UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATER-RESOURCES ACTIVITIES IN UTAH

BY THE U.S. GEOLOGICAL SURVEY,

JULY 1, 1986 TO JUNE 30, 1987

Compiled by Stefanie L. Dragos

Open-File Report 88-302

Salt Lake City, Utah
April 1988

DEPARTMENT OF THE INTERIOR

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INTRODUCTION

This report contains summaries of the progress of water-resources studies in Utah by the U.S. Geological Survey, Water Resources Division, Utah District, from July 1, 1986 to June 30, 1987. The program in Utah during this period consisted of 24 projects; a discussion of each project is given in the main body of the report. Short descriptions are given at the end of the report for six projects proposed to be started on or after July 1987.

The following sections outline the basic mission and program of the Water Resources Division, the organizational structure of the Utah District, the distribution of District funding in terms of source of funds and type of activity funded, and the agencies with which the District cooperates. The last part of the introduction is a list of reports produced by the District from July 1986 to June 1987.

Basic Mission and Program of the Water Resources Division, U.S. Geological Survey

The U.S. Geological Survey, through its Water Resources Division, investigates the occurrence, quantity, distribution, and movement of the surface and underground water that comprise the Nation's water resources, and coordinates Federal water-data acquisition activities.

The mission of the Division is accomplished through programs supported by the U.S. Geological Survey independent of, or in cooperation with, other Federal and non-Federal agencies. These programs involve:

1. Collecting, on a systematic basis, data needed for the continuing determination and evaluation of the quantity, quality, and use of the Nation's water resources.

2. Conducting analytical and interpretive water-resource appraisals of the occurrence, availability, and the physical, chemical, and biological characteristics of surface and ground water.

3. Conducting basic problem-oriented research in hydrology to improve the scientific basis for investigations and measurement techniques, and to predict quantitatively the response of hydrologic systems to stress.

4. Disseminating water data and the results of investigations and research through reports, maps, computerized information services, and other forms of public releases.

5. Coordinating the activities of Federal agencies in the acquisition of water data for streams, lakes, reservoirs, estuaries, and ground water.

6. Providing scientific and technical assistance in hydrologic fields to other Federal, State, and local agencies; to licensees of the Federal Power Commission; and to international agencies on behalf of the Department of State.

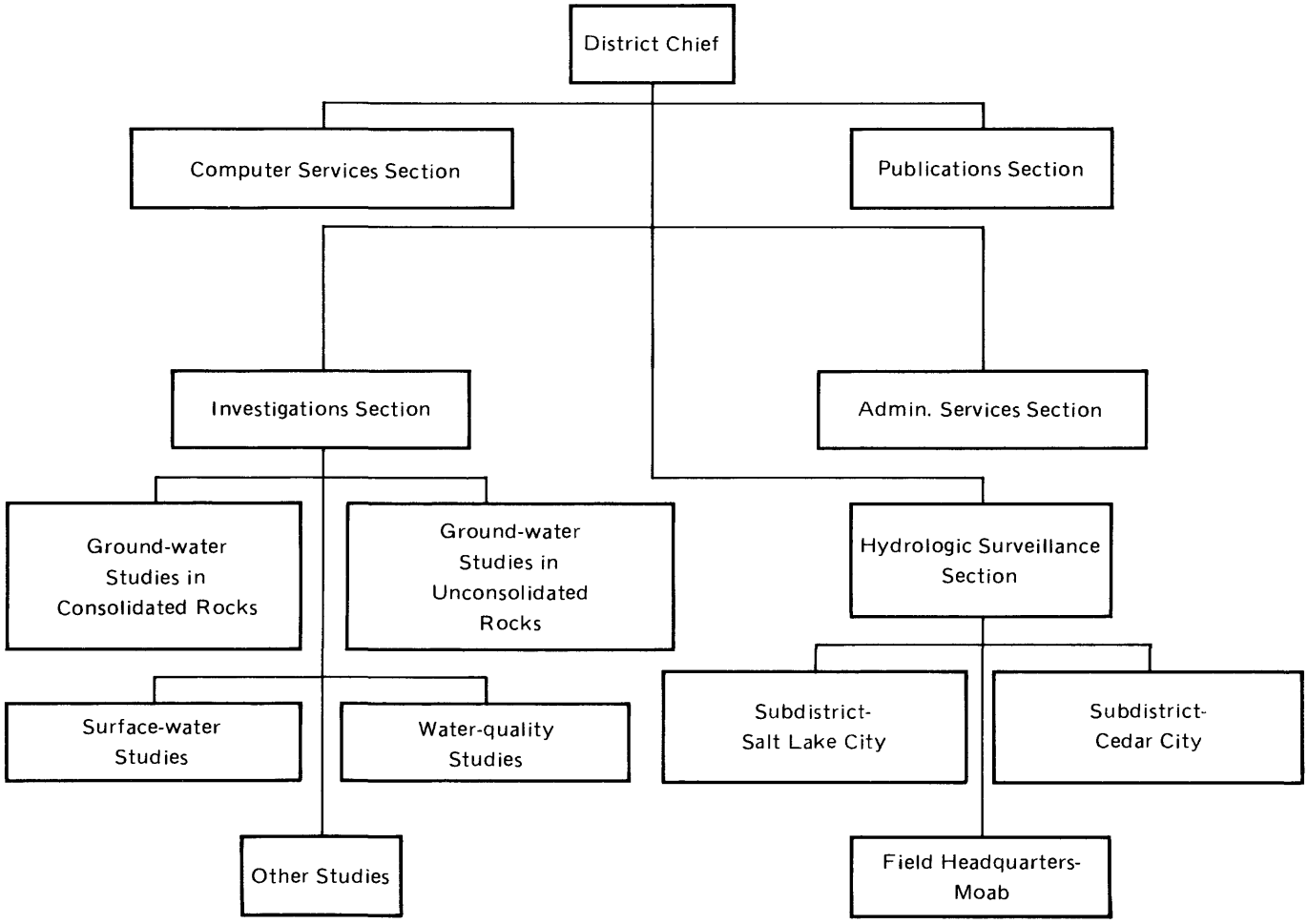
7. Administering the provisions of the Water Resources Research Act of 1984, which includes the State Water Resources Research Institute Program (Section 104) and the National Water Resources Research Grant Program (Section 105).

8. Acquiring information useful in predicting and delineating water-related natural hazards from flooding, volcanoes, mudflows, and land subsidence.

Utah District Organization

The Utah District of the Water Resources Division is organized into five operating sections under the District Chief (see organization chart). Water-resources projects are conducted by the Investigations Section (primarily interpretive studies) and Hydrologic-Surveillance Section (primarily collection of hydrologic data). Responsibility for each project is assigned to a project chief. Support for project work is supplied by the Publications Section, which processes and illustrates reports, and the Computer Services and Administrative Services Sections. The Utah District consists of the District Office in Salt Lake City, Subdistrict offices in Salt Lake City and Cedar City, and a Field Headquarters in Moab. The location of these offices and their areas of responsibility are shown in figure 1.

UTAH DISTRICT ORGANIZATION



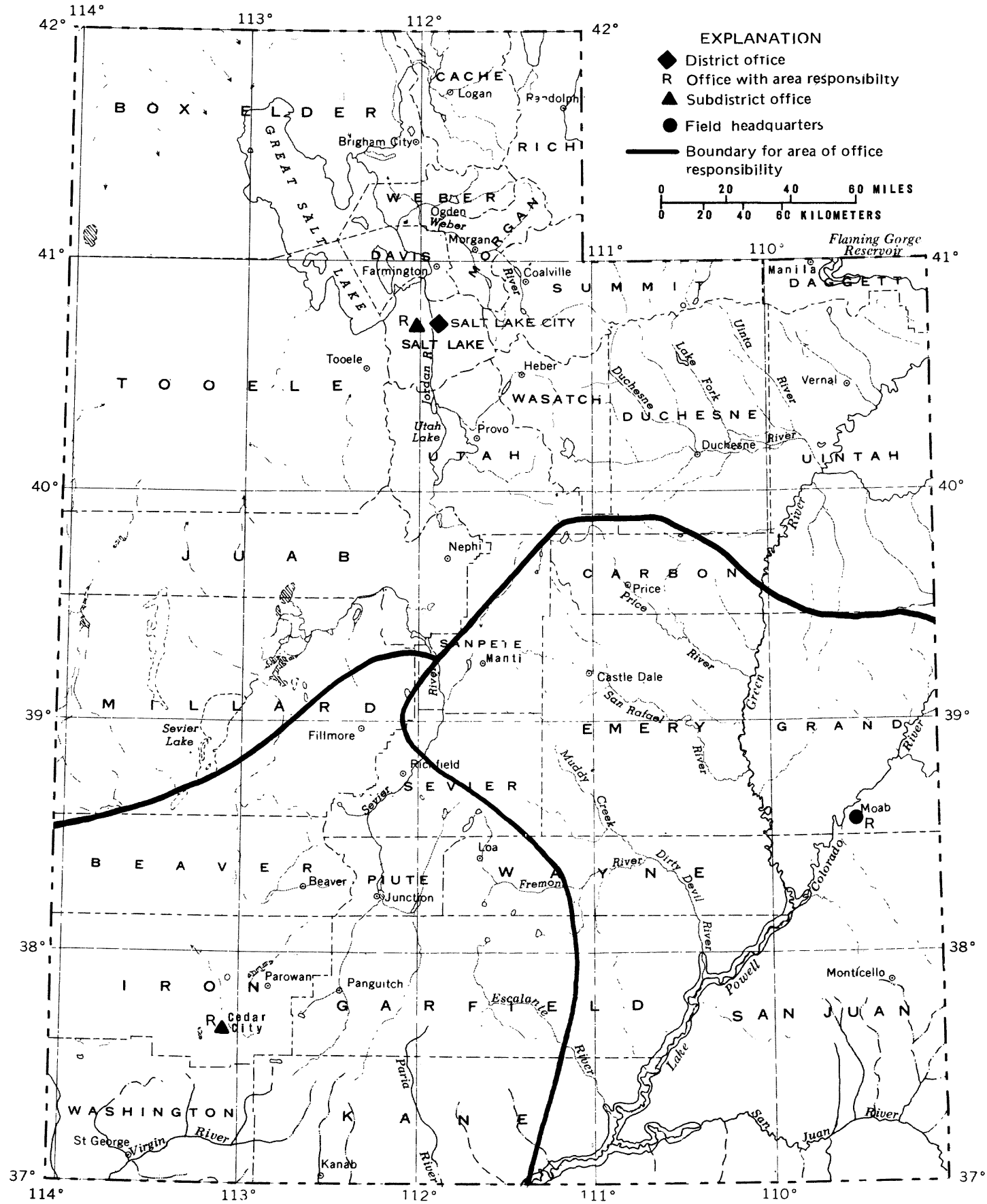
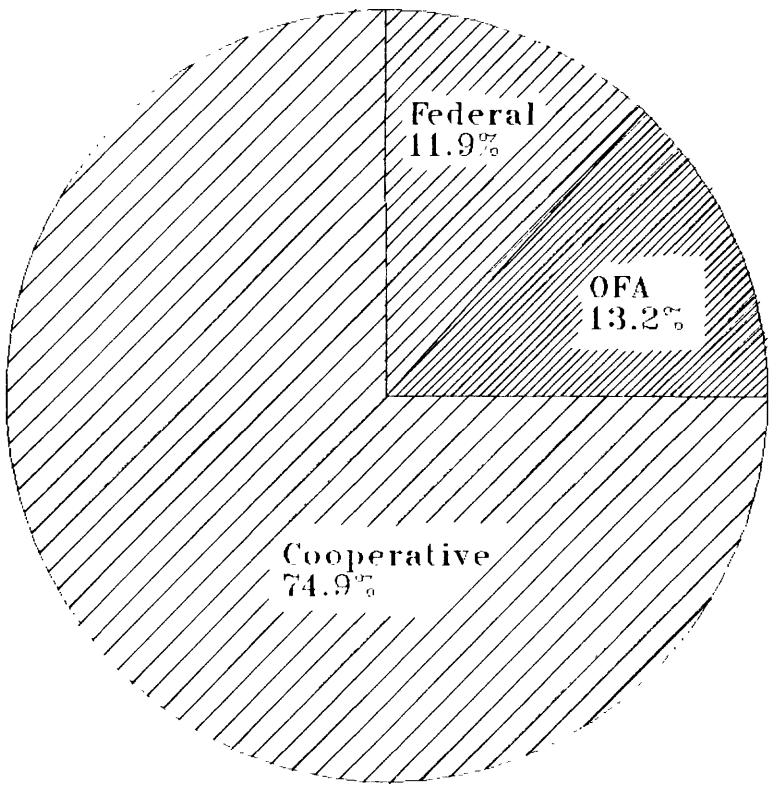


Figure 1.--Location of U.S. Geological Survey, Water Resources Division, offices and general areas of responsibility.

Program Funding and Cooperating Agencies

Funds to support water-resources work done by the Utah District are from three sources. Cooperative-Program funds and services are provided from State and local government agencies and are generally matched by Federal funds on a 50-50 basis. Funds transferred from other Federal agencies (OFA) are part of the OFA Program, and funds appropriated directly to the Geological Survey by the Congress are part of the Federal Program. In fiscal year 1987 the total financial support from these programs for the Utah District was about $3.08 million. The distribution of funds among the three sources is shown below:



In fiscal year 1987, the Utah District pursued two broad categories of studies: (1) hydrologic data collection, and (2) interpretive studies and areal appraisals. Approximately 50 percent of the program was for collection of hydrologic data and 50 percent for interpretive studies and appraisals. These studies provide water managers and planners with information about the availability and quality of Utah's water resources.

From July 1, 1986 to June 30, 1987, the State and local cooperators for District projects were:

Utah Department of Natural Resources
- Division of Water Rights
- Division of Water Resources
- Division of Wildlife Resources
- Division of Oil, Gas, and Mining
- Geological and Mineral Survey

Utah Department of Transportation
Utah Department of Health, Division of Environmental Health
Bear River Commission
Salt Lake County Division of Flood Control and Water Quality
Central Utah Water Conservancy District
Weber Basin Water Conservancy District
Lower Gunlock Reservoir Corporation

The Federal cooperators were:

Bureau of Land Management
Bureau of Reclamation
Department of the Army
Soil Conservation Service
Office of the Secretary of the U.S. Department of the Interior
Federal Power Commission (Utah Power and Light)

Reports Released or Published

Reports prepared by or in cooperation with the Utah District can be obtained at the following locations:

Utah District Office: Open-File Reports; Water-Resources Investigations Reports; Hydrologic-Data Reports; Water-Data Reports; and Utah Department of Natural Resources Technical Publications, Cooperative-Investigations Reports, and Water Circulars.

U.S. Geological Survey Public Inquiries Office (125 South State Street, Salt Lake City): U.S. Geological Survey Water-Supply Papers, Professional Papers, and Hydrologic Investigations Atlases.

Utah Department of Natural Resources, Division of Water Rights: Technical Publications, Water Circulars, Hydrologic-Data Reports, Water-Use Reports.

Utah Department of Natural Resources, Division of Water Resources: Cooperative Investigations Reports.

The following report was released to the Open File:

Howells, Lewis, Longson, M. S., and Hunt, G. L., (in press), The base of moderately saline water in the Uinta basin, Utah, and methods used in determining its position: U.S. Geological Survey Open-File Report 87-394.

