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Testing and Demonstration Sites For Innovative Ground-Water Remediation Technologies

U.S. Environmental Protection Agency
Office of Solid Waste and Emergency Response
Technology Innovation Office
Washington, DC 20460

Notice

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Foreword

The mission of U.S. EPA's Technology Innovation Office (TIO) is to promote the use of new, less costly, and more effective technologies to clean up contaminated soil and ground water at the nation's hazardous waste sites. The availability of public demonstration and testing sites is a key factor in the development of adequate remediation technologies.

TIO recognizes the need for extensive field demonstrations and verification testing of these technologies prior to general acceptance and full commercialization. Demonstration sites are relatively scarce and demonstrations involve some degree of financial and environmental risk. Ground-water contamination has been found at 85% of hazardous waste sites, and few efficient, cost-effective ground-water cleanup technologies are available. The difficulty in defining both contaminated areas and the subsurface environment compounds the need for diverse technologies and adequate demonstration sites to test these technologies. In addition, regulators that select or approve the use of cleanup technologies are usually reluctant to turn to innovative technologies if they lack demonstrated cost and performance information.

This report describes fifteen publicly-sponsored facilities available for testing and demonstration of ground-water technologies. It is intended to help technology developers choose appropriate demonstration sites. A profile of each site includes general site characterization and contamination information, appropriate types of demonstrations, technologies previously demonstrated, available analytical facilities, permitting requirements and an on-site contact. **This information is summarized for quick reference in two tables preceding the full profiles.**

Information for this report was obtained primarily through direct communication with on-site contacts. Additional material was obtained from a document titled *Environmental Technologies Testing and Demonstration Sites: A Federal Directory*, compiled by the U.S. Department of Agriculture. This directory, currently a work in progress, contains information on sites managed by U.S. Government departments and agencies.

To order a paper copy of this document, contact the National Center for Environmental Publications and Information at (513) 489-8190 or fax your request to NCEPI at (513) 489-8695. Refer to document number **EPA 542-R-97-002** when ordering.

For more information about this project, contact:

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Abbreviations

AA	=	Atomic Absorption (Spectrophotometry)
BTEX	=	Benzene, Toluene, Ethylene, Xylene
CT	=	Carbon Tetrachloride
DCA	=	Dichloroethane
DCE	=	Dichloroethene
DCM	=	Dichloromethane
DNAPL	=	Dense Non-Aqueous Phase Liquid
DNT	=	Dinitrotoluene
FID	=	Flame Ionization Detection
FTIR	=	Fourier Transform Infrared (Spectroscopy)
GAC	=	Granular Activated Charcoal
GC	=	Gas Chromatography
HCN	=	Hydrogen Cyanide
HPLC	=	High Performance Liquid Chromatography
IC	=	Ion Chromatography
ICP	=	Inductively Coupled Plasma
JP-4	=	Jet Fuel
LC	=	Liquid Chromatography
MCL	=	Maximum Contaminant Level
MS	=	Mass Spectrometry
nCI	=	Nanocuries
IRP	=	Installation Restoration Program
PAH	=	Poly-Aromatic Hydrocarbon
PCB	=	Poly-Chlorinated Biphenyl
PCE	=	Tetrachloroethylene (Perchloroethylene)
pCI	=	Picocuries
RS	=	Raman Spectrometry
SVE	=	Soil Vapor Extraction
SVOC	=	Semi-Volatile Organic Compound
TCA	=	1,1,1-Trichloroethane
TCE	=	Trichloroethylene
TNT	=	Trinitrotoluene
TOC	=	Total Organic Carbon
VOC	=	Volatile Organic Compound

Contents

Summary of Ground-Water Remediation Technology Testing and Demonstration Sites (Part 1)

