



# **EPA's Center for Ground-Water Research**

**Robert S. Kerr  
Environmental Research Laboratory**

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## *Past • Present • Future*

**E**nactment of the Federal Water Pollution Control Act in 1961 provided for the construction of a number of laboratories to combat increasing water pollution problems nationally. One of these was placed in Ada, Oklahoma. It was named for Robert S. Kerr, a long time U.S. Senator from the State, in honor of his dedication and concern for the conservation and development of our natural water resources and his pioneering legislation in environmental protection.

Initially the Laboratory provided technical assistance, presented training, and conducted research to solve water pollution problems indigenous to the states of Arkansas, Louisiana, New Mexico, Oklahoma, and Texas. In 1970 its role was expanded and it became one of fifteen research laboratories administered through the EPA's Office of Research and Development in Washington. In 1979 the Robert S. Kerr Environmental Research Laboratory (RSKERL) was designated as EPA's center for ground-water research by the Assistant Administrator of the Office of Research and Development.

Today the Laboratory focuses its activities on both research and technical assistance in the broad areas of ground-water protection and reclamation. Major research initiatives include understanding and expressing mathematically the physical, chemical, and biological processes which control the transport and transformation of contaminants in the subsurface environment. Parallel efforts are under way in wellhead protection and underground injection control research, as well as the treatment of hazardous wastes using soil and other natural systems.

Technical assistance at RSKERL falls within the purview of the Technology Support Center which carries out its mission in close association with the Laboratory's research scientists. Assistance is provided by direct participation in field investigations and decision making at specific Superfund and RCRA sites. Technology transfer endeavors include issue papers and briefing documents, workshops, seminars, conferences, and training courses.

While many inroads have been made toward the solution of environmental problems, new challenges are now in evidence for which there are no immediate answers. In addition to the myriad of hazardous waste sites which have contaminated the subsurface environment, other industrial, agricultural, and domestic practices graphically illustrate a lack of knowledge concerning the disposal of waste products and the protection of ground-water quality.

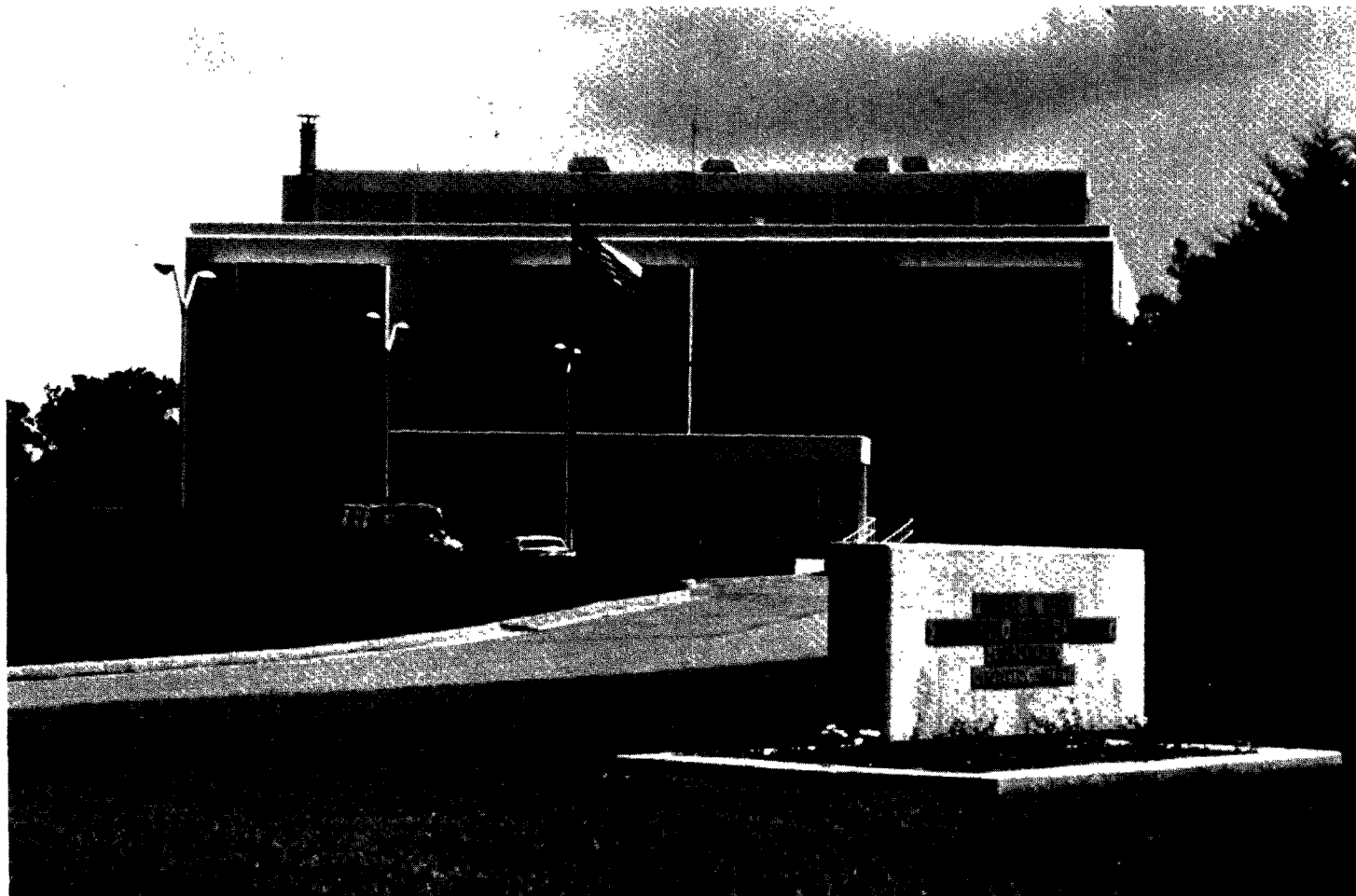
The future holds an increasing need for research related to the development of technology which allows for the environmentally safe disposal of waste products, as well as methods which assure a lasting and economically feasible remediation of sites where contamination has already occurred. Because of the RSKERL history and experience in ground-water and wastewater management research, it will remain in the forefront of technology development in this area for many years into the future. Due to the diverse skills and dedication of its personnel, the availability of unique field and laboratory facilities, and an association with scientists throughout the world, RSKERL maintains an exceptional capability for meeting the environmental challenges of the future.