The following reports were published:

Avery, Charles, 1986, Bedrock aquifers of eastern San Juan County, Utah: Utah Department of Natural Resources Technical Publication No. 86.

Blanchard, P. J., 1987, Ground-water conditions in the Kaiparowits Plateau area, Utah and Arizona, with emphasis on the Navajo Sandstone: Utah Department of Natural Resources Technical Publication No. 81.

Blanchard, P. J., 1987, Ground-water conditions in the northern Lake Powell area, Utah: Utah Department of Natural Resources Technical Publication No. 84.

Christensen, R. C., Johnson, E. B., and Plantz, G. G., 1986, Manual for estimating streamflow characteristics of natural-flow streams, Colorado River Basin in Utah: U.S. Geological Survey Water-Resources Investigations Report 85-4297.

Dragos, S. L., and Conroy, L. S., 1987, Bibliography of U.S. Geological Survey water-resources reports for Utah: Utah Department of Natural Resources Information Bulletin No. 28.

Gates, J. S., and Dragos, S. L., 1987, Water-resources activities in Utah by the U.S. Geological Survey, July 1, 1985, to June 30, 1986: U.S. Geological Survey Open-File Report 86-533.

Herbert, L. R., Cruff, R. W., Clark, D. W., and Avery, Charles, 1987, Seepage studies of the Weber River and the Davis-Weber and Ogden Valley Canals, Davis and Weber Counties, Utah, 1985: Utah Department of Natural Resources Technical Publication No. 90.

Holmes, W. F., Thompson, K. R., and Enright, Michael, 1986, Water resources of the Park City area, Utah, with emphasis on ground water: Utah Department of Natural Resources Technical Publication No. 85.

McCormack, H. F., Lindskov, K. L., and Stolp, B. J., 1986, Hydrologic maps of the Price 30 X 60 minute quadrangle, Utah: U.S. Geological Survey Water-Resources Investigations Report 84-4227.

Price, Don, and Arnow, Ted, 1987, Program for monitoring the chemical quality of ground water in Utah--summary of data collected through 1984: Utah Department of Natural Resources Technical Publication No. 88.

ReMillard, M. D., and others, 1986, Water resources data for Utah, water-year 1985: U.S. Geological Survey Water-Data Report UT-85-1.

Seiler, R. L., 1986, Selected hydrologic data for Salt Lake Valley, Utah, October 1968 to October 1985: U.S. Geological Survey Open-File Report 86-249.

Thomas, B. E., 1986, Simulation analysis of water-level changes in the Navajo sandstone due to changes in the altitude of Lake Powell near Wahweap Bay, Utah and Arizona: U.S. Geological Survey Water-Resources Investigations Report 85-4207.

Waddell, K. M., Seiler, R. L., Santini, M., and Solomon, D. K., 1987, Ground-water conditions in Salt Lake Valley, Utah, 1969-83, and predicted effects of increased withdrawals from wells: Utah Department of Natural Resources Technical Publication No. 87.

Wilberg, D. E., and Stolp, B. J., 1986, Physical characteristics and chemical quality of selected springs in Juab, Millard, Tooele, and Utah Counties, Utah: U.S. Geological Survey Water-Resources Investigations Report 85-4324.

Wilberg, D. E., and others, 1987, Ground-water conditions in Utah, Spring of 1987: Utah Division of Water Resources Cooperative Investigations Report No. 27.

Several reports on past projects are not yet released or published but are being completed. The status of these reports, listed by project number, is as follows:

UT-113

Holmes, W. F., and Kimball, B. A., (in press), Ground water in the southeastern Uinta Basin, Utah and Colorado: U.S. Geological Survey Water-Supply Paper 2248.

UT-129

Price, Don, and Plantz, G. G., (in press), Hydrologic monitoring in the coal fields of central and southern Utah--Summary of data collected during August 1978-September 1984: U.S. Geological Survey Water-Resources, Investigations Report 86-4017.

UT-147

Mason, J. L., Simulated alternatives for ground-water withdrawal and their possible effects on the basin-fill aquifer in the Milford area, southwestern Utah, U.S. Geological Survey, written commun, 1987.

UT-151

Price, Don, and others, (in press), Hydrology of Area 57, Northern Great Plains and Rocky Mountain Coal Provinces, Utah and Arizona: U.S. Geological Survey Water-Resources Investigations Report 84-068.

UT-160

Stephens, D. W., Thompson, K. R., and Wangsgard, J. B., Hydrology and effects of coal mining on water quality of Scofield Reservoir and hydrology of streams in the Pleasant Valley area, central Utah, water years 1983-84, U.S. Geological Survey, written commun., 1987.

UT-161
Christensen, R. C., Johnson, E. B., and Plantz, G. G., (in press), Streamflow characteristics of the Colorado River Basin in Utah through September 1981: U.S. Geological Survey Open-File Report 85-421 and Utah Hydrologic-Data Report No. 42.

UT-162
Clark, D. W., Appel, C. L., Lambert, P. M., and Puryear, R. L., Ground-water resources and simulated effects of withdrawals in the East Shore area of the Great Salt Lake, Utah, U.S. Geological Survey, written commun., 1987.

Lambert, P. M., Continuous seismic-reflection survey of the Great Salt Lake, Utah, east of Antelope and Fremont Islands, U.S. Geological Survey, written commun., 1987.

Clark, D. W., The ground-water system and simulated effects of ground-water withdrawals in the Bountiful area, Davis County, Utah, U.S. Geological Survey, written commun., 1987.

UT-169
Price, Don, Ellis, S. R., and Wilson, J. F., Jr., Water for an oil-shale industry—Summary results of the U.S. Geological Survey's hydrologic-study program for the major oil-shale areas of Colorado, Utah, and Wyoming, U.S. Geological Survey, written commun., 1987.

UT-174
Arnow, Ted, and Stephens, D. W., (in press), The Great Salt Lake, Utah: 1847-1986: U.S. Geological Survey Water-Supply Paper.

Stephens, D. W., and Arnow, Ted, (in press), Fluctuations of water level, water quality, and biota of Great Salt Lake, Utah, 1847-1986: Utah Geological Association Guidebook.

CURRENT PROJECTS

COLLECTION OF HYDROLOGIC DATA

SURFACE-WATER DATA, INCLUDING CANAL-LOSS STUDIES

Number: UT-00-001

Cooperating Agencies: U.S. Bureau of Reclamation; U.S. Bureau of Land Management; U.S. Soil Conservation Service; U.S. Department of the Army; Federal Power Commission; Utah Division of Water Rights; Utah Division of Water Resources; Utah Division of Wildlife Resources; Utah Geological and Mineral Survey; Bear River Commission; Central Utah Water Conservancy District; Weber Basin Conservancy District; Lower Gunlock Reservoir Corporation; Salt Lake County Division of Flood Control and Water Quality.

Staff: L. R. Herbert, Hydrologic Technician, Project Chief (part time)
Other District personnel as assigned

Period of Project: Continuing

Objective: To obtain data on stream discharge, reservoir contents, and lake stage at selected sites throughout Utah (fig. 2).

Approach: Standard methods for the operation and maintenance of streamflow-gaging stations and for the computation, computer storage, and publication of the data were used.

Progress: Data collection and computation necessary for the publication of discharge records for 209 streamflow-gaging stations and contents and stage records for 19 reservoir and 2 Great Salt Lake stations continued during the year. Figure 2 shows the locations of the stations and station numbers. Data collected at these stations, as well as larger-scale maps showing station locations, are given in the series of reports "Water resources data for Utah", U.S. Geological Survey Water-Data Reports. In addition, monthly flow measurements were made of water through the breach in the causeway across Great Salt Lake. The stations are classified as follows:

Discharge	
Current use	143
Hydrologic data for planning and design	54
Benchmark for long-term trends	12
Contents of reservoirs	19
Stage of Great Salt Lake	2

Due to funding constraints, 32 gaging stations were discontinued. These stations are:

Cottonwood Wash at I-70, near Cisco
Blacks Fork near Robertson, Wyoming
West Fork Avintaquin Creek near Fruitland

Sowers Creek near Duchesne
White River at mouth, near Ouray
Mud Creek below Winter Quarters Canyon, at Scofield
Price River below Miller Creek, near Wellington
Desert Seep Wash near Wellington
Floy Wash near Green River
Ferron Creek below Paradise Ranch, near Clawson
San Rafael River near Castle Dale
San Rafael River at San Rafael Bridge Campground, near Castle Dale
Muddy Creek below Interstate Highway I-70, near Emery
Muddy Creek at Delta Mine, near Hanksville
East Fork Bear River near Evanston, Wyoming
West Fork Bear River at Whitney Dam
West Fork Bear River below Deer Creek, near Evanston, Wyoming
Chapman Canal at State line, near Evanston, Wyoming
Woodruff Creek below Reservoir, near Woodruff
Bloomington Creek at Bloomington, Idaho
Eightmile Creek near Soda Springs, Idaho
Soda Creek at Fivemile Meadows, near Soda Springs, Idaho
Cottonwood Creek at Cleveland, Idaho
Bear River near Preston, Idaho
Cub River near Preston, Idaho
East Fork Little Bear River above reservoir, near Avon
Little Bear River near Paradise
Sulpher Creek near Corinne
Salt Spring near Tremonton
Salt Creek below Salt Spring, near Tremonton
Black Slough near Brigham City
Bear River Basin outflow across State Highway 83, near Corinne
Jordan River at 500 North, at Salt Lake City
Oak Creek below Big Spring, near Oak City

Gaging stations established were:

Deep Creek near Cedar City
East fork Deep Creek near Cedar City

Canal-loss studies: A reconnaissance of the Southbend and Richfield canals, and a section of the Vermillion canal was completed to obtain information needed for planning loss-gain studies. Flow measurements were started in May and finished in August. The report of the seepage study of canals in Davis and Weber Counties was completed (Herbert and others, 1987). A report quantifying canal losses along a section of the Central Utah Canal near Fillmore, Millard County, was completed and is in review.

Flood report: Work on the report of floods in the Great Basin during 1983 and 1984 continues; completion is expected in the spring of 1988.

Boulevard Ridge watershed study: Processed all tapes of precipitation and stage for the two reservoir sites and entered the data into a computer file. Computed reservoir cross-sections and capacity tables.

Plans for Next Year: Continue operation of network. Prepare 1987 water-year records for publication. Complete flood report for the Great Basin. Analyze data from the seepage measurements on the canals in the central Sevier River valley and prepare the report. Complete processing of all data for the Boulevard Ridge watershed. Analyze and furnish hydrographs of precipitation and reservoir stage, contents, and inflow to the U.S. Bureau of Land Management.

Reports:

Herbert, L. R., Cruff, R. W., Clark, D. W., and Avery, Charles, 1987, Seepage study of the Weber River and the Davis-Weber and Ogden Valley Canals, Davis and Weber Counties, Utah: Utah Department of Natural Resources Technical Publication 90.

Enright, Michael, Seepage study of a 15.3-mile section of the Central Utah Canal, Pahvant Valley, Millard County, Utah, U.S. Geological Survey, written commun., 1987.

ReMillard, M. D., and others, 1986, Water resources data for Utah, water year 1985: U.S. Geological Survey Water-Data Report UT-85-1.

ReMillard, M. D., and others, (in press), Water resources data for Utah, water year 1986: U.S. Geological Survey Water-Data Report UT-86-1.

"Streamflow and reservoir contents in Upper Colorado River Basin" is issued monthly.

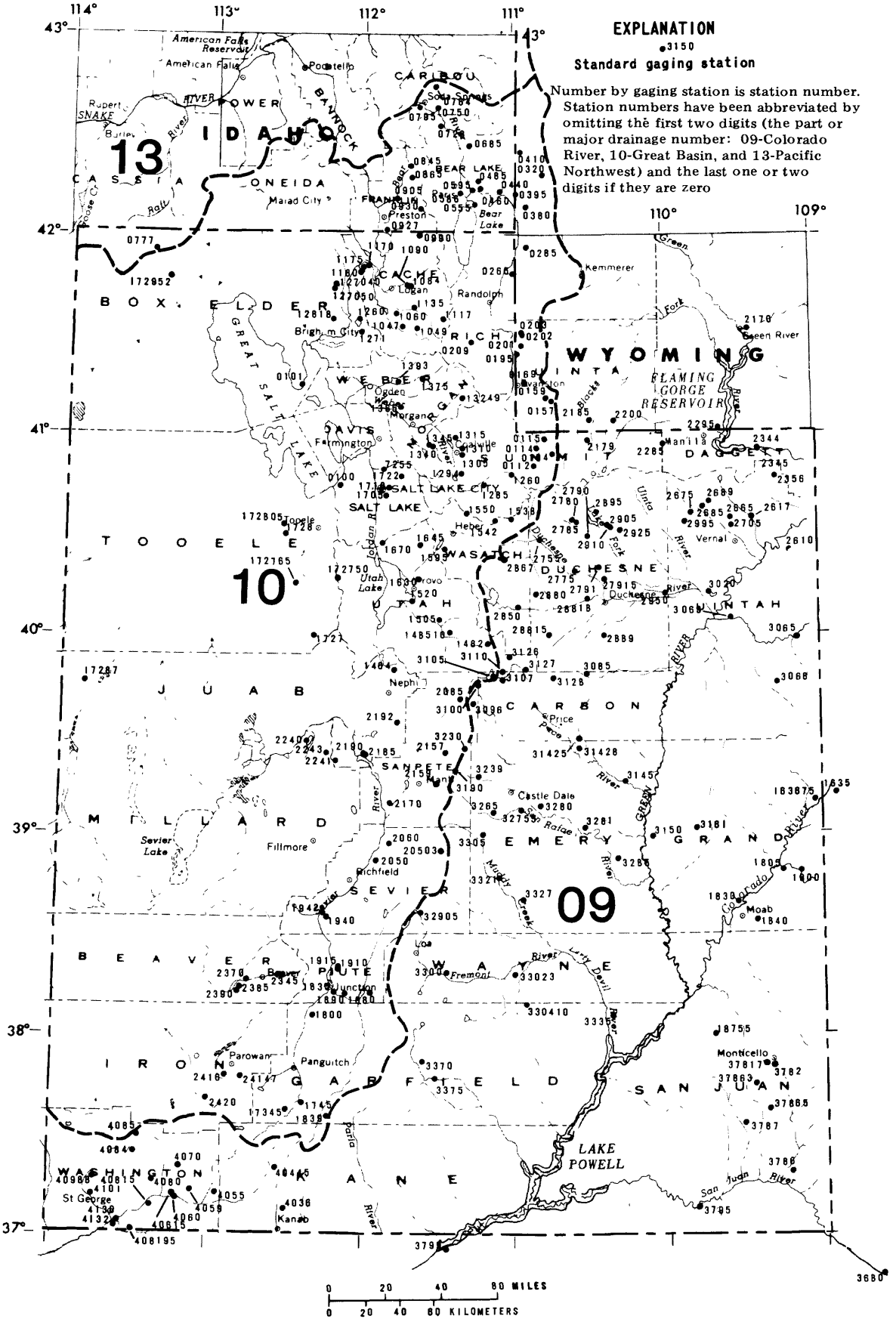


Figure 2.—Location of gaging stations, September 1986.