Site Name	Class(es) of Site Contaminants	App. Depth to Ground Water	On-Site Analytical Capabilities	Appropriate Types of Demonstrations
Argonne National Laboratory, Argonne, IL	halogenated volatile organics and non-halogenated aromatics in soils and ground water	10+ ft.	extensive	*In situ* remediation and monitoring technologies for soil or ground water
Borden Demonstration Site, University of Waterloo, Canada	landfill leachate, some controlled releases of halogenated VOCs	0-3 ft.	extensive	All *in situ* technologies; controlled releases have been conducted
Environmental Simulation Laboratory, University of Wyoming	None; Above-ground testing facility	10 ft. max.	extensive	All technologies
Groundwater Phytoremediation Test Facility, University of Washington	N/A	4 ft.	none; full capability available 50 miles away at the University of Washington	*In situ* phytoremediation of chlorinated hydrocarbons under controlled conditions
Ground-Water Remediation Field Laboratory, Dover AFB, DE	GRFL provides uncontaminated test beds and oversees sites contaminated with halogenated VOCs and BTEX	15-25 ft.	extensive	All *in situ* technologies, including controlled releases
Idaho National Engineering Laboratory, ID	radionuclides, heavy metals, halogenated VOCs	200-600 ft.	extensive, including microbiology and biochemistry	All *in situ* technologies
McClellan Air Force Base, CA	BTEX, halogenated VOCs	90-105 ft.	none available for private use, several nearby facilities	All technologies; previous demonstrations include ground-water and soil technologies
National Center for Integrated Bioremediation Research and Development, Wurtsmith AFB, MI	BTEX, VOCs, pesticides, fire fighting agents, landfill leachate	8-22 ft.	some; extensive facilities available at University of Michigan	All *in situ* technologies, particularly bioremediation
Naval Construction Battalion Center, Port Hueneme, CA	BTEX, PCBs, pesticides, metals, acids, solvents	8-12 ft.	none; several nearby facilities	All technologies, including sediment remediation
Oak Ridge Subsurface Weirs, TN	halogenated VOCs, non-halogenated aromatics, and radionuclides	10+ ft.	extensive for radioanalytical and tracer analyses	*In situ* characterization and monitoring technologies for soil or ground water
Sandia National Laboratories, California Site	BTEX	80-100 ft.	variety of equipment for chemical analyses	All *in situ* technologies

Summary of Ground-Water Remediation Technology Testing and Demonstration Sites (Part 1)

Site Name	Class(es) of Site Contaminants	App. Depth to Ground Water	On-Site Analytical Capabilities	Appropriate Types of Demonstrations
Sandia National Laboratories, New Mexico Site	VOCs, chromium	500 ft.	GC/RS, Geoprobe, mobile laboratory	*In situ* remediation and monitoring technologies for soil or ground water
Savannah River Site, SC	pesticides, BTEX, VOCs, radionuclides, metals	10-150 ft.	extensive	All technologies; many have been demonstrated previously
Smithville Phase IV Bedrock Remediation Program, Canada	PCBs, VOCs, BTEX, dioxin, furans	20 ft.	none; full-service contract laboratory nearby	All technologies
Volunteer Army Ammunition Plant, TN	TNT and other nitroaromatics	20-40 ft.	extensive for explosives analyses	All remediation technologies for explosives

Summary of Ground-Water Remediation Technology Testing and Demonstration Sites (Part 2)

