United States
Environmental Protection
Agency

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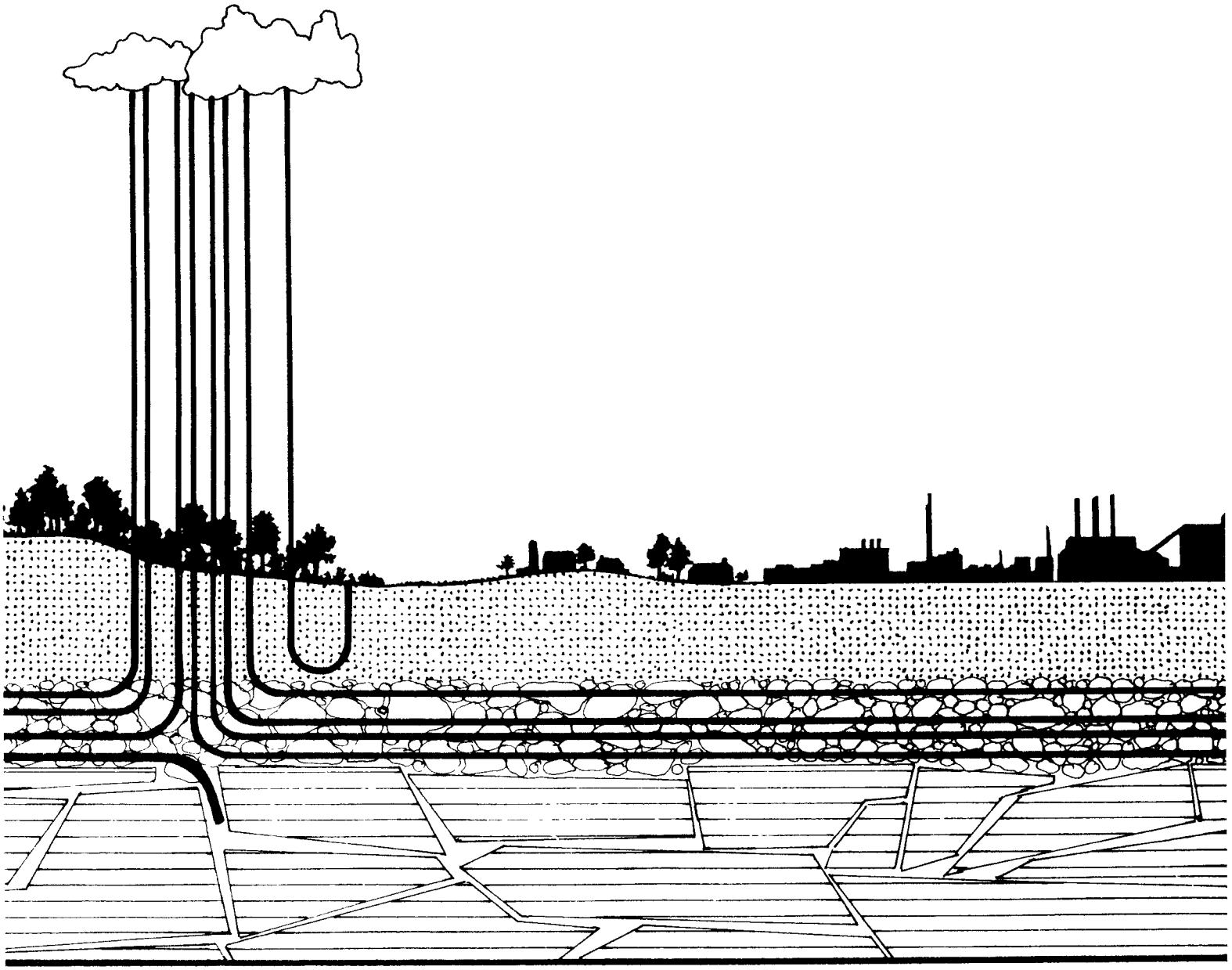
March 1987

EPA

Technical Assistance Directory

Ground-Water Research



EPA/600/9-87-008

GROUND-WATER RESEARCH
Technical Assistance Directory

Prepared for the

Office of Research and Development
Office of Environmental Engineering and Technology Demonstration
U.S. Environmental Protection Agency
Washington, D.C. 20460

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March 27, 1987

NOTICE

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1. INTRODUCTION

This Directory is intended to foster communication with appropriate scientists and engineers throughout EPA's Office of Research and Development (ORD) and EPA, state, and local personnel involved in the protection and management of ground-water resources. In addition to listing ORD researchers by location and subject matter, the Directory provides brief organizational descriptions of the ground-water research programs for each office. These organizational descriptions may aid in locating assistance in areas not covered by the subject indices. Chapter 6 contains an annotated bibliography of selected ground-water publications considered to be essential references for permitting and other regulatory personnel.

ORD's ground-water research program, reflecting the information needs of EPA's operating programs, consists of five elements:

- *Source control.* Control of discharges, leaks, and other surface and underground contaminant sources to prevent ground-water contamination, including regulated hazardous waste disposal sites, unregulated dump sites, underground tanks, and accidental spills.

- *Transport and fate.* The physical movement of ground water in the saturated and unsaturated zones and also the change in ground-water quality either through natural degradation or differential transport rates.

- *Monitoring.* Well-placement and sampling of the subsurface environment to locate and characterize potential or known ground-water contamination.

- *On-site and in-situ aquifer cleanup.* Restoring a polluted aquifer through physical removal, chemical treatment, and enhanced biodegradation.

- *Technical assistance and technology transfer.* Preparation and dissemination of information about current research to decision makers, field managers, the regulated communities, and the scientific community.

EPA derives its statutory authority to protect ground water from the Clean Water Act, the Comprehensive Environmental Response, Compensation, and Liability Act (Superfund), the Safe Drinking Water Act, the Resource Conservation and Recovery Act, the Federal Insecticide, Fungicide, and Rodenticide Act, the Toxic Substances Control Act, the Hazardous and Solid Waste Amendments of 1984, and the Superfund Amendments and Reauthorization Act of 1986. In response to these broad statutory mandates, in 1984 EPA's Office of Ground-Water Protection developed a Ground-Water Protection Strategy to give the Agency's program a focus and direction. It has four components:

- Short-term build-up of institutions at the state level.

- Assessment of problems that may exist from unaddressed sources of contamination including leaking storage tanks, surface impoundments, and landfills.

- Issuance of guidelines for ground-water protection and cleanup.

- Strengthening EPA's organization to improve ground-water management at the headquarters and regional levels and EPA's cooperation with Federal and state agencies.

The scientists and engineers listed in this Directory conduct or manage research, development, demonstration, and technical assistance projects to support the regulatory programs of the Office of Water, the Office of Solid Waste and Emergency Response, and the Office of Pesticides and Toxic Substances. To ensure cross-office integration of research programs, ORD designated a Ground-Water Research Matrix Manager to coordinate ORD, Program Office, and Regional input on issues and priorities in the areas of prediction, monitoring, and cleanup. The

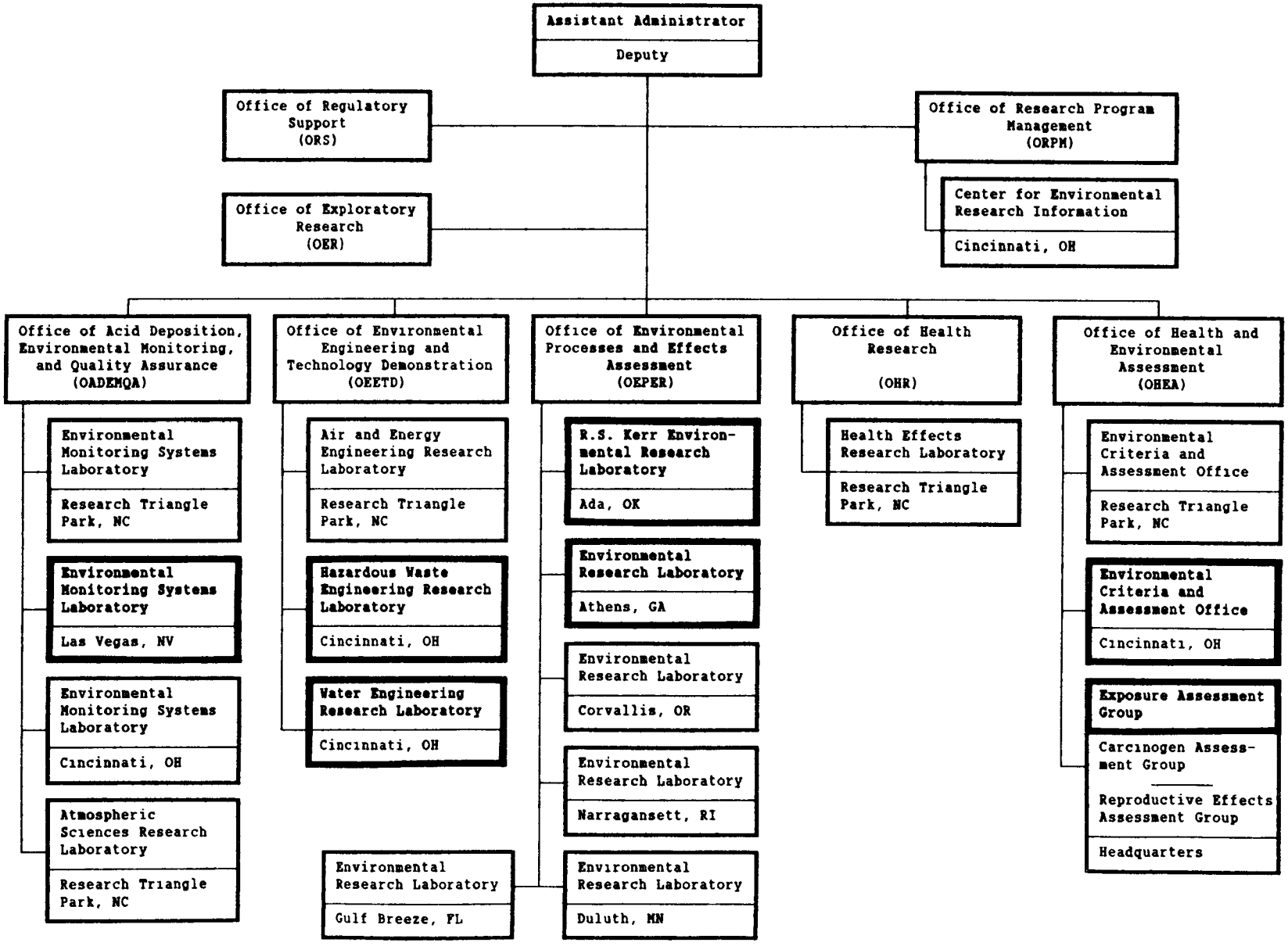
Matrix Manager supplements the Water and Hazardous Waste/Superfund Research Committees, which advise the Assistant Administrator for Research and Development on research and budget priorities.

Before calling technical assistance contacts listed in this Directory, interested persons should first become familiar with relevant publications listed in Chapter 6.