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**Robert S. Kerr Environmental Research Laboratory  
P.O. Box 1198, Ada, Oklahoma 74820  
(405) 332-8800/FTS 743-2011**

**U.S. Environmental Protection Agency  
Room 5, Library (PL-12J)  
1200 North Dearborn Street, 12th Floor  
Chicago, IL 60604-3590**



# *RSKERL Milestones*

**1961**

Federal Water Pollution Control Act established Regional Water Quality Laboratories.

**1966**

Dedication of RSKERL with a mission to provide technical assistance and training, and to conduct research indigenous to the states of Arkansas, Louisiana, New Mexico, Oklahoma, and Texas.

**1970**

RSKERL became National Research Laboratory administered by EPA's Office of Research and Development in Washington, D.C.

**1979**

RSKERL named EPA's Center for Ground-Water Research.

**1979**

National Center for Ground-Water Research, composed of the University of Oklahoma, Oklahoma State University, and Rice University, was founded to work with RSKERL in conducting long-range exploratory research addressing the Nation's emerging ground-water problems.

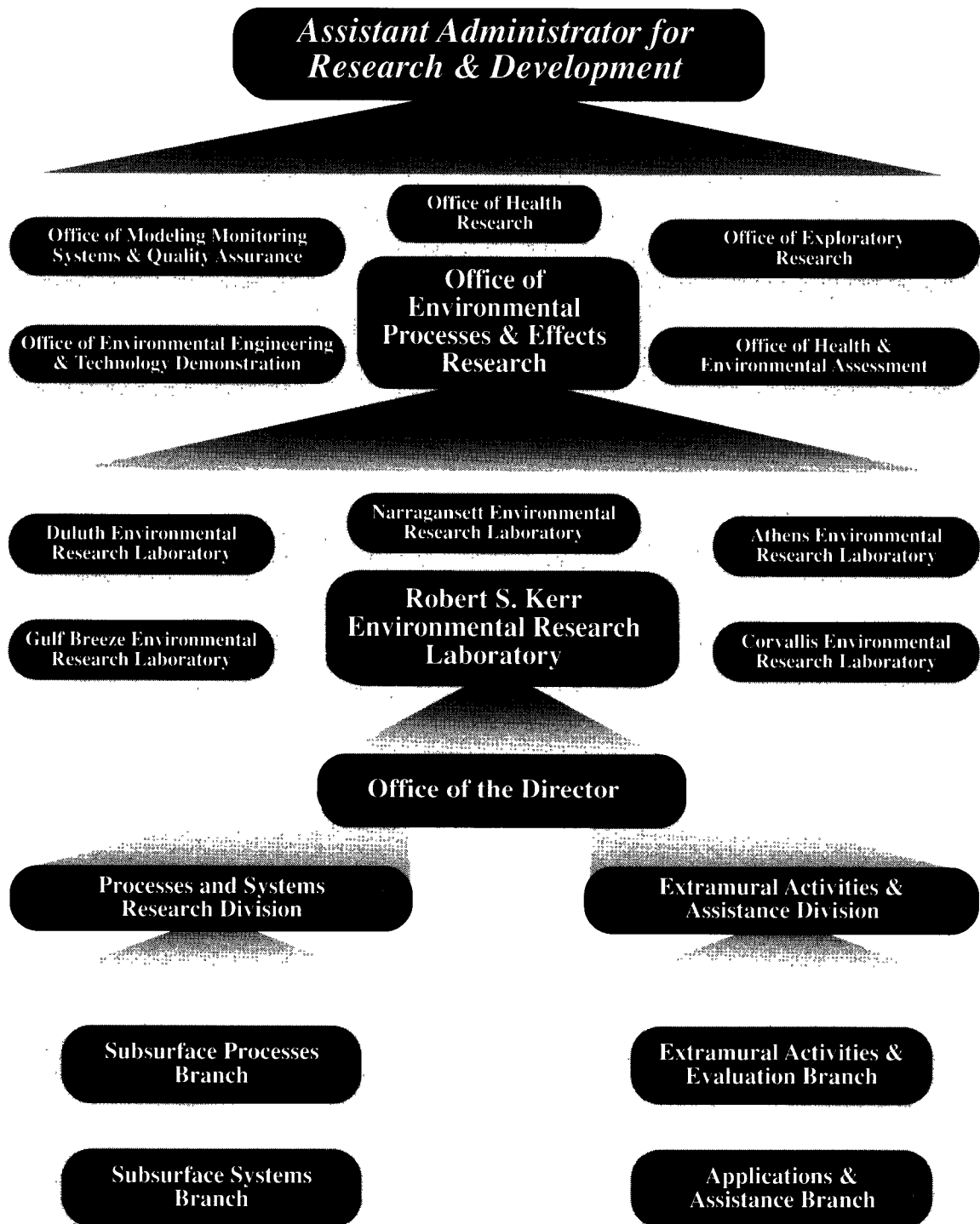
**1979**

Established the International Ground-Water Modeling Center which is now an integral part of the RSKERL Center for Subsurface Modeling Support (CSMoS).

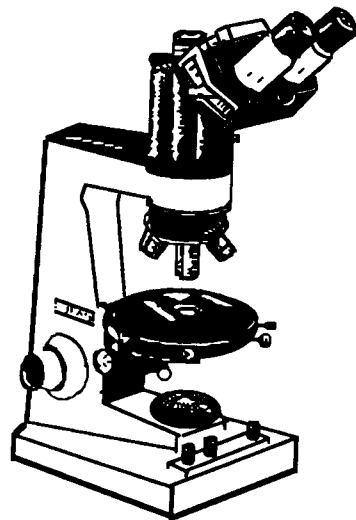
**1988**

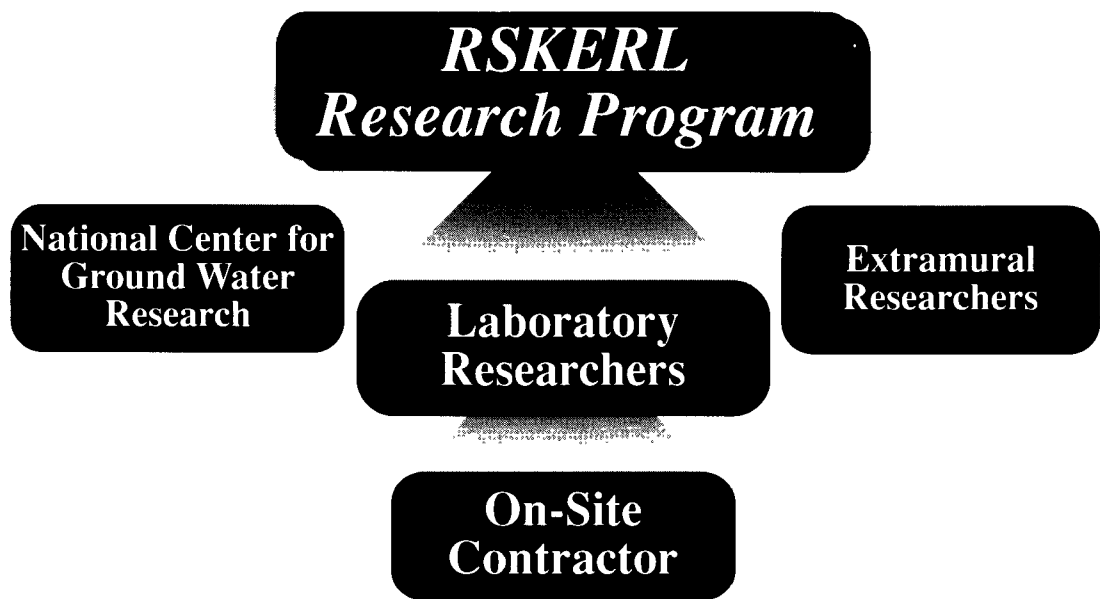
Established RSKERL Technology Support Center.

