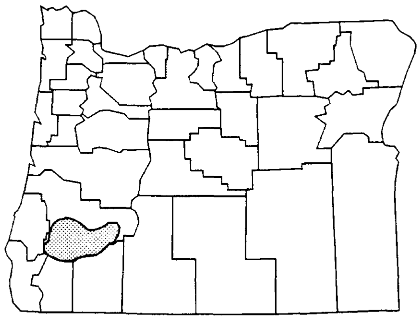
OBJECTIVE: The objective of this project was to develop the methodology to produce zone-of-contribution maps. The methodology required demonstrating the use of the Portland Basin three-dimensional (3-D) ground-water flow model, in conjunction with a particle-tracker module, for delineating zones of contribution to selected public supply wells. The methodology and model needed the capability to accommodate changing conditions of ground-water pumpage and variable hydraulic conductivity

APPROACH: The approach included the determination of present and projected pumping rates and well locations for wells used for definition of zones of contribution. A 3-D model was used in conjunction with the particle tracker to delineate zones for 45 wells. Results were used to demonstrate zone-of-contribution variation with changes in well pumpage and hydraulic conductivities. The demonstration was augmented by Clark County's use of EPA sanctioned analytical techniques and two-dimensional models.

PROGRESS: ARC/INFO coverages for a final map report were developed and reviewed. Hard copies of maps for all wells were produced and delivered to the IRC, which illustrate zones of contribution derived from seven different scenario-simulations. The simulations included variations in pumping and hydraulic conductivity.

PLANS FOR FY 1993: The report will be approved for publication and printed.

PROJECT TITLE:	Nutrient-Metabolism Relations in a Periphyton-Dominated Stream Community
PROJECT NUMBER:	PN-364
STUDY LOCATION:	South Umpqua River Basin in Douglas County, southwestern Oregon
COOPERATING AGENCY:	Douglas County, Oregon
PROJECT CHIEF:	Dwight Q. Tanner
PROJECT DURATION:	Complete, except for reports



PROBLEM: Excessive growth of periphytic algae in the South Umpqua River in Oregon becomes a problem each summer during baseflow periods. The algal growth results from excessive inputs of nutrients--primarily from point sources. In several river reaches, the primary productivity and respiration of the periphyton-dominated community results in pH values and dissolved-oxygen concentrations that do not comply with Oregon State standards. Because of continued water-quality violations in the South Umpqua River and other rivers, Oregon courts mandated that TMDLs (total maximum daily loads) be promulgated statewide for all water-quality limited streams. In general, relations between nutrient loads and the metabolism of the stream community are complex and poorly understood; and data was needed for the establishment of appropriate and defensible TMDLs for nutrients in periphyton-dominated streams.

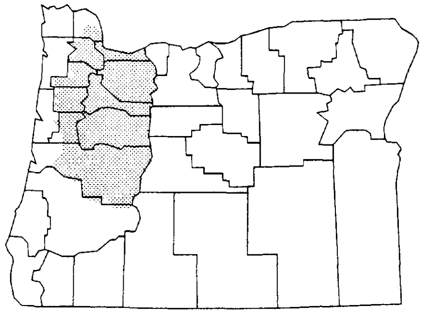
OBJECTIVES: The objectives were to: (1) quantify the metabolism (primary productivity and respiration) of the South Umpqua River during summer low-flow periods; (2) relate metabolism rates to levels of nutrient enrichment and physical properties of the stream (such as velocity, depth, substrate type, and light intensity); and (3) quantify these relations to determine the effectiveness of establishing TMDLs for controlling stream pH and dissolved-oxygen concentrations.

APPROACH: Data collection included three levels of effort: (1) synoptic surveys of water-quality throughout the basin to identify sources and sinks of water, nutrients, carbon, and other constituents; (2) a fixed- station sampling program for determining seasonal water-quality patterns; and (3) diel inflow/outflow sampling of six-river reaches to determine short-term (hours) water-quality patterns over a range of different nutrient concentrations, channel morphologies, and light intensities. A water-quality model of the main stem river was calibrated using synoptic-survey and fixed station data. Results from diel surveys were used to set model bounds for primary production and respiration rates, as they relate to physical, chemical, and biological characteristics of the river. The calibrated model was used to predict the effectiveness of TMDL scenarios for controlling water-quality problems.

PROGRESS: Synoptic surveys in the South Umpqua River and its major tributaries were conducted, and reach-intensive studies were performed to collect data in reaches affected by wastewater-treatment plant effluent and in a "control" reach. Effluent of five wastewater-treatment plants was sampled and analyzed, and four water-quality stations were sampled weekly on the South Umpqua River; a four-parameter minimonitor was maintained at an upstream site. Algal productivity was measured with a new technique utilizing a portable growth chamber. It was hypothesized that most nutrients in the South Umpqua River originate from wastewater-treatment plants during the summertime, and that gradients of nutrient concentrations decrease below treatment-plant outfalls.

PLANS FOR FY 1993: Data collected are to be reviewed, and published in a data report. The data analysis will be presented in an interpretive report.

PROJECT TITLE: National Water-Quality Assessment Program--The Willamette Basin



PROJECT NUMBER: PN-366

STUDY LOCATION: Willamette and Sandy River Basins, Oregon

PROJECT CHIEF: Dennis A. Wentz

PROJECT DURATION: Ongoing, beginning in August 1991

PROBLEM: The Willamette NAWQA basin includes the Willamette and Sandy River basins in northwestern Oregon. The basin contains the state's three largest cities--Portland, Eugene, and Salem--and has a population of about 1.9 million people representing 68 percent of Oregon's population. About 62 percent of the basin is forested land, located largely in the tributary basins. Approximately 33 percent of the basin is farmland, and the remaining 5 percent is urbanized or in other uses.Water levels in the surficial basin-fill aquifers that are found throughout the Willamette Valley tend to remain fairly steady from year to year. On the other hand, water levels in some wells in the Columbia River Basalt (CRB) aquifer unit in the northern half of the basin have shown a general decline over time. A Liaison Committee with representatives from 19 local, state, and federal agencies met in June 1991, and identified and prioritized water-quality issues for the basin, including: (1) biological degradation of surface- and ground-water resources; (2) erosion of soils due to changes in land-use activities; (3) effects of surface- and ground-water flow on water quality; (4) eutrophication and increasing nutrient concentrations; and (5) contamination by trace elements and trace organic compounds.

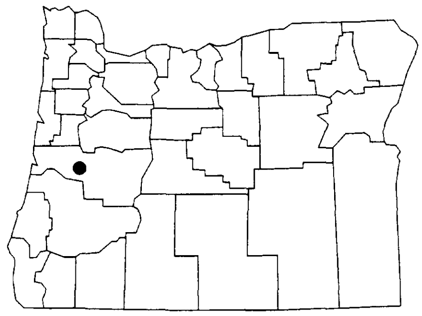
OBJECTIVES: The long-term goals of the Willamette NAWQA program are to (1) describe the status and trends of water quality in the surface- and ground-water resources of the basin, and provide a sound scientific understanding of natural and human factors affecting water quality; (2) provide a forum for interaction among Liaison Committee members representing agencies responsible for water-resources management with regard to water quality issues; and (3) distribute results of the NAWQA program to local, state, and federal agencies in a timely fashion and insure that the results are understood by management agencies.

APPROACH: An integrated program of water-resources investigations consistent at all scales is provided to adequately address water-quality issues at the national scale. Historical and existing data about water resources is accumulated to form a conceptual model of water resources and water quality. Additional data are collected in order to test hypotheses related to conceptual models, management alternatives, national NAWQA-synthesis objectives, and local needs and concerns.

PROGRESS: Project staffing was completed, with a biologist, chemist, and hydrologic technician hired during 1992. Several water-quality reconnaissance investigations were completed, including a "drive-by" assessment of 110 surface-water sites to appraise site accessibility; an "on-site" assessment of field water quality (biological and chemical constituents) at 33 sites; and an occurrence survey of trace elements and organic compounds in bed sediment and tissue at 12 sites. The Willamette NAWQA hosted a Training And Method Shakedown (TAMS) of ecological protocols at three of the drive-by sites. The TAMS was attended by representatives from the five Western Region NAWQA study units and personnel from other regions. A draft of a retrospective report on nutrients in surface and ground water of the Willamette NAWQA basin was begun.

PLANS FOR FY 1993: The retrospective analysis will be completed; the work plan will be updated; and field data collection will begin for fixed- station monitoring, intensive ecological assessments, and the ground- water study-unit survey.

PROJECT TITLE: Amazon Creek Water Quality Assessment



PROJECT NUMBER: PN-369

STUDY LOCATION: Eugene, Oregon

COOPERATING AGENCY: Lane Council of Governments; City of Eugene

PROJECT CHIEF: Frank A. Rinella

PROJECT DURATION: Complete

PROBLEM: Amazon Creek in the city of Eugene, Oregon, flows from a predominately urban headwaters into a wetland area important to wildlife preservation. Historic studies indicate the stream's water-quality is periodically degraded. The cooperator needed to define current water-quality conditions of the wetland and quantify pollutants entering the wetland from the urban area.

OBJECTIVES: The objectives were to supplement historical data, by analyzing samples of streambed sediment and water from Amazon Creek and adjacent wetlands for inorganic trace elements and organic compounds listed by the EPA as priority-pollutants. The temporal and spatial water-quality conditions of Amazon Creek were analyzed using available information and data gathered by the supplementary sampling. A program plan for more definitive temporal and spatial water-quality sampling in the adjacent creek and wetlands data was provided to the cooperator; and alternative methods of improving water quality and the efficacy of in-place improvements were evaluated.