2. ORD GROUND-WATER RESEARCH FACILITY DESCRIPTIONS

OFFICE OF RESEARCH AND DEVELOPMENT

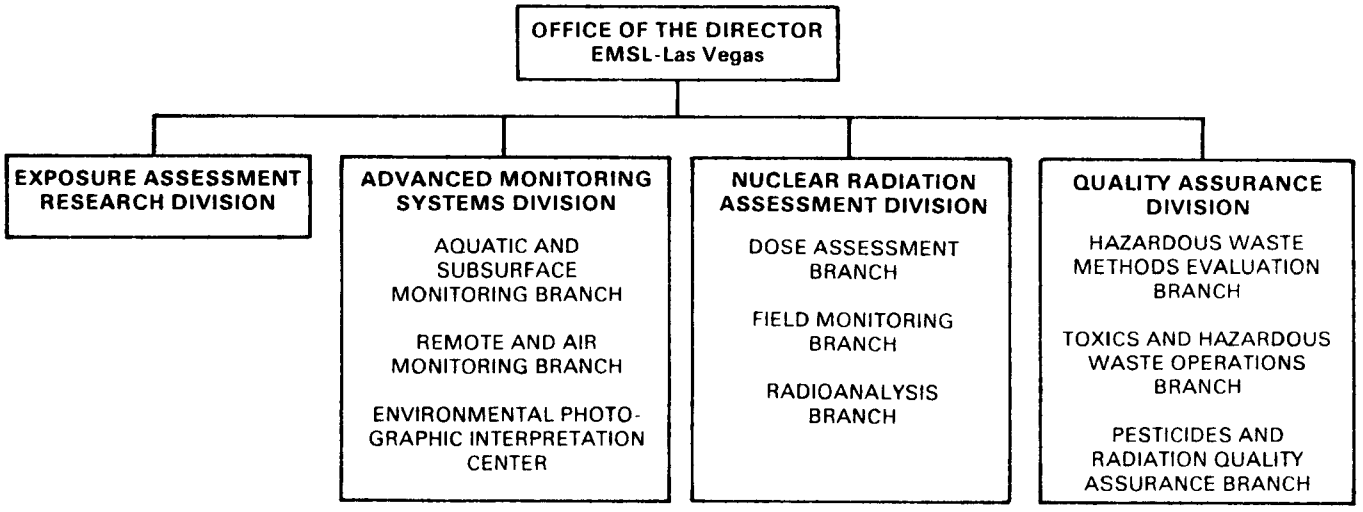
U.S. Environmental Protection Agency



Environmental Monitoring Systems Laboratory
Office of Acid Deposition, Environmental Monitoring, and Quality Assurance
U.S. Environmental Protection Agency
P.O. Box 15027, Las Vegas, Nevada 89114
FTS 545-2525, (702) 798-2525

The Aquatic and Subsurface Monitoring Branch of the Environmental Monitoring Systems Laboratory in Las Vegas (EMSL-LV) conducts ground-water monitoring research and technical assistance to support EPA operating programs. Ground-water related research includes:

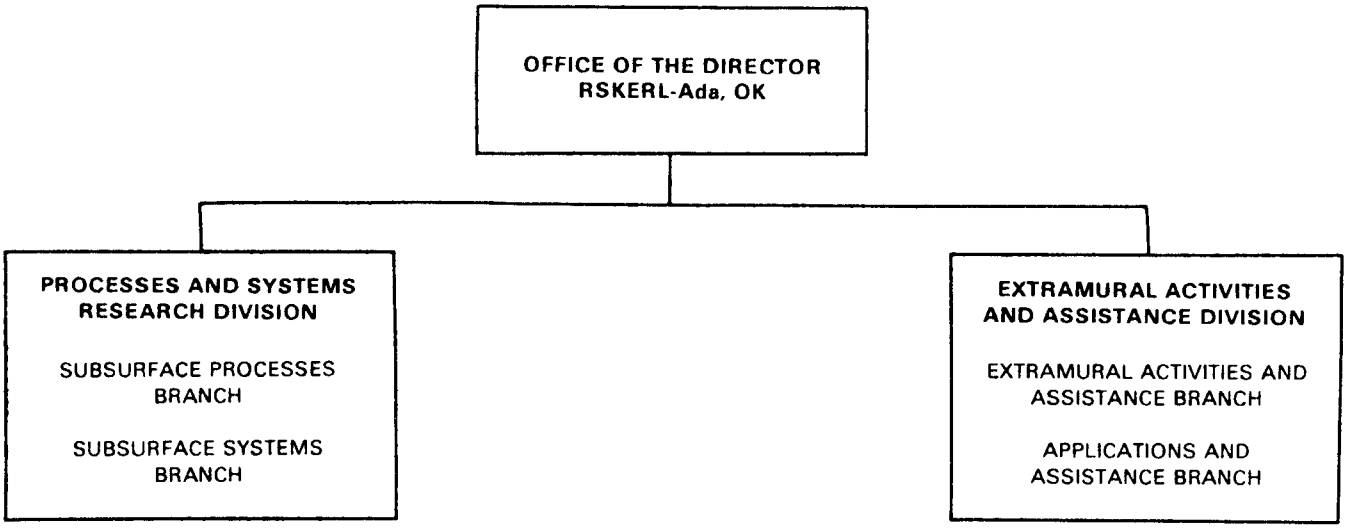
- Development, testing, and application of geophysical and geochemical techniques for detecting and mapping shallow contaminant plumes, locating abandoned wells, and mapping deeply buried contaminant plumes associated with injection wells.
- Development of advanced technologies, including laser-fluorescence spectroscopy, for *in-situ* ground-water contamination monitoring.
- Evaluation of indicator parameters for RCRA ground-water contaminant detection monitoring.
- Development of vadose zone monitoring technologies to detect percolation of pollutants from hazardous wastes.
- Evaluation of the influence of seasonal variability, well placement, spatial variability, and monitoring-well construction methods on water quality data from drinking water monitoring wells.
- Evaluation of underground storage tank external leak detection monitoring methods.
- Assistance to field teams in the use of geophysical methods in hazardous waste site investigations.



Robert S. Kerr Environmental Research Laboratory
Office of Environmental Processes and Effects Research
U.S. Environmental Protection Agency
P.O. Box 1198, Ada, Oklahoma 74820
FTS 743-2224, (405) 332-8800

The Robert S. Kerr Environmental Research Laboratory (RSKERL) is entirely devoted to ground-water research, concentrating on studies of the transport and fate of contaminants in the subsurface, development of methodologies for protection and restoration of ground-water quality, and evaluation of the applicability and limitations of using natural soil and subsurface processes for the treatment of hazardous wastes. The core of RSKERL's program is research into the hydrologic, biotic, and abiotic processes that govern the transport and fate of contaminants in the subsurface. This provides the scientific foundation for further application-oriented research in support of EPA operating programs. To promote the immediate needs of EPA operating programs, RSKERL:

- Determines the mechanical integrity of injection wells for the Underground Injection Control Program.
- Evaluates remediation technologies for the Office of Underground Storage Tanks.
- Develops technical information for the Office of Solid Waste land treatment permitting program.
- Provides evaluations and direct technical assistance for the Superfund program.
- Transfers technology by sponsoring technical training courses, conferences, and symposia.
- Supports the operations of the International Ground-Water Modeling Center at the Holcomb Research Institute in Indianapolis, Indiana; and the Ground-Water Information Center at the National Water Well Association in Dublin, Ohio.



Environmental Research Laboratory
Office of Environmental Processes and Effects Research
U.S. Environmental Protection Agency
College Station Road, Athens, Georgia 30613
FTS 250-3134, (404) 546-3134

The Athens Environmental Research Laboratory (ERL-Athens) conducts fundamental and applied research to assess the human and environmental risks associated with pollutants in water and soil ecosystems. Ground-water related research activities include:

- Identification and characterization of significant physical, chemical, and biological processes affecting ground water to facilitate the prediction of transformation products, the rate and extent of transport, and the distribution of pesticides, hazardous wastes, and their constituents in saturated- and unsaturated-soil environments.

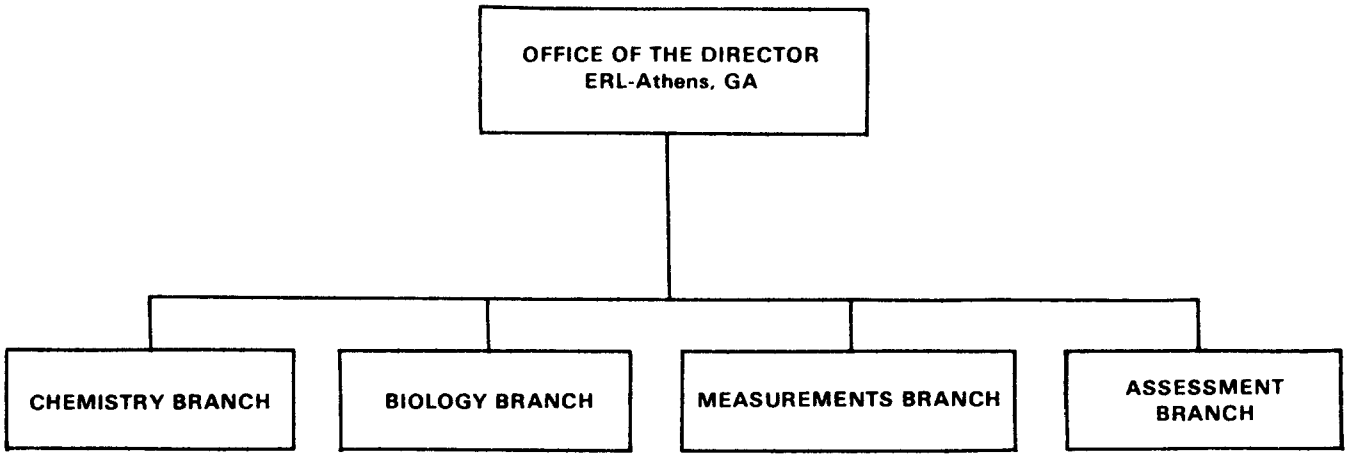
- Development of measurement protocols and data bases for chemical-specific properties, process-rate constants, and environmental properties that govern pollutant exposure, impact, and risk in soils and ground-water environments.

- Development of multimedia models and methods to predict the release, transport, and fate of pesticides, hazardous wastes, and toxic substances for the full range of exposure and risk assessment scenarios relevant to regulatory programs.

- Reduction of prediction uncertainties through field validations and the application of uncertainty-analysis techniques to developed models and methodologies.

- Multispectral identification of organic compounds that remain unidentified after application of conventional mass-spectrometric techniques.

- Technology transfer to communicate research results through workshops, publication of user's manuals, and distribution of user-friendly computer codes.



International Ground Water Modeling Center
Holcomb Research Institute, Butler University
4600 Sunset Ave., Indianapolis, Indiana 46208
(317) 283-9458

The International Ground Water Modeling Center (IGWMC), established at Holcomb Research Institute (HRI) in 1978, operates a clearinghouse for ground-water modeling software, organizes and conducts short-courses and seminars, and conducts a modeling research program to support the Center's technology transfer and educational activities. Partially supported through a Cooperative Agreement with EPA's Robert S. Kerr Environmental Research Laboratory, the Center provides assistance to federal and state agencies and private groups in organizing and conducting specially designed training programs. The Center's activities focus on:

- Collection and organization of information regarding ground-water models. Data bases compiled by the Center contain computer codes, test files, and descriptions of ground-water models.

- Distribution and support of ground-water modeling software, including model evaluation, code acquisition and implementation, code testing, preparation of documentation, and the development of code support capabilities.

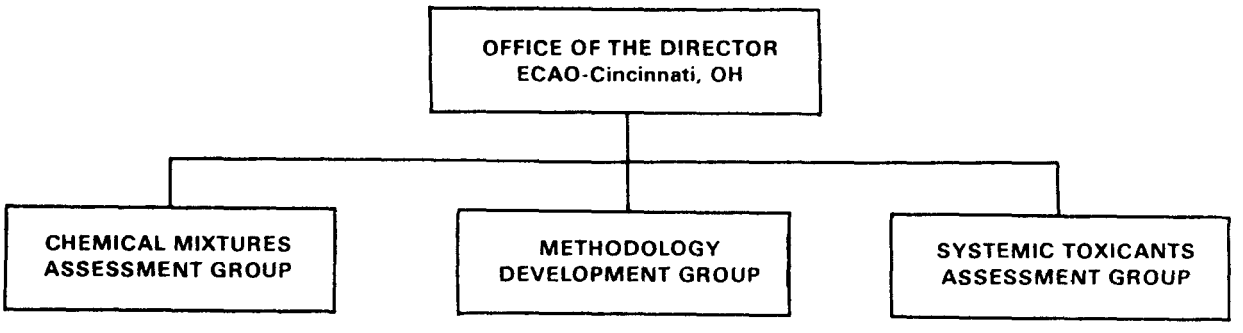
- Research and development in ground-water model screening and testing, evaluation of model uses and needs, software development and improvement, and reviews.

- Training and Education to enhance the use of ground-water models by qualified personnel. The Center offers a comprehensive program of short courses, workshops, and seminars stressing principles, concepts, theories, and applications of ground-water models. Individual, computer-interactive training courses are under development.

- Brochures, reports, and newsletters intended to expand contacts within the ground-water management and research community, available on request.

Environmental Criteria and Assessment Office
Office of Health and Environmental Assessment
U.S. Environmental Protection Agency
26 W. St. Clair, Cincinnati, Ohio 45268
FTS 684-7531, (513) 569-7531

The Environmental Criteria and Assessment Office in Cincinnati (ECAO-CIN) has developed ground-water risk assessment methodologies (GRAMs) in support of the Office of Water regulations for municipal sludge landfill and land application programs (*Clean Water Act §405(d)*). The GRAMs assist in evaluating risks of human exposure from ground-water contamination resulting from various disposal practices. ECAO-CIN is also developing GRAMs for the municipal waste combustion programs of the Office of Air Quality Planning and Standards and the Office of Solid Waste.



Exposure Assessment Group
Office of Health and Environmental Assessment
U.S. Environmental Protection Agency
401 M Street, S.W., Washington, D.C. 20460
FTS 475-8909, (202) 475-8909

The Exposure Assessment Group (EAG) research program focuses on predicting human exposure risks from hazardous materials. Current ground-water priorities include:

- Characterization of contaminant dispersion in ground water are being evaluated using data from recent field experiments to develop a realistic approach to modeling dispersive transport in exposure assessments.

- Criteria for the selection of mathematical models that can be applied to exposure assessments are being developed. Use of the criteria will help eliminate the use of inappropriate models for estimating contaminant migration in ground water.