# Organization



# RSKERL Research Program



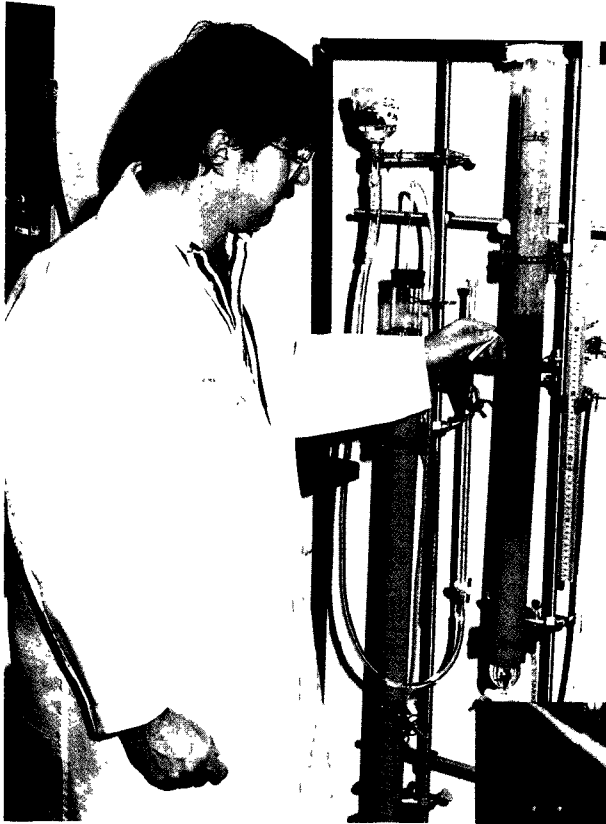




**T**he Robert S. Kerr Environmental Research Laboratory (RSKERL) serves as the Environmental Protection Agency's center for ground-water research, focusing its efforts on investigations related to the transport and transformation of contaminants in the subsurface, the development of methods and techniques directed toward the protection and restoration of ground-water quality, and evaluating the applicability and limitations of using natural soil and subsurface processes for the treatment of hazardous wastes. Other active areas of research include: Site characterization to assist in decisions concerning risk assessment and remediation; underground injection control; and wellhead protection.

The Laboratory has a long history of conducting basic and applied research related to the use of soil and subsurface media for waste treatment, and the protection of surface and ground water. In addition to its research on ground-water quality protection and restoration, RSKERL has historically been at the vanguard in developing and demonstrating cost-effective treatment technologies for municipal, industrial, and agricultural wastes.

RSKERL carries out its research responsibilities through in-house projects as well as cooperative efforts with other EPA laboratories, universities, national research laboratories, state organizations, and a number of other federal agencies including the Department of Defense.



## *Active Program Areas*

- Site Characterization
- Contaminant Transport and Transformation
- Subsurface Remediation
- Underground Injection Control
- Wellhead Protection
- Mathematical Modeling

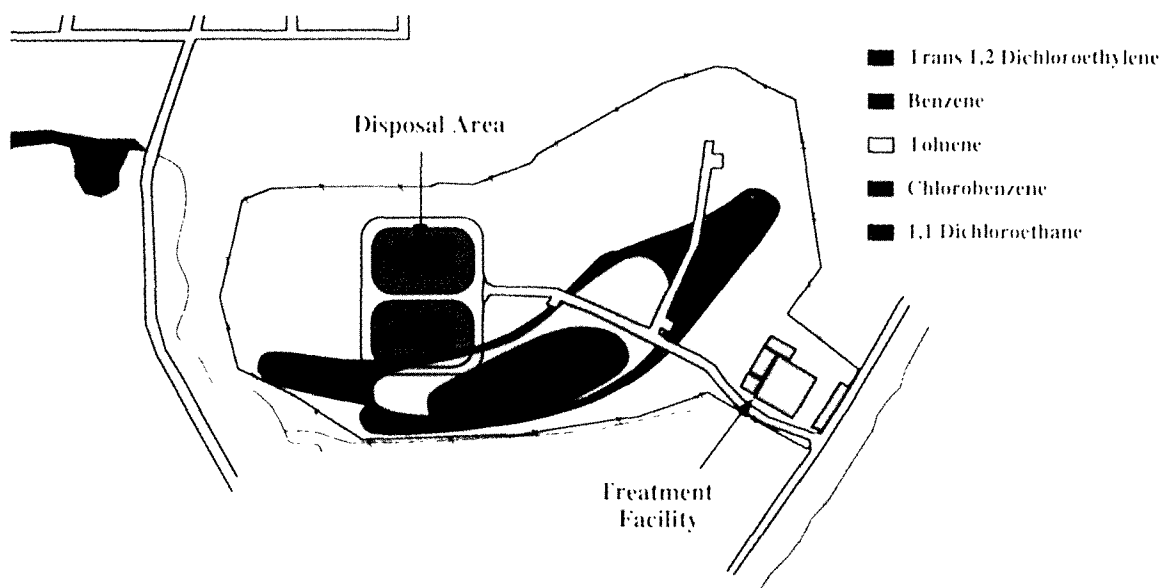


## *Unique Research Facilities*

- Modern Analytical Equipment
- Injection Well Research and Training Facility
- Large Aquifer Models
- Drilling and Coring Equipment
- Soil Sampling Equipment
- Subsurface Microcosm Research Systems
- Logging and Aquifer Testing Equipment
- Geographic Information Systems (GIS)

## Site Characterization

Site characterization research is conducted in order to improve the ability to assess risks associated with a contaminated site, evaluate the need for corrective action, and select, as well as evaluate the effectiveness of proper remediation technologies. Exposure assessments must be based on an awareness of the geologic, hydrologic, geochemical, chemical, and biological characteristics of the site. Research in this area is aimed at the development of methods of investigation and interpretation in order to determine the parameters which describe a site and define their spatial distribution.