APPROACH: Measurement locations were established through a reconnaissance study. Bed materials were collected during summer low-flow at about 10 locations along the main stem of Amazon Creek and in adjacent wetlands, and water samples were taken at the same time. The sampling identified potential industrial point-sources and the existence of agricultural pollution.

PROGRESS: The sampling and data collection activities were completed, and a report was written.

PLANS FOR FY 1993: The report will be approved for publication and printed.

PROJECT TITLE: Hydrologic and geochemical monitoring of hydrothermal systems in Oregon and northern California

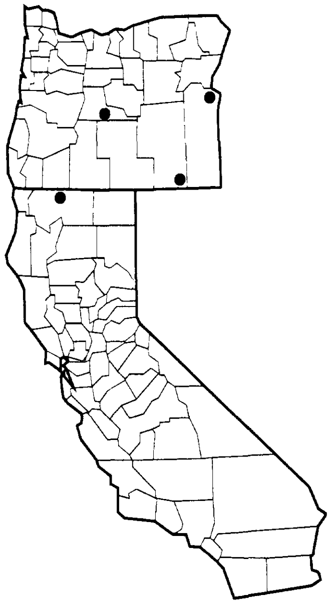
PROJECT NUMBER: PN-374

STUDY LOCATION: Oregon, northern California

COOPERATING AGENCY: Bonneville Power Administration

PROJECT CHIEF: David Morgan

PROJECT DURATION: Ongoing, beginning in June 1991



PROBLEM: Although the Pacific Northwest is thought to have abundant geothermal resources, they remain essentially undeveloped. To encourage responsible resource evaluation and development, the BPA (Bonneville Power Administration), in coordination with the Northwest Power Planning Council, selected three sites for geothermal pilot projects in Oregon and northern California. Pilot projects are to be located at Newberry Caldera in central Oregon, near Vale in eastern Oregon, and at the Glass Mountain Geothermal Area on the Medicine Lake Volcano in northern California. The Borax Lake area, in the Pueblo Valley of south-central Oregon, is also identified as a potential site for geothermal development, but is not currently a designated pilot project. Prior to the development of geothermal pilot projects, environmental monitoring must be performed--baseline conditions regarding hydrologic and water quality must be established, and continued monitoring is required throughout the life of the projects. In the case of Borax Lake, there is concern for the protection of natural geothermal features such as hot springs, as well as wildlife.

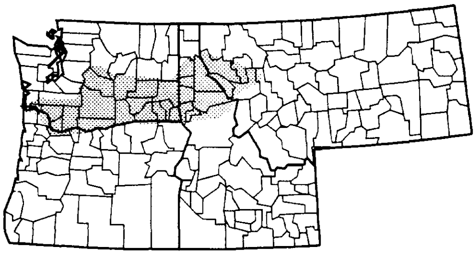
OBJECTIVES: A major goal of the pilot projects is to assure that environmental and land-use issues are adequately evaluated prior to and during development of geothermal resources. The USGS will participate in the pilot projects by designing and implementing monitoring networks. The networks will establish baseline (current, pre-development) hydrologic and geochemical conditions in surface and ground water, in the areas of potential geothermal development.

APPROACH: Depending on the site, aquifers, springs, wells, and lakes at or near the pilot project are monitored to establish pre-development baseline data; water from wells at, or in proximity to, project sites is analyzed to detect changes in the concentrations of various chemical constituents. Water-levels in wells are measured at appropriate intervals, and data regarding physical parameters such as temperature, specific conductance and pressure of ground water in and around known geothermal resource areas (KGRA) are collected. In the case of Glass Mountain, information regarding snow-pack depth is collected, and gas samples from a "hot spot" are analyzed.

PROGRESS: This project consists of the following four subprojects, all involved with the collection of baseline hydrologic and water-quality data at sites of potential geothermal development in Oregon and northern California: (1) Nubbier Crater: Gages were installed at Paulina and East Lakes, and one on Paulina Creek. A meteorological station was placed within the crater. Data are accessible by radiotelemetry from the Portland District Office. Water-level, temperature, and specific conductance were monitored every 2 weeks in 8 wells to define seasonal variations. Three water-quality sampling trips were made in April, June, and September to collect data on water-quality chemistry. Hydrologic features in the crater were sampled; (2) Borax Lake: The comprehensive plan for monitoring and baseline data collection has been postponed; instead, a low-level monitoring program was established in the Pueblo Valley near Borax lake in order to establish baseline information of regional ground-water levels and spring discharge rates and temperatures; (3) Vale: A number of wells and springs have been selected for collecting baseline data and monitoring possible effects of geothermal development in the Vale area; and (4) Glass Mountain, California: A number of wells and springs were located as potential monitoring sites during two reconnaissance trips to the area. Preliminary surveys of depth, temperature, specific conductance, dissolved oxygen, and pH were made in three lakes within the study area.

PLANS FOR FY 1993: (1) Monitoring will continue at Newberry Crater, and piezometers will be drilled at the hot springs. A data report will be published. (2) Monitoring at Borax Lake will be discontinued in FY 1993. Monitoring programs at Vale and Glass Mountain have been postponed until developers are ready to begin work in these areas.

PROJECT TITLE: Retrospective Analysis of Processes Affecting Water Quality Due to Eruptions of Mount St. Helens



PROJECT NUMBER: PN-375

STUDY LOCATION: The Pacific Northwest

PROJECT CHIEF: Douglas B. Lee

PROJECT DURATION: Complete, except for report

PROBLEM: The blast, debris avalanches, mudflows, and ashfall associated with the eruptions of Mount St. Helens on May 18, 1980 altered the physical, chemical, and biological characteristics of numerous streams, lakes, and aquifers. The massive disturbance of ecosystems provided the research community with exceptional and unique opportunities of studying ecological and geological processes. Although volcanic eruptions are generally viewed as rare events, volcanos within the Pacific Rim have, and may continue to occur, at intervals well within a human life span. Examples include eruptions of Lassen Peak, Mount Redoubt, and Mount St. Helens. Hundreds of scientific papers and articles regarding various aspects of volcanic eruptions are to be found, but a comprehensive review of the literature emphasizing water-quality effects related to the 1980 events has previously never been compiled. A retrospective analysis of water-quality studies regarding the Mount St. Helens eruptions was needed to provide insight into potentially important processes for study, in the event of future volcanic activity.

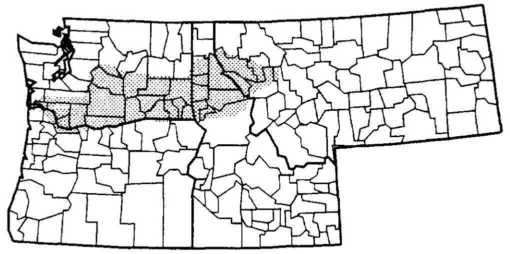
OBJECTIVES: The objective of this project was to provide a summary highlight and detailed retrospective analysis of what is known about the water-related geochemical and biological processes affected by the 1980 eruptions of Mount St. Helens. The literature review and summary will help researchers to identify additional important study elements and hypotheses that might be investigated, to facilitate a better understanding of water-quality effects caused by future volcanic eruptions.

APPROACH: A bibliography was compiled of investigations conducted as a result of the eruption of Mount St. Helens, that related to physical, chemical, and biological effects on water quality of surface and ground water, precipitation, and the Columbia River Estuary. The papers were discussed in a comprehensive literature review. Phenomena documented include effects on sedimentation, geochemistry, microbiology, and limnology. Some of the processes described are alterations of stream habitat, changes in fish and other populations, nutrient dynamics of lakes and streams, and modifications in inorganic and organic chemistry of water found in lakes and rivers. A case history approach was utilized, in an attempt to best relate physical, chemical, and biological phenomena to one another, and to illustrate "cause-and- effect" relations.

PROGRESS: The draft report has been completed and is currently being reviewed. Owing to the length of the report, each major section was summarized for the convenience of the reader. The scientific papers, circulars, and articles listed in the report's bibliography have been archived.

PLANS FOR FY 1993: The first part of the project is was the completion of the literature review. A proposal has been approved, to accomplish the second phase of the project. Authors of the papers described in the report will be contacted by phone, for interviews. Ideas and opinions will be solicited, regarding suggestions for future research topics. Recommended topics and study approaches will be documented; the results of the interviews will be compiled and summarized. The literature survey will be reviewed by a committee of water-quality scientists, who will add their ideas to the summary proposals gathered during the interview process. The committee may prioritize suggested research topics. A open- file report summarizing the results of the interviews and the findings of the committee will be written.

PROJECT TITLE:	Maintenance, Enhancement, and Dissemination of the 100K River Reach Data System
PROJECT NUMBER:	PN-379
STUDY LOCATION:	Pacific Northwest: Oregon, Washington, Idaho, and Montana
COOPERATING AGENCY:	Bonneville Power Administration
PROJECT CHIEF:	Bruce Fisher
PROJECT DURATION:	Ongoing, beginning in July 1991



PROBLEM: The Oregon District has developed a digital hydrography data base, at a resolution of 1:100,000 for the Pacific Northwest region. The database has links to a natural resource database from the Northwest Power Planning Council (NPPC) and to the STORET database from EPA. The digital hydrography has upstream and downstream routing connections and is suitable for use in Geographic Information System (GIS). The work was completed for BPA and many other State and Federal agencies during FY 1991. The system, called the River Reach Data System, was distributed to cooperators. A central clearinghouse is needed for the River Reach Data System, to provide uniformity to the format of data sets and to provide coordination between agencies. The clearinghouse is essential to provide and insure current and accurate updates for all users of the system.