- A technical support document is being prepared to help select ground-water fate and transport models for quick assessments as well as for detailed analyses.

- The EAG is conducting experimental studies to investigate the migration characteristics of concentrated organics in ground water for use in developing two-phase transport models.

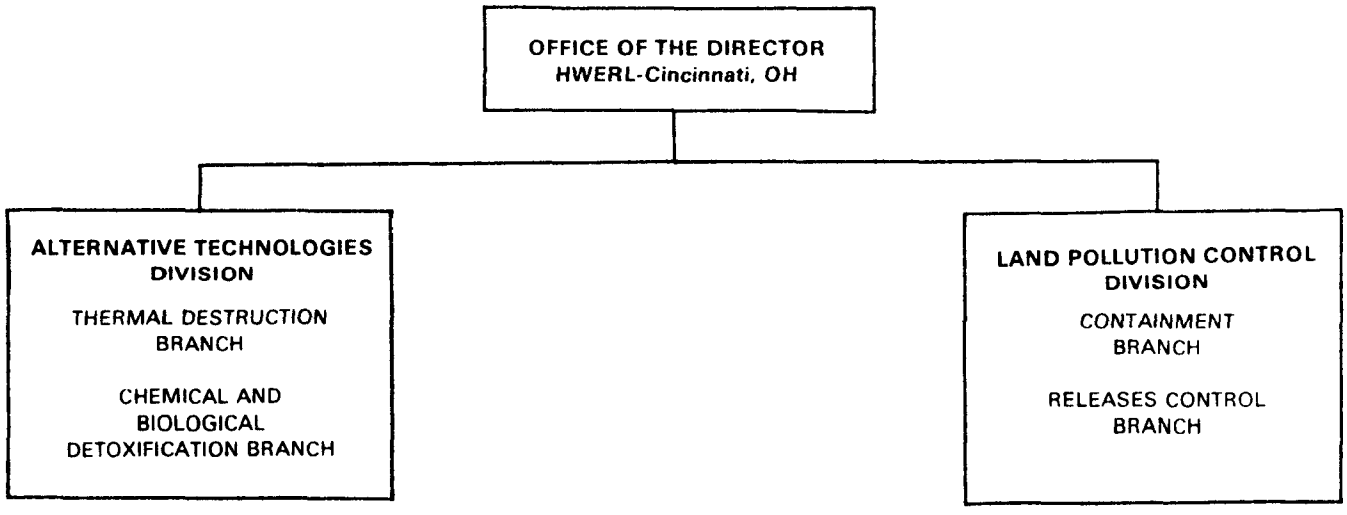
Hazardous Waste Engineering Research Laboratory
Office of Environmental Engineering and Technology Demonstration
U.S. Environmental Protection Agency
26 W. St. Clair, Cincinnati, Ohio 45268
FTS 684-7418, (513) 569-7418

The Hazardous Waste Engineering Research Laboratory (HWERL) ground-water research programs, conducted by the Land Pollution Control Division, concentrate on developing methods to prevent the contamination of ground water by controlling surface pollutant sources. HWERL research and technical assistance programs fall into three major areas:

- Land disposal technology development including research on cover systems, waste leaching, waste solidification and stabilization, flexible membrane liners, clay soil liners, construction quality assurance and quality control, expert systems, and "Subtitle D" facility waste characterization.

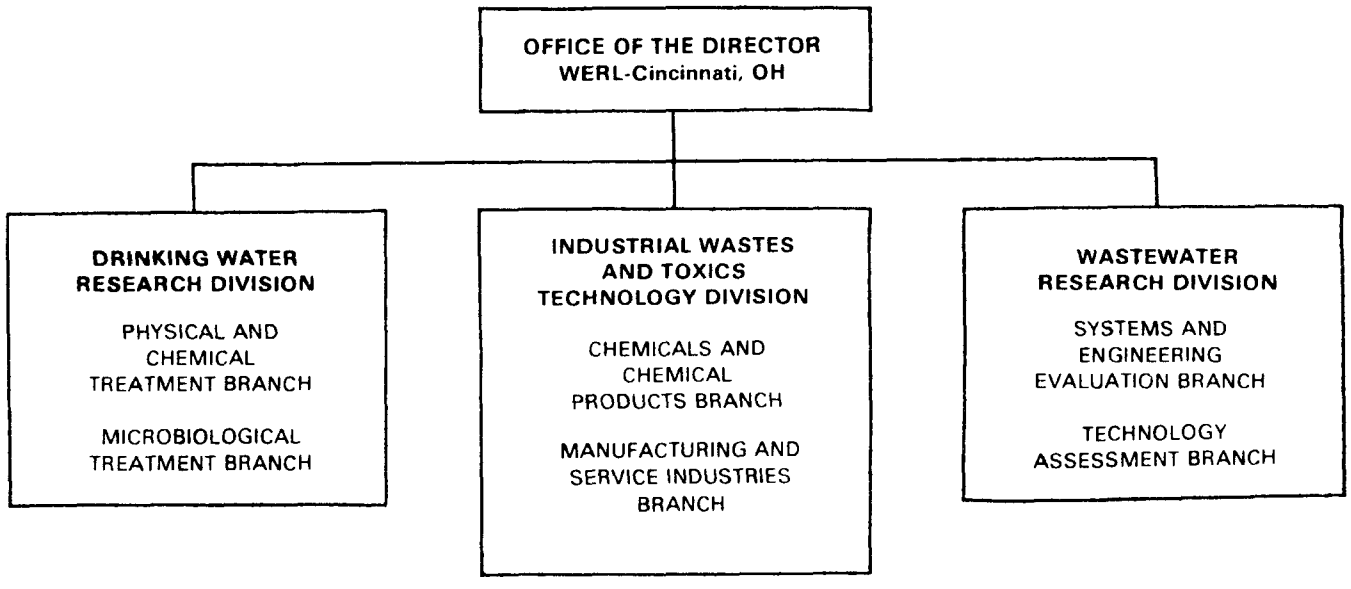
- Remedial-technology development and technical assistance, including Superfund site and situation assessments, verification of remedial action design and implementation projects, development of on-site cleanup and *in-situ* treatment technologies, development of personnel protection techniques, and other technical assistance services necessary to support an increasingly field-oriented program.

- Prevention and control of hazardous releases including development of technologies to allow emergency response personnel to prevent, contain, and clean up hazardous releases, and development of technologies for the prevention and control of releases from underground storage tanks.



Water Engineering Research Laboratory
Office of Environmental Engineering and Technology Demonstration
U.S. Environmental Protection Agency
26 W. St. Clair, Cincinnati, Ohio 45268
FTS 684-7951, (513) 569-7951

The Drinking Water Research Division of the Water Engineering Research Laboratory (WERL) conducts research on new or improved technologies needed for regulating the treatment of drinking water. This includes laboratory and pilot-scale studies and field-scale evaluations of processes for removing organic, inorganic, microbial, particulate, and radionuclide contaminants. Capital, operating, and maintenance costs are compiled for various unit processes and treatment trains to permit analyses of the cost-effectiveness of proposed systems. Large, centralized treatment systems, small systems, and individual point-of-entry units are analyzed.



3. TECHNICAL ASSISTANCE CONTACTS BY RESEARCH FACILITY

ENVIRONMENTAL MONITORING SYSTEMS LABORATORY - LAS VEGAS

Jane Denne
Aquatic and Subsurface Monitoring Branch
FTS 545-2655
702-798-2655

Well construction
Sampling techniques

Joe D'Lugosz
Aquatic and Subsurface Monitoring Branch
FTS 545-2598
702-798-2598

Hydrogeology

Phil Durgin
Aquatic and Subsurface Monitoring Branch
FTS 545-2623
702-798-2623

Soil gas monitoring

Larry Eccles
Aquatic and Subsurface Monitoring Branch
FTS 545-2385
702-798-2385

Vadose zone monitoring
In-situ monitoring methods development

Eric Koglin
Aquatic and Subsurface Monitoring Branch
FTS 545-2432
702-798-2432

Fractured bedrock
Well placement
Geographic Information System (GIS)

Aldo Mazzella
Aquatic and Subsurface Monitoring Branch
FTS 545-2254
702-798-2254

Geophysical methods devel/eval
CERCLA site investigation
Underground injection control monitoring

Charles O. Morgan
Aquatic and Subsurface Monitoring Branch
FTS 798-2389
702-798-2389

Hydrogeology
Data acquisition

Ann Pitchford
Aquatic and Subsurface Monitoring Branch
FTS 545-2366
702-798-2366

Ground-water monitoring methods standardization/Quality Assurance
Indicator parameters/seasonal variation
Monitoring strategies

R. Rajagopal
Aquatic and Subsurface Monitoring Branch
FTS 545-2358
702-798-2358

Resource management and economics
Mathematical modeling
Ground-water quality monitoring systems

Ken Scarbrough
Aquatic and Subsurface Monitoring Branch
FTS 545-2645
702-798-2645

Fluid levels in underground injection wells
Air Force technical support

Jeff van Ee
Aquatic and Subsurface Monitoring Branch
FTS 545-2367
702-798-2367

Underground storage tank external leak-detection monitoring

John Worland
Aquatic and Subsurface Monitoring Branch
FTS 545-2656
702-798-2656

Training, technology transfer, and project management

ROBERT S. KERR ENVIRONMENTAL RESEARCH LABORATORY

*Lowell Leach
Applications and Assistance Branch
FTS 743-2333
405-332-8800

Subsurface sampling
Land treatment of wastewaters
Underground injection
Monitoring

*Leon Myers
Applications and Assistance Branch
FTS 743-2202
405-332-8800

Land treatment of hazardous wastes

*Marion (Dick) Scalf
Applications and Assistance Branch
FTS 743-2308
405-332-8800

Technical assistance
Technology transfer
Wellhead protection
Monitoring

*Jerry Thornhill
Applications and Assistance Branch
FTS 743-2310
405-332-8800

Underground injection
Hydrogeological investigations

Bert Bledsoe
Subsurface Processes Branch
FTS 743-2324
405-332-8800

Inorganic analytical chemistry

Dermont Bouchard
Subsurface Processes Branch
FTS 743-2321
405-332-8800

Subsurface abiotic processes

Don Clark
Subsurface Processes Branch
FTS 743-2311
405-332-8800

Inorganic analytical chemistry

Roger Cosby
Subsurface Processes Branch
FTS 743-2320
405-332-8800

Organic analytical chemistry

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*The Applications and Assistance Branch is the focus for technical assistance and technology transfer in RSKERL. When calling for technical assistance, please first contact the specialists in the Applications and Assistance Branch (listed first and starred) who will either answer your questions or direct you to the appropriate researcher.

William Dunlap
Subsurface Processes Branch
FTS 743-2314
405-332-8800

Transport and fate of organics

Carl Enfield
Subsurface Systems Branch
FTS 743-2334
405-332-8800

Contaminant transport modeling

Jerry Jones
Extramural Activities and Evaluation Branch
FTS 743-2251
405-332-8800

Underground storage tanks
Aquifer restoration
Water chemistry

Michael Henson
Subsurface Processes Branch
FTS 743-2420
405-332-8800

Anaerobic biotransformations
Aquifer restoration

Don Kampbell
Subsurface Systems Branch
FTS 743-2332
405-332-8800

Soil chemistry

John Matthews
Subsurface Processes Branch
FTS 743-2233
405-332-8800

Toxicity testing
Land treatment of hazardous wastes

James McNabb
Extramural Activities & Evaluation Branch
FTS 743-2216
405-332-8800

Extramural research management
Aquifer Restoration

Fred Pfeffer
Subsurface Systems Branch
FTS 743-2305
405-332-8800

Inorganic analytical chemistry

Marvin Piwoni
Subsurface Processes Branch
FTS 743-2262
405-332-8800

Subsurface abiotic processes

Thomas Short
Subsurface Systems Branch
FTS 743-2234
405-332-8800

Contaminant transport modeling

Garmon Smith
Subsurface Processes Branch
FTS 743-2316
405-332-8800

Organic analytical chemistry

John Wilson
Subsurface Processes Branch
FTS 743-2259
405-332-8800

Subsurface microbiology
In-situ biorestoration

Lynn Wood
Subsurface Processes Branch
FTS 743-2304
405-332-8800

Subsurface abiotic processes

Marylynn Yates
Subsurface Processes Branch
FTS 743-2236
405-332-8800

Virus transport

Scott Yates
Subsurface Systems Branch
FTS 743-2246
405-332-8800

Contaminant transport modeling

ENVIRONMENTAL RESEARCH LABORATORY - ATHENS

Leo V. Azarraga
Chemistry Branch
FTS 250-3453
404-546-3453

Fate of metals

George W. Bailey
Chemistry Branch
FTS 250-3307
404-546-3307

Fate of metals

David S. Brown
Assessment Branch
FTS 250-3310
404-546-3310

Metal speciation
Transport and transformation of metals

Robert F. Carsel
Assessment Branch
FTS 250-3565
404-546-3565

Model applications
Uncertainty analysis

J. Jackson Ellington
Measurements Branch
FTS 250-3197
404-546-3197

Hydrolysis rate constants
Chemical transformation rate measurement

Fred F. Fong
Assessment Branch
FTS 250-3210
404-546-3210

Modeling multiphasic transport in porous media
Numerical analysis

Chad T. Jafvert
Chemistry Branch
FTS 250-3349
404-546-3349

Pollutant sorption-desorption

Heinz P. Kollig Measurements Branch FTS 250-3770 404-546-3770	Rate constant data for pollutant-fate modeling
John M. McGuire Measurements Branch FTS 250-3185 404-546-3185	Multispectral identification of organic chemicals
Lee A. Mulkey Assessment Branch FTS 250-3476 404-546-3476	Multimedia modeling and uncertainty analysis
John E. Rogers Biology Branch FTS 250-3592 404-546-3592	Anaerobic biodegradation processes
Charles N. Smith Assessment Branch FTS 250-3302 404-546-3302	Conduct of field studies Analysis of monitoring data
William C. Steen Measurements Branch FTS 250-3776 404-546-3776	Aerobic microbial transformation rate measurement
Eric J. Weber Chemistry Branch FTS 250-3198 404-546-3198	Pollutant degradation
N. Lee Wolfe Chemistry Branch FTS 250-3429 404-546-3429	Pollutant degradation