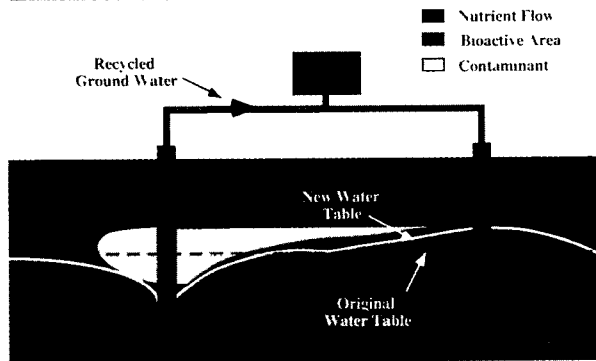
## *Contaminant Transport and Transformation*

Research is aimed at describing the hydrologic, abiotic, and biotic processes which influence contaminant transport and transformation characteristics in the subsurface environment. As in other areas of research, many transport and transformation studies are carried out in concert with universities and other research institutions.

## Subsurface Remediation

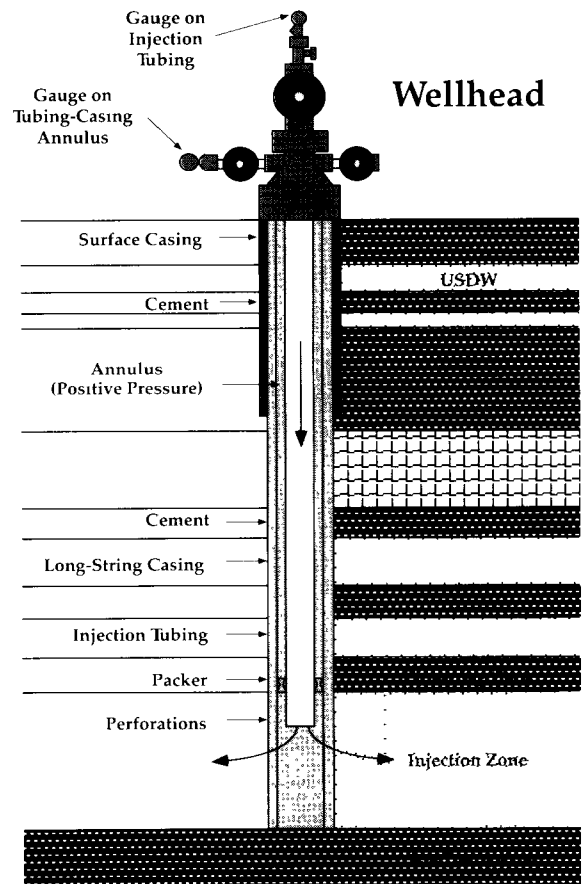
In addition to developing technologies which protect and restore the subsurface environment, research in this area must assure that such methods are cost effective without being unnecessarily complex, and do not unduly restrict other land use activities.

### Enhanced Bioreclamation



## Underground Injection Control

Research in support of the Underground Injection Control Program is directed at developing methods to assure the mechanical integrity of the injection well itself, and that wastes remain in the zone of injection. Research is also aimed at determining the fate of wastes that enter the injection zone.





## Wellhead Protection

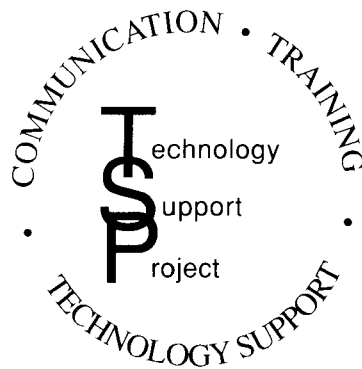
The 1986 Amendments to the Safe Drinking Water Act require the delineation of protection areas around public water wells to protect water systems. RSKERL is conducting research to advance the fundamental scientific knowledge of subsurface processes, develop new wellhead protection methods, and provide technical assistance on basic scientific and engineering wellhead protection issues. The audiences for research results are EPA's Regional Offices, state and local officials, and public water suppliers.

