

Center for Water Resources Research

Annual Technical Report

FY 1998

Introduction

Research Program

Abstract

In FY 98 (UWRL FY 99), the Utah Water Research Laboratory (UWRL) expended approximately \$6 million in water research support. USGS Section 104 funds administered through the Utah Center for Water Resources Research (UCWRR) accounted for about one percent of this total and were used for outreach, information dissemination, and strategic planning with regard to water resources and environmental quality issues in the State of Utah. Outreach within the UCWRR is a form of scholarship that is stimulated, supported, and rewarded. Outreach activities through the UCWRR, the UWRL, and Utah State University (USU) have had an impact on the technical and economic development of the State of Utah. As part of the UCWRR outreach activities supported by USGS Section 104 funds, there continues to be a vigorous dialogue and experimentation with regard to efficiency and effectiveness of outreach activities of the UCWRR. Faculty have been involved in regular meetings with State of Utah agencies, including the Department of Environmental Quality (DEQ) and the Department of Natural Resources (DNR), to provide on-site training, technology transfer, and development of water resources planning documents within the context of Utah issues. Types of information dissemination partially supported by USGS Section 104 funds include: (1) research publications, (2) applied research summaries, (3) guidance manuals, and (4) newsletters. Research publications have traditionally been a very high priority and will remain a strong and dominant type of UCWRR outreach, with external (to USU) audiences consisting of other researchers in non-university settings, State of Utah agency personnel, consultants, and other specialists in government and private sector positions in the generation and application of new knowledge applied to water resources and environmental issues. Applied research summaries are provided to summarize findings in specific areas of concern, and include chemistry of contaminant transport and fate, and bioremediation of soils. Guidance manuals represent the use of research results for specific applications with regard to engineering or management to accomplish specified tasks. Guidance manuals have been prepared by the UCWRR addressing on-site (septic tank) wastewater treatment for Utah environments, soil bioremediation, land treatment, and corrective action. A future video on on-site wastewater treatment for Utah is planned. Strategic planning with regard to water resources and environmental quality issues in the State of Utah has continued to be a top priority in FY 98 (UWRL FY 99) due to the rapid growth in industry and population both in rural and urban areas. The UCWRR Director, Dr. Ronald C. Sims, is serving on the Utah Committee on Infrastructure for Quality Growth at the request of the Utah Governor's Office of Planning and Budget. Dr. Sims is providing input to the Committee on issues addressing water quality and wastewater treatment in rural areas. UCWRR faculty have been working along two parallel planning activities: (1) Utah State Water Plan 2000, and (2) future water-related challenges to quality growth in Utah. Utah State Water Plan 2000 assists the State of Utah Division of Water Resources with review, comment, and input regarding current water resources and projected water needs. Future water-related issues assist the State of Utah and the Intermountain West in identifying intra-state and inter-state water management scenarios and options as impacted by long-term trends in climate, population, land use, and transportation. This USGS Fiscal Year 1998 (UWRL 1999) Report represents another avenue for UCWRR outreach that is supported by Section 104 funds. This Report

provides an opportunity to summarize the outreach, information dissemination, technology transfer, and strategic planning activities of the UCWRR and the UWRL.