HOLCOMB RESEARCH INSTITUTE
INTERNATIONAL GROUND WATER MODELING CENTER

Milovan S. Beljin Senior Research Assistant 317-283-9458	Groundwater models Software support Model use
Margaret A. Butorac Technical Program Assistant 317-283-9458	Short course coordination Newsletter production Publication & software distribution
Aly I. El-Kadi Research Scientist 317-283-9458	Flow and transport modeling Stochastic modeling Training

Paul K.M. van der Heijde
Director
317-283-9458

Groundwater modeling research and training

Richard E. Rice
Research Scientist
317-283-9458

Ground-water chemistry
Hydrochemical modeling

Stanley A. Williams
Hydrologist
317-283-9458

Ground-water models
Software support
Model use

ENVIRONMENTAL CRITERIA AND ASSESSMENT OFFICE - CINCINNATI

Randall J.F. Bruins
Systemic Toxicants Assessment Branch
FTS 684-7539
513-569-7539

Ground-water risk assessment methodologies

Larry Fradkin
Systemic Toxicants Assessment Branch
FTS 684-7584
513-569-7584

Ground-water risk assessment methodologies

EXPOSURE ASSESSMENT GROUP

Seong T. Hwang
Exposure Assessment Group
FTS 475-8919
202-475-8919

Fate and transport modeling
Health risk assessment for ground-water contaminants
Selection of models for exposure assessment
Analysis of monitoring data

John Schaum
Exposure Assessment Group
FTS 475-8920
202-475-8920

Fate and transport modeling
Health risk assessment for ground-water contaminants
Selection of models for exposure assessment
Analysis of monitoring data

HAZARDOUS WASTE ENGINEERING RESEARCH LABORATORY

Douglas C. Ammon
Remedial Action Staff
FTS 684-7876
513-569-7876

Remedial Investigation/Feasibility Study process
Remedial action costs and modeling

Naomi P. Barkley
Remedial Action Staff
FTS 684-7854
513-569-7854

Plume management
Building decontamination
Grouting

Edwin Barth Remedial Action Staff FTS 684-7875 513-569-7875	Stabilization/fixation
Michael I. Black Remedial Action Staff FTS 684-7664 513-569-7664	Gas works site
John Brugger Technology Development Staff FTS 340-6634 201-321-6634	Physical, chemical, biological, and thermal treatment Contaminated ground-water control
Paul dePercin Pollution Assessment Staff FTS 684-7797 513-569-7797	Volatile emissions Fugitive dust control Stabilization/fixation
G. Kenneth Dotson Pollution Assessment Staff FTS 684-7858 513-569-7858	Soil liners
John Farlow Technology Development Staff FTS 340-6631 201-321-6631	Underground storage tanks (UST) hazardous release technology
Richard Field Technology Development Staff FTS 340-6674 210-321-6674	UST reportable quantity technology Ground-water hydraulics
Uwe Frank Chemistry Staff FTS 340-6626 201-321-6626	Chemical analysis Soil-water chemistry
Frank Freestone Technology Evaluation Staff FTS 340-6632 201-321-6632	On-site technology Superfund Innovative Technology Evaluation (SITE) program
Daniel G. Greathouse Pollution Control Staff FTS 684-7859 513-569-7859	Expert systems Statistical design and analysis
Richard Griffiths Technology Development Staff FTS 340-6629 201-321-6629	OHMSETT* facility, oil spill technology Water chemistry

*Oil and Hazardous Materials Simulated Environmental Test Tank.

Walter G. Grube, Jr. Pollution Assessment Staff FTS 684-7798 513-569-7798	Slurry walls Soil and admixture liners Hydraulic conductivity
Michael Gruenfeld Chemistry Staff FTS 340-6625 201-321-6625	Chemical analysis Personnel protection Soil-water chemistry
Eugene F. Harris Land Pollution Control Division FTS 684-7838 513-569-7838	Mining sites Technical Assistance Large-volume wastes
Robert P. Hartley Pollution Control Division FTS 684-7838 513-569-7838	Covers Flexible membrane liners
Ronald D. Hill Land Pollution Control Division FTS 684-7861 513-569-7861	Superfund Innovative Technology Evaluation (SITE) program *In-Situ* Treatment
Robert Hillger Technology Development Staff FTS 340-6639 201-321-6639	Underground storage tank technology
Jonathan G. Herrmann Pollution Control Staff FTS 684-7839 513-569-7839	Sorbents Electrokinetics Construction QA/QC
Janet M. Houthoofd Remedial Action Staff FTS 684-7863 513-569-7863	Mine storage
Stephen C. James Land Pollution Control Division FTS 684-7877 513-569-7877	Superfund Innovative Technology Evaluation (SITE) program
Robert E. Landreth Pollution Control Staff FTS 684-7836 513-569-7836	Flexible membrane liners Municipal solid waste Expert systems
Norma Lewis Land Pollution Control Division FTS 684-7877 513-569-7877	Superfund Innovative Technology Evaluation (SITE) program

Ronald F. Lewis Remedial Action Staff FTS 684-7856 513-569-7856	Biodegradation technology Soil contamination
Hugh Masters Technology Evaluation Staff FTS 340-6678 201-321-6678	UST canine olfaction technology Technical Information Exchange (TIX)
Charles J. Moench, Jr. Pollution Control Staff FTS 684-7819 513-569-7819	Municipal solid waste leaching Municipal solidwsate combustion residue
Charles I. Mashni Pollution Assessment Staff FTS 684-7857 513-569-7857	Hazardous waste leachates
Edward J. Opatken Remedial Action Staff FTS 684-7855 513-569-7855	Thermoplastics Ion exchange Leachate treatment
Mike H. Roulier Pollution Assessment Staff FTS 684-7796 513-569-7796	Soil liners Waste leaching
Michael Royer Chemistry Staff FTS 340-6633 201-321-6633	Personnel protection
Donald E. Sanning Remedial Action Staff FTS 684-7875 513-569-7875	Remedial action Uncontrolled sites *In-situ* treatment
Norbert B. Schomaker Containment Branch FTS 684-7871 513-569-7871	Hazardous waste land disposal Municipal solid waste
Mary Stinson Technology Evaluation Staff FTS 340-6683 201-321-6683	Superfund Innovative Technology Evaluation (SITE) program
Anthony Tafuri Technology Development Staff FTS 340-6604 201-321-6604	UST technology *In-situ* treatment processes

Richard Traver
Technology Evaluation Staff
FTS 340-6677
201-321-6677

Mobile, on-site, *in-situ* treatment technology

Ira Wilder
Releases Control Branch
FTS 340-6635
201-321-6635

Waste site hazardous releases

Carlton C. Wiles
Pollution Assessment Staff
FTS 684-7795
513-569-7795

Solidification, stabilization, fixation, and encapsulation
Surface impoundments
Municipal solid wastes

James Yezzi, Jr.
Technology Evaluation Staff
FTS 340-6703
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Mobile treatment technology

WATER ENGINEERING RESEARCH LABORATORY

Robert M. Clark
Director, Drinking Water Research Division
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513-569-7201

Treatment technology cost estimation

Walter A. Feige
Drinking Water Research Division
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513-569-7496

Organic treatment processes

Kim R. Fox
Inorganics and Particulate Control Branch
FTS 684-7820
513-569-7820

Radionuclide treatment processes

Carol Ann Fronk
Organics Control Branch
FTS 684-7592
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Organic treatment processes

James A. Goodrich
Systems and Cost Evaluation Staff
FTS 684-7605
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Modeling

Richard P. Lauch
Inorganics and Particulate Control Branch
FTS 684-7237
513-569-7237

Radium and nitrate treatment processes

Benjamin W. Lykins, Jr.
Systems and Cost Evaluation Staff
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Organic treatment processes

Richard Miltner
Organics Control Branch
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Organic treatment processes

Thomas J. Sorg
Inorganics and Particulate Control Branch
FTS 684-7370
513-569-7370

Inorganic treatment processes

4. TECHNICAL ASSISTANCE CONTACTS BY SUBJECT

Subject	Name	Office	FTS	Commercial
Aquifer restoration				
Biodegradation	John Wilson	RSKERL	743-2259	405-332-8800
	Michael Henson	RSKERL	743-2420	405-332-8800
In-situ	Jerry Jones	RSKERL	743-2251	405-332-8800
	James McNabb	RSKERL	743-2216	405-332-8800
Biodegradation	Ron Lewis	HWERL	684-7856	513-569-7856
	John Wilson	RSKERL	743-2259	405-332-8800
Chemistry				
Analytical chemistry				
Inorganic	Bert Bledsoe	RSKERL	743-2324	405-332-8800
	Don Clark	RSKERL	743-2311	405-332-8800
	Fred Pfeffer	RSKERL	743-2305	405-332-8800
Organic	Roger Cosby	RSKERL	743-2320	405-332-8800
	Garmon Smith	RSKERL	743-2316	405-332-8800
Chemical analysis	Uwe Frank	HWERL	340-6626	201-321-6626
	Michael Gruenfeld	HWERL	340-6625	201-321-6625
Multispectral	John McGuire	ERL-Ath	250-3185	404-546-3185
Ground-water	Richard Rice	IGWMC		317-283-9458
Soil chemistry	Don Kampbell	RSKERL	743-2332	405-332-8800
Soil-water chemistry	Uwe Frank	HWERL	340-6626	201-321-6626
	Michael Gruenfeld	HWERL	340-6625	201-321-6625
Transformation rates	Jack Ellington	ERL-Ath	250-3197	404-546-3210
	Heinz Kollig	ERL-Ath	250-3770	404-546-3770
Water chemistry	Richard Griffiths	HWERL	340-6629	201-321-6629
	Jerry Jones	RSKERL	743-2251	405-332-8800
Control of Contaminated ground water	John Brugger	HWERL	340-6634	201-321-6634
Contaminant source control				
Covers	Robert Hartley	HWERL	684-7838	513-569-7838
Construction QA/QC	Jonathan G. Herrmann	HWERL	684-7839	513-569-7839
Gas works site	Michael Black	HWERL	684-7664	513-569-7664
Flexible membrane liners	Robert Hartley	HWERL	684-7838	513-569-7838
	Robert Landreth	HWERL	684-7836	513-569-7836
Fugitive dust control	Paul dePercin	HWERL	684-7797	513-569-7797
Hazardous waste land disposal	Norbert Schomaker	HWERL	684-7871	513-569-7871
Mining sites	Eugene Harris	HWERL	684-7838	513-569-7838
Municipal solid waste	Robert Landreth	HWERL	684-7836	513-569-7836
	Charles Moench, Jr.	HWERL	684-7819	513-569-7857
	Norbert Schomaker	HWERL	684-7871	513-569-7871
Slurry walls	Walter Grube, Jr.	HWERL	684-7798	513-569-7798
Soil liners	G. Kenneth Dotson	HWERL	684-7858	513-569-7858
	Walter Grube, Jr.	HWERL	684-7798	513-569-7798
	Mike Roulier	HWERL	684-7796	513-569-7796
Underground Storage Tanks (UST)	John Farlow	HWERL	340-6631	201-321-6631
	Richard Field	HWERL	340-6674	210-321-6674