GROUND-WATER DATA AND GROUND-WATER CONDITIONS IN UTAH

Number: UT-00-002

Cooperating Agencies: Utah Division of Water Rights;
Utah Division of Water Resources;
Utah Department of Transportation

Staff: L. R. Herbert, Hydrologic Technician, Project Chief (part time)
G. J. Smith, Hydrologic Technician (part time)
D. E. Wilberg, Hydrologist, Editor of annual ground-water conditions report (part time)
Other District personnel as assigned

Period of Project: Continuing

Objectives: To obtain long-term records of ground-water levels, to determine water-level changes for yearly or other periods, and to determine withdrawals from and status of development of aquifers in the State. To make an annual evaluation of ground-water conditions in Utah.

Approach: Measure water levels annually or semiannually (normally February-March and September) and operate continuous water-level recorders on selected wells. Visit selected pumped irrigation wells, measure discharge, determine the ratio of water produced to energy consumed, and use the ratio along with energy-consumption data to compute total pumpage. Visit selected flowing wells and measure discharge. Obtain estimates of ground water withdrawn from wells for public supply and industrial use from the Utah Division of Water Rights. Obtain additional selected estimates of industrial use of water from wells by interviewing users, or by rating pumps and using the ratio of water produced to energy consumed with energy-consumption records. Determine the number and diameters of new wells drilled annually from well drillers' reports to the Division of Water Rights. Prepare an annual report on ground-water conditions in Utah which includes data, graphs, and maps showing water-level changes; withdrawals from wells; number of wells drilled in defined ground-water basins or areas; and a discussion of ground-water conditions in each basin or area. Store water-level data in computer files and publish selected data in the annual report of water-resources data for Utah.

Progress: Water levels were measured in about 1,100 wells in February and March; 600 of these wells also were measured in September. Continuous water-level recorders were maintained on 33 wells. Locations of the water-level observation wells are shown in figure 3. During the irrigation season, about 500 pumped irrigation wells were visited; discharge was measured at about one-half of the wells, and the ratio of water production to energy consumption was determined. Natural flow was measured for about 50 wells during the irrigation season. Number and diameters of new wells drilled were determined. The twenty-fourth in the series of annual reports on ground-water conditions in Utah was completed.

Plans for Next Year: Collecting, recording, and publishing data on water levels, ground-water withdrawals, and wells drilled will continue. The twenty-fifth in the series of annual ground-water reports will be compiled.

Reports:

ReMillard, M. D., and others, 1986, Water resources data for Utah, water year 1985: U.S. Geological Survey Water-Data Report UT-85-1.

ReMillard, M. D., and others, (in press), Water resources data for Utah, water year 1986: U.S. Geological Survey Water-Data Report UT-86-1.

Water-level-change maps, for the period February or March 1986-February or March 1987, of 15 areas in Utah--Issued April 1 as local press releases and distributed to agencies and interested individuals.

Wilberg, D. E., and others, 1987, Ground-water conditions in Utah, spring of 1987: Utah Division of Water Resources Cooperative-Investigations Report 27.

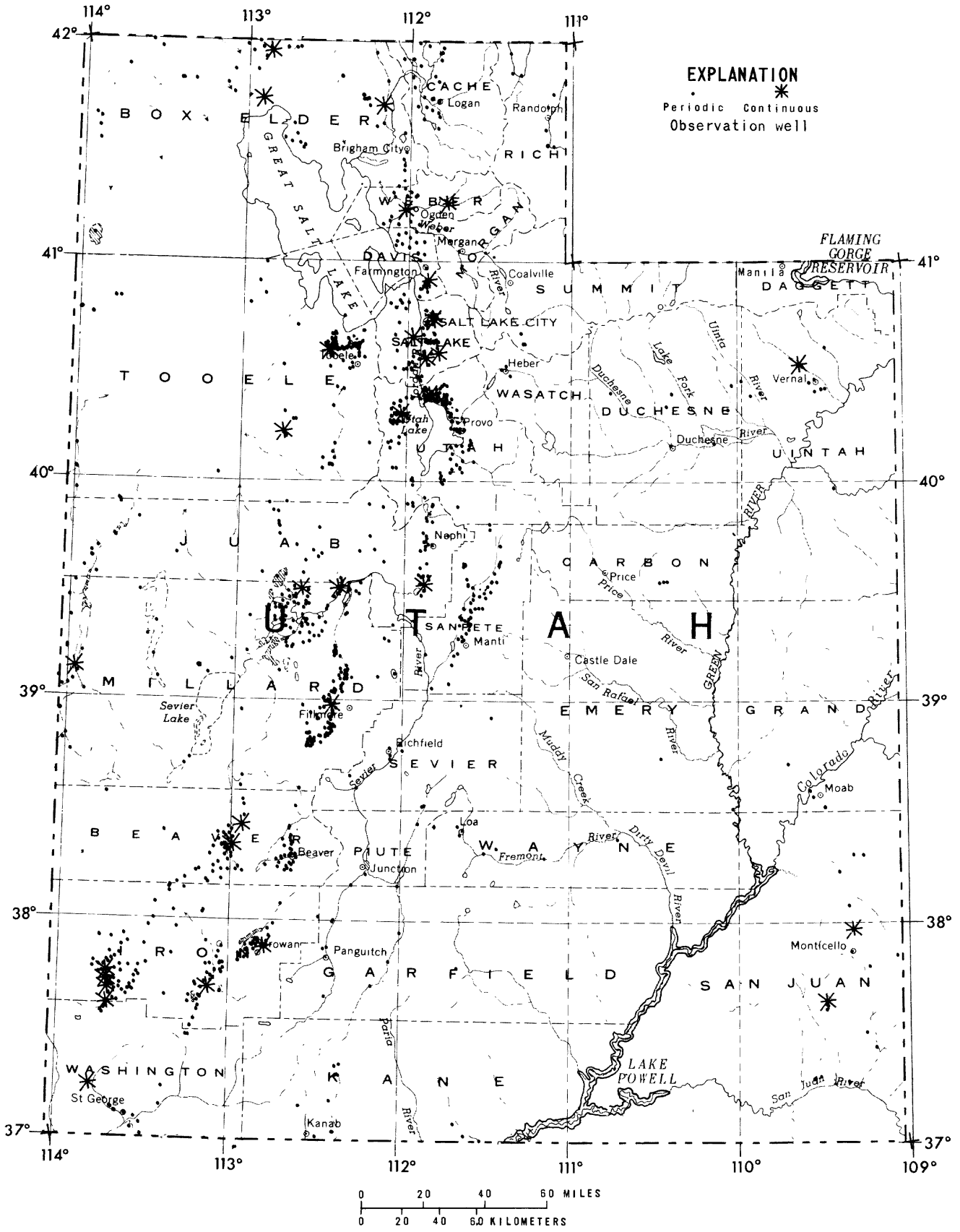


Figure 3.--Location of observation wells where ground-water levels are measured, September 1986.

WATER-QUALITY AND FLUVIAL-SEDIMENT DATA

Number: UT-00-003; UT-00-004

Cooperating Agencies: Utah Division of Water Resources;
Utah Division of Water Rights;
Utah Geological and Mineral Survey;
U.S. Bureau of Land Management;
U.S. Bureau of Reclamation;
U.S. Department of the Army;
U.S. Soil Conservation Service

Staff: L. R. Herbert, Hydrologist, Project Chief (part time)
Other District personnel as assigned

Period of Project: Continuing

Objectives: To obtain records of the quality of water at selected stream sites (fig. 4), of springs and wells (fig. 5), and of sediment (fig. 4) at selected sites throughout Utah and at sites on Great Salt Lake.

Approach: Standard methods for the collection and analysis of chemical-quality, fluvial-sediment, biological samples, and computer storage and publication of data were used.

Progress: Samples for chemical analysis were obtained periodically (about eight times per year) at 25 stream sites. In addition, temperature and specific-conductance data were obtained daily at seven stream sites. Temperature and specific-conductance data were also obtained periodically at an additional 162 stream sites. Sediment data were obtained daily at four sites and periodically at an additional five sites. Samples for chemical analysis of ground water were obtained at about 210 wells. All water-quality data for streams and wells are listed in the annual water-resources data reports.

Physical and chemical data were also obtained for long-term sites on Great Salt Lake. Temperature and density are measured at the sites at various depths, and selected samples are submitted for chemical and biological analysis. Seasonal and areal variation are defined by sampling three times a year at five sites in the north part of the lake and three sites in the south part. Monthly measurements of temperature, density, velocity, and direction of flow are made along several verticals through cross sections at both the upstream and downstream sides of the causeway at the breach between the south and north parts of the lake.

Plans for Next Year: Continue collecting and processing data and preparing records for publication. Continue monitoring Great Salt Lake and attempt to collect and count brine-shrimp samples. Continue monitoring stage and salt balance in the West Desert Evaporation Pond.

Reports:

Price, Don, and Arnow, Ted, 1986, Program for monitoring the chemical quality of ground water in Utah--summary of data collected through 1984: Utah Department of Natural Resources Technical Publication No. 88.

ReMillard, M. D., and others, 1986, Water resources data for Utah, water year 1985: U.S. Geological Survey Water-Data Report UT-85-1.

ReMillard, M. D., and others, (in press), Water resources data for Utah, water year 1986: U.S. Geological Survey Water-Data Report UT-86-1.

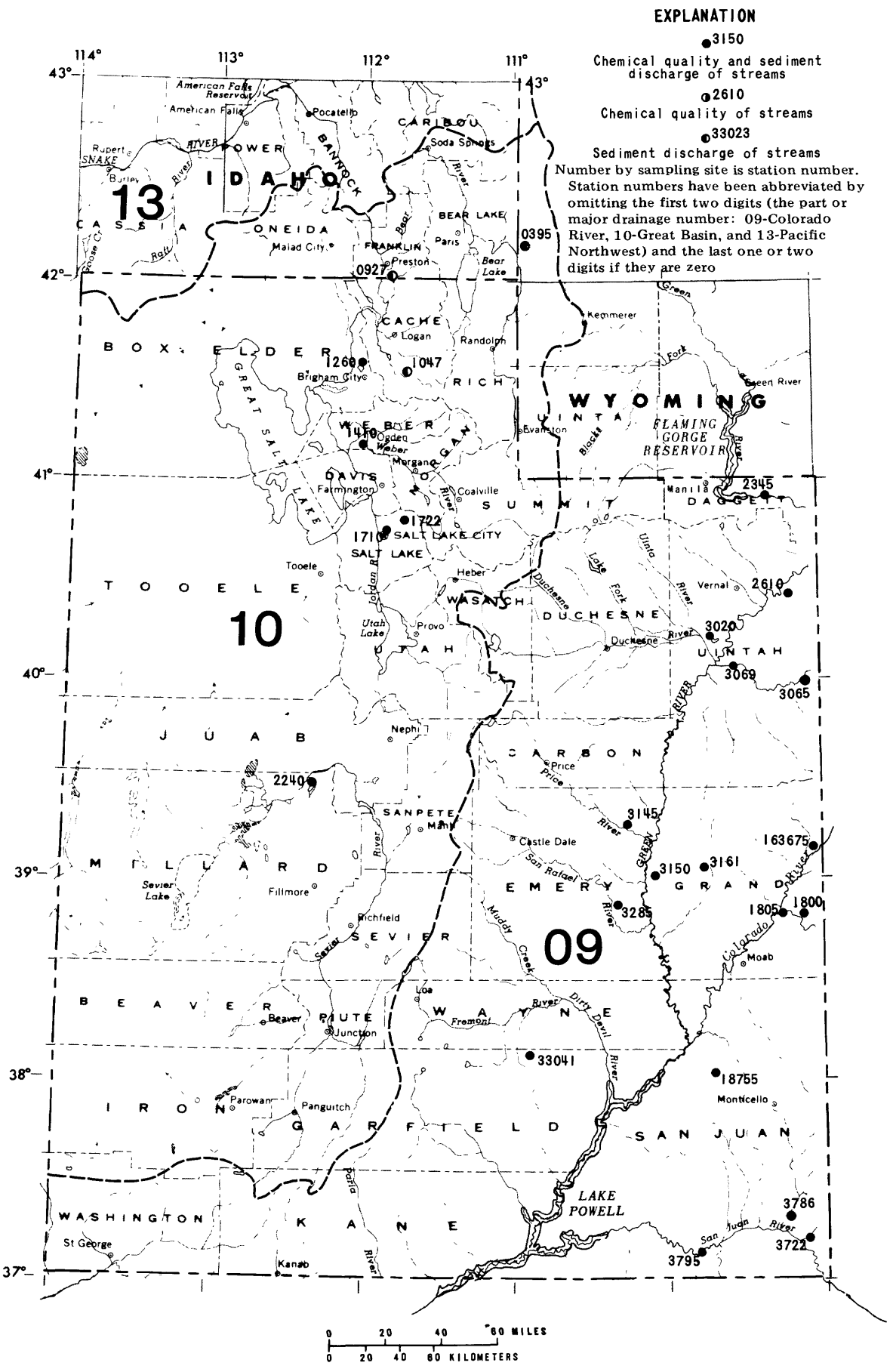


Figure 4.—Location of surface-water quality stations, September 1986.

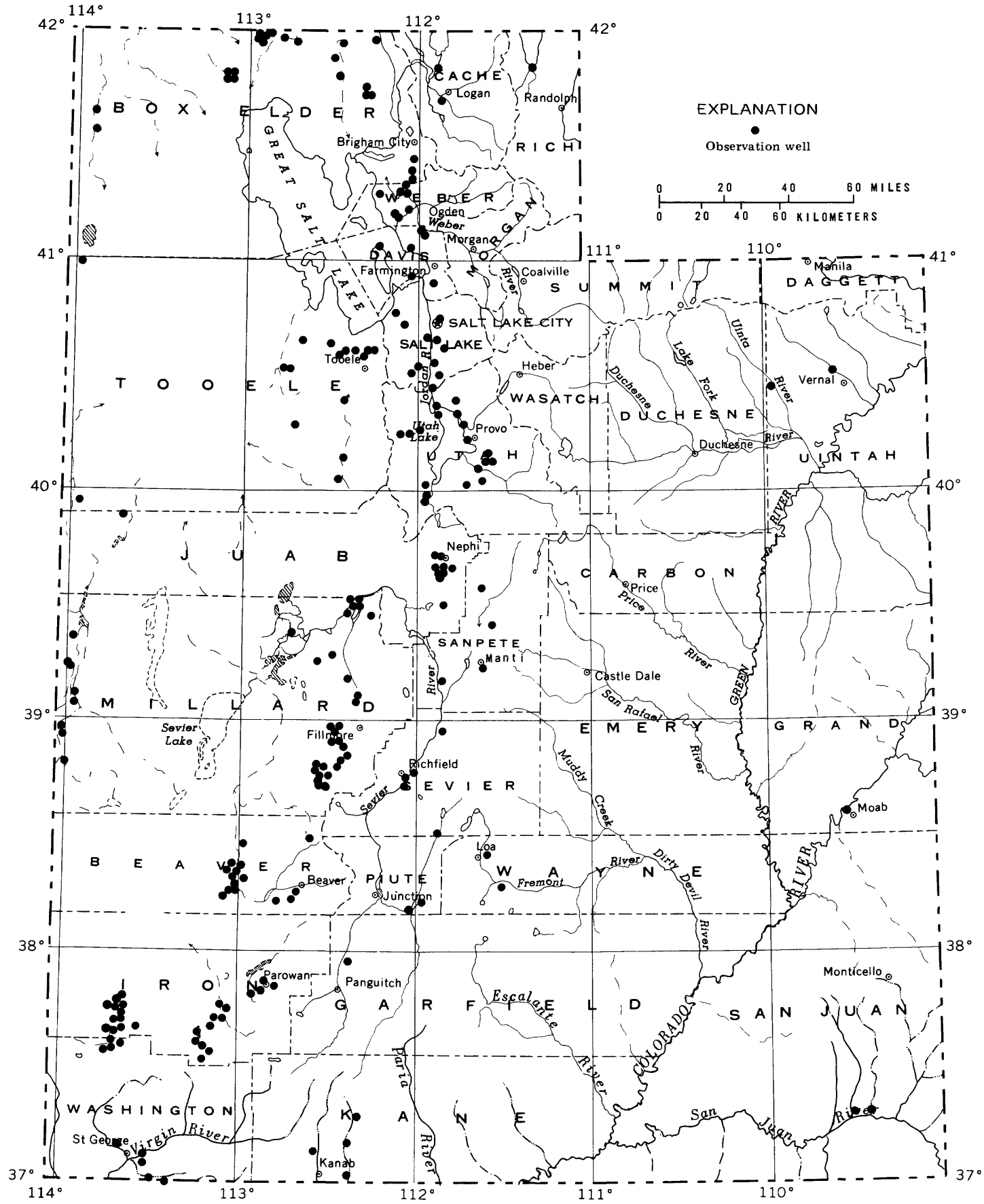


Figure 5.--Location of observation wells where water samples are collected for monitoring ground-water quality, July 1987.