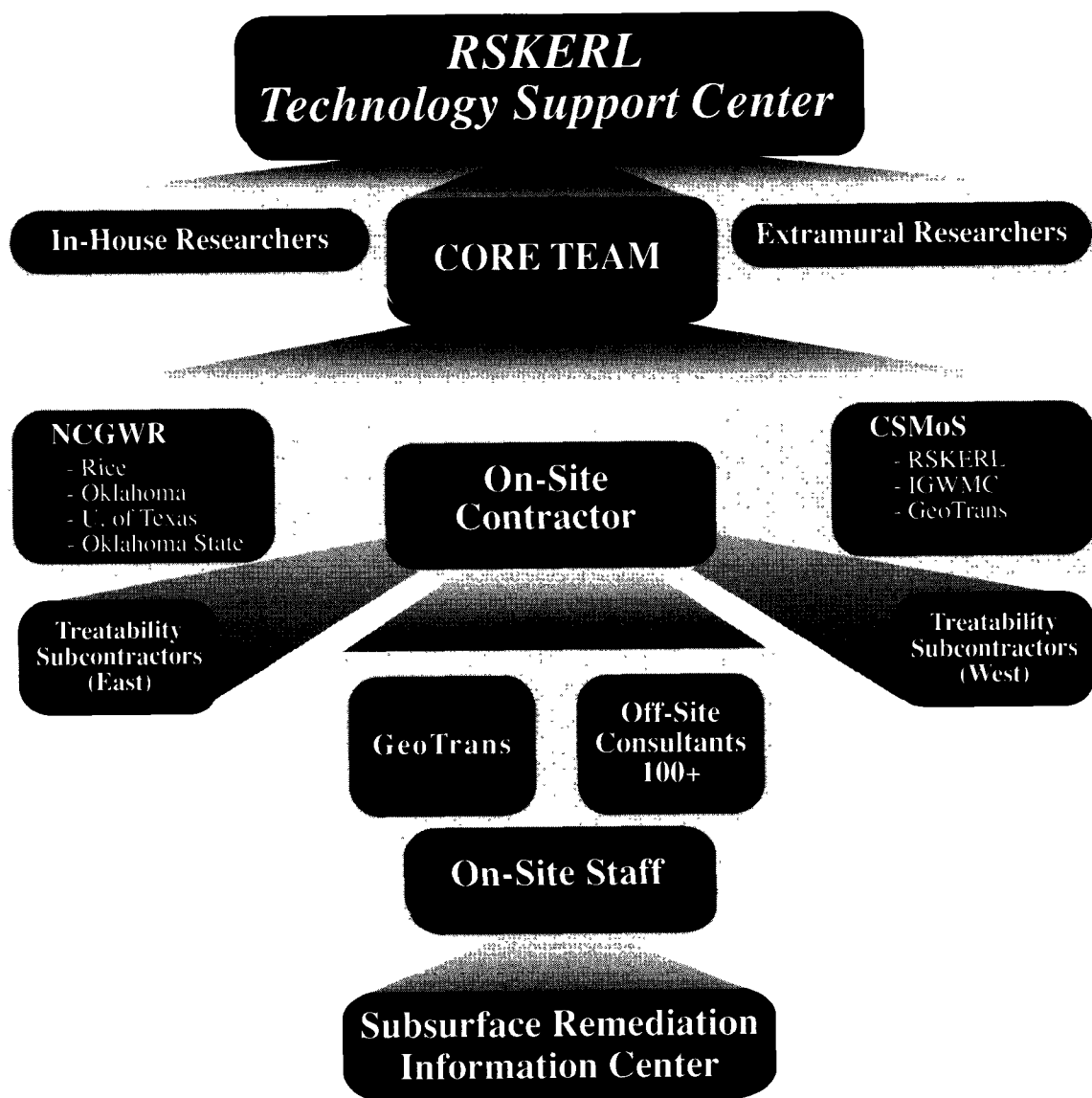
## Mathematical Modeling

RSKERL scientists are developing and testing a variety of mathematical models that describe and predict contaminant transport in porous and fractured media under a variety of conditions from biodegradation to immiscible flow. From planning and evaluating remediation scenarios to identifying wellhead protection areas and permitting injection wells, mathematical modeling is becoming an increasingly important tool in Agency decision making.

$$\begin{aligned} & \frac{\partial(\theta\rho_a C_a)}{\partial t} + \frac{\partial(\theta\rho_o C_o)}{\partial t} + \frac{\partial(\eta\rho_v C_v)}{\partial t} + \frac{\partial(\rho_s C_s)}{\partial t} = \\ & D_a \frac{\partial^2(\theta\rho_a C_a)}{\partial x^2} + D_o \frac{\partial^2(\theta\rho_o C_o)}{\partial x^2} + D_v \frac{\partial^2(\eta\rho_v C_v)}{\partial x^2} - V_a \frac{\partial(\theta\rho_a C_a)}{\partial x} - V_o \frac{\partial(\theta\rho_o C_o)}{\partial x} \\ & - V_v \frac{\partial(\eta\rho_v C_v)}{\partial x} - k_{ta}\theta\rho_a C_a - k_{to}\theta\rho_o C_o - k_{tv}\eta\rho_v C_v - k_{ts}\rho_s C_s \end{aligned}$$

# RSKERL Technology Support Center







**A**pplying research results through technical assistance on a variety of environmental issues has been a tradition at the RSKERL since its beginning in 1965. Even though the Laboratory gained a national and international reputation for its research, it was not until 1986 that events occurred which led to a structured program in technical assistance and made it an integral part of the Laboratory's activities, particularly with regard to the remediation of soil and ground water at hazardous waste sites.

Following the Superfund Amendments and Reauthorization Act of 1986, Regional decision makers, charged with administering cost-effective and permanent restoration technologies at Superfund sites, quickly became overburdened by the technical complexity of this responsibility. Informed decisions concerning soil and ground-water remediation require a broad, interdisciplinary, state-of-the-science level of expertise in a rapidly developing and complex environmental field.

In 1987, in order to make EPA's Office of Research and Development scientists more accessible to Regional decision makers, the Office of Solid Waste and Emergency Response (OSWER) provided direct funding to ORD laboratories in Las Vegas, Cincinnati, Athens, and Ada to establish Superfund Technology Support Centers.