Subject	Name	Office	FTS	Commercial
Contaminant source control (Cont.)				
	Robert Hillger	HWERL	340-6639	201-321-6639
	Anthony Tafuri	HWERL	340-6604	201-321-6604
	Jerry Jones	RSKERL	743-2251	405-332-8800
canine olfaction	Hugh Masters	HWERL	340-6678	201-321-6678
Waste leaching	Mike Roulier	HWERL	684-7796	513-569-7796
Wastewater land treatment	Lowell Leach	RSKERL	743-2333	405-332-8800
Volatile emissions	Paul dePercin	HWERL	684-7797	513-569-7797
Fate of contaminants				
Anaerobic biodegradation	John Rogers	ERL-Ath	250-3592	404-546-3592
biotransformations	Michael Henson	RSKERL	743-2420	405-332-8800
Degradation	Eric Weber	ERL-Ath	250-3198	404-546-3198
	N. Lee Wolfe	ERL-Ath	250-3429	404-546-3429
Metals	Bert Bledsoe	RSKERL	743-2324	405-332-8800
	Leo Azarraga	ERL-Ath	250-3453	404-546-3453
	George Bailey	ERL-Ath	250-3307	404-546-3307
Metals speciation	David Brown	ERL-Ath	250-3310	404-546-3310
Organics	William Dunlap	RSKERL	743-2314	405-332-8800
Pesticide field studies	Charles Smith	ERL-Ath	250-3302	404-546-3302
Sorption/desorption	Chad Jafvert	ERL-Ath	250-3349	404-546-3349
Geographic Information System	Eric Koglin	EMSL-LV	545-2432	702-798-2432
Ground-water hydraulics	Richard Field	HWERL	340-6674	210-321-6674
Hydraulic conductivity	Walter Grube Jr.	HWERL	684-7798	513-569-7798
Hydrogeology	Joe D'Lugosz	EMSL-LV	545-2598	702-798-2598
	Jerry Thornhill	RSKERL	743-2310	405-332-8800
	Charles Morgan	EMSL-LV	545-2389	702-798-2389
Hydrolysis rate constants	J.J. Ellington	ERL-Ath	250-3197	404-546-3197
Injection wells	Lowell Leach	RSKERL	743-2333	405-332-8800
	Jerry Thornhill	RSKERL	743-2310	405-332-8800
Monitoring	Aldo Mazzella	EMSL-LV	545-2254	702-798-2254
	Ken Scarbrough	EMSL-LV	545-2645	702-798-2645
International Ground Water Modeling Center				
Courses, publications	Margaret Butorac	IGWMC		317-283-9458
Software support	Milovan Beljin	IGWMC		317-283-9458
	Stanley Williams	IGWMC		317-283-9458

Subject	Name	Office	FTS	Commercial
Large-Volume Wastes	Eugene Harris	HWERL	684-7862	513-569-7862
Microbiology	John Wilson	RSKERL	743-2259	405-332-8800
Mining	S. Jackson Hubbard	HWERL	684-7502	513-569-7502
Modeling	Douglas Ammon	HWERL	684-7876	513-569-7876
	Milovan Beljin	IGWMC		317-283-9458
	Stanley Williams	IGWMC		317-283-9458
Applications	Robert Carsel	ERL-Ath	250-3565	404-546-3565
Contaminant fate	Seong Hwang	EAG	475-8919	202-475-8919
	John Schaum	EAG	475-8920	202-475-8920
treatment	James Goodrich	WERL	684-7605	513-569-7605
transport	Carl Enfield	RSKERL	743-2334	405-332-8800
	Seong Hwang	EAG	475-8919	202-475-8919
	John Schaum	EAG	475-8920	202-475-8920
	Thomas Short	RSKERL	743-2234	405-332-8800
	Scott Yates	RSKERL	743-2246	405-332-8800
porous media	Fred Fong	ERL-Ath	250-3210	404-546-3210
Exposure assessment	Seong Hwang	EAG	475-8919	202-475-8919
	John Schaum	EAG	475-8920	202-475-8920
Flow and transport	Aly I. El-Kadi	IGWMC		317-283-9458
Hydrochemical	Richard Rice	IGWMC		317-283-9458
Mathematical	R. Rajagopal	EMSL-LV	545-2358	702-798-2358
	Fred Fong	ERL-Ath	250-3210	404-546-3210
Model use	Milovan Beljin	IGWMC		312-283-9458
	Stanley Williams	IGWMC		317-283-9458
Multimedia	Lee Mulkey	ERL-Ath	250-3476	404-546-3476
Research	Paul van der Heijde	IGWMC		317-283-9458
Pollutant rate constants	Heinz Kollig	ERL-Ath	250-3770	404-546-3770
Stochastic	Aly I. El-Kadi	IGWMC		317-283-9458
Training	Aly I. El-Kadi	IGWMC		317-283-9458
	Paul van der Heijde	IGWMC		317-283-9458
Monitoring				
	Lowell Leach	RSKERL	743-2333	405-332-8800
Analysis of data	Seong Hwang	EAG	475-8919	202-475-8919
	John Schaum	EAG	475-8920	202-475-8920
	Charles Smith	ERL-Ath	250-3302	404-546-3302
CERCLA site investigation	Aldo Mazzella	EMSL-LV	545-2254	702-798-2254
Data acquisition	Charles Morgan	EMSL-LV	545-2389	702-798-2389
Fractured bedrock	Eric Koglin	EMSL-LV	545-2432	702-798-2432
Indicator parameters	Anne Pitchford	EMSL-LV	545-2366	702-798-2366
Injection wells	Aldo Mazzella	EMSL-LV	545-2254	702-798-2254
	Ken Scarbrough	EMSL-LV	545-2645	702-798-2645
In-situ methods	Larry Eccles	EMSL-LV	545-2385	702-798-2385
Geophysical methods	Aldo Mazzella	EMSL-LV	545-2254	702-798-2254
Method standards/QA	Ann Pitchford	EMSL-LV	545-2366	702-798-2366
Sampling techniques	Jane Denne	EMSL-LV	545-2655	702-798-2655
	Marion (Dick) Scalf	RSKERL	743-2308	405-332-8800
Soil Gas	Phil Durgin	EMSL-LV	545-2623	702-798-2623

Subject	Name	Office	FTS	Commercial
Monitoring (Cont.)				
Systems	R. Rajagopal	EMSL-LV	545-2358	702-798-2358
Technology transfer	John Worland	EMSL-LV	545-2656	702-798-2656
UST external leak detection	Jeff van Ee	EMSL-LV	545-2367	702-798-2367
Vadose Zone	Larry Eccles	EMSL-LV	545-2385	702-798-2385
Well construction	Jane Denne	EMSL-LV	545-2655	702-798-2655
Well placement	Eric Koglin	EMSL-LV	545-2432	702-798-2432
Oil & Hazardous Materials				
Simulated Environ. Test Tank	Richard Griffiths	HWERL	340-6629	201-321-6629
Pesticides				
Field studies	Charles Smith	ERL-Ath	250-3302	404-546-3302
Remedial action	Douglas Ammon	HWERL	684-7876	513-569-7876
	Donald Sanning	HWERL	684-7875	513-569-7875
Biodegradation	John Wilson	RSKERL	743-2259	405-332-8800
	Ronald Lewis	HWERL	684-7856	513-569-7856
Building decontamination	Naomi Barkley	HWERL	684-7854	513-569-7854
Electrokinetics	Jonathan Herrmann	HWERL	684-7863	513-569-7863
In-situ treatment	Ronald Hill	HWERL	684-7861	513-569-7861
	Donald Sanning	HWERL	684-7875	513-569-7875
Mobile	Richard Traver	HWERL	340-6677	201-321-6677
	James Yezzi, Jr.	HWERL	340-6703	201-321-6703
Ion exchange	Edward Opatken	HWERL	684-7855	513-569-7855
Land treatment of hazardous wastes	John Matthews	RSKERL	743-2233	405-332-8800
	Leon Myers	RSKERL	743-2202	405-332-8800
Leachate treatment	Edward Opatken	HWERL	684-7855	513-569-7855
Mine storage	Janet Houthoofd	HWERL	684-7863	513-569-7863
Oil spill technology	Richard Griffiths	HWERL	340-6629	201-321-6629
On-site technology	Frank Freestone	HWERL	340-6632	201-321-6632
Personnel protection	Michael Gruenfeld	HWERL	340-6625	201-321-6625
	Michael Royer	HWERL	340-6633	201-321-6633
Plume management	Naomi Barkley	HWERL	684-7854	513-569-7854
Construction QA/QC	Jonathan Herrmann	HWERL	684-7839	513-569-7839
Soil contamination	Ronald Lewis	HWERL	684-7856	513-569-7856
Sorbents	Paul dePercin	HWERL	684-7797	513-569-7797
	Jonathan Herrmann	HWERL	684-7839	513-569-7839
Stabilization/ fixation	Edwin Barth	HWERL	684-7875	513-569-7875
	Janet Houthoofd	HWERL	684-7863	513-569-7863
	Charles Mashni	HWERL	684-7857	513-569-7857
	Carlton Wiles	HWERL	684-7795	513-569-7795
Technical information Exchange	Hugh Masters	HWERL	340-6678	210-321-6678
Thermoplastics	Edward Opatken	HWERL	684-7855	513-569-7855
Treatment	John Brugger	HWERL	340-6634	201-321-6634
	John Wilson	RSKERL	743-2259	405-332-8800
Uncontrolled sites	Donald Sanning	HWERL	684-7875	513-569-7875
Waste site releases	Ira Wilder	HWERL	340-6635	201-321-6635

Subject	Name	Office	FTS	Commercial
Rate constants	Heinz Kollig	ERL-Ath	250-3770	404-546-3770
Resource management/economics	R. Rajagopal	EMSL-LV	545-2358	702-798-2358
Risk assessment	Randall Bruins	ECAO-CIN	684-7539	513-569-7539
	Larry Fradkin	ECAO-CIN	684-7584	513-569-7584
Health	Seong Hwang	EAG	475-8919	202-475-8919
	John Schaum	EAG	475-8920	202-475-8920
SITE (Superfund Innovative Technology Evaluation Program)				
	Frank Freestone	HWERL	340-6632	201-321-6632
	Ronald Hill	HWERL	684-7861	513-569-7861
	Stephen James	HWERL	684-7877	513-569-7877
	Norma Lewis	HWERL	684-7877	513-569-7877
	Mary Stinson	HWERL	340-6683	201-321-6683
Soil chemistry	Don Kampbell	RSKERL	743-2332	405-332-8800
Soil-water chemistry	Uwe Frank	HWERL	340-6626	201-321-6626
	Michael Gruenfeld	HWERL	340-6625	201-321-6625
Statistical design and analysis	Daniel Greathouse	HWERL	684-7859	201-569-7859
Subsurface abiotic processes	Dermont Bouchard	RSKERL	743-2321	405-332-8800
	Marvin Piwoni	RSKERL	742-2262	405-332-8800
	Lynn Wood	RSKERL	743-2304	405-332-8800
Subsurface microbiology	John Wilson	RSKERL	743-2259	405-332-8800
Subsurface sampling	Jane Denne	EMSL-LV	545-2655	702-798-2655
	Lowell Leach	RSKERL	743-2333	405-332-8800
Testing for toxicity	John Mathews	RSKERL	743-2233	405-332-8800
Transport of contaminants				
Metals	David Brown	ERL-Ath	250-3310	404-546-3310
Modeling	Carl Enfield	RSKERL	743-2334	405-332-8800
	Thomas Short	RSKERL	743-2234	405-332-8800
	Scott Yates	RSKERL	743-2246	405-332-8800
porous media	Fred Fong	ERL-Ath	250-3210	404-546-3210
Organics	William Dunlap	RSKERL	743-2314	405-332-8800
Viruses	Marylynn Yates	RSKERL	743-2236	405-332-8800

Subject	Name	Office	FTS	Commercial
Treatment	John Brugger	HWERL	340-6634	201-321-6634
Inorganic processes	Thomas Sorg	WERL	684-7370	513-569-7370
In-situ biorestoration	John Wilson	RSKERL	743-2259	405-332-8800
Modeling	James Goodrich	WERL	684-7605	513-569-7605
Nitrate processes	Richard Lauch	WERL	684-7237	513-569-7237
Organic processes	Walter Feige	WERL	684-7496	513-569-7496
	Carol Ann Fronk	WERL	684-7592	513-569-7592
	Benjamin Lykins, Jr.	WERL	684-7460	513-569-7460
	Richard Miltner	WERL	684-7403	513-569-7403
Radionuclides	Kim Fox	WERL	684-7820	513-569-7820
Radium processes	Richard Lauch	WERL	684-7237	513-569-7237
Technology costs	Robert Clark	WERL	684-7201	513-569-7201
Uncertainty analysis	Robert Carsel	ERL-Ath	250-3565	404-546-3565
	Lee Mulkey	ERL-Ath	250-3476	404-546-3476
Underground Storage Tanks (UST)				
Tank leakage	John Farlow	HWERL	340-6631	201-321-6631
	Richard Field	HWERL	340-6674	210-321-6674
	Robert Hillger	HWERL	340-6639	201-321-6639
	Anthony Tafuri	HWERL	340-6604	201-321-6604
	Jerry Jones	RSKERL	743-2251	405-332-8800
Canine olfaction	Hugh Masters	HWERL	340-6678	201-321-6678
External leak detection monitoring	Jeff van Ee	EMSL-LV	545-2367	702-798-2367
Wellhead Protection	Marion (Dick) Scalf	RSKERL	743-2308	405-332-8800