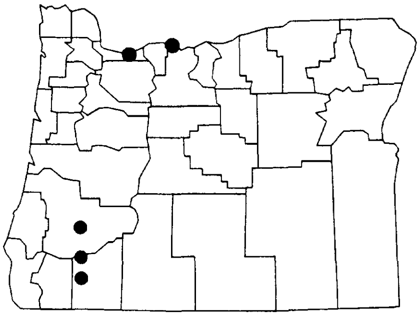
OBJECTIVES: The major objective of this project is to develop an infrastructure for managing the newly developed, region-wide 1:100,000 scale River Reach Data System. The overall goal is to establish the River Reach Data System as the cornerstone data set of hydrography and associated agency identifiers. Successful implementation of this project will result in consistent spatial-hydrographic base for river-related data collection efforts in other regions of the country.

APPROACH: The implementation of this region-wide 1:100,000 scale River Reach Data System is being accomplished through an active program of maintenance, enhancement, and dissemination. Tasks include: (1) converting files to other formats for agencies using different software; (2) archiving of all files in permanent storage media; (3) disseminating of the system to all cooperating agencies; (4) making corrections and enhancements, as needed, (5) providing technical assistance to cooperators; and (6) developing long-term infrastructure for future system maintenance and data interchange.

PROGRESS: The River Reach Task Force established priorities for providing enhancement, and a digital librarian system for managing River Reach files was implemented. Work contracts between State agencies in Oregon, Idaho, Montana, and Washington, and the BPA are in progress, and new work on the reach files has begun.

PLANS FOR FY 1993: The River Reach Clearinghouse will administer the development of protocols for State agencies to follow when correcting or adding enhancements to the 100K River Reach Files. The priority enhancements will be stream order and stream names. The USGS has developed a software program to add stream order to each reach in the stream network; the program will be run on the Reach Files after the corrections are complete. The task force will continue to provide future directions for the River Reach Data Base; clearinghouse personnel will chair meetings, resolve technical issues, and provide on-site training, and write documentation.

PROJECT TITLE: Measurement of Scour at Selected Bridges in Oregon to Define Maximum Pier Scour and Infilling of Scour Holes



PROJECT NUMBER: PN-380

STUDY LOCATION: Oregon

COOPERATING AGENCY: Oregon Department of Transportation (ODOT)

PROJECT CHIEF: Milo D. Crumrine

PROJECT DURATION: October 1991 to September 1993

PROBLEM: Exposure or undermining of bridge pier and abutment foundations by the erosive action of flowing water can result in structural failure of a bridge, possibly causing fatalities. Repairs or replacement of bridges arising from structural failure require major expenditures. The ODOT is required by the Federal Highway Administration to inspect every bridge over water, but periodic surveillance does not detect scour as it occurs and may not measure maximum scour. In a flood, deep scour can occur rapidly due to increased water velocity, and scour holes can infill quickly during flood recession and decreased water velocity. Underwater inspections by divers may be delayed until periods of low water, and may fail to detect maximum scour.

OBJECTIVES: The objective of this work was to install continuous-recording depth-sounding equipment to monitor scour around bridge piers, where scour is determined to be scour-critical. Data collected by the equipment are to be verified.

APPROACH: The Bridge Section of ODOT was contacted to select candidate locations for bridge-scour investigations. Field reconnaissance investigations by USGS, ODOT and Federal Highway personnel determined sites to be monitored. A second field reconnaissance was made by project personnel to determine the location of maximum scour, best placement of transducer(s), and equipment requirements necessary to determine the points of deepest scour and infilling. After equipment was installed, sites were visited monthly to retrieve data and measure the depth of scour holes, to verify recorded data. Personnel from ODOT were trained in the use and monitoring of equipment, and field collection methodology.

PROGRESS: During 1991 and 1992, two sites were monitored: (1) The Deschutes River and Highway I-84 bridge, and (2) the Sandy River at Highway I-84 bridge. No scour was recorded or observed at the Deschutes site, possibly owing to low runoff. Two noncritical occurrences of scour events were observed at the Sandy River site.

PLANS FOR FY 1993: Monitoring at the Deschutes River was discontinued. Other sites being monitored for bridge scour, in addition to the Sandy River at Highway I-84 bridge are: (1) Hood River at Highway I-84; (2) Sutherlin Creek near Sutherlin at Highway I-5; (3) Cow Creek near Canyonville at Highway I-5; and (4) Grave Creek near Grants Pass at Highway I-5.

Scouring has been recorded at all sites except the Sandy river site; monitored scour at the other four sites will be verified. An open-file data report will be prepared at the end of the 1993 fiscal year.An updated proposal for FY 1994 will be sent to ODOT for monitoring additional scour-critical sites, and monitoring and data-verification at some existing sites will continue. A proposed technique for verification of scour would utilize ground-penetrating radar. Scour-hole elevations at the Sandy River site will be discontinued.

PROJECT TITLE: Assessment of Nutrient Loading to Upper Klamath Lake, Oregon

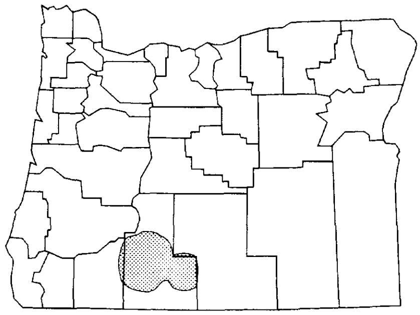
PROJECT NUMBER: PN-381

STUDY LOCATION: Klamath County, Oregon

COOPERATING AGENCY: U.S. Bureau of Reclamation (USBR)

PROJECT CHIEF: Michael E. Darling

PROJECT DURATION: Ongoing, beginning in October 1991



PROBLEM: Since the 1930's, large areas of marsh have been diked, ditched, and drained for agricultural use in low-lying areas surrounding and north of Upper Klamath Lake. Regulation of the lake for irrigation purposes has caused lake-stage fluctuations to be both higher and lower than natural levels. At low levels the lake is more susceptible to wind- induced resuspension of bottom sediment. Lake flushing patterns have changed as a result of reservoir regulation and stream diversions. A hydrologic analysis with investigations of water-quality in tributaries to Upper Klamath Lake is needed to better understand the effect and timing of nutrient loads from rivers.

OBJECTIVES: The overall objective will be to assess sources of nutrient loading to the lake and the role of reservoir regulation on flushing patterns on the lake. A major element of work by the USGS will be assessment of nutrient loading from agricultural sources to Upper Klamath Lake from the two tributary rivers draining into the lake. Another major objective is to provide an evaluation of nutrient flux to the lake from shallow ground water. Nutrient loading to the lake from small streams, ditches, and canals will be assessed by the USBR and the Klamath Tribe.

APPROACH: The 5-year study includes an appraisal of surface-and ground- water nutrient sources and loading to the lake. Nutrient loading of agricultural sources from major tributary rivers will be determined by fixed station and synoptic sampling, coupled with discharge measurements. Nutrient loading from shallow ground water is assessed by determinations of nutrient concentrations at multiple depths in marsh areas and pasture lands near the lake and estimations of water flux. A retrospective analysis of the methodology described provides a conceptual model of nutrient sources, both natural and anthropogenic in origin, and their seasonal variability. Data collection covers a 3-year period.

PROGRESS: Three field trips were made in the Klamath Basin, and nutrient and discharge measurements were made at more than 100 sites in the Wood, Williamson, and Sprague sub-basins. Five fixed sites have been established at lower stream reaches within the basin. Nutrient and discharge measurements are made monthly at those sites. The historical water quality in the basin was analyzed using WATSTORE and STORET data, and land use was classified in the basin using 1:24,000 photos. All data have been put into a geographic information system.

PLANS FOR FY 1993: All contributing drainage areas above water-quality sites will be defined and mapped. Further delineation of land-use codes for agriculture, wetland, and forest lands using SPOT image data will continue. Historical water quality and lake flushing patterns will be investigated; and information on wind action, lake levels, and sediment dispersion are to be obtained from the literature and historic data. A report documenting all current and historical water-quality bibliographic references in the Klamath Basin will be written; two interpretative reports, and a WRD data report, are planned for subsequent fiscal years.

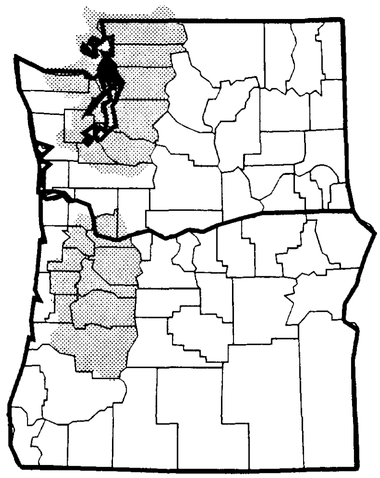
PROJECT TITLE: Puget-Willamette Lowland Regional Aquifer-System Analysis

PROJECT NUMBER: WA-336

STUDY LOCATION: Puget Sound, Washington and Willamette, Oregon Lowlands

PROJECT CHIEF: John J. Vaccaro

PROJECT DURATION: October 1988 to September 1993



PROBLEM: The Puget-Willamette Lowland regional aquifer-system is one of the 28 regional aquifer systems chosen for study under the USGS Regional Aquifer System Analysis (RASA) program. The states of Washington and Oregon need this study because more than 70 percent of their population resides within the study area boundaries. Within the project area, such information as quantity and direction of ground-water flow, lengths of flow paths, locations of ground-water discharges, stream-aquifer interaction, relations with older rock materials, and continuity between aquifer units is largely unknown. All of these topics require better definition; lack of that information impairs the ability of managers to make knowledgeable decisions.