INTERPRETIVE STUDIES

FLOOD MAPPING

Number: UT-00-006

Cooperating Agency: Federal Emergency Management Agency

Staff: R. C. Christensen, Hydrologist,
Project Chief (part time)
E. B. Johnson, Hydrologist (part time)
Other District personnel as assigned

Period of Project: May 1983 to December 1987

Objectives: To delineate the parts of areas selected by the Federal Emergency Management Agency (FEMA) that are subject to inundation by floods of selected recurrence intervals, primarily the 100-year flood. The information is needed by FEMA to assist State and local agencies to control development in the flood-plain areas and to determine rates for the flood-insurance program.

Approach: Determine areas subject to inundation by floods of selected magnitude by ground surveys or photogrammetric methods. Determine frequency relationships using local historical information, gaging-station records, and other applicable information. Determine water-surface profiles at flood stage using step-backwater models or by other acceptable methods and present the results in information releases to FEMA, prepared to their specifications.

Progress: Ground surveys were completed in the Morgan County area. For the Tooele City and Morgan County areas, 100-year water-surface profiles were determined for some streams. Flood-mapping work for Washington City was discontinued by FEMA.

Plans for Next Year: For the Tooele City and Morgan County study areas, complete the determination of water-surface profiles at the 100-year flood stage, delineate, on topographic maps, areas subject to inundation by the 100-year flood, summarize the results of the studies in preliminary reports, and submit the information to FEMA.

Reports: None.

STATEWIDE WATER USE

Number: UT-00-007

Cooperating Agency: Utah Division of Water Rights;
Utah Division of Water Resources

Staff: G. E. Pyper, Hydrologic Technician, Project Chief
Brent Johnson, Engineer, Utah Division of Water Rights
Other State and District personnel as assigned

Period of Project: Began July 1977, continuing

Objective: To obtain information about withdrawals and return flows of water for various uses and about consumptive use of water in connection with each type of withdrawal.

Approach: Total water diversions and consumptive use will be determined by field inventory and measurement of surface-water diversions, selected types of ground-water diversions, and verification of user measurements and records. Acreage and crop surveys will be used to aid in estimating consumptive use by irrigation. The results of a pilot study in Tooele Valley will be used to determine an optimum way to estimate water used for irrigation. State personnel are collecting data on public supply and industrial use; Geological Survey personnel are collecting data on irrigation use.

Progress: Mail surveys were made by the Division of Water Rights to determine water use by about 350 public suppliers and 130 major self-supplied and public-supplied industries. Approximately 90 public suppliers were visited during the year to verify the data. A report on water use during 1984 and 1985 by public suppliers and industry was initiated. Work continued on determining water use for irrigation in Utah. Compilation and preparation of data for the National Water Summary 1987 was completed. Compilation of data by 8-digit hydrologic units for twelve categories of water use for 1985 was completed.

Plans for Next Year: Data for public supply and industrial use will continue to be collected and verified. The National water-use data base will be updated from the verified State data base. Work will continue on determining irrigated acreage and water used for irrigation. Water use for irrigation will be determined for the Weber River system drainage. A data report for twelve categories of water use by county and hydrologic subregion for the year 1985 will be planned and prepared. The reports on 1984-85 water use and use of water for irrigation in Tooele Valley are planned for completion. The results of water use investigations will be presented in a paper at a National water use conference.

Reports:

Johnson, Brent, Utah water-use data, public and industrial water supplies, 1984 and 1985, Utah Department of Natural Resources, written commun., 1987.

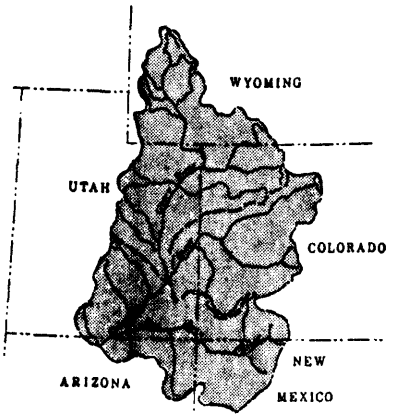
Pyper, G. E., and Baskin, R. L., Comparison of methods to estimate use of water for irrigation, Tooele Valley, Tooele County, Utah, U.S. Geological Survey, written commun., 1987.

REGIONAL AQUIFER SYSTEMS ANALYSIS—MESOZOIC SANDSTONE AQUIFERS IN THE UPPER COLORADO RIVER BASIN

Number: UT 81-154

Staff: G. W. Freethey, Hydrologist, Project Chief
B. E. Thomas, Hydrologist
G. E. Cordy, Hydrologist
J. F. Weigel, Hydrologist

Period of Project: October 1981 to September 1988



Objectives: This study is one of the series of National studies of regional aquifer systems that together will cover much of the United States. In the Upper Colorado River Basin, aquifers that are truly regional include the complex of thick sandstones of Jurassic and Triassic age and carbonate and sandstone aquifers of Mississippian and Permian age. This study will target the thick sandstones of the Mesozoic System and locally related aquifers of lesser extent. The study is intended to (1) provide a basin-wide data base; (2) define and quantify recharge, occurrence, movement, discharge, and quality of ground water; (3) model the system(s) in order (a) to understand the natural (pre-development) flow and geochemical system(s) and (b) to evaluate or predict the effects of future development and differences in these effects due to various management strategies.

Approach: Computer simulation will be the main tool used to analyze the hydrogeologic regimen of the Mesozoic-aquifers system. The results of prior local, areal, and regional studies will be collected and combined, and basic data from those studies will be updated. Concurrently, subregional-flow models will be constructed in order to test provisional hypotheses and show areas where additional data are needed. Following will be a period of data collection, during which the models will be updated as field data are obtained. Final analyses will incorporate consideration of the effects of development on the ground-water flow regimen and storage, on surface-water flow, and on possible water-quality changes that would accompany development. Results of the study will appear as a planning document, data report(s), hydrologic atlases, model documentation, and a final interpretive report.

Progress: Reports detailing the principal findings of the investigation are being written and reviewed for publication.

Plans for Next Year: All reports will be completed and processed for publication and distribution.

Reports:

Freethey, G. W., Lithologic and hydrologic properties of Mesozoic rocks in the Upper Colorado River Basin, U.S. Geological Survey, written commun., 1987.

Freethey, G. W., Upper Colorado River Basin Regional Aquifer-Systems Analysis--the Mesozoic system, U.S. Geological Survey, written commun., 1987.

Freethey, G. W., and Cordy, G. E., Geohydrology of Mesozoic rocks in the Upper Colorado River Basin--excluding the San Juan Basin--in Colorado, Utah, Wyoming, Arizona, and New Mexico, U.S. Geological Survey, written commun., 1987.

Freethey, G. W., Kimball, B. A., Wilberg, D. E., and Hood, J. W., 1984, General hydrogeology of aquifers of Mesozoic age, Upper Colorado River Basin--excluding the San Juan Basin--Colorado, Utah, Wyoming, and Arizona: U.S. Geological Survey Open-File Report 84-716 (pending publication as a Hydrologic Investigations Atlas).

Kimball, B. A., Geochemistry of water associated with the Navajo Sandstone aquifer, San Rafael Swell area, Utah, U.S. Geological Survey, written commun.

Kimball, B. A., Geochemical indications of mixing between Paleozoic and Mesozoic aquifer waters, Montezuma Canyon area, Utah, U.S. Geological Survey, written commun., 1987.

Kimball, B. A., Geochemistry of the principal aquifers in the Upper Colorado River Basin, U.S. Geological Survey, written commun., 1987.

Taylor, O. J., Synthesis of ground-water information in the Upper Colorado River Basin—excluding the San Juan Basin—in Colorado, Utah, Wyoming, and Arizona, U.S. Geological Survey, written commun.

Thomas, B. E., 1985, Simulation analysis of water-level changes in the Navajo Sandstone due to changes in the altitude of Lake Powell near Wahweap Bay, Utah and Arizona: U.S. Geological Survey Water-Resources Investigations Report 85-4207.

Thomas, B. E., Simulation analysis of the ground-water system in Mesozoic rocks in the Four Corners area, Utah, Colorado, Arizona, and New Mexico: U.S. Geological Survey, written commun., 1987.

Weigel, J. F., (in press) Selected hydraulic and lithologic data of the Mesozoic formations in the Upper Colorado River Basin in Colorado, Utah, Wyoming, and Arizona: U.S. Geological Survey Water-Resources Investigations Report.

Weigel, J. F., (in press), Selected water-level data for Mesozoic formations in the Upper Colorado River Basin, Arizona, Colorado, Utah, and Wyoming—excluding the San Juan basin: U.S. Geological Survey Open-File Report 87-397.

Weigel, J. F., Hydrologic-data sources for Mesozoic formations in the Upper Colorado River Basin, U.S. Geological Survey, written commun., 1987.

Weiss, E. J., 1986, Ground-water flow in the Navajo Sandstone in parts of Emery, Grand, Carbon, Wayne, Garfield, and Kane Counties, southeast Utah: U.S. Geological Survey Water-Resources Investigations Report 86-4012.

Weiss, E. J., [ed.], Summary of ground-water flow modeling for the Upper Colorado River Basin Regional Aquifer-Systems Analysis: U.S. Geological Survey, written commun., 1987.

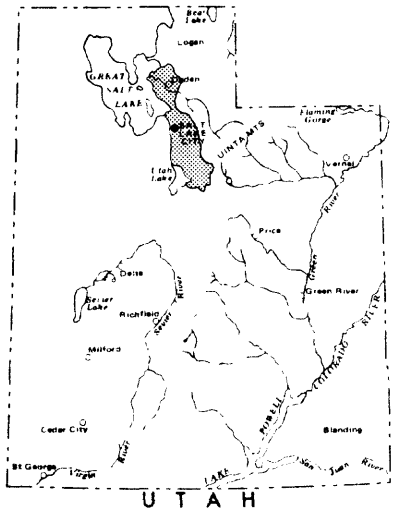
FLOOD CHARACTERISTICS OF URBAN WATERSHEDS

Number: UT-84-165

Cooperating Agency: Utah Department of Transportation

Staff: K. L. Lindskov, Hydrologist, Project Chief (part time)
K. R. Thompson, Hydrologist (part time)
G. G. Plantz, Hydrologic Technician (part time)

Period of Project: July 1984 to September 1987



Objectives: (1) Obtain hydrologic data for 12 representative urban watersheds to define frequency relations of peak flow and volumes of flood flow. The results will be used to determine the impacts of urban development on floods along the Wasatch Front (Salt Lake, Davis, and parts of Utah and Weber Counties). (2) Develop methods for determining peak flow and volumes of flood flow for selected recurrence intervals for ungaged urban watersheds. (3) Document increases or decreases in peak flow between the canyon mouth and the stream mouth for major streams that receive most of their flow from mountain snowmelt, flow through the urban areas, and are tributary to the Jordan River, Utah Lake, and the Great Salt Lake. This will provide methods for estimating snowmelt runoff combined with the thunderstorm runoff contributed by the areas between the canyon mouth and the stream mouth.

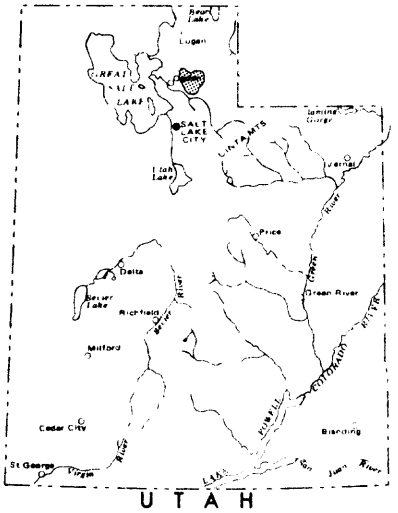
Approach: Floodflow and rainfall data will be obtained at sites in 12 representative urban watersheds for 3 years. The data for about 20 storms will be used to calibrate an urban rainfall-runoff model for each site. The model will be used, along with synthetic rainfall data, to compute peak flow of selected frequencies. After the data collection and computation of peak flows are complete, various techniques will be investigated for transferring the information from gaged to ungaged sites. One possible method would be to relate peak flows to basin and climatic characteristics using multiple-regression techniques. Case histories will be compiled by comparing peak flow at canyon mouths with peak flow at points where selected larger streams flow into the Jordan River, Utah Lake, and the Great Salt Lake. This will enable modification of the snowmelt peak flow as measured at the canyon mouth.

Progress: Data collection was discontinued at the eleven watersheds instrumented to record runoff and rainfall. Data for the 1984-86 water years were used to calibrate rainfall-runoff models for seven watersheds. Long-term rainfall data for the Salt Lake International Airport were used with the model for one site to generate annual peak flows for frequency analysis.

Plans for Next Year: Complete calibration of an urban rainfall-runoff model for two additional watersheds. Compute flood-frequency relations for each of nine watersheds using results from the calibrated models coupled with long-term rainfall data for Salt Lake International Airport. Develop relations for transferring the information from gaged to ungaged sites. Complete a draft of the report summarizing the results of the modeling, computation of flood-frequency relations for the nine watersheds, and development of relations for estimating peak flow of selected frequencies for ungaged watersheds.

Reports: None.

WATER RESOURCES OF OGDEN VALLEY, WEBER COUNTY, WITH EMPHASIS ON GROUND WATER



Number: UT-84-167

Cooperating Agency: Utah Division of Water Rights

Staff: Charles Avery, Hydrologist, Project Chief
Other District personnel as assigned

Period of Project: July 1984 to June 1987

Objectives: Assess current conditions in Ogden Valley in terms of recharge, movement, and discharge of ground water, surface-water and ground-water relationships, ground water in storage, and general water quality. Gain a better understanding of the hydrologic system and its operation, and estimate the effects of potential changes in discharge from the ground-water reservoir. Conduct a reconnaissance of ground-water occurrence in the drainage basin upstream from Ogden Valley.