5. PROGRAM OFFICE AND REGIONAL OFFICE CONTACTS

OFFICE OF WATER

OFFICE OF DRINKING WATER

Françoise Brasier
Land Disposal Restrictions Task Force
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OFFICE OF GROUND-WATER PROTECTION

Norbert Dee
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Ground-Water Protection Strategy

OFFICE OF SOLID WASTE AND EMERGENCY RESPONSE

OFFICE OF SOLID WASTE

Jeanette Hansen
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RCRA Monitoring Requirements

Amy Mills
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202-382-3298, -2224

RCRA Monitoring Requirements

James Bachmaier
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RCRA Regulations/Technical Guidance Documents

Vernon Meyers
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RCRA Regulations/Technical Guidance Documents

Zubair Saleem
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Ground-Water Modeling

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CERCLA Ground-Water Coordinator

Marlene Berg
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202-382-2339

Superfund Remedial Analysis

Paul M. Beam
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Discovery and Investigation, Monitoring Well Construction

OFFICE OF UNDERGROUND STORAGE TANKS

Richard Valentinetti
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Underground Storage Tanks

OFFICE OF WASTE PROGRAMS ENFORCEMENT

Ron G. Wilhelm
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Kenneth Jennings
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RCRA Enforcement
Technical Enforcement Guidance Document

OFFICE OF PESTICIDES AND TOXIC SUBSTANCES

OFFICE OF PESTICIDE PROGRAMS

Stephen L. Johnson
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Pesticides Ground-Water Team Hazard Leader

Catherine Eiden
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Pesticides Exposure Assessment

OFFICE OF TOXIC SUBSTANCES

Karen Hammerstrom
Exposure Evaluation Division
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202-382-3922

TSCA Ground-Water Coordinator

Annett Nold
Exposure Evaluation Division
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TSCA Ground-Water Modeling

Loren Hall — TSCA Data Bases
Exposure Evaluation Division
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202-382-3931

REGION I
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John F. Kennedy Federal Building
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Boston, MA 02203

Connecticut ■ Maine ■ Massachusetts ■ New Hampshire ■ Rhode Island ■ Vermont

George Furst — RCRA
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Massachusetts Waste Management Branch
FTS 223-1926
617-223-1926

David Lang — CERCLA
Waste Management Division
VT, RI, and NH Waste Management Branch
FTS 835-3662
617-565-3662

Joeseph N. DeCola — Ground-Water Protection
Water Management Division
Office of Ground Water Protection
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617-565-3599

Ray Tompson — Field Services
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REGION II
Environmental Protection Agency
26 Federal Plaza
New York, NY 10278

New Jersey ■ New York ■ Puerto Rico ■ Virgin Islands

Charles Anderson — RCRA
Air and Waste Management Division
Hazardous Waste Compliance Branch
FTS 264-6143
212-264-6143

Grant Kimmel — CERCLA
Emergency and Remedial Response Division
FTS 264-7364
212-264-7364

John Malleck — Ground-Water Protection
Water Management Division
Office of the Ground-Water Coordinator
FTS 264-5635
202-264-5635

Louis DiGuardia — Field Services
Environmental Services Division
Surveillance and Monitoring Branch
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201-321-6612

REGION III

Environmental Protection Agency
841 Chestnut Street
Philadelphia, PA 19107

Delaware ■ Maryland ■ Pennsylvania ■ Virginia ■ West Virginia

Frank Quirus — RCRA
Hazardous Waste Management Division
Waste Management Branch
FTS 597-3176
215-597-3176

Mindi B. Snoparsky — CERCLA
Hazardous Waste Management Division
Superfund Branch
FTS 597-1268
215-597-1268

Tom Merski — Ground-Water Protection
Water Management Division
Water Supply Branch
FTS 597-2786
215-597-2786

Gary Bryant — Field Services
Environmental Services Division
Wheeling Field Office
304-233-1271

REGION IV

Environmental Protection Agency
345 Courtland Street, NE
Atlanta, GA 30365

Alabama ■ Florida ■ Georgia ■ Kentucky ■ Mississippi ■ North Carolina ■ South Carolina

Michael Arnette — RCRA
Waste Management Division
Residuals Management Branch
FTS 257-3433
404-347-3433

John Mann — CERCLA
Waste Management Division
Emergency and Remedial Response Branch
FTS 257-2643
404-347-3433

Gail Mitchell — Ground-Water Protection
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Field Services

6. ANNOTATED BIBLIOGRAPHY

These documents were selected by ORD for inclusion in the Directory as essential references for permitting or other regulatory personnel involved in ground-water protection and treatment.

EPA documents are cited in the bibliography using both the EPA document number (*e.g.*, EPA/600/8-86/004) and the National Technical Information Service number (prefixed by a PB; *e.g.*, PB 81-166-340). EPA documents may be consulted in the EPA Headquarters or Regional libraries, though in some Regional libraries it may be necessary to cross-reference documents from the EPA or NTIS classification to another classification scheme (*e.g.*, Library of Congress or EPAX). EPA documents that are marked *CERI* are available from ORD Publications, Cincinnati, Ohio (FTS 684-7562, or 513-569-7562). The rest must be purchased from NTIS at 5285 Port Royal Road, Springfield, Virginia 22161 (FTS/703-487-4650).

Documents are listed by subject category under one of the following seven headings:

- Overview.
- Monitoring.
- Fate and Transport.
- Aquifer Reclamation.
- Treatment.
- Source Control.
- Risk Assessment.

EPA Ground-Water Research Programs. EPA/600/8-86/004, PB86 212-552, April 1986. *CERI.*

A description of EPA's role in ground-water research and current EPA research in five major areas of concern: source control, prediction, monitoring, aquifer cleanup, and information transfer and technical assistance. The specific roles of various EPA branches and laboratories in ground-water research are discussed along with future research directives.

Protection of Public Water Supplies from Ground-Water Contamination. EPA/625/4-85/016, PB86 168-358, September 1985. *CERI.*

Material from a series of technology transfer seminars designed to help the water-supply community prevent contamination and treat previously contaminated water supplies. There is a good description of basic ground-water hydrology as well as sections dealing with classification of ground-water regions, ground-water and surface-water relationships, ground-water pollution, management alternatives, controlling volatile organic compounds in ground water used for drinking, and *in-situ* treatment, restoration and reclamation of ground water.

Underground Waste Management and Environmental Implications. T.D. Cook, Ed. Amer. Assoc. Petroleum Geol. 1972.

A collection of papers from the Symposium on Underground Waste Management and Environmental Implications held in Houston, Texas, December 6-9, 1971. The papers discuss the volume of wastes being disposed underground, the techniques of underground disposal, the effects of mistakes and accidents and the ability to recognize and avoid mistakes and recover from accidents, the role of regulatory agencies, and the costs of various underground disposal methods.

Water Well Technology. M.D. Campbell and J.H. Lehr. National Water Well Association, 1982.

A basic compendium of all of the salient features of water well technology. It is a complete review of the water well industry including exploratory drilling, development of production wells for industrial, municipal, and individual domestic water supplies, water quality, and treatment of drilling contaminants.

Handbook of Applied Hydrology: A Compendium of Water Resources Technology. V.T. Chow, Ed. McGraw-Hill, 1964.

An interdisciplinary handbook covering hydrology and water-resources technology. Information comes under four major groupings dealing with: the closely related sciences upon which hydrology depends; various phases of the hydrologic cycle and phenomena; practice and application of hydrology in various fields; and some socio-economic aspects of hydrology, including planning, policy, and law.

Ground-Water Hydraulics. S.W. Lohman, Geological Survey Professional Paper 708, 1972.

A basic textbook for working professionals covering all subjects of concern in ground-water hydraulics--the natural or induced movement of water through permeable geologic

formations. The principal method of analysis in ground-water hydraulics is the application, generally by field tests of discharging wells, of equations derived for particular boundary conditions. Topics discussed include unsaturated zone testing, aquifer testing, and confined and unconfined conditions.

MONITORING

Methods for Determining Permeability, Transmissibility, and Drawdown. R. Bentall, Geological Survey Water-Supply Paper 1536-I, 1963.

Suggestions for correcting drawdown measurements analyzed by the Theis graphical method; remarks pertaining to Wenzel's limiting formula, gradient formula, and the recovery method; a formula for corrections to be applied if wells used for aquifer tests tap less than the full thickness of the aquifer; formulas for the determination of aquifer constants from water-level data obtained when a well is bailed or a slug of water is injected into a well; analyses of the effects of cyclic fluctuations of the water level, the pumping rate, or the pumping interval; and methods relating the specific capacity of a well to the aquifer coefficient of transmissibility.

Theory of Aquifer Tests. J.G. Ferris, D.B. Knowles, R.H. Brown, and R.W. Stallman, Geological Survey Water-Supply Paper 1536-E, 1962.

Survey of developments in fluid mechanics that apply to ground-water hydrology. The origin, occurrence, and motion of ground water in relation to the development of terminology and analytic expressions for selected flow systems. Emphasis is on concepts, principles, and the delineating limits of applicability of mathematical models for analyzing flow systems in the field. The importance of the geologic variable and its role in governing the flow regimen is stressed.

Specific Yield--Compilation of Specific Yields for Various Materials. A.I. Johnson, Geological Survey Water-Supply Paper 1662-D, 1967.

A compendium of excerpts from selected reports that present and evaluate methods for determining specific yield, limitations of those methods, and results of the determinations made on a wide variety of rock and soil materials. Although no particular values are recommended in this report, it does summarize values of specific yield and their averages determined for 10 rock textures.

Underground Tank Leak Detection Methods: A State-of-the-Art Review. EPA/600/2-86/001, PB86 137-155, January 1986.

A discussion of 36 leak detection methods for underground storage tanks used primarily for gasoline and other liquid petroleum fuels. The emphasis is on volumetric and non-volumetric leak detection methods. General engineering comments are provided for each method and there is a discussion of variables that may affect the accuracy of each method.

Practical Guide for Ground-Water Sampling. EPA/600/2-85/104, PB86 137-304, September 1985. *CERI.*

Detailed information on how to conduct a ground-water sampling program. Topics covered include: sampling frequency and analytical detail required for assessment of monitoring data sets; well placement, construction and design; well development, performance, maintenance, and purging strategies; and sampling mechanisms and collection. There are also recommended protocols for various types of sampling and discussions of associated errors.

"Sorption of Organics by Monitoring Well Construction Materials." A.L. Sykes, R.A. McAllister, and J.B. Homolya, Ground Water Monitoring Review, 6(4):44-47, Fall 1986.

A study of the effect of well-casing material (PVC, teflon, or stainless steel) on the sorption of volatile organic hydrocarbons found in contaminated groundwater. It also considers the sampling and storage stabilities of these contaminants for periods up to nine days. Results showed no significant differences in sorption between casing materials, but did find that length of storage resulted in some variability.

"Underground Storage Tank Monitoring: Observation Well Based Systems." R.A. Scheinfeld, J.B. Robertson, and T.G. Schwendeman, Ground Water Monitoring Review, 6(4):49-55, Fall 1986.

A discussion of the currently available leak-detection monitoring systems that can be used with the three main types of observation wells: ground-water observation wells, vapor wells and U-tubes. Seven types of liquid hydrocarbon detectors and six types of hydrocarbon vapor detectors are described.

"The Effect of Sampling Frequency on Ground Water Quality Characterization." R. Rajagopal, Ground Water Monitoring Review, 6(4):65-73, Fall 1986.

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"The Use of Industrial Hygiene Samplers for Soil-Gas Surveying." H.B. Kerfoot and C.L. Mayer, Ground Water Monitoring Review, 6(4):74-78, Fall 1986.

A description of soil-gas surveying using a passive sampler, which allows quantitative determination of concentration of volatile organic compounds and remote analysis of samples. Use of this sampler above a chloroform ground-water plume is compared to results obtained through ground-water analysis and from a previous soil gas study above the same plume. Chloroform concentrations measured with passive samplers correlate well with the other two techniques. The short-term variability of the technique is characterized by a coefficient of variation of 12% over a 27-foot distance for nine samplers, and compares favorably with grab-sample results at the same location.

Unsaturated Zone Monitoring Protocols for Hazardous Waste Land Treatment Units. L.G. Everett, L.G. Wilson, and L.G. McMillion, National Water Well Association Proceedings in Las Vegas, Nevada, December 8-10, 1983.