Site Name	Permitting Requirements	Addition of Injectants for Studies	Unique Site Features
Argonne National Laboratory, Argonne, IL	None; regulatory agencies require notification only	Remediation solutions allowed on case-by-case basis	Wide variety of solvents (20+). Soil has very low permeability, complex lithology of glacial till material.
Borden Demonstration Site, University of Waterloo, Canada	Permit required	Allowed	Site includes a well-characterized, relatively simple surficial aquifer/ shallow aquitard system.
Environmental Simulation Laboratory, University of Wyoming	Not yet determined (facility yet to host remediation project)	At present, allowed if subsequently removed and disposed of off-site	Simulation of environmental conditions allows controlled research at a scale between bench and field.
Groundwater Phytoremediation Test Facility, University of Washington	Permit required	Remediation solutions allowed on case-by-case basis	Control over influent composition. Ability to produce approximate mass balances of chlorinated hydrocarbons in influent and effluent streams allows measurement of transpired chlorinated hydrocarbons.
Ground-Water Remediation Field Laboratory, Dover AFB, DE	Permit required	Allowed, including hazardous contaminants	Developers may conduct controlled releases of contaminants in sheetpile-lined cells. Developers also may conduct demonstrations at other areas of Dover AFB through GRFL.
Idaho National Engineering Laboratory, ID	Permit required	Remediation solutions allowed on case-by-case basis	Deep ground water, radioactive contamination, vadose zone transport of volatile organics.
McClellan Air Force Base, CA	None for remediation technologies	Remediation solutions allowed on case-by-case basis	Multiple operable units offer range of platforms. Centralized treatment facility for extracted ground water.
National Center for Integrated Bioremediation Research and Development, Wurtsmith AFB, MI	Permit required, filed by the facility	Remediation solutions and on-site contaminants may be introduced	Opportunity to study intrinsic phytoremediation. Aqueous solutions of on-site contaminants may be injected for controlled experiments. Site includes three air strippers.
Naval Construction Battalion Center, Port Hueneme, CA	Permit required	Remediation solutions allowed on case-by-case basis	Three-dimensional monitoring network with long-term data retrieval available for data comparison.
Oak Ridge Subsurface Weirs, TN	Permit may be required	Remediation solutions allowed on case-by-case basis	Investigation of flow and transport, ground-water tracer injections, and advection and diffusion in fractured shale.
Sandia National Laboratories, California Site	Permit not required	Remediation solutions allowed on case-by-case basis	Many existing monitoring and geophysical logging wells.
Sandia National Laboratories, New Mexico Site	Permit required	Remediation solutions allowed on case-by-case basis	Arid environment, thick vadose zone, soil contamination plume.

Summary of Ground-Water Remediation Technology Testing and Demonstration Sites (Part 2)

Site Name	Permitting Requirements	Addition of Injectants for Studies	Unique Site Features
Savannah River Site, SC	Permit required	Remediation solutions allowed on case-by-case basis	A wide variety of well-defined test sites with monitoring wells across a wide variety of soil types and contaminants.
Smithville Phase IV Bedrock Remediation Program, Canada	Permit required	Remediation solutions allowed on case-by-case basis	Work in progress to model site conditions with a three-dimensional fracture flow model. Bedrock geology.
Volunteer Army Ammunition Plant, TN	State or local permit may be required	Remediation solutions allowed on case-by-case basis	Karst geology with complex ground-water flow patterns overlain by tight clays.

Department of Energy Sites

Argonne National Laboratory, Argonne, IL

HISTORIC AND CURRENT SITE USES

The site includes an inactive liquid waste disposal unit which consisted of a "dry well" where liquid chemicals were disposed in the late 1950s and 1960s. A variety of solvents, including chlorinated and aromatic hydrocarbons and ketones, are still present in the soil and ground water at concentrations up to 200 mg/kg. The area is located in a radioactive waste management area, but the soil and ground water are not contaminated with radionuclides.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ remediation or monitoring of soil or ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

None

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: Argonne National Laboratory contains the full range of analytical capabilities, both for routine compliance analysis as well as unique specialty analysis. In addition, numerous off-site commercial laboratories are located in the area. Technology developers are permitted to do their own analysis using available facilities.

SITE CONTAMINATION PROFILE

VOC contamination in soil is approximately 5 to 25 feet deep and covers 30,000 square feet. A total of 24 VOCs have been detected. Similar contaminants have been found in ground water. The following constituents are the most prevalent in soil:

Carbon Tetrachloride	54,000 ppb
Chloroform	21,000 ppb
1,1,1-Trichloroethane	140,000 ppb
Isobutyl alcohol	39,000 ppb
Trichloroethene	33,000 ppb
4-Methyl-2-pentanone	8,000 ppb
Tetrachloroethene	190,000 ppb
Toluene	4,400 ppb

SITE CHARACTERISTICS

Depth to ground water: Ground water is present in a series of porous layers ranging from 10 to 50 feet deep. The first substantial aquifer is approximately 70 feet deep.

Hydrogeology/soil types: Glacial till that includes a mixture of clay, silty clay, and sandy silt interbedded with sand and gravel layers is about 60 feet thick. Bedrock is weathered dolomite.