OBJECTIVES: The primary goal of this program is to obtain a better understanding of the regional ground-water system. To achieve this goal, the following objectives have been defined: (1) describe the geologic framework of the principal aquifers; (2) describe the geohydrologic characteristics of the principal aquifers; (3) describe the regional flow system; (4) estimate the water budget for selected areas of the aquifer system; and (5) use ground-water-flow models to evaluate the geohydrologic data and test concepts on how the regional flow system operates.

APPROACH: The Puget Sound and Willamette Lowland parts of the Puget-Willamette Lowland RASA are being studied separately, because the two parts are geographically separated and represent two distinct regional aquifer systems. The Oregon District Office has primary responsibility for the Willamette Lowland study. In the Willamette Lowland study area, geologic maps were compiled and digitized, and lithologic information from more than 3,000 field-located water wells was computerized. Using this information, several dozen hydrogeologic sections were generated and used to identify hydrogeologic units. The top elevation and thickness of each of these units were contoured. Ground-water pumpage was calculated using a variety of methods, and municipal use was determined largely from pumpage records. Agricultural pumpage was estimated using water-rights records, crop water requirements, and cropping information from ground observation and Landsat imagery. Water level information was derived primarily from existing reports and records. Hydraulic characteristics of aquifer units are being determined largely from specific capacity and singe-well pump test data.

PROGRESS: A bibliography of hydrogeology for the Willamette Valley has been published. Data compilation and analysis are complete for the geologic framework and water-use parts of the Willamette Lowland study, and reports are in preparation. Data compilation is finished for the hydrogeology; analysis and modeling are ongoing.

PLANS FOR FY 1993: Geologic framework and water use reports for the Willamette Lowland will be completed and approved for publication; and the hydrogeology report should be largely completed.

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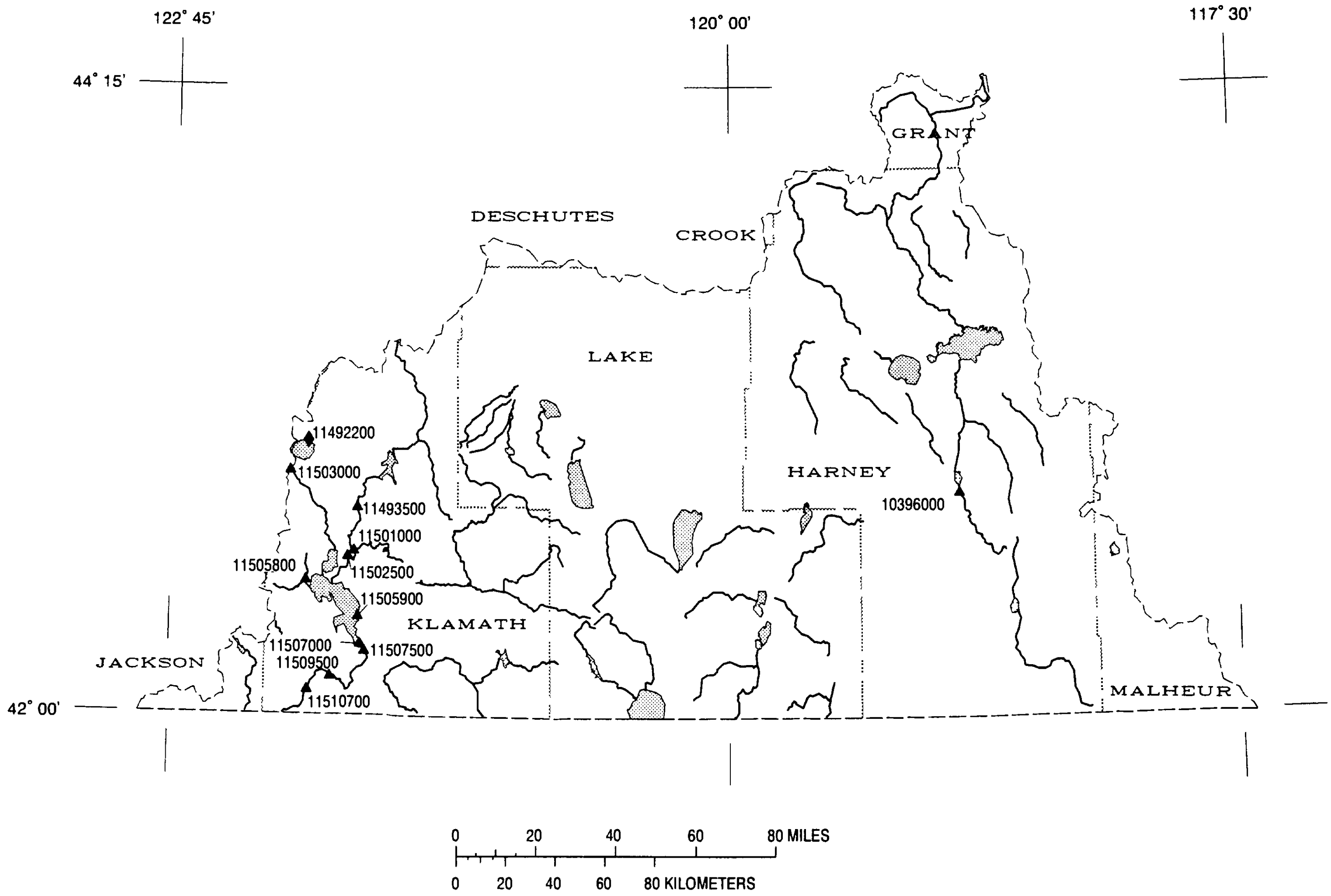
THE GREAT BASIN AND KLAMATH RIVER BASIN



EXPLANATION

10371500 ▲ **Stream-gaging station**

11492200 ◆ **Stream-gaging station and water-quality data collection site**

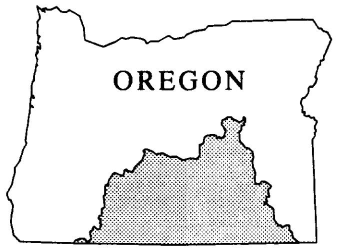


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year.

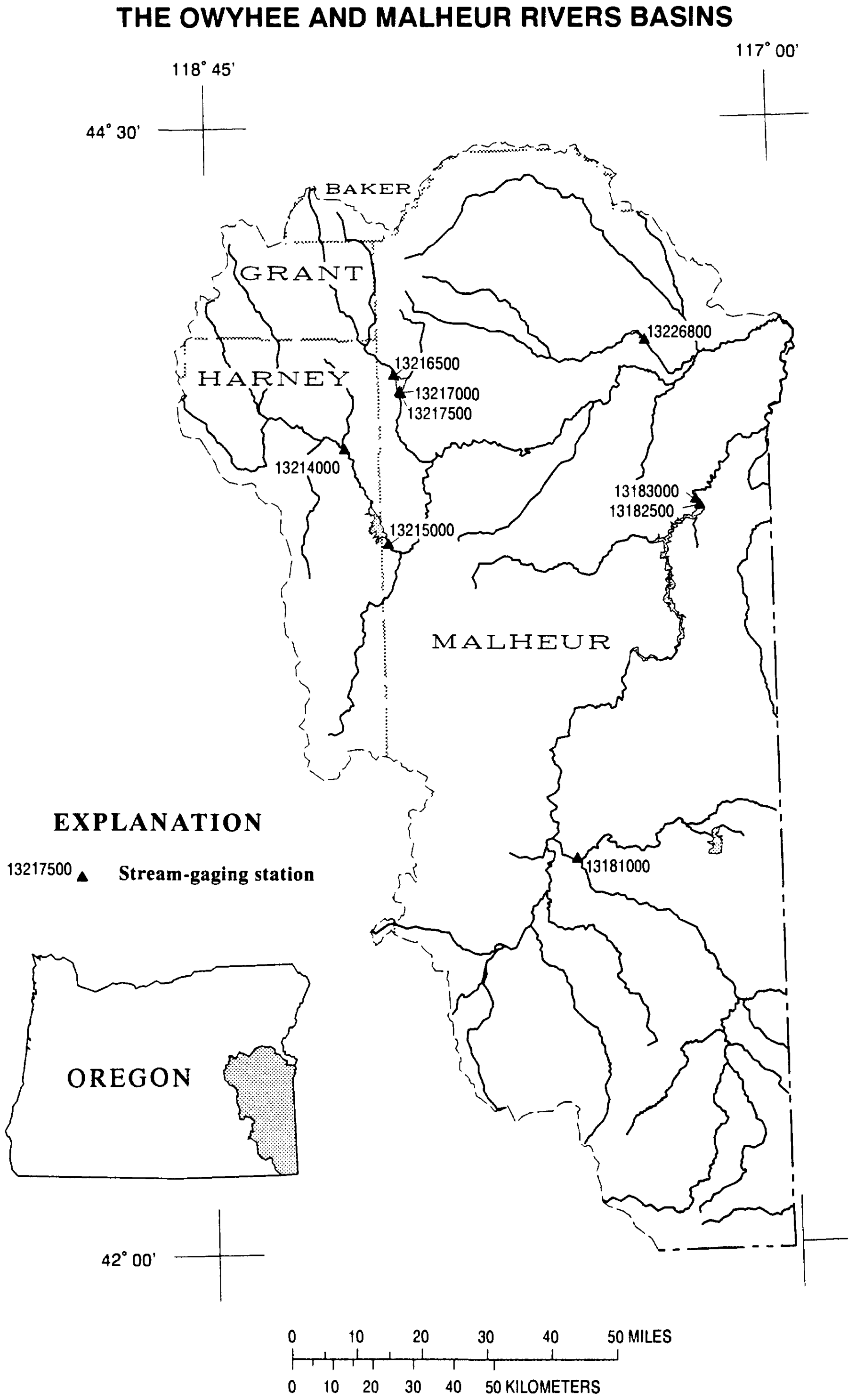


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE BURNT RIVER, POWDER RIVER, PINE CREEK, IMNAHA RIVER, AND GRANDE RONDE RIVER BASINS