A discussion of unsaturated zone monitoring at hazardous-waste land treatment units with particular reference to the Unsaturated Zone Monitoring Requirements in the hazardous-waste land-disposal regulations. Methods for detecting slowly and rapidly moving hazardous constituents include many types of hand-held and power-driven soil samplers and suction lysimeters. Criteria for sample selection, number, frequency, size, and depths are presented.

Shortcuts and Special Problems in Aquifer Tests. R. Bentall, Ed. Geological Survey Water-Supply Paper 1545-C, 1963.

Seventeen previously unpublished papers dealing with special methods for solving fundamental ground-water formulas or solving particular ground-water problems are brought together. Shortcut methods include the use of special charts, scales, or graphs for the solution of the general nonequilibrium formula. Some extend the equilibrium straight-line methods to obtain more information with less work; some analyze specific boundary problems; and one discusses hydraulic and economic factors in well spacing in a multiple-well system.

A Guide to the Selection of Materials for Monitoring Well Construction and Ground-Water Sampling. M.J. Barcelona, J.P. Gibb, and R.A. Miller, Illinois State Water Survey Contract Report 327, 1983.

A basic text on the selection of cost-effective materials, target chemical constituents, and procedures for monitoring-well casing materials to minimize disturbance of the subsurface. Other topics covered include sampling apparatus and strategies, monitoring-well network design, and specific recommendations.

Ground Water and Wells. E.E. Johnson, Ed. Johnson Division, UOP, Inc., Minneapolis, Minnesota, 1982.

A basic reference presenting the technical aspects of ground-water occurrence, ground-water movement, well hydraulics, well design and ground-water geology, and the practical aspects of well drilling, well-screen selection, well maintenance, and well operation.

Analysis and Evaluation of Pumping Test Data. E.P. Kruseman and N.A. De Ridder, Inter. Inst. Land Reclamation and Improvement, P.O. Box 6700AA, Wageningen, Netherlands, 1983.

A guidebook for analyzing and evaluating data from pumping tests. The methods presented are collected from the literature dealing with ground-water flow towards discharging wells, with emphasis on when and how to apply a certain method. Users of the book will need only an elementary background of mathematics and physics.

Practical Hydraulics. A.L. Simon, John Wiley & Sons, 1976.

A basic reference on the science of hydraulics, including chapters on the physical properties of water, laws of fluid mechanics, water pressure, pipe flow, pumps, seepage, elements of hydrology, open channel flow, flow through hydraulic structures, and flow measurements.

Modeling Remedial Actions at Uncontrolled Hazardous Waste Sites. EPA/540/2-85/001, PB85 211-357, April 1985.

The use of mathematical models to assess remedial action performance at uncontrolled hazardous-waste sites is presented in this four volume set. The first volume presents model selection methodology. Volumes 2 and 3 describe remedial-action modeling requirements, model application guidance and numerical models for evaluation of subsurface and waste control actions. Volume 4 describes analytical and numerical model use for evaluation of remedial actions in surface water.

Users Manual for the Pesticide Root Zone Model (PRZM). EPA/600/3-84/109. December 1984. *CERI.*

The PRZM simulates the vertical movement of pesticides in the unsaturated soil within and below the plant root zone and extending to the water table. The model uses generally available input data and hydrology and chemical transport components to simulate runoff, erosion, plant uptake, leaching, decay, foliar washoff, and volatilization of the pesticide. Predictions can be made for daily, monthly, or annual output. It is designed to run on a DEC PDP 1170 mini-computer, but with modification will run on other computers with FORTRAN compilers.

Leaching Evaluation of Agricultural Chemicals (LEACH) Handbook. EPA/600/3-84/068, PB84 236-413, June 1984. *CERI.*

The LEACH method provides an indication of the presence, absence, and severity of pesticide leaching below the rooting depth for major crop growing areas of the United States. LEACH was developed from long-term simulation of annual pesticide-leaching time series using the Pesticide Root Zone Model. Key parameters of a pesticide-site-crop-management scenario are used to locate unique cumulative-frequency distributions, which indicate whether the annual quantity of pesticides leached past the crop rooting depth will exceed a given value.

MEXAMS--The Metals Exposure Analysis Modeling System. EPA/600/3-84/031, PB84 157-155, February 1984

MEXAMS provides enhanced capability for assessing the impact of priority-pollutant metals on aquatic systems. It allows the user to consider the complex chemistry affecting the behavior of metals in conjunction with the transport processes that affect their migration and fate. This is accomplished by linking MINTEQ, a geochemical model, to EXAMS, an aquatic exposure assessment model.

MINTEQ--A Computer Program for Calculating Aqueous Geochemical Equilibria. EPA/600/3-84/032, PB84 157-148, February 1984.

MINTEQ is a thermodynamic equilibrium model that computes aqueous speciation, adsorption, and precipitation/dissolution of solid phases. It combines the best features of two existing geochemical models, MINEQL and WATEQ3, and was developed for incorporation into the Metals Exposure Analysis Modeling System (MEXAMS). It has a well-documented thermodynamic data base that contains equilibrium constants and accessory data for seven priority-pollutant metals: arsenic, cadmium, copper, lead, nickel, silver, and zinc. MINTEQ

also features algorithms for temperature correction and ionic-strength correction as well as six different adsorption algorithms and a large number of user-oriented features.

DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeological Settings. EPA/600/2-85/018, PB85 228-146, May 1985.

DRASTIC allows for the evaluation of the pollution potential of any hydrogeologic setting in the United States. Hydrogeologic settings are described for different regions of the United States and incorporate the major hydrogeologic factors that affect or control ground water movement: depth to water table, net recharge, aquifer media, topography, impact of the vadose zone, and hydraulic conductivity of the aquifer. These factors, which combine to form the acronym DRASTIC, are used to infer the potential for contamination of ground water. A numerical value, the DRASTIC INDEX, helps rank vulnerability to ground-water contamination.

Groundwater Transport: Handbook of Mathematical Models. I. Javandel, C. Doughty, and C.F. Tsang, Amer. Geophysical Union, Water Resources Monograph 10, 1984.

A presentation of the best and most usable mathematical methods for predicting the extent of subsurface contamination, in a format useful to field-response personnel. It contains selected analytical solutions, semianalytical methods and numerical approaches, and discusses the strengths and possible pitfalls in the application of each. It also contains comprehensive tables and computer-program listings. It should enable the user to make initial estimations of contaminant transport at a given site, and if the need arises, to select sophisticated numerical models.

Groundwater Management: The Use of Numerical Models (Second Edition). P. van der Heijde, Y. Bachmat, J. Bredehoeft, B. Andrews, D. Holtz, and S. Sebastian, Amer. Geophysical Union, Water Resources Monograph 5, 1985.

A compilation by the International Ground Water Modeling Center of information on almost 400 ground-water simulation models from around the world. There is a general discussion of ground water systems, a description of the basic equations used to model ground water systems, a detailed examination of the intrinsic strengths and deficiencies of existing ground-water models, and information on the use of models in management.

"Evolving Concepts of Subsurface Contaminant Transport." J.F. Keely, M.D. Piwoni, and J.T. Wilson, J. Water Pollution Control Fed. 58(5):349-357, May 1986.

This paper, by three EPA scientists, examines the changing perceptions of how natural processes control the fate of contaminants in the subsurface. The discussion focuses on three levels of understanding: conceptual (state of the knowledge), theoretical (state of the science), and practical (state of the art). Physical, chemical, and biological processes are discussed.

Ground Water Modeling Newsletter. International Ground Water Modeling Center, Holcomb Research Institute, Butler University, 4600 Sunset Avenue, Indianapolis, Indiana, 46208.

The *Ground Water Modeling Newsletter* is published quarterly by the Ground Water Modeling Center and is available free of charge [telephone (317) 283-9458]. It contains up-to-date information about new publications, computer models, conferences and seminars, and announcements of services related to ground-water modeling.

Ground-Water Modeling. J.W. Mercer and C.R. Faust, National Water Well Assoc., 1981.

Background and description of ground-water models for managers and hydrologists with little or no modeling experience. It explains the basic concepts in mathematical and numerical modeling and presents the uses and limitations of ground-water models as they are applied towards solving complicated ground-water problems.

AQUIFER RECLAMATION

"In-Situ Biorestoration as a Ground Water Remediation Technique." J.T. Wilson, L.E. Leach, M. Henson, and J.N. Jones, Ground Water Monitoring Review, 6(4):56-64, Fall 1986.

This paper discusses the role of microorganisms in degrading or transforming a wide variety of subsurface organic contaminants and the possibilities for enhancing this process through various remediation techniques.

TREATMENT

"Treatment of Ground-Water with Granular Activated Carbon." Wood, P.R., and DeMarco, J. J. Amer. Wtr. Wrks. Assn. 71(11):674-682, 1979.

An evaluation of raw, lime-softened, and finished water from the Hialeah, Florida, water system determined the adsorption capacities for four types of granular activated carbon. The carbons were tested for halogenated organic compounds, total organic compounds, and trihalomethane formation potential, as well as for several high molecular weight compounds.

Treatment of Volatile Organic Compounds in Drinking Water. EPA/600/8-83/019, PB83 239-434, May 1983.

A review of the properties, occurrence, and efforts to control the following organic chemicals in drinking water: tri- and tetrachloroethylene; cis- and trans-1,2-dichloroethylene; 1,1-dichloroethylene; vinyl and methylene chloride; 1,1,1-trichloroethane; 1,2-dichloroethane; carbon tetrachloride; benzene; chlorobenzene; 1,2-, 1,3-, and 1,4-dichlorobenzene; and 1,2,4-trichlorobenzene.

"Treatment of Drinking Water Containing Trichloroethylene and Related Industrial Solvents." O.T. Love, Jr. and R.G. Eilers. J. Amer. Wtr. Wrks. Assoc., 74(8):413-425, 1982.

A discussion of the effects of aeration, adsorption, and boiling on water contaminated with the volatile organic solvents trichloroethylene, tetrachloroethylene, 1,1,1-trichloroethylene, cis-1,2-dichloroethylene, carbon tetrachloride, and 1,2-dichloroethane. Characteristics of the compounds and estimates of the treatment costs are also provided.

Treatment Techniques for the Removal of Inorganic Contaminants from Drinking Water. T.J. Sorg, In: *Manual of Treatment Techniques for Meeting Interim Primary Drinking Water Regulations*, EPA/600/8-77/005, PB 268-029, May 1977. *CERI.*

Provides utilities with information needed to apply treatment necessary to improve their drinking-water quality to meet the Interim Primary Drinking Water Regulations for inorganic contaminants. It also provides information on the types of treatment techniques available and commonly used for removing inorganic contaminants in drinking water, and a discussion of the primary factors affecting removal results.

"Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics (Part 1, Nitrate and Fluoride)." T.J. Sorg, J. Amer. Wtr. Wrks. Assoc. 70(2):105-112, 1978.

The first of a series, this article presents a summary of the USEPA Water Supply Research Division's overall project to evaluate contaminant removal techniques. The research program consisted of two phases: (1) a series of laboratory tests to determine critical variables affecting removal of contaminants and (2) pilot plant tests to verify laboratory results. This articles gives specific details on nitrate and flouride health effects, chemistry and removal treatment technology. Subsequent articles will review the treatment technology for the eight other NIPDWR-regulated inorganic contaminants and the radionuclides.

"Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics (Part 2, Arsenic and Selenium)." T.J. Sorg and G.S. Logsdon. J. Amer. Wtr. Wrks. Assoc. 70(7):379-393, 1978.

The second in a series summarizing existing treatment technology to meet the inorganic National Interim Primary Drinking Water Regulations. Presents health effects, chemistry, and current treatment methods for removing arsenic and selenium from drinking water.

"Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics (Part 3, Cadmium, Lead, and Silver)." T.J. Sorg and G.S. Logsdon, J. Amer. Wtr. Wrks. Assoc. 70(12):680-691, 1978.

The third in a series summarizing existing treatment technology to meet the inorganic National Interim Primary Drinking Water Regulations, this report describes current treatment methods for removing cadmium, lead, and silver from drinking water. The chemistry and health effects of each metal are presented.

"Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics (Part 4, Chromium and Mercury)." T.J. Sorg, J. Amer. Wtr. Wrks. Assoc. 71(8):454-466, 1979.

The fourth in a series summarizing existing treatment technology to meet the inorganic National Interim Primary Drinking Water Regulations, this report describes current treatment methods for removing chromium and mercury from drinking water. Detailed discussion of the health effects of contamination and the chemistry of these two metals are included.

"Treatment Technology to Meet the Interim Primary Drinking Water Regulations for Inorganics (Part 5, Barium and Radionuclides)." T.J. Sorg and G.S. Logsdon, J. Amer. Wtr. Wrks. Assoc. 72(7):411-422, 1980.