The RSKERL Technology Support Center consists of a Core Team of scientists and engineers supported by RSKERL in-house and extramural researchers, the National Center for Ground Water Research, the RSKERL Center for Subsurface Modeling Support, and an on-site technology support contractor with off-site subcontractors and consultants.

In addition to Superfund which remains the major client, the RSKERL Technology Support Center provides assistance to Headquarters and to Regional and State personnel responsible for RCRA Corrective Action, Underground Storage Tank, Pesticides, and the Underground Injection Control Programs. These activities not only provide a "real world" testing ground for research results but aid RSKERL scientists in focusing on high priority research needs.

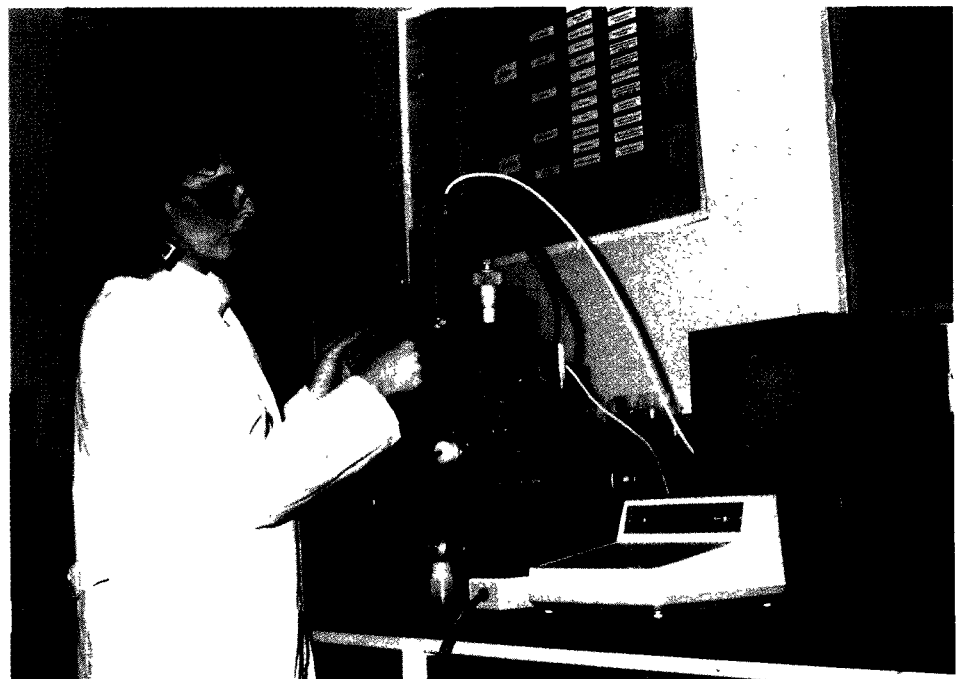


## *RSKERL Technology Support Core Team*

RSKERL scientists and engineers in the Applications and Assistance Branch provide a readily available source of interdisciplinary support along with the skills of Laboratory researchers and an on-site contractor with its cadre of consultants and subcontractors.

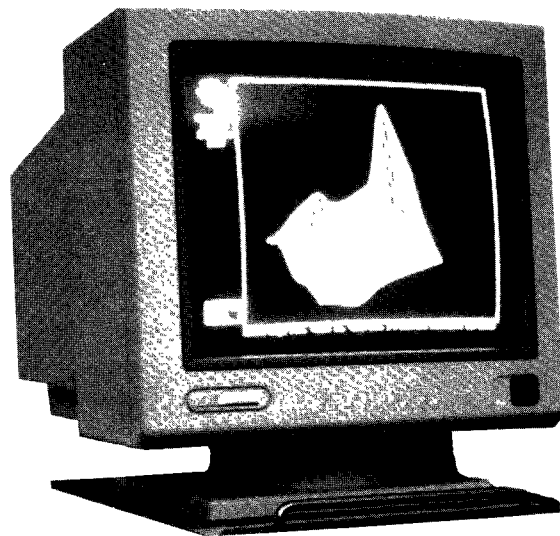
## *RSKERL Research Program*

In-house scientists and engineers at the Laboratory provide the technical base for the Technology Support Center along with associates in universities and other research institutes.