1.0 Water Problems and Issues of Utah

Utah has an arid and semi-arid continental climate. Mountain snowmelt waters feed lower valley areas where the flatter topography and milder temperatures attract development. Pioneers diverted mountain streams for culinary, agricultural, and mining uses; secured legal protection of water rights; and built an economy and a culture that values "full water development" and abhors "water waste." The strong commitment of the State of Utah to water development is well demonstrated by the investment of nearly \$260 million in almost 1,300 water development and conservation projects through the Utah Board of Water Resources since 1947. A State Water Plan 2000, completed in 1999, has been prepared by the State Water Plan Coordinating Committee and includes Utah Water Research Laboratory (UWRL) faculty members. It contains the foundation, guidelines, and principles for a continuing planning process, and addresses the various aspects of water resources supply, conservation, development, management, protection, and use that are critical to the future of the state. Lake Powell is heavily used by Utah citizens, equivalent to over one million people spending one night between April and September, 1999 for swimming, boating, and camping. This has resulted in increased pressure on the water quality of the beaches of Lake Powell. A Technical Advisory Committee (TAC) was formed by the Utah Department of Environmental Quality to address issues of human and non-point source animal contamination, monitoring, and management to ensure protection of human health and the environment. Two UWRL faculty members, including the Director, serve as members of the Lake Powell TAC. Unsewered areas of Utah, including both urban and rural environments, have experienced failure of decentralized on-site wastewater systems. UCWRR and UWRL faculty have teamed with the Utah Local Health Departments and with the Utah Department of Environmental Quality to address issues including establishing criteria, testing, and monitoring for decentralized systems. With current and projected industrial growth and population trends in Utah, changing land use patterns, and transportation system expansion, the need exists in many areas of the State for evaluation of water quality issues. The Utah Water Quality Board, under the direction of the Utah Department of Environmental Quality, addresses issues and needs for the State of Utah. These include non-point sources of contaminants to Utah's rivers, lakes, and streams, abatement or elimination of impacts, alternative treatment systems, and expansion of existing wastewater treatment systems. The UWRL Director serves as a member of the Utah Water Quality Board. Rapid and sustained growth predicted for both rural and urban areas of Utah have placed increased stress on infrastructure systems and resources, including water quantity and quality. The UCWRR currently serves as a member of the Ad Hoc Committee on Infrastructure, created by the Governor of Utah to address these issues and develop quality growth tools for use by State planners. Utah's water supply is highly variable, responding to large swings in precipitation, characteristic of semi-arid climates. This variability has accentuated water disagreements and disputes, increased interest in moving existing water rights to other locations and uses, and heightened concern about the over-appropriation and degradation of groundwater quality in many Utah basins. This provides incentive for water conservation, a new level of cooperation among water users working together to find valley-wide solutions to water supply problems, growth of conjunctive use and artificial groundwater recharge projects, and an increasing emphasis on water quality maintenance and improvement. Agriculture continues to contribute significantly to the Utah economy. It is, however, vulnerable to the erratic water supply, and is a major contributor to non-point source water pollution, including salinity from irrigation return flows and pesticides in ground water. Also, agriculture will be impacted by the implementation of the state dam safety program, which is expected to require costly dam rehabilitation measures. Water rights are being transferred from agricultural water use to municipal and industrial use through the free market process. Some are concerned that large transfers may lead to unacceptable environmental or social costs which cannot be satisfactorily mitigated, and believe that administrative controls may be needed to limit the future impact of these transfers. Alterations to natural streams now must be evaluated to ensure that adequate protection of riparian habitat and stream channel integrity will be provided. There is, however, concern about deterioration in water quality in some major reservoirs. New federal source water protection plan requirements require river-basin-wide characterization, assessment, and reevaluation with regard to risks of contamination of source water from near and far sources. Both point sources and non-point sources (NPS) need to be identified. Risks to Utah's source water include both point and non-point sources. Several UCWRR

faculty are assisting the State of Utah water agencies in developing source water protection plans. Prevention of continual degradation of limited surface and groundwater supplies, and remediation and renovation of soil and water resources impacted from historical and on-going industrial, mining agriculture, and military activities are high priorities. An aggressive UCWRR program for the detection and remediation of releases of fuels, agricultural chemicals, and other hazardous materials has supported the Utah Department of Environmental Quality.

2.0 Program Goals and Priorities

The Section 104 program facilitates the important functions of linking water research programs throughout Utah, linking Utah programs with those in the region and nationally, and supporting seed projects. Utah Section 104 funds have been used in FY 98 (UWRL FY 99) to support information transfer, program management, and statewide, regional, and national research coordination activities. The objectives of the research, information transfer, and program management/coordination aspects of the Utah Section 104 program are discussed in Subsections 2.1 and 2.2.

2.1 Information Program The information transfer activities of the Utah Section 104 program are limited to those managed directly by the Utah Center for Water Resources Research (UCWRR)/UWRL. Our information transfer activities include our World Wide Web (WWW) site, the Utah Water Atlas, The Utah Water Journal, conferences, workshops, training for U.S. and international professionals, publications' production support and sales, publications of all types, general education, availability of faculty to share their expertise with users, and brochures. The UCWRR/UWRL library has been integrated with the main university library to make UCWRR/UWRL publications and holdings more widely available to users across the campus and throughout the state. The UWRL is involved in efforts to increase the amount of water research information available to the general public. The UWRL World Wide Web (WWW) pages (<http://www.engineering.usu.edu/uwrl>) include information on UWRL staff and full text of major publications. It is easy for users to download and print the information they are looking for. Currently we have provided links to The Utah Water Atlas, which is a comprehensive work covering all aspects of water in the State of Utah. Users are able to quickly link to our experts and obtain information on issues of interest using our searchable database publications and reports.

2.2 Program Management/Coordination Administration of the Section 104 program in FY 98 (UWRL FY 99) involved the UCWRR Director, Dr. Ronald C. Sims; UCWRR Associate Director, Upmanu Lall; UCWRR Administrative Assistant, Jan Urroz; UCWRR Information Dissemination Coordinator, Ivonne Harris, and the UCWRR Business Office Supervisor, Tamara Peterson, and her staff. Coordination activities can be divided into state, regional, and national activities. At the state level, we administer the Section 104, Program, publish an annual report that summarizes UCWRR research, co-sponsor the Utah Section AWRRA Annual Meeting, and keep UCWRR associates informed through various mailings. At the regional level, the UCWRR Director participates in meetings of the Powell Consortium of Water Research Institutes in the Colorado River Basin states. The UCWRR Director also participates as a member of the Lake Powell Technical Advisory Committee composed of representatives of the State of Utah, State of Arizona, and the National Park Service. At the national level, the UCWRR Director participates in the National Institutes for Water Resources (NIWR) Annual Meeting and either the Director or the Associate Director attends the Annual Meeting of the Universities Council on Water Resources Research (UCOWRR).