The fifth in a series summarizing treatment technology to meet the inorganic National Interim Primary Drinking Water Regulations. This report describes current methods for removing barium and radionuclides from drinking water, along with discussions of the health effects and chemistry of these two contaminants.

"The Occurrence and Reduction of Sodium in Drinking Water." R.P. Lauch and T.J. Sorg, J. Amer. Wtr. Wrks. Assoc. 73(5):256-265, 1981.

Discussion of how sodium can be increased during drinking-water treatment, what concentrations can be expected after treatment, and how sodium in drinking water can be reduced or eliminated. A literature review on treatment techniques for reduction of total dissolved solids and a brief introduction on the health effects of sodium are also included.

"Removal of Radium-226 from Drinking Water by Reverse Osmosis in Sarasota, Florida." T.J. Sorg, R.W. Forbes, and D.S. Chambers, J. Amer. Wtr. Wrks. Assoc. 72(4):230-237, 1980.

Eight reverse osmosis treatment systems were studied for their effectiveness in removing naturally occurring ^{226}Ra and other dissolved solids from water. Although the age, type, and performance of the eight systems varied, all systems lowered the ^{226}Ra concentration in the raw water to below the EPA contaminant level of 5 pCi/L.

"Bacteriological Criteria for Ground Water Quality." M.J. Allen and E.E. Geldreich, Ground Water, 13(1):45-52, Jan-Feb 1975.

Article emphasizing the need for increased awareness and better detection of bacterial pathogens in untreated or marginally treated ground water used for human consumption. Well protection, unsatisfactory well construction, and inadequate treatment are common causes of poor ground-water quality.

"Microbiology of Potable Water and Groundwater." D.J. Reasoner, J. Water Pollution Control Fed. 55(6):891-895, 1983.

Recent studies of the microbiology of both potable water and ground water are presented in this paper. These studies include information on sampling techniques, environments conducive to different types of microbial growth, resistant strains of bacteria, and effects of various treatments on controlling microbial growth in different settings.

SOURCE CONTROL

Evaluating Cover Systems for Solid and Hazardous Waste. EPA Technical Resource Document, EPA/530/SW-867C, PB81 166-340, 1980.

A description of 36 steps for evaluating solid- and hazardous-waste cover systems, it helps form a basis for issuing a permit to the owner/operator of a waste-disposal facility. It discusses factors such as available soils, site conditions, details of cover design, post-closure maintenance, and contingencies.

Hydrologic Simulation on Solid Waste Disposal Sites (HSSWDS). EPA Technical Resources Document, EPA/530/SW-868C, PB81 166-332, 1980.

A microcomputer program for the IBM-PC/XT/AT to simulate a solid- or hazardous-waste disposal site operation. From minimal input data (geographic location, area, hydrologic length, and final soil and vegetative characteristics), the model will simulate daily, monthly, and annual runoff, deep percolation, temperature, soil-water, and evapotranspiration. The program is a combination of the SCS curve number runoff method and the hydrologic portion of the USDA-SEA hydrologic model (CREAMS), modified to conform to the design characteristics of solid and hazardous waste disposal sites. No prior experience with computer programming is necessary.

Landfill and Surface Impoundment Performance Evaluation. EPA Technical Resource Document, EPA/530/SW-869C, PB81 166-357, September 1980. (Revised April 1983)

Recommended procedures for evaluating the effectiveness of liquid transmission control systems for hazardous-waste landfill and surface impoundments. Equations allow a determination of the performance of compacted-clay liners intended to impede the vertical flow of liquids, sand or gravel drainage layers used to convey liquids laterally into collection systems, slopes on liners and drain layers, and spacings of collector drain pipes.

Management of Hazardous Waste Leachate. EPA Technical Resource Document, SW-871, EPA68-03-2766, PB81 189-359, September 1980.

Management options for a permit writer or hazardous-waste landfill operator to consider in controlling a leaching problem. The manual contains sections on: leachate generation; leachate composition and relative hazards; potential management options for off-site treatment of leachate or on-site treatment of hazardous waste; and a discussion of treatment technologies that have had reasonable success in treating leachate.

Closure of Hazardous Waste Surface Impoundments. EPA Technical Resource Document, EPA/530/SW-873, PB81 166-894, September 1980.

Considerations for planning the closure of surface impoundments containing hazardous wastes. It contains engineering techniques for closure operations that minimize the possibility of adverse environmental impacts.

The Hydrologic Evaluation of Landfill Performance (HELP) Model: Volume I. EPA Technical Resource Document EPA/530/SW-84/009, PB85 100-840, June 1984.

The HELP program was developed to facilitate rapid, economical estimation of the amounts of surface runoff, subsurface drainage, and leachate that may be expected from a wide variety of landfill designs. The program models the effects of hydrologic processes including precipitation, surface storage, runoff, infiltration, percolation, evapotranspiration, soil-moisture storage, and lateral drainage using a quasi-two-dimensional approach. Volume I contains information on some basic elements of the model, input/output options, and instructions for running the program on the National Computer Center IBM Computer.

The Hydrologic Evaluation of Landfill Performance (HELP) Model: Volume II. EPA Technical Resource Document EPA/530/SW-84/010, PB85 100-832, June 1984.

The second of two volumes on the HELP program, it contains detailed discussions of the

theories and assumptions upon which the HELP model is based, the solution techniques employed, and the internal logic of the computer program.

Review of In-Place Treatment Techniques for Contaminated Surface Soils: Volume I, Technical Evaluation. Remedial Action Handbook, EPA/540/2-84/003a, PB85 124-881, September 1984.

In-place treatment technologies applicable to contaminated soils less than 2 feet deep. Volume I discusses the selection of the appropriate in-place technology for a particular site and provides specific information on each technology. Selection of technologies follows the process in the National Contingency Plan. The type of in-place treatment and selection of a specific technology are determined from remedial investigations, assessments of waste, soil, and site-specific variables, and cost-effectiveness.

Review of In-Place Treatment Techniques for Contaminated Surface Soils: Volume II, Background Information for In-Situ Treatment. Remedial Action Handbook, EPA/540/2-84/003b, PB85 124-899, November 1984.

Supports the treatment methodologies described in Volume I. Includes monitoring techniques to determine treatment effectiveness, to characterize and evaluate the behavior and fate of hazardous constituents in soil/waste systems, and on properties of various compounds. This information is intended to help users make more complex decisions and select analyses concerning site, soil, and waste interactions not covered in Volume I.

Slurry Trench Construction for Pollution Migration Control. Remedial Action Handbook, EPA/540/2-84/001, PB84 177-831, February 1984.

This report is intended to provide reviewers of remedial action plans with the necessary background material to evaluate the use of slurry walls to control pollution migration. Information is presented on the history, theory and fundamentals of slurry-wall use; procedures for planning a slurry-wall installation; slurry-wall design and construction practices; methods to monitor and maintain a slurry wall; and evaluation criteria that correspond to the stages of slurry-wall installation.

Covers for Uncontrolled Hazardous Waste Sites. Remedial Action Handbook, EPA/540/2-85/002, PB86 119-483, September 1985. *CERI.*

A technical handbook to aid designers of cover systems and regulatory personnel evaluate cover systems to minimize percolation and leachate formation from uncontrolled hazardous-waste sites. Topics covered include procedures for estimating leachate production from given covers, site specific guidelines for cover designs, and characteristics of contaminated soils.

Leachate Plume Management. Remedial Action Handbook, EPA/540/2-85/004, PB86 122-330, November 1985.

An overview of the fundamental concepts, procedures, and technologies used in leachate-plume management, including plume-generation dynamics and delineation. Plume-control technologies are evaluated and selection criteria for site application are defined. Aquifer-restoration technologies include groundwater pumping, subsurface drains, and low-permeability barriers.

Handbook for Stabilization/Solidification of Hazardous Wastes. Remedial Action Handbook, EPA/540/2-86/001, June 1986.

This handbook provides designers and reviewers of remedial action plans with the information and general guidance necessary to judge the feasibility of stabilization/solidification technology for the control of pollutant migration from hazardous wastes disposed on land. The chemical basis for this technology, the waste characteristics and site considerations which make it appropriate, and the methods for determining its success are all discussed. Four stabilization/solidification scenarios illustrate the strengths and weaknesses of each alternative and offer guidance on processing technologies most suited to specific waste types and site conditions.

Handbook for Remedial Action at Waste Disposal Sites (Revised). Remedial Action Handbook, EPA/625/6-85/006, October 1985. *CERI.*

A basic reference tool on remedial action designed to assist in understanding remedial technologies, selecting applicable technologies for a given waste site, and planning remedial action. Technologies are organized by the type of site problem they are intended to remedy (*e.g.*, surface-water controls, ground-water controls). Information on applications, limitations, design, construction, operational considerations, feasibility, and cost are presented for each major technology. Demonstrated technologies are emphasized, but information is also included on emerging technologies.

Underground Storage Tank Corrective Action Technologies. EPA/625/6-87/015, January 1987.

Technologies currently used to correct underground storage tanks that are leaking primarily gasoline and petroleum products, and information for determining state-of-the-art applicability costs and effectiveness of alternative corrective action technologies. Technologies and practices used in other environmental remediation programs were also evaluated for potential use in underground storage tank corrective actions.

Removal of Hazardous Material Spills from Bottoms of Flowing Waterbodies. EPA/600/2-81/137, PB81 230-922, July 1981.

Results of a feasibility study for removing spilled insoluble hazardous materials from the bottom of flowing watercourses. Two full-scale systems are described that were developed to collect spilled materials and contaminated bottom mud, remove excess water from the pumped slurry, and return decontaminated water to the stream. The two systems were successfully demonstrated at a creosote spill on the Little Menomonee River in Milwaukee, Wisconsin.

Feasibility of Commercialized Water Treatment Techniques for Concentrated Waste Spills. EPA/600/2-81/213, PB82 108-440, September 1981.

The suitability and economics of reverse osmosis, ultrafiltration, ion exchange, wet-air oxidation, high-purity oxygen-activated sludge process, ultraviolet-ozone oxidation, and coagulation/precipitation for on-site treatment of concentrated wastes were evaluated from published literature and data obtained from process suppliers. Alone, none of the processes would be economically applicable for on-site treatment of the variety of concentrated wastes encountered, although reverse osmosis, ion exchange, and wet-air oxidation meet many of the application requirements.

Mobile System for Extracting Spilled Hazardous Materials from Excavated Soils. EPA/600/2-83/100, PB84 123-637, October 1983.

Based on laboratory tests with three pollutants (phenol, arsenic trioxide, and PCBs) and two widely different soils, a full scale, field-use system was designed, assembled, and briefly tested for cleansing soil contaminated with hazardous materials. The system includes two major soil-scrubbing components: a water-knife stripping and soaking unit for disintegrating the soil matrix and solubilizing the contaminant from the larger particles (>2mm) and an existing but re-engineered, four-stage countercurrent extractor for freeing the contaminants from smaller particles (<2mm). The processing rate of the system, complete with wastewater recycling, is 2.3 to 3.8 m^3/hr.

Design and Construction of a Mobile Activated Carbon Regenerator System. EPA/600/2-86/015, PB86 156-486, January 1986.

A mobile carbon regeneration unit is described that can be used with mobile activated carbon adsorption units. It is housed in a standard van type of trailer and includes a rotating barrel kiln to thermally regenerate the carbon, an incinerator and scrubber to destroy the desorbed materials and treat the offgases, and a separator to reclaim the reactivated carbon granules. In test runs from the on-site treatment of a spill, the carbon was returned to essentially 100% activity with an 88% volume recovery.

Treatment of Contaminated Soils with Aqueous Surfactants. EPA/600/2-85/129, PB86 122-561, November 1985.

An investigation of aqueous nonionic surfactants for cleaning soil contaminated with PCBs, petroleum hydrocarbons, and chlorophenol. Contaminant removal from the soil was 92% for PCBs, and 93% for petroleum hydrocarbons. While these results are an order of magnitude greater than obtained with water alone, the inability to separate the surfactants from the contaminants for reuse would render the process uneconomical for field application. Future work should investigate the use of other surfactants that may be more amenable to separation.

RISK ASSESSMENT

"Health Risk Comparison Between Groundwater Transport Models and Field Data." Environmental Progress, 5(1):66-70, February 1986.

Methods to predict contaminant migration using both computer modeling and field monitoring data, and case studies comparing health-risk (exposure) assessments and plume delineation based on modeling and monitoring predictions.

Rapid Assessment of Potential Ground-Water Contamination Under Emergency Response Conditions. EPA/600/8-83/030, November 1983. *CERI.*

A rapid assessment method for evaluating potential ground-water contamination from a spill or waste site under a 24-hour emergency-response time frame. The method allows order-of-magnitude estimates of contaminant concentrations with time and distance below the surface. Assumptions and limitations of the procedures, auxiliary sources of information, and example applications are discussed.

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