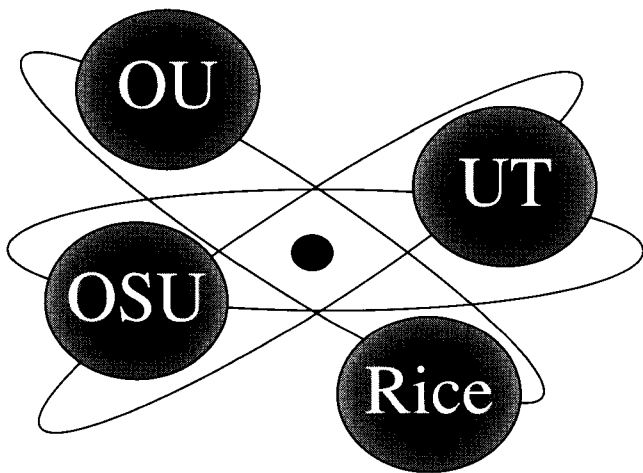
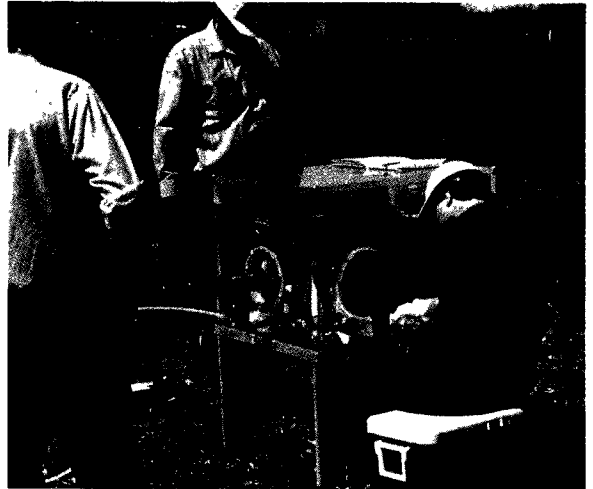
## *Center for Subsurface Modeling Support (CSMoS)*

CSMoS distributes and services all RSKERL developed models and software, and provides assistance and training on modeling applications to the ground-water and vadose zones of the subsurface. CSMoS is composed of RSKERL scientists and is supported by the International Ground Water Modeling Center (IGWMC), the National Center for Ground Water Research, and a number of ground-water modeling consultants.



## *On-Site Contractor*

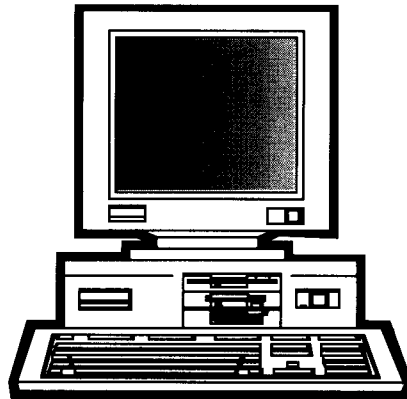
The RSKERL on-site contractor, along with over 100 of its consultants and subcontractors, provides support to the Core team, carries out information transfer activities, and houses the Subsurface Remediation Information Center.



## *National Center for Ground Water Research*

The Center, a consortium of Oklahoma, Oklahoma State, and Rice Universities, and more recently the University of Texas at Austin, develops and conducts long-range exploratory research to address new challenges in ground-water protection and restoration.

# Technical Assistance Provided





## *Site Specific Assistance*

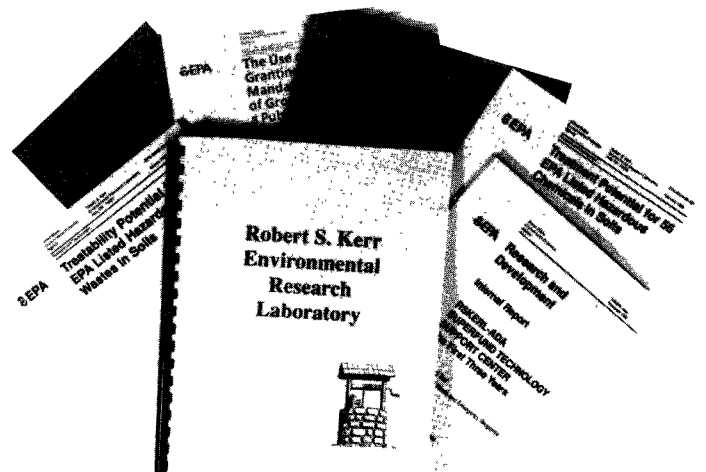
In its first three years, the RSKERL Technology Support Center provided assistance in all ten EPA Regions at more than 130 Superfund Sites primarily in the areas of site characterization, groundwater modeling and bioremediation, soil

venting, and pump-and-treat remediation technologies. While some requests for assistance involve short term reviews of technical documents, others result in extensive field and laboratory investigations and treatability studies.

## Technology Transfer

Technology transfer activities may be carried out without specific requests or in response to generic needs suggested by the Regions or Headquarters. They often take the form of:

- Issue Papers
- Briefing Documents
- Workshops
- Seminars and Conferences
- Training Courses



## Subsurface Remediation Information Center

The Subsurface Remediation Information Center provides a forum for the rapidly developing, highly specialized information in the scientific arena. Activities are conducted toward developing, collecting, evaluating, coordinating, and disseminating information relating to the transport and fate of contaminants in soil and ground water. In addition, the Subsurface Remediation Technology data base provides site specific information concerning contaminants and remediation activities at existing hazardous waste sites.



for Sites.		
Proceed	Site name Remediation used at the site Contaminants occurring at site Firm associated with this site Article(s) referring to the site City County State EPA region Remedial Project Manager (RPM) Phone number of RPM On-scene coordinator (OSC) Phone number of OSC	Equals Contains Sounds Like Does not equal Does not contain
		And Or Done
Select all records where [site name] equals Landfill		