Approach: Conduct a well and spring inventory in Ogden Valley, including collection of water-level, discharge and specific-capacity, and water-quality data. Inventory wells and major springs, and determine the general occurrence of ground water in the upstream drainage basin. This information will be placed in the WATSTORE data base. Conduct a survey of ground-water discharge in Ogden Valley, including that from wells, springs, base flow in streams, and phreatophytes. Also estimate by various methods the discharge from the artesian aquifer to Pineview Reservoir, and attempt to estimate the effects of stage changes in the reservoir on this discharge. Estimate recharge to Ogden Valley, where possible, including that from streams, irrigation, precipitation, and subsurface flow from consolidated rocks bounding the valley. Establish an observation-well network, including wells near surface-water bodies. Use surface geophysics to map the base of the valley fill. Conduct aquifer tests to more precisely determine the hydraulic characteristics of the valley fill. Construct a digital-computer model of the valley to help understand ground-water flow and effects of changes in the system.

Progress: All field-data collection was completed, including data to estimate ground-water discharge to Pineview Reservoir. The results of seepage studies of the Weber River and Davis-Weber and Ogden Valley Canals were published in a report. The computer model of the ground-water model system was calibrated and used to simulate the system. The report of the results of the study was written and is being reviewed.

Plans for Next Year: Complete review and publish report.

Reports:

Herbert, L. R., Cruff, R. W., Clark, D. W., and Avery, Charles, 1987, Seepage studies of the Weber River and the Davis-Weber and Ogden Valley Canals, Davis and Weber Counties, 1985: Utah Department of Natural Resources Technical Publication 90.

Avery, Charles, Ground-water hydrology of Ogden Valley and surrounding areas, eastern Weber County, Utah, U.S. Geological Survey, written commun., 1987.

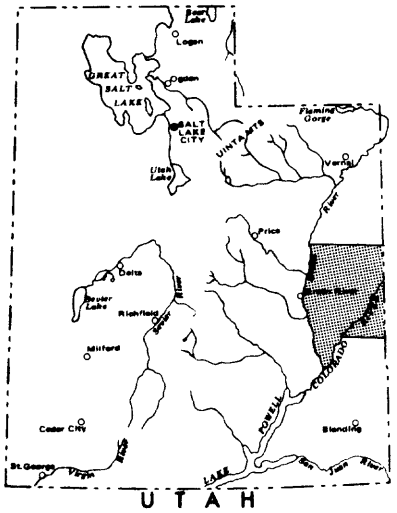
GROUND-WATER CONDITIONS IN GRAND COUNTY AND NORTHWESTERN SAN JUAN COUNTY, WITH EMPHASIS ON THE ENTRADA, NAVAJO, AND WINGATE SANDSTONES

Number: UT-84-168

Cooperating Agency: Utah Division of Water Rights

Staff: P. J. Blanchard, Hydrologist, Project Chief
Other District personnel as assigned

Period of Project: July 1984 to June 1987



Objectives: (1) To increase knowledge and understanding of the ground-water system(s) in Grand County, including areas and rates of recharge, movement, and areas and rates of discharge. (2) To determine the hydrologic characteristics of the aquifers. (3) To determine the chemical quality of ground water. (4) To estimate the hydrologic effects of increased development of energy resources and related withdrawals of ground water. The upland areas of northern Grand County (Book and Roan Cliffs) will be investigated in less detail than the lower areas in southern Grand County.

Approach: (1) Inventory wells, springs, and exploration holes and enter data into computer storage. Wells and springs in the Entrada-Navajo-Wingate sequence will have first priority. (2) Estimate recharge to the ground-water system(s) from precipitation, streams, and interformational movement. (3) Prepare potentiometric-surface maps to help define ground-water movement. (4) Estimate discharge from the ground-water system(s) by wells, springs, evapotranspiration, seepage to streams, and by interformational movement. (5) Determine aquifer characteristics from aquifer tests and laboratory analysis of shallow-core and outcrop samples. (6) Estimate the amount of usable water in storage based on aquifer-thickness data from well logs and estimates of saturated thickness from measured water levels in wells. (7) Determine the chemical quality of ground water by analyzing water samples from wells and springs, and attempt to identify the sources of constituents in the water. Investigate natural contamination of fresh ground water by saline ground water from the Paradox Formation. (8) Attempt to determine (a) the hydrologic effects of increased energy-resource extraction, and (b) the effects of related ground-water withdrawals on the quantity and quality of ground water.

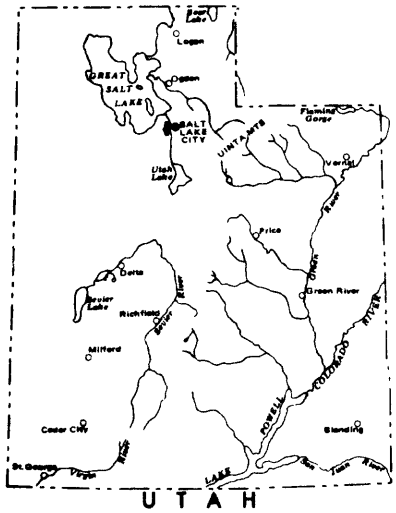
Progress: Field work has been completed, data has been analyzed and interpreted, and the report is being completed for review.

Plans for next year: Complete review and publish report.

Reports:

Blanchard, P. J., Ground-water conditions in Grand County and parts of northern San Juan County, Utah, with emphasis on the Entrada, Navajo, and Wingate Sandstones, U.S. Geological Survey, written commun., 1987.

RECONNAISSANCE OF DECKER LAKE, SALT LAKE COUNTY



Number: UT-85-170

Cooperating Agency: Salt Lake County Division of Flood Control and Water Quality

Staff: D. W. Stephens, Hydrologist, Project Chief (part time)
K. R. Thompson, Hydrologist (part time)

Period of Project: April 1985 to September 1986

Objectives: Quantify the range of nonstorm inflows, outflow, and water quality of Decker Lake. Quantify the range of storm inflows and outflow and effects of storm loads of nutrients, metals, and sediment on the lake's water quality.

Approach: Inflow and discharge will be measured whenever water-quality samples are collected. This will include nonstorm and storm samples at four inflow points and the outflow channel. Nonstorm samples will be collected monthly from May through September. Samples from five storms will be collected as flow-weighted composites from the inflow points and the outflow channel and a point sample from the lake. Analyses will be made of major trace metals, hardness, nitrogen and phosphorus species, oil and grease, and suspended sediment. Samples for bacterial enumeration will be collected for processing by the Salt Lake City-County Health Dept. During July, pesticide analyses and a gas-chromatograph/flame-ionization detector scan for toxic organic compounds will be done on several water samples. Sediment cores will be used in laboratory experiments to determine leaching rates for various trace metals and nutrients.

Progress: Project suspended due to lack of funding.

Plans for Next Year: Complete report and submit for Director's approval.

Reports:

Stephens, D. W., Sediments and water quality in Decker Lake storm-water retention pond, U.S. Geological Survey, written commun., 1987.

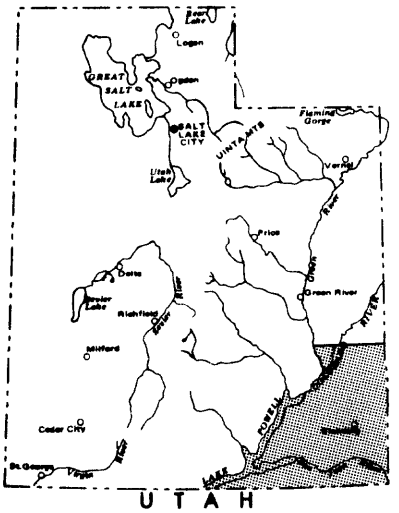
DEPTH TO BASE OF MODERATELY SALINE GROUND WATER, SAN JUAN COUNTY

Number: UT-84-171

Cooperating Agency: Utah Division of Oil, Gas, and Mining

Staff: L. W. Howells, Hydrologist, Project Chief

Period of Project: February 1985 to March 1987



Objectives: To determine the depth to the base of ground water containing 10,000 milligrams per liter or less of dissolved solids in San Juan County; to portray the depth on a map or maps; and to prepare a report including the map(s), tables of ground-water data used in preparing the map(s), a discussion of how the map(s) were prepared, and a brief summary of the county's hydrogeology. This will aid the State in determining criteria to protect ground water from contamination during exploration for and production of oil and gas.

Approach: The files of the Utah Division of Oil, Gas, and Mining, Utah Division of Water Rights, U.S. Geological Survey, Bureau of Land Management, and oil companies will be searched to locate data on ground-water quality, borehole-geophysical logs that could be interpreted to indicate ground-water quality, and geologic information related to hydrogeology. Empirical relations between water quality and formation resistivity (from resistivity logs) will be developed. Maps showing contours of the depth to the base of water with 10,000 milligrams per liter or less of dissolved solids will be prepared using water samples, empirical relations between resistivity and water quality, theoretical determination of water quality from resistivity data and geologic information.

Progress: Collection of file data has been completed. Analysis of geophysical well logs has been completed. Final report has been written.

Plans for Next Year: Complete review and publish report.

Reports:

Howells, Lewis, The base of moderately saline ground water in San Juan County, Utah, U.S. Geological Survey, written commun., 1987.

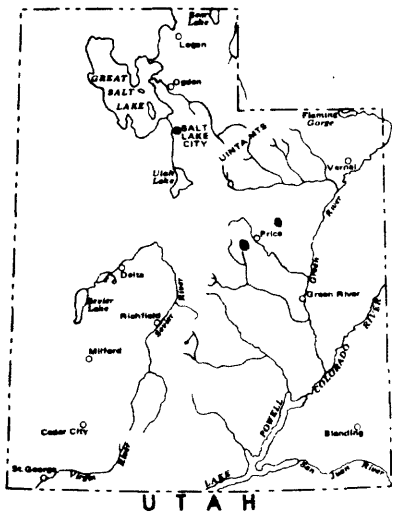
HYDROLOGIC EVALUATION OF THE CASTLE VALLEY RIDGE AND ALKALI CREEK COAL-LEASE AREAS

Number: UT-85-173

Cooperating Agency: U.S. Bureau of Land Management

Staff: R. L. Seiler, Hydrologist, Project Chief (part time)

Period of Project: March 1985 to January 1987



Objectives: In order to allow the U.S. Bureau of Land Management to evaluate hydrologic conditions for an environmental impact statement for the Castle Valley Ridge and Alkali Creek coal-lease areas, the following objectives have been defined: (1) Determine aquifer characteristics, the degree of aquifer-stream interconnection, areas and types of recharge and discharge (including spring discharge and its variability), ground-water movement (including influences of geologic structure on movement), and ground-water quality and storage. (2) Determine the pre-mining variability in quantity and quality of streamflow and sediment loads. (3) Estimate potential effects of proposed coal mining on the hydrologic system.

Approach: The hydrologic system of the two areas will be defined using information from previous studies supplemented with site-specific data collected through September 1986. Information obtained will include data on quantity and quality of spring discharge and streamflow, water levels in and aquifer tests of wells, discharges of nearby mines, geologic features such as faults and fracturing, and evapotranspiration along stream channels. Most springs and wells will be inventoried. Two sets of base-flow measurements will be obtained on all perennial streams to determine losing and gaining reaches. Periodic water-quality and suspended-sediment samples will be obtained for laboratory analysis. Pre-mining quantity and quality of streamflow and ground-water movement and quality will be documented for possible postmining comparison studies.

Progress: The report was completed, reviewed, and submitted for approval.

Plans for Next Year: Complete review and publish report.

Reports:

Seiler, R. L., and Baskin, R. L., Hydrology of Alkali Creek and Castle Valley Ridge coal-resource areas, Central Utah, U.S. Geological Survey, written commun., 1987.

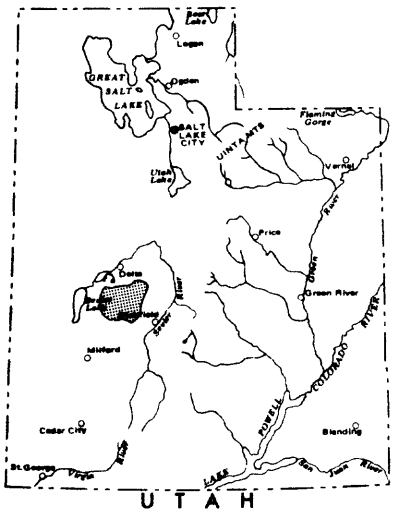
GROUND-WATER HYDROLOGY OF PAHVANT VALLEY AND ADJACENT AREAS

Number: UT-85-175

Cooperating Agency: Utah Division of Water Rights

Staff: W. F. Holmes, Hydrologist, Project Chief
M. Enright, Hydrologic Technician
S. A. Thiros, Hydrologist (part time)

Period of Project: July 1985 to June 1988



Objectives: (1) Improve understanding of the ground-water system and how it functions, including directions of movement, aquifer coefficients, locations and amounts of recharge and discharge, ground-water quality, and amount of water in storage. (2) Provide an assessment of the current state of the ground-water system by determining the changes in water levels and water quality due to increased withdrawals for irrigation, changes in the amounts and locations of recharge and discharge, and recirculation of ground water pumped for irrigation. (3) Project the effects of continued large ground-water withdrawals on water levels and water quality.

Approach: (1) Input existing ground-water data into computer storage. (2) Collect data on discharge of ground water from wells, springs, drains, and to streams and estimate discharge by phreatophytes and subsurface outflow. (3) Estimate recharge from streams, unconsumed irrigation water, precipitation, and subsurface inflow from consolidated rocks. (4) Determine the relationship between ground-water withdrawals and increasing concentrations of dissolved solids. (5) Conduct aquifer tests and reanalyze data from past tests. (6) Construct a digital model capable of simulating three-dimensional flow to provide a method of evaluating the components of the flow system and their interactions and to simulate past and present ground-water flow conditions. (7) Project the effects of potential changes in recharge and discharge on the various components of the system using the ground-water model. (8) Prepare a basic-data report for release to the open file, an interpretive report for publication by the Utah Department of Natural Resources, and document the ground-water model in an open-file report.

Progress: Data collection has been completed. Data has been entered into computer storage. A steady-state ground-water model has been designed and calibrated. A transient model has been developed. A canal-loss study was completed and the report has been reviewed.

Plans for next year: Complete calibration of transient model. Complete basic-data report. Analyze data and write final report.

Reports:

Enright, Michael, Seepage study of a 15.3-mile section of the Central Utah Canal, Pahvant Valley, Millard County, Utah, U.S. Geological Survey, written commun., 1987.

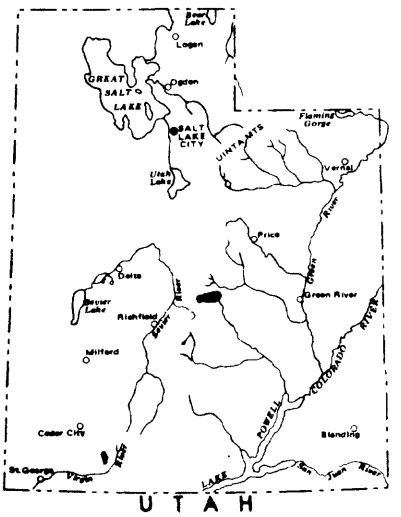
HYDROLOGIC EVALUATION OF THE QUITCHUPAH, PINES, AND L. C. HOLDING COAL-LEASE AREAS

Number: UT-85-176

Cooperating Agency: U.S. Bureau of Land Management

Staff: G. E. Cordy, Hydrologist, Project Chief
S. A. Thiros, Hydrologist (part time)

Period of Project: October 1985 to January 1988



Objectives: Characterize the pre-mining aspects of the local hydrology of two coal-lease areas which have been designated by the Bureau of Land Management as priority areas in their coal-leasing program. Resulting data and evaluations will be used in environmental-impact statements. Aspects of hydrology to be included are: (1) Average streamflow, variability in flow, quality, and fluvial-sediment production. (2) Geologic units and their water-bearing characteristics and identification of geologic structure that may influence hydrology; and, in the L. C. Holding lease, general stability of local geologic units in relation to sediment production, road construction, and mining. (3) Recharge, movement, and discharge of ground water; ground-water quality; and ground water in storage. (4) Potential effects of coal mining on the pre-mining hydrologic system in and near the coal-lease areas. In the L. C. Holding lease area, this will include (a) potential post-mining fluvial-sediment production, (b) stability of geologic units during road construction and of overburden during underground coal-mining (to evaluate the potential for land subsidence), (c) potential effects on the downstream surface-water habitat of the Virgin River spindace, and (d) potential effects on the hydrology of alluvial valleys and flood plains if they or underlying aquifers are disrupted by mining.