2.3 Individuals Cooperating in Program Development

Utah Water Research Laboratory and Utah Center for Water Resources Research Ronald C. Sims, Director Upmanu Lall, Associate Director (on Sabbatical September, 1999 - August, 2000) Mac McKee, Acting Associate Director (September, 1999 - August, 2000) R. Ryan Dupont, Head, Environmental Division Steve Iverson, Manager, Utah On-Site Wastewater Treatment Training Center David G. Tarboton, Head, Water Division Geoffrey G. Smith, Manager, International Office for Water Education

Utah State University Water Resources Research Council A. Bruce Bishop, Dean, College of Engineering (Chair) Ronald C. Sims, Director, Utah Water Research Laboratory/ Utah Center for Water Resources Research Rodney J. Brown, Dean, College of Agriculture Fee Busby, Dean, College of Natural Resources Peter F. Gerity, Vice President for Research James A. MacMahon, Dean, College of Science Brian L. Pitcher, Dean, College of Humanities, Arts, and Social Sciences H. Paul Rasmussen, Director, Agricultural Experiment Station Martyn Caldwell, Director, Ecology Center

Representatives from Other Utah Universities Danny Vaughan, Weber State University Larry DeVries, University of Utah A. Woodruff Miller, Brigham Young University

3.0 Research Project Synopses

There were no projects funded during this reporting period.

Information Transfer Program

4.0 Information Transfer Activities

To promote the application and dissemination of current, past, and related research results, the following principal activities were carried out during the fiscal year. **4.1 Formal Gatherings** Each fall, the UWRL participates in the Governor's Banquet on Water Education that is held in Salt Lake City, Utah. To promote K-6 water education throughout the state, the UWRL and the Department of Water Resources conduct a poster contest among students at elementary schools to reinforce the statewide program of in-service training and to support water education in the elementary schools. The following workshops have been conducted by UWRL Faculty:

- "Quantitative Evaluation of Natural Attenuation Processes for Site Remediation." This five-day workshop is taught each summer to provide participants with tools for the quantitative description of natural attenuation processes taking place in contaminated groundwater and soil systems. Basic principles of groundwater movement, sorption, biodegradation, field sampling and analysis, and fate and transport modeling were provided, and classroom instruction was augmented with hands-on computer laboratory sessions and field sampling activities. Individuals that participated in this workshop represented state and federal environmental regulatory agencies, Department of Defense site management personnel, private consulting firms, USU environmental engineering and water resources graduate students, and USU faculty members.
- "On-Site Wastewater Treatment Training." Over 200 people in Utah received training regarding important site characterization information that is necessary to select sites, size systems, and protect public health. These training workshops were offered across the State of Utah.

4.2 Principal Information Transfer Publications Principal information transfer items include the *Comprehensive Water Education Grades K-6* manual (several thousand copies of the manual have been distributed throughout the country), newsletters addressing the on-site wastewater issues, and a Mineral Lease Report to the Utah Office of the Legislative Fiscal Analyst. UWRL's International Office for Water Education (IOWE) produced and distributed a regional water education calendar to elementary schools in Arizona, California, Colorado, Nevada, New Mexico, Wyoming, Alaska, Hawaii, Idaho, Montana, Oregon, and Washington. The calendar featured the winning posters from the K-6 poster contests conducted in the seven Colorado River and Columbia River states. It also included lessons, questions with answers, and facts about water. A separate water education calendar was produced and distributed to all elementary school classrooms in Utah. UWRL has prepared two water education manuals for elementary school teachers. More than 20 in-service workshops were conducted. Preservice training workshops were completed at universities throughout the state. The Program is expanding into other states. More than 200 elementary school teachers received water related training through UWRL/UCWRR-sponsored credit workshops.