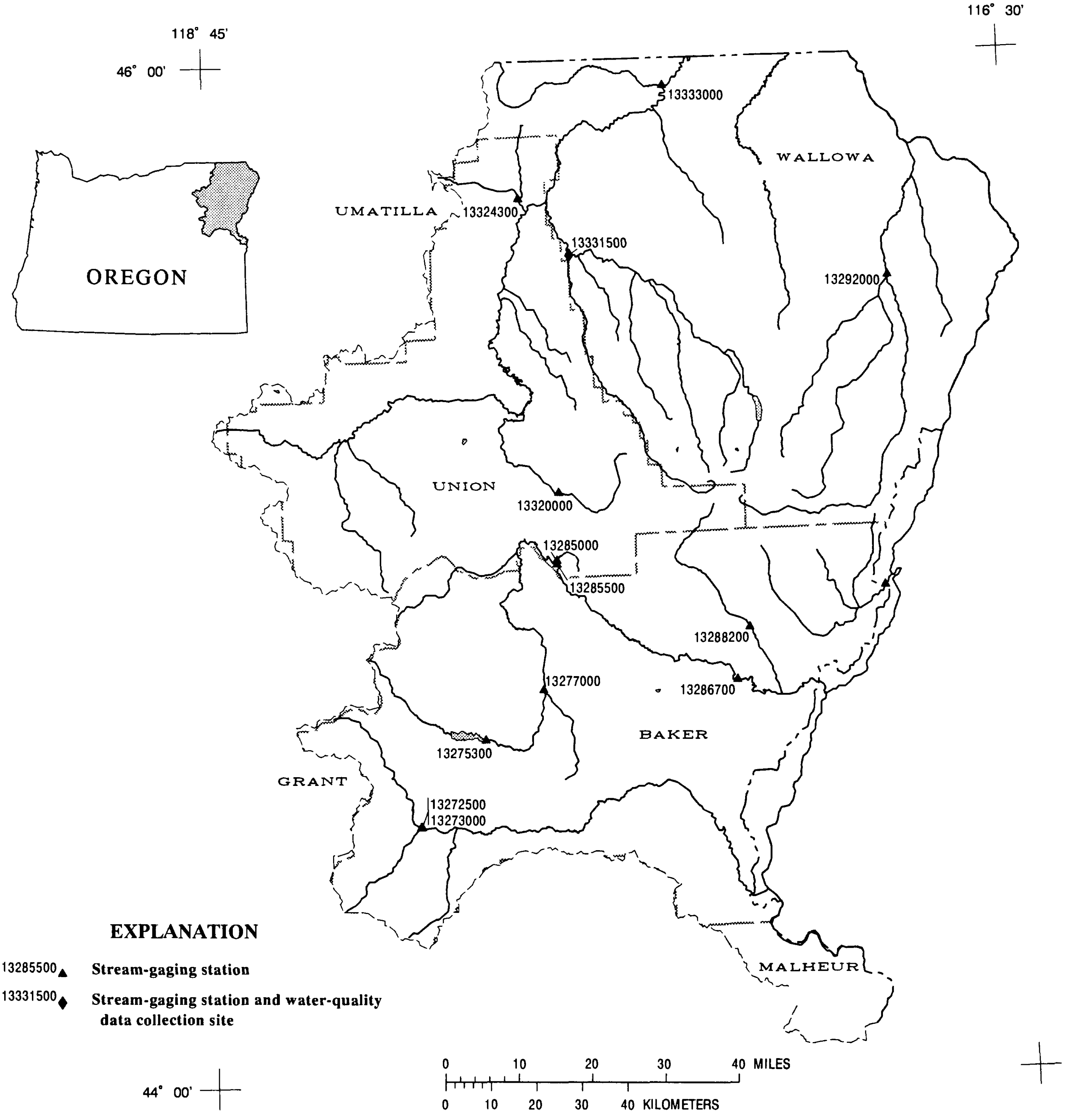


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE WALLA WALLA RIVER, UMATILLA RIVER, AND WILLOW CREEK BASINS

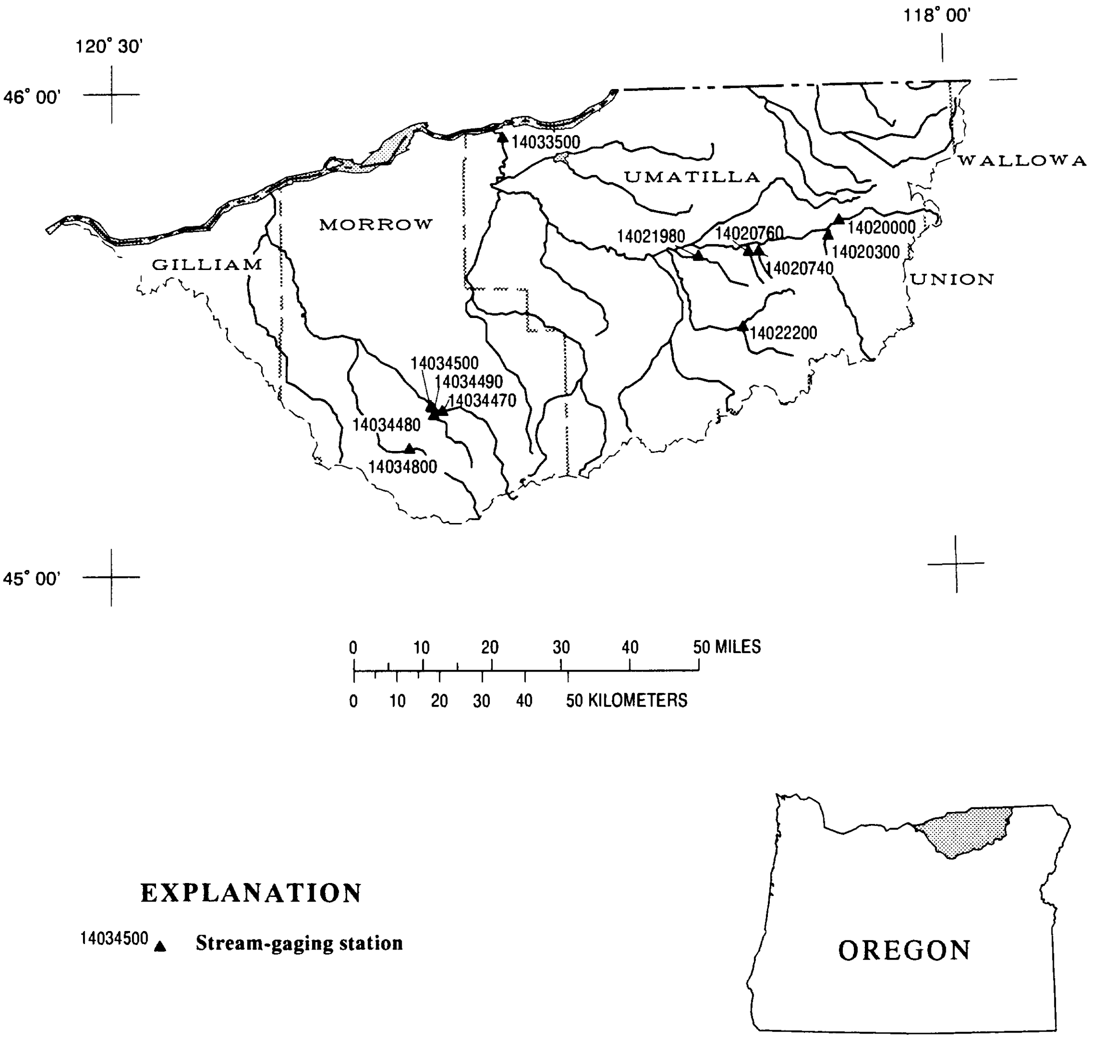
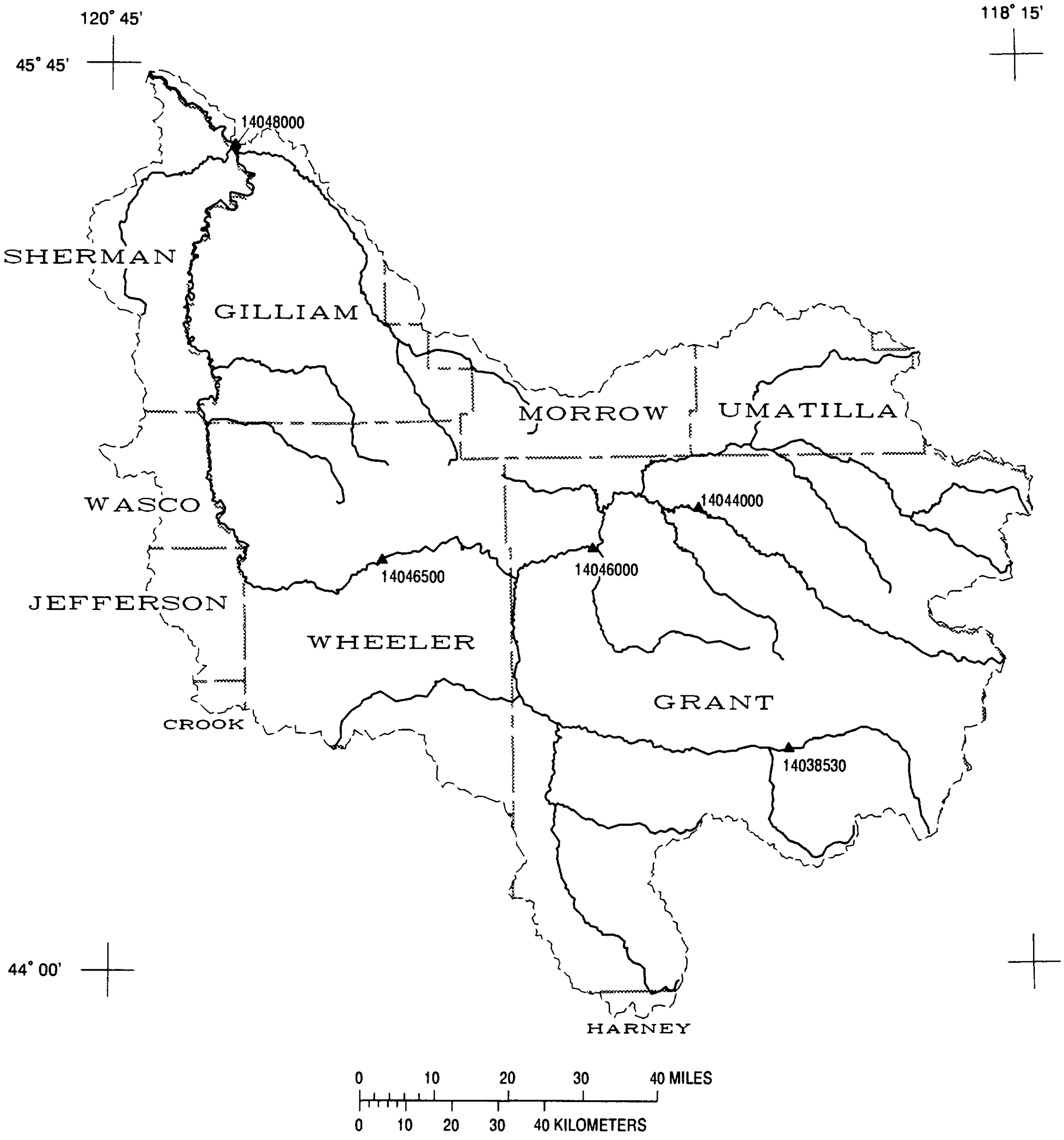