Approach: (1) Measure streamflow in and near the lease areas periodically and correlate flow with that for nearby gaging stations. Estimate average and peak flows using regression relations developed in prior Bureau of Land Management-U.S. Geological Survey studies. Sample streamflow for chemical analysis and periodically for suspended-sediment concentration. (2) Field evaluation of water-bearing characteristics of geologic units and hydrologic effects of geologic structure (supplementing available geologic maps with limited field investigations). Test holes will be drilled and tested in each of the lease areas if funds and suitable test locations are available. Tests will include determining the water level in each hole, taking a water sample, and attempting to determine hydraulic conductivity of the aquifers. In the L. C. Holding lease area, map the extent of underlying alluvial aquifers. Obtain data on stability of geologic units, especially those above the coal

beds. Obtain consulting help from Geologic Division on stability of geologic units. (3) Identify sources of ground-water recharge, and points or areas of discharge. Conduct seepage studies on streams to identify areas of ground-water recharge and discharge. Inventory springs and wells in and near the lease areas. Use available water-level data in wells to estimate direction of ground-water movement. Obtain hydrologic data from nearby existing coal mines in hydrologically similar areas. Sample water from springs and wells for chemical analysis. Estimate saturated thickness of geologic units and the volume of ground-water in storage. (4) Using available hydrologic, mine-plan, mine-production, and mining-method data, qualitatively estimate the potential hydrologic effects of mining.

Progress: Literature search for data from and studies of the L. C. Holding area has been completed and field data collection is nearly complete. Test-hole drilling in the L. C. Holding area has been completed and data are now being analyzed. Literature search, compilation of available data, and collection of field data for the Quitchupah-Pines area have been completed. The final reports for the lease areas are in preparation.

Plans for Next Year: Complete data analysis and submit final reports.

Reports:

Thiros, S. A., and Cordy, G. E., Hydrology of the Quitchupah and Pines coal-lease tracts, central Utah, U.S. Geological Survey, written commun., 1987.

Cordy, G. E., Seiler, R. L., and Stolp, B. J., Hydrology of the L. C. Holding coal-lease tract, southwestern Utah, U.S. Geological Survey, written commun., 1987.

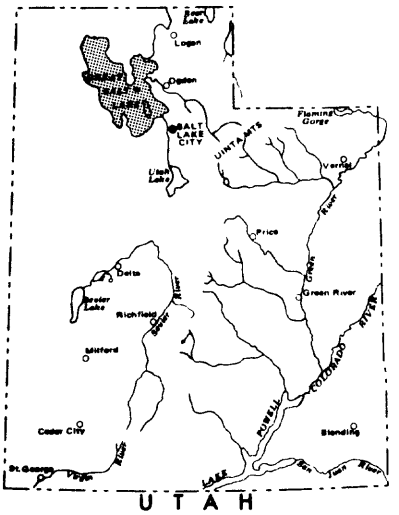
MODEL FOR PREDICTING THE WATER AND SALT BALANCE OF GREAT SALT LAKE FOR SELECTED LAKE LEVELS

Number: UT-87-177

Cooperating agency: Utah Division of State Lands and Forestry

Staff: K. M. Waddell, Hydrologist, Project Chief (part time)
B. E. Thomas, Hydrologist

Period of Project: January 1986 to December 1987



Objectives: To update the existing model (constructed in 1972) of the water and salt balance for Great Salt Lake so that it can be used to predict the water and salt balance between the north and south parts of the lake for variable amounts of freshwater inflow. The existing model is out-of-date in terms of current higher water levels and modification to the causeway between the north and south parts of the lake since 1972. An attempt will be made to incorporate variation of stratification in the south part of the lake in the model.

Approach: The equations used for the causeway breach will be taken from Holley and Waddell (1976) and new equations for stratified flows through the submerged culverts will be developed. The causeway fill flows are being updated using the two-constituent solute-transport model of Sanford and Konikow (1985). The fill-flow model will be calibrated by indirectly estimating flow through the causeway fill as the unknown variable, and calculating the fill-flow values using the equations which describe the water and salt balance for the north and south parts of the lake.

Data collected by the Utah Geological and Mineral Survey indicate the deep stratified layer in the south part of the lake remained relatively stable during 1962-83 but began to change when the causeway was breached in 1984. The effects of different variables on stratification patterns will be determined by plotting time trends of density for each sampling section and then contrasting the trends for other parameters such as surface inflow and breach width that affect the water and salt balance of the lake.

Progress: Completed the water and salt budget for 1980-86, verified equations for breach flow, and began calibrating the solute-transport model for the causeway fill flows.

Plans for Next Year: Complete modeling of fill flows, calibrate overall model, determine effects of various parameters on stratification, and write report.

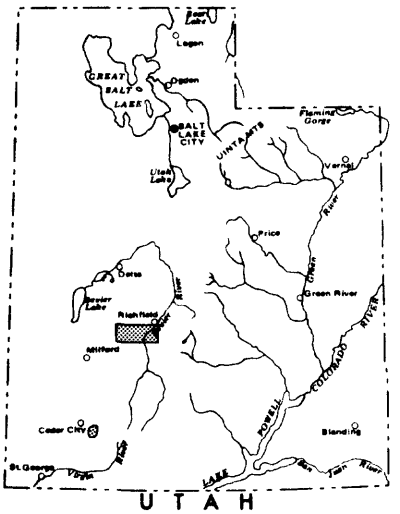
Reports: None.

References:

Sanford, Ward E., and Konikow, Leonard F., 1985, A two-constituent solute-transport model for ground-water having variable density: U.S. Geological Survey Water-Resources Investigations Report 85-4279, 88 p.

Holley, E. R., and Waddell, K. M., 1976, Stratified flow in Great Salt Lake culvert: Journal of the Hydraulics Division, American Society of Civil Engineers, v. 102, no. HY7, Proceedings Paper 12250, July 1976, p. 969-985.

HYDROLOGY OF THE PAIUTE INDIAN RESERVATION LANDS, SOUTHWESTERN UTAH



Number: UT-86-178

Staff: D. W. Stephens, Hydrologist, Project Chief (part time)
Don Price, Hydrologist (part time)
L. S. Conroy, Hydrologic Technician (part time)
Other District personnel as assigned

Period of Project: April 1986 to September 1987

Objectives: To inventory the water resources of the five parcels of land in the new Paiute Indian Reservation in terms of the occurrence and availability of surface and ground water. This inventory will include: (1) Determination of surface-water resources, if any, in the area, including average annual streamflow, variability in flow, and the potential for production of fluvial sediment; (2) quality of surface water and its variability; (3) geologic units present and their water-bearing characteristics, and identification of geologic structure that may influence local hydrology; (4) recharge, movement, and discharge of ground water; and ground water in storage; and (5) ground-water quality.

Approach: The study will be done using the following techniques and collecting the following data: (1) Periodically measure streamflow in and near the parcels of land and correlate flow with that of nearby gaging stations, if possible. Estimate average and peak flows using established equations. Measurements of channel geometry may be used to estimate streamflow characteristics. Sample surface water for chemical analysis and determination of suspended-sediment concentrations. (2) Limited field evaluation of water-bearing characteristics of geologic units and hydrologic effects of geologic structure (to supplement available geologic maps). (3) Identify sources of ground-water recharge, direction of ground-water movement, and points or areas of discharge. Make seepage studies of streams to identify areas of ground-water recharge and discharge if perennial stream reaches exist and are suitable for measurement. Make a complete inventory of springs and wells in and near the five parcels of land. Use ground-water levels to estimate direction of movement. Sample water from springs and wells for chemical analysis. Estimate saturated thickness of geologic units and the volume of ground water in storage. (4) Identify areas where ground or surface water could be developed for use.

Progress: All field reconnaissance has been completed and the draft report prepared. The availability of surface and ground water available on or near each of the parcels was determined.

Plans for Next Year: Complete review and publish report.

Reports:

Price, Don, Stephens, D. W., and Conroy, L. S., Preliminary hydrologic evaluation of the areas of five Paiute Indian Reservation land parcels, Millard, Sevier, and Iron Counties, Utah, U.S. Geological Survey, written commun., 1987.

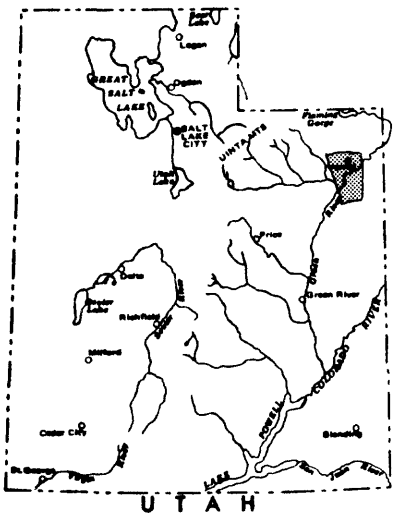
IRRIGATION-DRAINAGE PROBLEMS IN THE MIDDLE GREEN RIVER BASIN, UTAH

Number: UT-86-179

Cooperating Agencies: Office of the Secretary of the U.S. Department of the Interior

Staff: D. W. Stephens, Hydrologist, Project Chief (part time)
Bruce Waddell, U.S. Fish and Wildlife Service (full time)
Jerry Miller, U.S. Bureau of Reclamation (part time)
K. R. Thompson, Hydrologist (part time)

Period of Project: April 1986 to September 1988



Objectives: Determine the extent, magnitude, and effects of contaminants associated with agricultural drainage and where effects are documented, determine the sources and exposure pathways that cause contamination.

Approach: Water samples will be collected during early and late irrigation seasons on all inflows and outflows from Stewart Lake, Ouray National Wildlife Refuge, and Pariette Wetlands. Waterfowl, fish, and sediment samples from the areas will be collected. All samples will be analyzed for most trace metals. In situ and laboratory bioassays will be used to determine toxicity due primarily to selenium and boron.

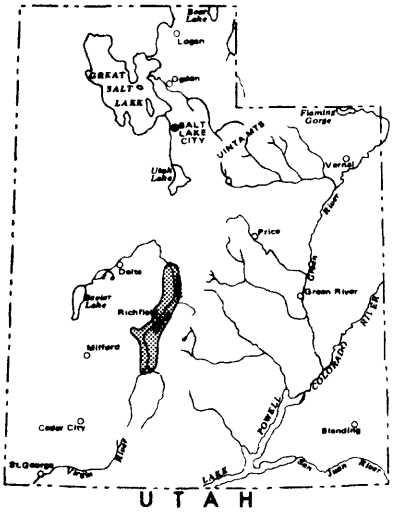
Progress: Water, sediment, and biological samples were collected in April and August 1986, and in April and June 1987 at Stewart Lake, Marsh 4720, and Ouray National Wildlife Refuge (NWR). Concentrations of boron, selenium, and zinc in drain waters entering Stewart Lake and the North Roadside Pond at Ouray National Wildlife Refuge are commonly larger than allowed by Utah Division of Environmental Health standards for wildlife. Water from two drains at Stewart Lake and at the North Roadside Pond commonly contains selenium concentrations greater than 90 µg/L. Concentrations of selenium in coot livers from Stewart Lake have been as large as 26 ppm (dry weight) and as large as 43 ppm at Ouray NWR. A draft report of the first screening study has been completed.

Plans for Next Year: Initiate intensive, process-oriented studies at each of the problem sites to identify the sources, transport, and fate of selenium and boron. Limited reconnaissance will be done to identify other possible problem areas within the middle Green River Drainage.

Reports:

Stephens, D. W., Waddell, Bruce, and Miller, Jerry, Reconnaissance investigation of water quality, bottom sediment, and biota associated with irrigation drainage in the middle Green River basin, Utah, U.S. Geological Survey, written commun., 1987.

EFFECTS OF IRRIGATION AND NATURAL SOURCES OF SALT ON SURFACE- AND GROUND-WATER QUALITY IN THE CENTRAL SEVIER VALLEY



Number: UT-86-180

Cooperating Agency: Utah Division of Water Rights

Staff: D. W. Clark, Hydrologist, Project Chief, succeeded by R. L. Seiler, Hydrologist, Acting Project Chief
P. M. Lambert, Hydrologist

Period of Project: July 1986 to June 1990

Objectives: To assess the current state of the hydrologic system of the Central Sevier Valley, in terms of surface-water flow, ground-water levels, and water quality. To quantify the hydrologic system in terms of surface-water runoff and ground-water recharge, movement and discharge, and to determine the relations between surface and ground water. To determine the factors that result in an increase in dissolved solids in surface and ground water along the valley. To estimate the effects of continued and increased ground-water withdrawals on the hydrologic system, including water quality.

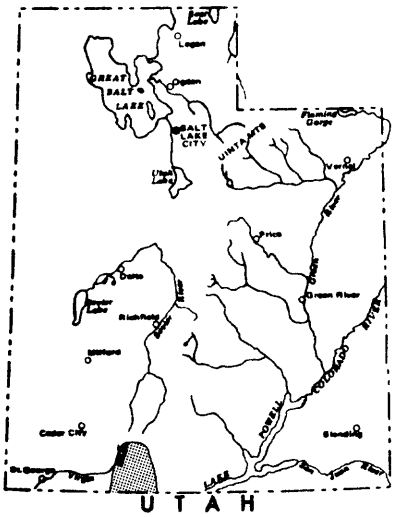
Approach: Update data on streamflow, ground-water levels, and surface- and ground-water quality. Refine previous estimates of ground-water recharge and discharge, especially recharge from irrigation and discharge by seepage to the Sevier River. Sample ground and surface water to define in detail the changes that occur in water quality. Construct a digital model (or models) of the valley's ground- and surface-water system (or a representative part of the system) to define surface-water/ground-water interaction. Install a series of shallow wells near selected river reaches to determine quality of ground-water seepage to the river and to obtain the gradient from the aquifer to the stream. Conduct seepage studies during low flow combined with sampling to better define quality and quantity of inflow to the river. Analyze ground water for isotopes to help determine sources of recharge, and to differentiate recharge by irrigation, precipitation, and inflow from adjacent areas. Apply geochemical models (such as salt-routing models) in an attempt to quantitatively characterize changes in water quality. A solute-transport model of a representative part or cross-section of the valley may also be used to study changes in ground-water quality. Use the analytical techniques to further estimate the effects of continued and increased ground-water withdrawals on the hydrologic system, including water quality.