4.3 Professional Publications Technical publications in FY 98 (UWRL FY 99) that were partially supported by the cooperative program described in this report are listed below. Other publications from the Utah Water Research Laboratory appear regularly as technically reviewed project reports, professional journal articles, other publications and presentations, theses and dissertation papers presented at conferences and meetings, and project completion reports to other funding agencies. *Mineral Lease Fund Report* (1998). Utah State University, Logan, UT. Sims, J.L. (1998-1999). *Utah Watch* (Volumes 1-4). The newsletter addressing on-site wastewater treatment issues in Utah. Utah Water Research Laboratory, Utah State University, Logan, UT. Sims, J.L. and M. Cashell (1998-1999). *On-Site Wastewater Treatment--Site Characterization*. Utah Water Research Laboratory, Utah State University, Logan, UT. Smith, G.G. (1999). *Utah Water Education Calendar*. International Office for Water Education, Utah Water Research Laboratory, Utah State University, Logan, UT. Smith, G.G. (1998-1999). *Powell States and Columbia Water Education Calendar*. International Office for Water Education, Utah Water Research Laboratory, Utah State University, Logan, UT. Smith, G.G. (1999). *Substitute Teacher Handbook (Elementary Edition)*. International Office for Water Education, Utah Water Research Laboratory, Utah State University, Logan, UT. Smith, G.G. (1999). *Substitute Teacher Handbook (Secondary Edition)*. International Office for

Water Education, Utah Water Research Laboratory, Utah State University, Logan, UT.

5.0 Cooperative Arrangements

The UCWRR maintains a List of Center Associates and distributes mailings on research opportunities to faculty on the campuses of Utah State University, the University of Utah, Brigham Young University, and Weber State University. Program coordinators have long been established on each campus. The UCWRR/UWRL works with the regional group of Center Directors (Powell Consortium of Water Institute Directors, in Arizona, California, Colorado, Nevada, New Mexico, and Utah) in maintaining a current statement of regional research priorities and developing collaborative research of regional significance. Also UCWRR/UWRL participates in annual National Institutes for Water Resources (NIWR) and Utah State University Water Resources Research Council meetings. The UCWRR interacts with federal (National Forest Service, U.S. EPA), and state agencies (Utah DEQ, DNR, Water Rights) involved in water resources planning and management, water quality control, and environmental protection. The research response to state needs is coordinated with other universities through established interactive and iterative processes. The UCWRR/UWRL's current cooperative studies with governmental agencies and private sector firms include: 1) a research agreement with the United States Department of Agriculture - Agricultural Research Service on *Scaling up spatially distributed models of arid water sheds*; 2) an agreement with U.S. Department of the Interior - Fish and Wildlife Service on *Habitat and flow requirements study for the Comal Ecosystem*; 3) research agreement with U.S. Department of the Interior - Bureau of Reclamation on *Study of water yields on semi-arid environments under projected climate change and impact of global climate change on urban water demand*; 4) joint effort with U.S. Bureau of Reclamation, State of Utah, Division of Water Quality, and Weber Basin Water Conservancy District on *Weber Basin water quality study*. In addition, several faculty have worked on IPAs with National Science Foundation, Hill Air Force Base, and U.S. Army Corps of Engineers. Other cooperative arrangements were: 1) U.S. Department of the Interior - Geological Survey on *Distribution of Water Education Calendars to Students*; 2) with Utah State Board of Regents and various Utah school districts on *Retraining Teachers in Science and Math Using Water Concepts*; 3) with Utah Department of Environmental Quality on *On-site Wastewater Treatment-Site Characterization*; 4) with U.S. Department of the Interior - Bureau of Land Management on *Seasonal Use of the Virgin River Gorge by Protected Fish*; 5) with Utah Division of Water Rights on Poster Contest and *Teacher Inservice/Assemblies/Classroom Demonstrations*; 6) with U.S. Department of Agriculture - Agricultural Research Service on *Water Quantity and Quality Analysis of Mining Areas Located Within Wasatch Plateau of Central Utah*; 7) with Department of Natural Resources - Utah Division of Water Resources, U.S. Department of the Interior - Bureau of Reclamation, and Cache County Commission on *Cache County Municipal Water Demand Model*; and 8) with Utah Department of Environmental Quality - Division of Solid and Hazardous Waste on *Training Sessions for DEQ's Division of Solid and Hazardous Waste*.

USGS Internship Program

Student Support

Awards & Achievements

6.0 Notable Achievements

- The Utah Training Center for On-Site Wastewater Treatment was awarded to the UCWRR/UWRL by the Utah Department of Environmental Quality (UDEQ), Water Quality division to assist the local health departments and others with a stake in on-site treatment systems to improve site selection and performance, and to improve protection of public health and the environment.
- The UWRL was awarded a \$2 million competitive contract from the Idaho National Engineering and Environmental Laboratory (INEEL) for research development, and technology transfer related to water resources planning and management at the river-basin scale. The project involves the development and

implementation of a user-driven decision support system for water resources development.

- Dr. William J. Doucette was nominated and appointed to the Utah Hazardous Waste Management Board by the Governor of the State of Utah.
- The UCWRR Director, Dr. Ronald C. Sims, was nominated and appointed to a second term on the Utah Water Quality Board by the Governor of the State of Utah.

Publications from Prior Projects

Articles in Refereed Scientific Journals

Book Chapters

Dissertations

Water Resources Research Institute Reports

Conference Proceedings

Other Publications