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE JOHN DAY RIVER BASIN



EXPLANATION

14046500 ▲ **Stream-gaging station**

14048000 ♦ **Stream-gaging station and water-quality data collection site**

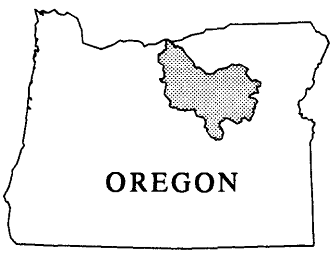


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

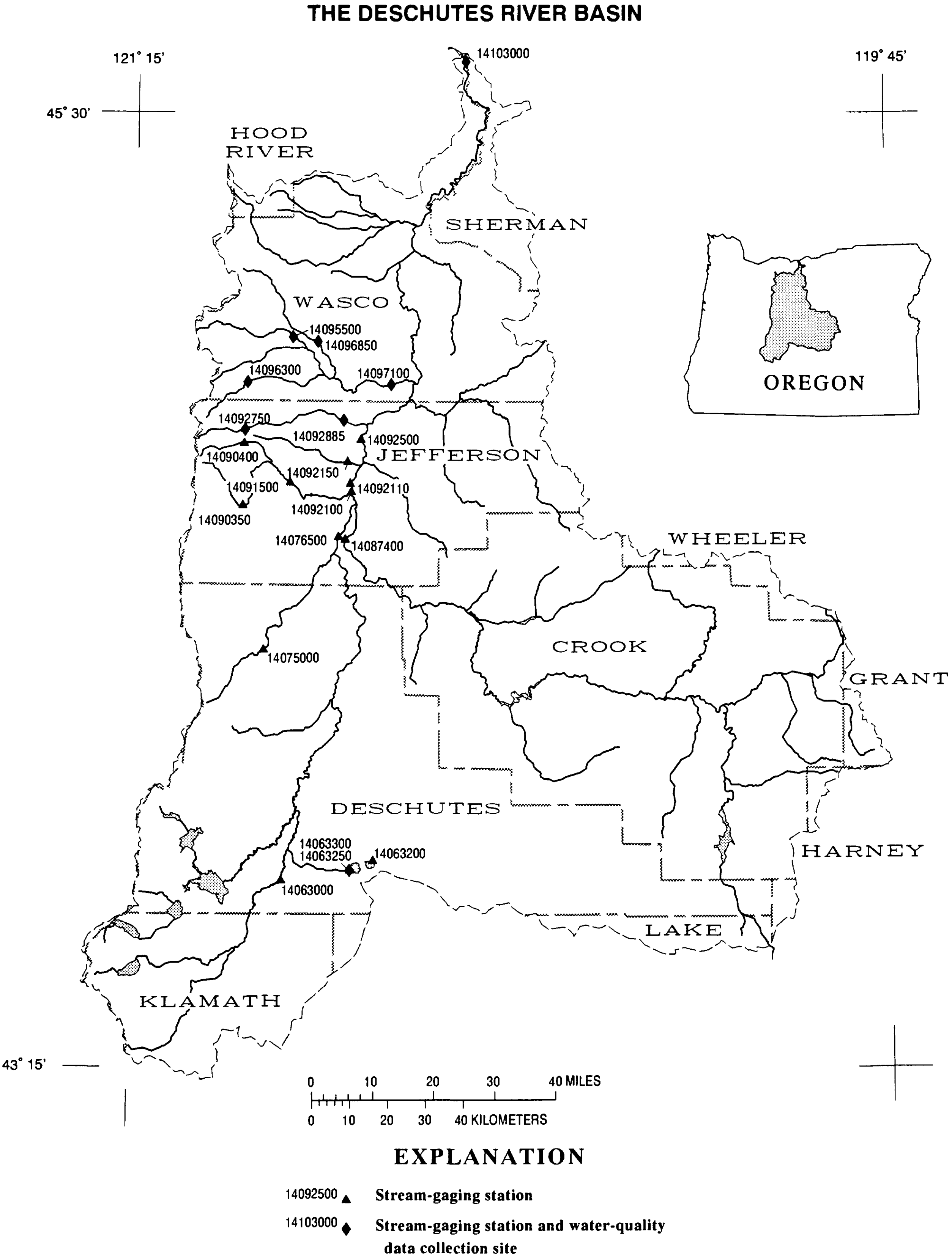


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE MIDDLE AND LOWER COLUMBIA RIVER AND HOOD RIVER BASINS

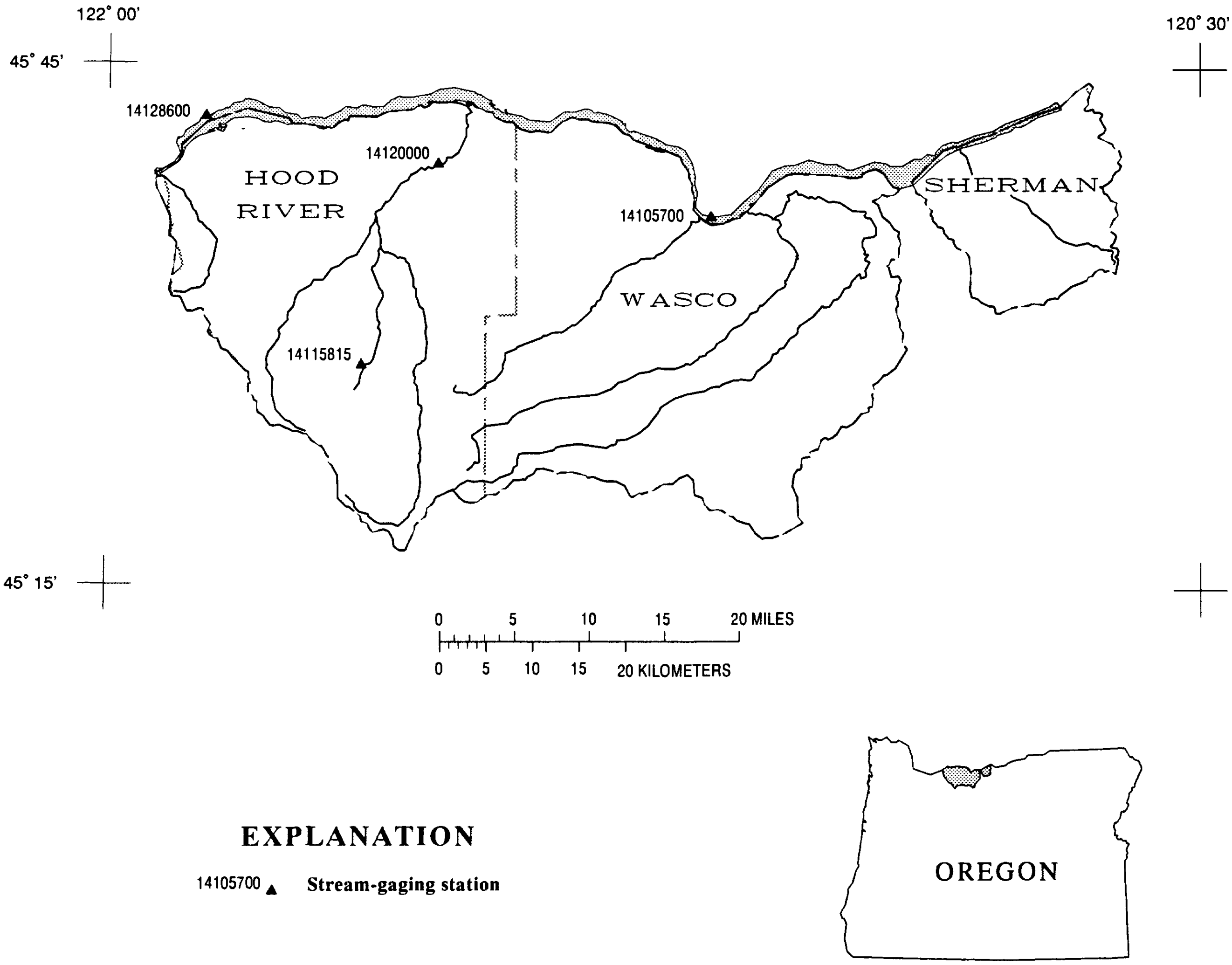
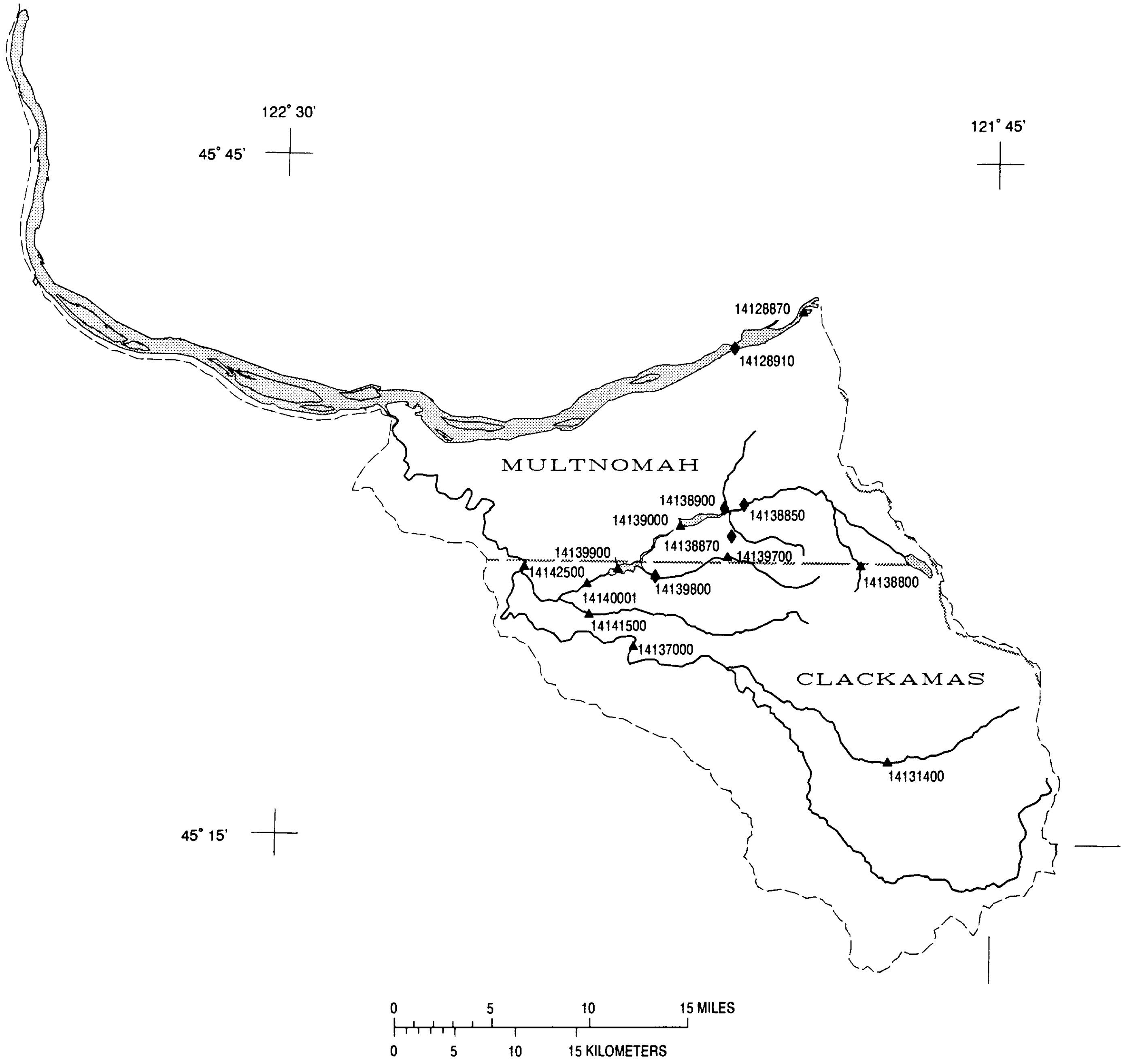


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE MIDDLE AND LOWER COLUMBIA RIVER AND SANDY RIVER BASINS



EXPLANATION

14137000 ▲ **Stream-gaging station**

14138870 ◆ **Stream-gaging station and water-quality data collection site**

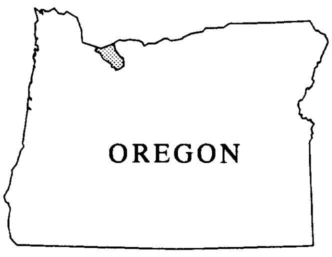


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE UPPER WILLAMETTE RIVER BASIN

EXPLANATION

14158795▲ Stream-gaging station

14151000◆ Stream-gaging station and water-quality data collection site

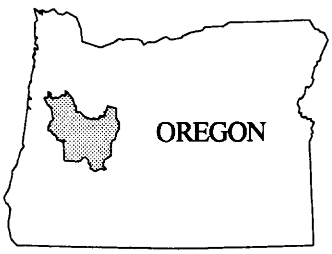


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE LOWER WILLAMETTE RIVER BASIN