Progress: A planning document, including a report outline and work schedule, has been prepared. Measurements of discharge of the Sevier River and tributaries were combined with sampling to define the sources, quantity, and quality of the unmeasured inflow. Observation wells used in the 1956-61 study of Young and Carpenter have been relocated and water levels were measured where possible to determine long-term changes. Fieldwork was begun to locate new wells and establish an observation-well network. Began periodic measurements of water levels and ground-water quality. A seepage study of the South Bend, Richfield, and Vermillion canals was conducted as part of the canal-loss studies in conjunction with project UT-001.

Plans for Next Year: Continue establishment of observation-well network and make mass measurements of water levels in March 1988. Continue periodic measurements of water levels and ground-water quality. Drill shallow wells to determine water quality and water levels. Conduct geophysical investigation of areas near Brine and Lost Creeks to determine cross-sectional area of channel deposits transmitting underflow to the valley. Continue conducting seepage studies of selected reaches of the Sevier River. Conduct aquifer tests on selected wells.

Reports: None.

AVAILABILITY OF GROUND WATER IN THE ALTON COAL-FIELD, WESTERN KANE COUNTY



Number: UT-87-181

Cooperating Agency: Utah Division of Oil, Gas, and Mining

Staff: G. W. Freethey, Hydrologist, Project Chief

Period of Project: October 1986 to September 1987

Objectives: (1) To assist the Utah Division of Oil, Gas, and Mining in determining the most plausible concept of the hydrologic system in the Alton area including hydrologic boundaries, the direction of ground-water flow, the hydrologic conditions along major and minor fault zones, the quantity and location of recharge to and discharge from the system, and the vertical connection between the upper and lower parts of the Navajo Sandstone that are separated by a tongue of the Kayenta Formation. (2) To specify the possible impacts that the proposed increase in ground-water withdrawal from the Navajo will have on the ground-water system.

Approach: The results of previous investigations and new information regarding aquifer properties, direction of ground-water flow, and the effect of faulting on ground-water movement will be reviewed and analyzed to determine the most plausible conceptualization of the ground-water system. An existing multi-layered ground-water flow model will be used to help evaluate this updated conceptualization, and to test model sensitivity to possible variations in recharge and discharge boundaries. Model sensitivity to horizontal and vertical variability in the hydrologic properties of the Navajo Sandstone, the confining layers that form its upper and lower boundary, and the tongue of the Kayenta Formation that possibly divides the Navajo into upper and lower aquifer systems will also be examined.

Progress: Results from previous investigations and new information regarding aquifer properties, water levels, and the effects of faulting on ground-water movement have been reviewed and analyzed. A report summarizing the conceptual flow system, indicating areas where data deficiencies exist, and recommending the direction of additional data-collection efforts, is being prepared.

Plans for Next Year: Complete and publish report.

Reports:

Freethey, G. W., Geohydrology of the Navajo Sandstone, western Kane, southwestern Garfield, and southeastern Iron Counties, Utah, U.S. Geological Survey, written commun., 1987.

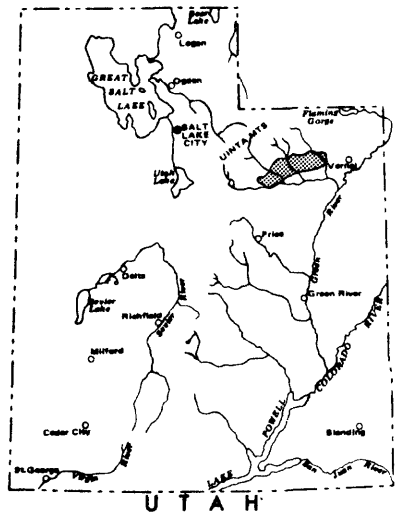
PLAN TO DETERMINE EFFECTS OF INJECTING BRINE, UINTA BASIN

Number: UT-87-182

Cooperating Agency: Utah Division of Oil, Gas, and Mining

Staff: Geoffrey W. Freethey, Hydrologist, Project Chief

Period of Project: October 1986 to September 1987



Objectives: To determine the best method of estimating the effects of injecting brines produced by oil and gas wells on the ground-water system of the Uinta Basin. If digital modeling is determined to be part of the method, define the type of data needed and the availability of that data for developing a model to simulate the hydraulic and chemical effects of injecting oil-production water.

Approach: (1) Evaluate methods for estimating the effects of brine injection, especially various digital models, (2) determine data requirements for modeling, (3) determine availability, sources, reliability, and distribution of these data, (4) design a data-collection program to obtain these data if they are not available, or (5) begin model development if data are available and time allows.

Progress: Available flow and transport models have been reviewed. Data availability has been reviewed and additional data-collection programs outlined and assessed. A report outlining the requirements of the four most pertinent model codes; the availability and distribution of pressure-head, hydrologic-property, and water-quality data; and a plan for determining the effects of brine injection, has been prepared and is in review.

Plans for next year: Complete review and publish report. If the project is funded for another year, begin assembling data for a digital model. Begin collecting any field data designated as necessary for the modeling effort.

Reports:

Freethey, G. W., A plan for determining the effects of injecting salt water into disposal wells in the Greater Altamont-Bluebell oil and gas field, Northern Uinta Basin, Utah, U.S. Geological Survey, written commun., 1987.

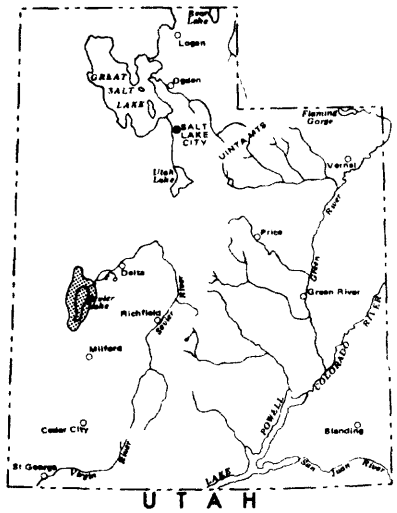
HYDROLOGIC ASSESSMENT OF THE SEVIER LAKE AREA

Number: UT-87-183

Cooperating Agency: Utah Division of Water Rights

Staff: D. E. Wilberg, Hydrologist, Project Chief
J. L. Mason, Hydrologist (part time)

Period of Project: April 1987 to September 1988



Objectives: (1) To define the extent, thickness, and characteristics of the basin fill in the Sevier Lake area. (2) To define the potentiometric surface and ground-water flow directions. (3) To define a ground-water budget by estimating recharge and discharge within the area. (4) To assess ground-water quality. (5) To estimate surface-water runoff to Sevier Lake.

Approach: (1) Use published geophysical surveys and available geophysical data to derive thickness of basin fill, depth to consolidated rock, and to help determine depositional history of the study area. Use shallow test-hole data obtained from consultants to help define lithology, the potentiometric surface, and ground-water quality. (2) Obtain water-level measurements, both historical and current, to determine potentiometric surface and ground-water flow directions. (3) Estimate water budget using climatological data for precipitation and evaporation, inflow from adjacent areas (determined from previous studies), and outflow from the area based on potentiometric surfaces and flow directions. (4) Obtain water samples from test-holes and wells, analyze constituents, and determine water types using Piper diagrams, which may help to determine the direction of flow. (5) Use channel-geometry surveys and/or equations based on basin characteristics to estimate surface-water flow and recharge from surface water. (6) Use data from a private test-drilling program to help define basin-fill characteristics. When a production well is drilled and tested, use data to estimate hydraulic characteristics of basin fill. (7) Compile historical data on surface-water inflow to and levels of Sevier Lake.

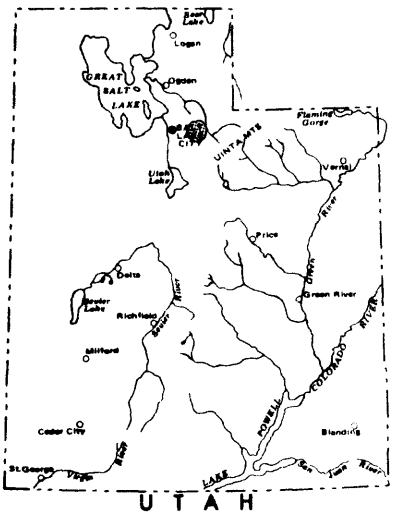
Progress: An initial field reconnaissance was done in May to locate wells and measure water levels and to view the topographic and hydrologic setting. In June, the non-producing wells in the area were pumped by air to cleanse the casing in preparation for the collection of water samples in August. Chemical analyses and water-level data from USGS files have been retrieved and geologic and hydrologic literature are being reviewed for information about the study area. Consultants with extensive knowledge of the Sevier Lake area have been contacted.

Plans for Next Year: Complete field work and analyze data. Participate in aquifer test on recently-completed production well. Write report.

Reports: None.

GROUND- AND SURFACE-WATER QUALITY IN THE SILVER CREEK TAILINGS AREA OF PARK CITY, UTAH

Number: UT-87-184



Cooperating Agency: Utah Department of Health, Division of Environmental Health

Staff: J. L. Mason, Hydrologist, Project Chief
W. F. Holmes, Hydrologist (part time)
K. R. Thompson, Hydrologist (part time)

Period of project: July 1987 to September 1988

Objectives: To determine the quality of ground water, surface water, and stream sediment in and adjacent to the Silver Creek tailings site. The data and analyses will be used by the Utah Division of Environmental Health and the U.S. Environmental Protection Agency to determine if contaminants are being released from the tailings to Silver Creek, or to the aquifers underlying the site.

Approach: Ground-water samples will be obtained from 11 monitoring wells on a quarterly basis, with the exception of the months February through June, when monthly samples may be required due to rapid changes in water levels from increased recharge. Additional ground-water samples will be collected at a spring discharging from the unconsolidated valley fill on the eastern side of the site, and from subsurface drains that are buried in the eastern and northeastern part of the site. Surface-water samples will be collected above and below the tailings site. The data will be used to determine if water from the site is causing degradation of water quality in Silver Creek or if sediments may be transporting metals from the site.

Progress: Surface water and stream sediments were sampled at five sites during spring and mid-summer of 1987. Ground-water samples were collected from 13 monitoring wells and two drains.

Plans for Next Year: The last surface-water samples will be collected at high flow during the spring runoff. Ground-water samples will be collected from the 13 monitoring wells and two drains on at least three more occasions with the last sampling taking place during the period of highest ground-water levels. A report of the study will be prepared.

Reports: None.

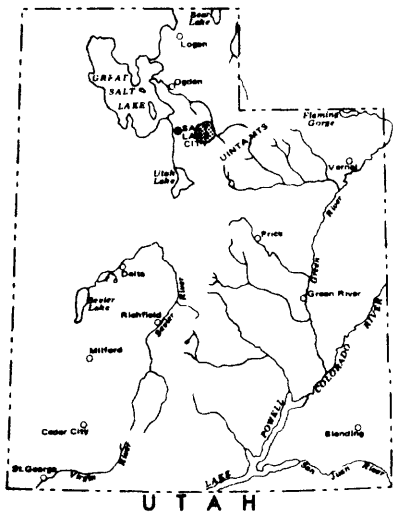
GROUND-WATER HYDROLOGY OF THE PROSPECTOR SQUARE AREA, SUMMIT COUNTY, UTAH

Number: UT 87-185

Cooperating Agency: Utah Department of Health, Division of Environmental Health

Staff: J. L. Mason, Hydrologist, Project Chief
W. F. Holmes, Hydrologist (part time)
K. R. Thompson, Hydrologist (part time)

Period of project: July 1987 to September 1988



Objectives: (1) To characterize the ground-water hydrology in the area of Prospector Square including water levels, direction of flow, estimates of recharge, discharge, and vertical leakage between unconsolidated valley fill and underlying consolidated-rock aquifers. (2) To prepare a detailed plan of study for a second phase of this project if data from this study or other studies show a need for additional data and analyses.

Approach: The characterization of the ground-water system will include determining depth to water, direction of flow, and seasonal fluctuations in water levels in the unconsolidated valley fill. Data will be obtained from 2 deep and 11 shallow observation wells that will be drilled in the valley fill. Additional data may be obtained from existing wells in the area. Data collected will identify seasonal changes in water levels and the discharge of springs and drains due to changes in recharge and discharge that occur during the year. A limited aquifer test may be conducted to assess the vertical and horizontal hydraulic properties of the unconsolidated- and consolidated-rock aquifers and the degree of connection that exists between them.

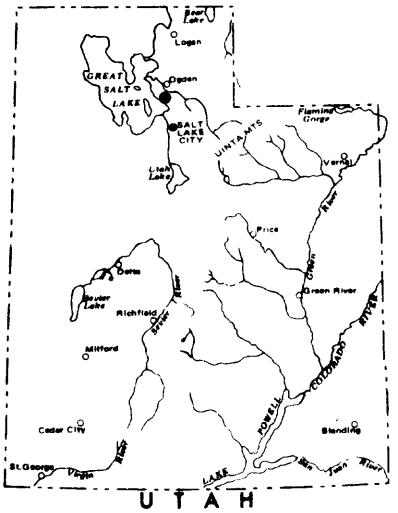
Progress: Thirteen observation wells were completed, cuttings were collected for chemical and mineralogic analysis, and water-level measurements were made on a monthly basis. A continuous water-level recorder was installed in one of the deeper observation wells. A potentiometric surface map was prepared and the direction of ground-water flow was determined. An extensive aquifer test program was designed.

Plans for Next Year: An additional five observation wells will be completed near the base of the unconsolidated valley fill. Data obtained from these observation wells will be used to further describe the lithology, to determine the hydraulic properties at depth, and to quantify the vertical hydraulic gradient in the unconsolidated valley fill. Two of the additional observation wells will be used to determine whether a hydraulic connection exists between the Thaynes Formation and the overlying unconsolidated valley fill.

Reports: None.

PROPOSED PROJECTS

A. GROUND-WATER CONTAMINATION AT HILL AIR FORCE BASE LANDFILLS ONE AND TWO



Cooperating Agency: U.S. Air Force

Staff: R. L. Seiler, Hydrologist, Project Chief
K. M. Waddell, Hydrologist (part time)
Other District and Regional personnel as assigned

Period of Project: October 1987 to September 1988

Problem: Contamination of ground water by organic solvents has been observed at several sites near landfills on Hill Air Force Base. Two monitor wells have detected high levels (up to 4.3 milligrams per liter) of trichloroethene in ground water under landfills 1 and 2. The Air Force needs to determine if hazardous waste at landfills 1 and 2 poses a threat to human health and welfare or to the environment.

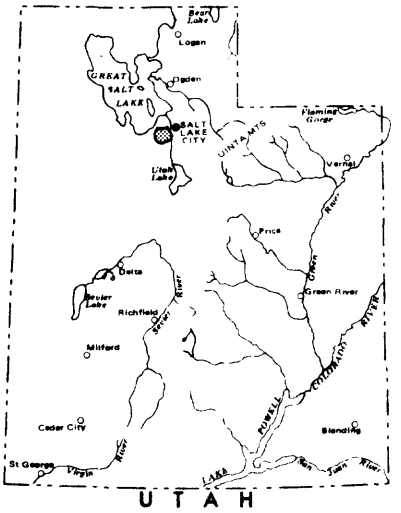
Objectives: To conduct a remedial investigation/feasibility study at landfills 1 and 2 to identify the existence of hazardous waste and to evaluate the source, extent, and degree of contamination of ground water. To assess the risk to human health and the environment. To define and assess alternative actions which will control or eliminate the risk.