EXPLANATION

14183000 ▲ Stream-gaging station

14187200 ♦ Stream-gaging station and water-quality data collection site

Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE NORTHERN OREGON COASTAL DRAINAGES BASINS

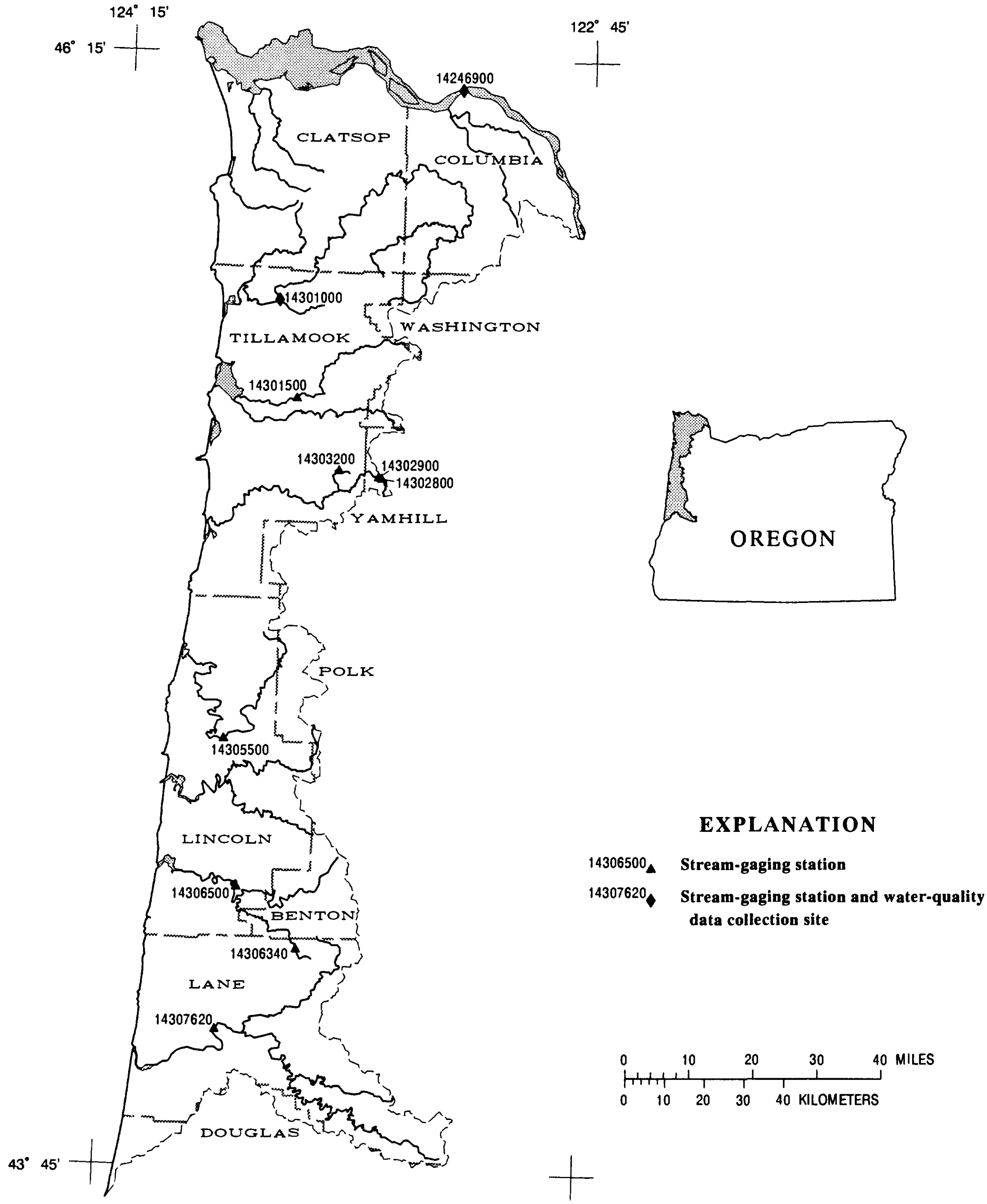
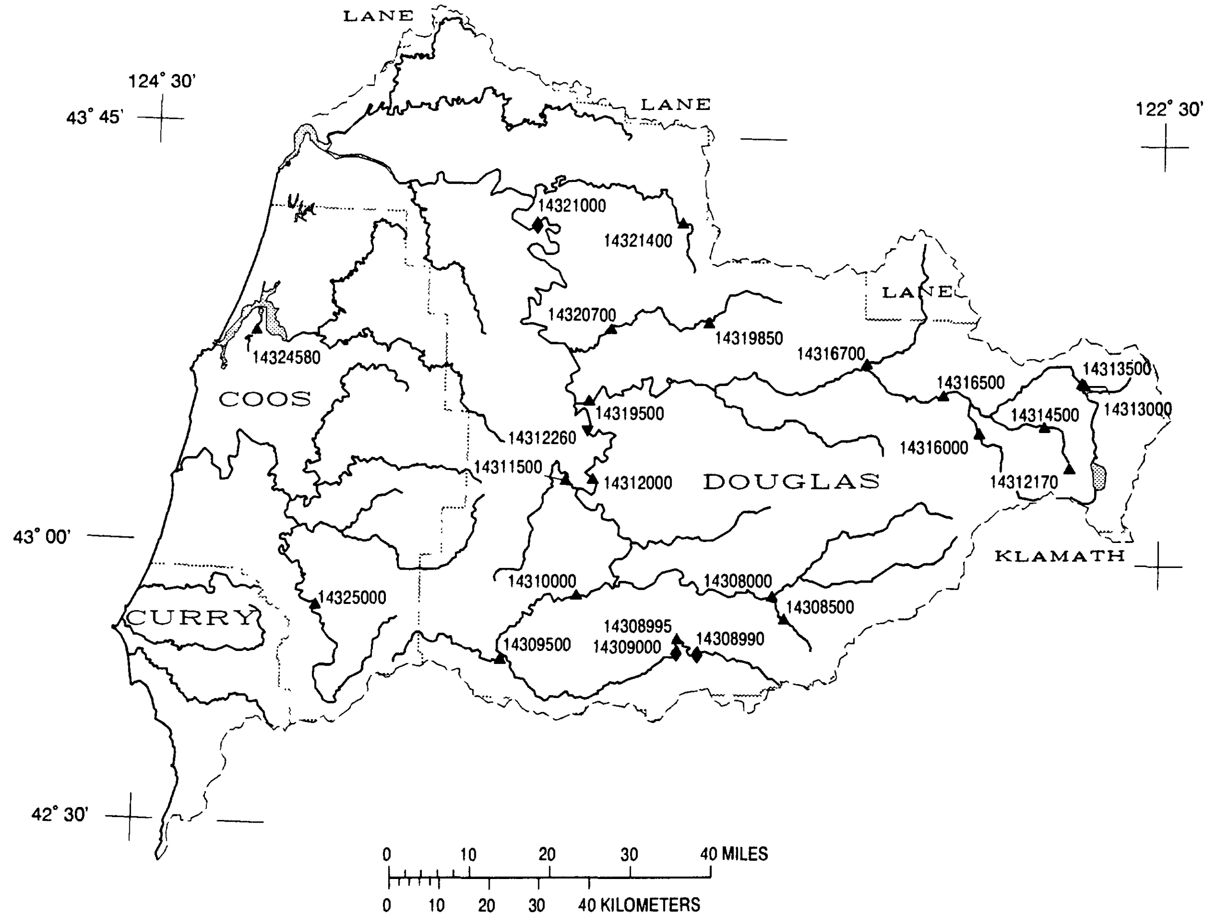


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE UMPQUA RIVER, COOS RIVER, AND COQUILLE RIVER BASINS



EXPLANATION

14321400 ▲ **Stream-gaging station**

14312260 ▼ **Water-quality data collection site**

14309000 ◆ **Stream-gaging station and water-quality data collection site**

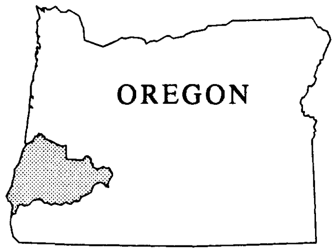
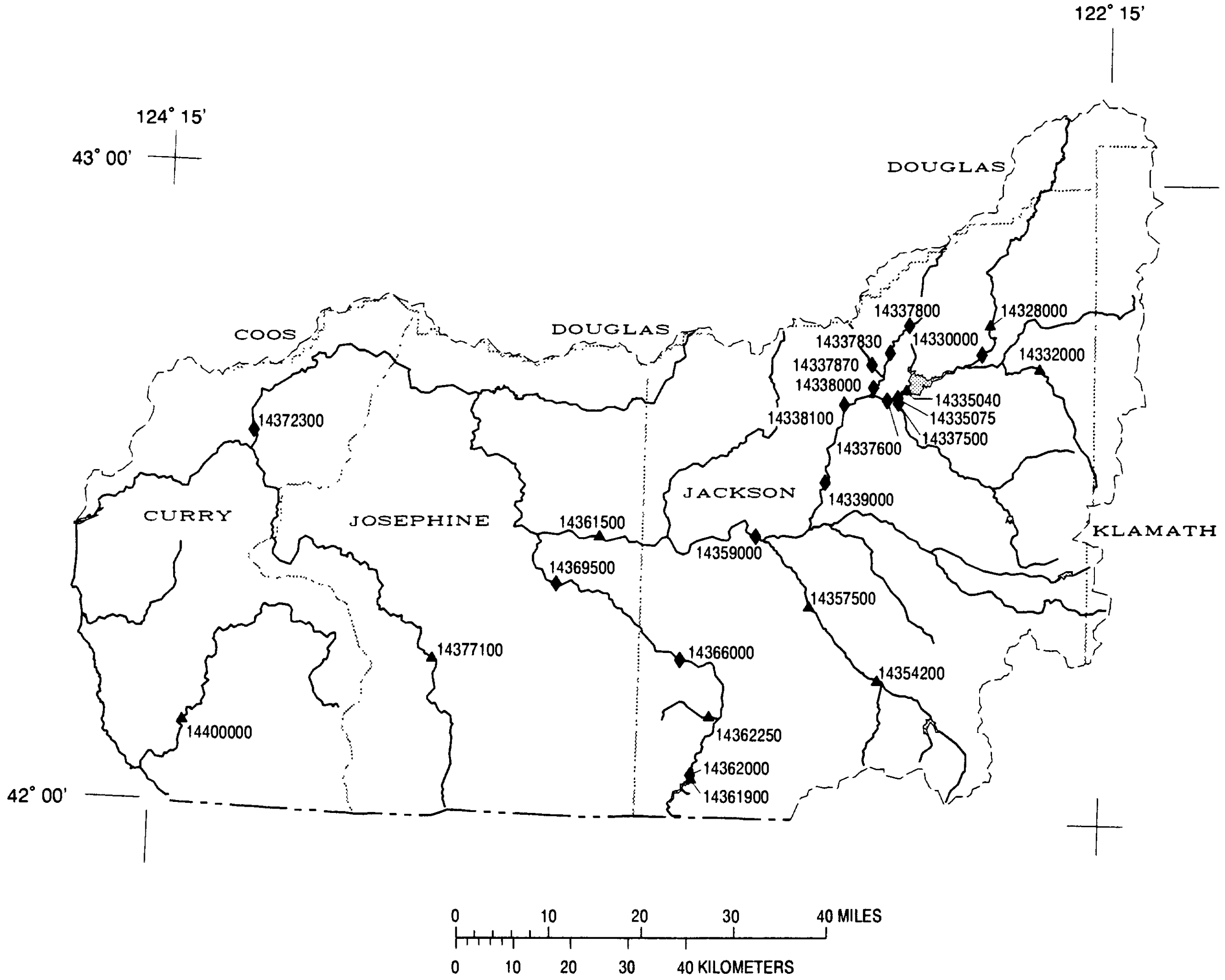


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

THE ROGUE RIVER AND CHETCO RIVER BASINS



EXPLANATION

14371500 ▲ **Stream-gaging station**

14339000 ♦ **Stream-gaging station and water-quality data collection site**

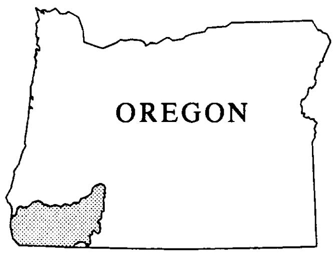


Figure 1. Location of water-resources data collection sites in Oregon, 1992 water year--continued.

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