Approach: Determine the hazard level of the site so that the proper safety equipment will be used. Define the source, extent, and degree of contamination by sampling and analyzing soil gas and by drilling monitoring wells and sampling and analyzing cuttings and water. Conduct geophysical surveys and use data from test holes to characterize the local hydrogeologic system. Measure water levels in monitor wells to determine directions of ground-water movement. The data collected at the site will be used to prepare a risk assessment. A contractor will design and evaluate alternatives for controlling or removing the contaminant source and the contaminated ground water.

Progress: The project proposal has been prepared.

Plans for next year: Determine hazard level of site. Complete proper safety classes. Conduct soil-gas and geophysical surveys. Drill monitor wells. Collect samples, analyze results, and prepare a report on the evaluation of the site.

B. REVIEW OF GROUND-WATER CONTAMINATION, SOUTHWESTERN SALT LAKE VALLEY



Cooperating agency: Utah Division of Environmental Health

Staff: Charles Avery, Hydrologist, Project Chief
K. M. Waddell, Hydrologist (part time)

Period of Project: July 1987 to September 1988

Problem: Ground water between Bingham Canyon in the Oquirrh Mountains and the Jordan River, about 10 miles to the east in the southwestern part of Salt Lake County, has been contaminated by seepage of leachate, which has been discharged to Bingham Creek, and by seepage of the leachate from reservoirs and evaporation ponds. The leachate is associated with mining operations and secondary recovery of metals from mine tailings. Much of this leachate has total dissolved solids greater than 10,000 mg/L. Eleven domestic and one public-supply well were closed in 1985-86 due to contamination. Kennecott Minerals Co., the current owner/operator of the mining property, has contracted for a hydrogeologic study of the area of ground-water contamination and for design and construction of a flow and solute-transport model of the area. The Utah Division of Environmental Health requires an independent review of the hydrogeologic characterization and the models to help assure that the model correctly represents the hydrologic system and the contamination problem.

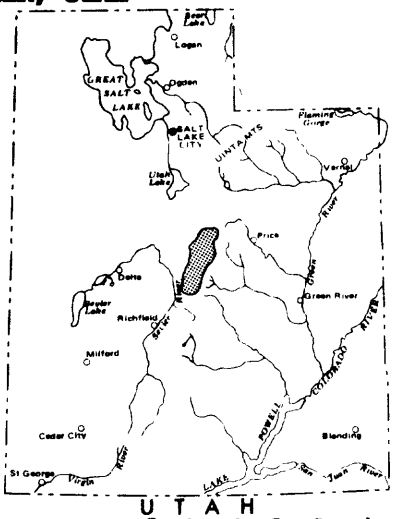
Objectives: At the request of the Utah Division of Environmental Health, the U.S. Geological Survey will review the characterization of the hydrogeologic system and the flow and solute-transport models to help insure that the models represent the ground-water system within the limitations of the data base.

Approach: The data base will be examined to determine if all data pertinent to the study are included and will be spot-checked to determine consistency with original sources of data. Estimates of recharge, discharge, and aquifer properties will be checked for consistency with other reports. Definitions of the extent, thickness, and physical characteristics of the geologic units will be reviewed using the results of test drilling, core samples, and geophysical logging. Water levels and land-surface datums will be reviewed to determine consistency between field data, illustrations, and tables. Chemical analyses will be reviewed to see if analytical balances are within acceptable limits. The conceptual model of the ground-water system will be reviewed to evaluate consistency with the data base and other hydrologic information deemed pertinent to the study area. Representations and assumptions that are made to apply the computer models to the ground-water system will be evaluated.

Historical time trends of selected water-quality parameters will be compared with model-computed trends.

Plans for Next Year: Prepare progress reports after reviews of designated parts of the study. A summary report evaluating the accuracy and limitations of the model will be prepared at the conclusion of the study.

C. GROUND-WATER HYDROLOGY OF SANPETE VALLEY AND THE SAN PITCH RIVER DRAINAGE BASIN, UTAH



Cooperating Agency: Utah Division of Water Rights

Staff: Charles Avery, Hydrologist, Project Chief
Vacancy, Hydrologic Technician (part time)

Period of Project: July 1987 to June 1990

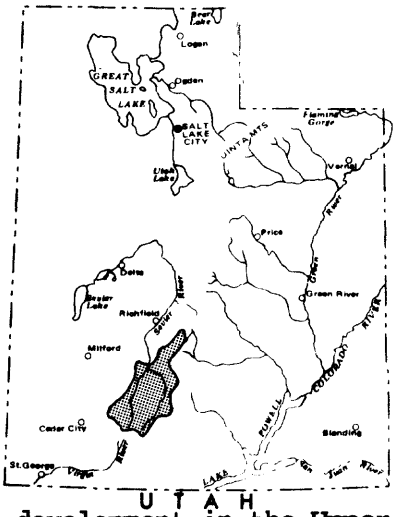
Problem: The State of Utah needs to know the current state of the hydrologic system in Sanpete Valley. Water may be imported to the Sevier River drainage from the Price River drainage and the State needs to know conditions prior to the importation so it can better assess resulting changes. The State also is interested in methods for predicting effects on the hydrologic system resulting from changes in development of ground water; importation of surface water; and changes in irrigation practices such as using sprinklers. These changes may increase irrigated acreage and consumptive use and decrease return flows.

Objectives: (1) To assess current hydrologic conditions, in terms of recharge, movement, and discharge of ground water; ground-water levels; surface-water flow; and ground- and surface-water quality. (2) To improve understanding of the hydrologic system and how it functions, especially its ground-water component. (3) To provide methods for estimating the effects on the hydrologic system resulting from changes in ground-water withdrawals, importation of surface water, and changes in irrigation practices. (4) To determine the causes of (a) downstream deterioration in quality of surface water; (b) variations in quality of ground water; and (c) the lesser deterioration of ground water in the lower part of valley.

Approach: (1) Compile data on ground water and surface water that has been collected since the last study in the area during 1964-67. (2) Measure and estimate ground-water discharge from wells, springs, drains, to streams, and by evapotranspiration; and estimate recharge from streams, irrigation, and seepage from consolidated rock. (3) Conduct aquifer tests to obtain hydraulic characteristics of the valley fill. (4) Construct a digital model of the valley-fill aquifer to simulate the three-dimensional ground-water system and to provide a means of estimating the effects of changes in the hydrologic system. (5) Install temporary surface-water gages on major tributaries of the San Pitch River in order to better define surface-water runoff prior to importation of surface water. (6) Sample and analyze water from wells, springs, streams, and drains to define variations in ground- and surface-water quality and provide information to use in estimating causes of these variations.

Plans for Next Year: Compile all available data including water levels, well logs, surface- and ground-water discharge, and surface- and ground-water quality. Begin field inventory of wells and measurements of ground-water discharge. Set up observation-well network. Locate wells that can be used for aquifer tests. Measure discharge of the San Pitch River and its major tributaries. Begin collection and analysis of water samples.

D. GROUND WATER-SURFACE WATER RELATIONS IN THE UPPER SEVIER RIVER DRAINAGE BASIN, UTAH



Cooperating Agency: Utah Division of Water Rights

Staff: S. A. Thiros, Hydrologist, Project Chief

Period of Project: July 1987 to June 1990

Problem: There is increasing demand for ground-water development in the Upper Sevier River Drainage basin. The State of Utah and local water agencies need to be able to better understand the effects of this potential development on water levels in wells, streamflow, evapotranspiration by phreatophytes, and discharge from springs.

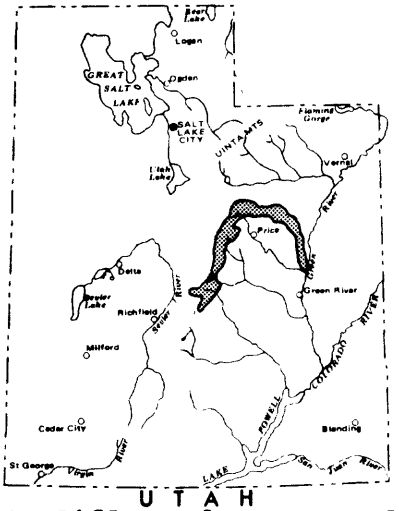
Sprinkler irrigation is increasingly being practiced throughout the basin. The State is interested in quantifying and relating the return flows from sprinkler-applied irrigation water to changes in consumptive use. The State is also interested in describing the current distribution of and documenting historic changes in water quality.

Objectives: (1) To define the hydrology of the Upper Sevier River drainage basin and the current state of the hydrogeologic system, including the hydrologic budget, ground water-surface water relations, and characterization of the ground-water reservoir. (2) To define the chemical quality of ground and surface water and to describe the mechanisms for quality changes in the downstream direction. (3) To estimate the hydrologic effects of increased ground-water development, changes in irrigation practices, and impounding surface water, especially on ground-water levels, streamflow, springs, and evapotranspiration.

Approach: (1) Compile all data on ground water, surface water, and chemical quality of water collected since the last study in the area in 1961-64. (2) Conduct seepage runs and/or install short-term gaging stations along the major streams to define ground-water seepage to or from streams and gaining and losing reaches. Select observation wells to better define periods of ground-water seepage to or from streams. Conduct aquifer tests on suitable wells. (3) Estimate ground-water recharge from streams and irrigation, ground-water inflow from adjacent basins, and discharge by wells, springs, seepage to streams, and evapotranspiration. (4) Sample and analyze water from wells, springs, drains, and streams to define quality of ground and surface water, and use analyses to determine causes of downstream changes in water quality. (5) Construct analytical or digital models simulating flow in parts of the basin to help estimate hydrologic effects of increased ground-water development, changes in irrigation practices, or surface-water impoundment.

Plans for Next Year: Collect all available data on water levels in wells; ground water discharge and quality; well logs; and surface-water discharge and quality. Begin field inventory of wells and measurements of well discharge. Set up observation-well network. Plan and begin supplemental surface-water gaging and seepage runs on the Sevier River and its major tributaries. Begin collection and analysis of water samples.

E. ROCK FRACTURES AND COAL CLEATS AND THEIR EFFECTS ON GROUND-WATER HYDRAULICS IN COAL FIELDS OF CENTRAL UTAH



Cooperating Agency: U.S. Bureau of Land Management

Staff: G. W. Freethey, Hydrologist, Project Chief
L. W. Howells, Hydrologist (part time)

Period of Project: October 1987 to September 1990

Problem: Mine dewatering in the Wasatch Plateau, Book Cliffs, and Emery coal fields is known to cause dimunition of spring flows and base flows of streams, depletion of ground-water storage, and degradation of the quality of water in streams that receive mine discharge. Subsidence and associated fracturing may provide additional conduits for water to enter a mine.

In order to predict and mitigate the hydrologic impacts of dewatering, a reasonably complete understanding of regional and local ground-water hydraulics is needed. Although several studies have been completed in these coal fields, much remains to be learned before the ground-water hydraulics can be quantified for coal-bearing aquifers and other water-bearing zones (where most of the flow probably occurs along fractures).

Objectives: The major objectives of this study are to determine, quantitatively where possible, the effects of fractures (both natural and subsidence-induced) and coal cleats on: (1) Hydraulic conductivity and anisotropy, (2) natural movement of ground water, and (3) inflows of water to underground mines.

Approach: (1) Search and review literature. (2) Contact government and local agencies and search WRD files for existing aquifer-test data and unpublished geologic and hydrologic data. (3) Prepare project description and detailed planning document by January 1, 1988. (4) Identify surface fractures on aerial photographs (Landsat and low altitude), field check, compare with regional lineaments, and relate to geologic structures. (5) Map fractures and coal cleats in outcrops and selected underground mines to determine continuity, orientation, frequency, aperture, and any relationship to geologic structures, depth of burial, topographic setting, lithology, or subsidence. (6) Document ground-water inflow to selected mines and estimate quantity of water discharging from fractures versus that from unfractured mine faces. Determine if quantity of inflow is related to orientation of fractures or mine workings. (7) Analyze water samples from fractures to estimate length of time in flow system. (8) Review aquifer-test data and compare with laboratory hydraulic conductivity values and field measurements of fractures. Participate in other aquifer tests conducted by consultants or mining

companies when possible. (9) Estimate principal axes of hydraulic conductivity from stereonet plots of fracture orientation and density.

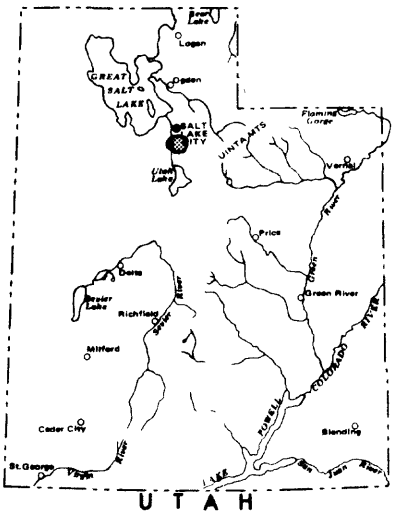
Plans for Next Year (pending approval and funding): Review all data and reports collected during the original study conducted during October 1983 to January 1984. Prepare project plan. Begin identifying fractures on aerial photographs and fieldwork to collect data on fractures and joints on the surface and in mines. Begin compiling data on occurrence of water in and inflow to mines. Assemble and simulate aquifer-test and laboratory-permeability data.

F. GROUND-WATER HYDROLOGY OF THE SANDY, UTAH AREA, WITH EMPHASIS ON THE OCCURRENCE AND PROBLEMS ASSOCIATED WITH SALINE WATER

Cooperating Agency: City of Sandy

Staff: K. M. Waddell, Hydrologist, Project Chief

Period of Project: October 1987 to September 1989



Problem: The city of Sandy would like to define the location and depth of bodies of saline water so they can better locate new wells. They would also like to know how to determine the pattern and rate of pumping of existing wells which would minimize contamination of currently usable ground water.

Objectives: (1) To define the hydrogeologic system of the area. (2) To define the location, extent, and thickness of the body or bodies of warm, saline water in the Sandy area. In addition, to define the paths by which saline water moves to existing wells. (3) To develop a method to define patterns and rates of pumping which would minimize migration of saline water toward existing production wells.

Approach: (1) Collect all existing information and data including well logs, drillers' and consultants' reports, water analyses and temperature data, water withdrawals and water levels, and geophysical data. Use this information to prepare a preliminary conceptual model. (2) Collect additional field data--water levels in wells, temperatures of ground water, samples of water for chemical analysis, and well-discharge rates. (3) Run borehole geophysical logs, (temperature and conductivity) in suitable wells to determine relative ground-water movement and quality with depth. (4) Conduct a transient electomagnetic survey to help define the extent of saline water. (5) Conduct an aquifer test or tests. (6) Refine the conceptual model of the hydrogeologic system. (7) Construct a digital-computer model capable of simulating three-dimensional ground-water flow in the Sandy area. Use the model to determine the effects of various rates and patterns of pumping on the water levels and water movement in the area. This will complete the first phase, which will extend over a two-year period, October 1987 through September 1989. The second phase of the study, if it is determined to be necessary, will extend over an 18- to 24-month period and will include construction of a cross-sectional and/or areal solute-transport model and an attempt to define a method to determine optimal rates and patterns of pumping that will minimize the encroachment of saline ground water.

Plans for Next Year (pending approval and funding): Compile all available data on water levels; withdrawals; chemical quality; and temperature, and assemble available well logs; drilling records; and geophysical data. Measure water levels, temperatures, and well discharge. Run geophysical logs in available wells. Locate wells suitable for aquifer tests. Conduct transient electromagnetic survey.