Annual precipitation: 35 inches

Temperature (in degrees F):

summer:	72 average	60 to 100 range (min-max)
winter:	28 average	-20 to 50 range (min-max)

Unique site features relevant to demonstration opportunities: The wide variety of solvents is unusual, allowing for evaluation of technology effectiveness on up to 20 different volatile organics simultaneously. In addition, some of the soils have very low permeabilities (as low as 4E-8 in./sec). The site contains a complex lithology of glacial till materials, making characterization and remediation challenging.

Approximate distance to the nearest airport: 15 miles

PERMITTING AND REGULATORY REQUIREMENTS

A permit is not required to conduct demonstrations but state regulatory agencies must be notified. Receipt of RCRA Part B permit is anticipated in late 1997 and until that time operations are under interim status. Permission to add injectants for remediation may be granted on a case-by-case basis.

ON-SITE CONTACT

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Argonne National laboratory
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lmoos@smtpgate.anl.gov

Idaho National Engineering Laboratory, Idaho Falls, ID

HISTORIC AND CURRENT SITE USES

The INEL initially was established by the federal government as the National Reactor Testing Station in 1949. Its purpose was to provide an isolated location where prototype nuclear reactors could be designed, built, and tested. In the 1950s, the Aircraft Nuclear Propulsion (ANP) program was conducted at Test Area North. During the course of this program, three Heat Transfer Reactor Experiments (HTRE-I, -II, and -III) were built and tested.

There are three main areas available for technology demonstrations. The Record of Decision (ROD) for Test Area North includes provisions for innovative remediation technologies. The Central Facilities Area and the Radioactive Waste Management Complex are appropriate for demonstration of near-surface technologies such as barrier walls. The Test Area North is currently used for handling, storage, and research and development of spent nuclear fuel. In addition, reactor safety studies, energy research, and defense programs (including production of tank armor) are also conducted. The Central Facilities Area contains two waste operations facilities: the Hazardous Waste Storage Facility, which temporarily stores hazardous wastes pending transport to an off-site facility, and the INEL Landfill Complex. The Radioactive Waste Management Complex has two main operating areas, the Transuranic Storage Area, dedicated to management of transuranic waste, and the Subsurface Disposal Area, dedicated to the permanent disposal of low-level waste generated at the INEL site.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ remediation, characterization, or monitoring in soil or ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

In situ air stripping, bioremediation

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: The INEL Research Center conducts research and development in materials science, physical science, biotechnology, environmental science, and geoscience. The laboratory complex includes standard labs for chemical analysis and materials research as well as electronics design, optics, and laser and material testing. Biotechnology laboratories feature modern microbiology and biochemistry facilities, including a high-bay bioengineering area for scaled-up research prototype reactors and a greenhouse. Depending on customer requirements and the nature and complexity of the facility and equipment being used, different modes of operation will be employed. Some are simple in design and can be operated by the customer after brief instructions. Others will be operated by INEL facility personnel under customer direction. Technology developers are permitted to do their own analysis using available facilities.

Available equipment includes:

Solvent Extraction materials/equipment
Centrifugal Contactor Fluidized Bed
Acid Fractionator
INEL Digital Radiography and Computed Tomography Scanner (DRCT)
ESCA-Auger Spectrometer
On-line Isotope Separator
Scanning Electron Microscope
Spectroscopy System
MTR Mass Spectrometer
GSSI - System 10 Ground Penetrating Radar

SITE CONTAMINATION PROFILE

Site characterization is not yet complete. Specific information about depth and concentration of contaminants may be provided prior to scheduled demonstrations. INEL issues a yearly environmental report that can be provided to interested demonstrators.

The following contaminants are found in ground water and soil:

Radionuclides: tritium, strontium-90, iodine-129, cobalt-60, cesium-137, plutonium-238, plutonium-239/240, americium-241

Heavy metals: chromium, lead, mercury

VOCs: chloroform, cis-1,2-dichloroethylene, 1,1-dichloroethylene, trans-1,2-dichloroethylene, trichloroethylene, tetrachloroethylene, vinyl chloride

There is some VOC contamination of the Snake River aquifer, but no confirmed radioactive contamination.

SITE CHARACTERISTICS

Depth to ground water: 200 to 600 feet

Hydrogeology/soil types: The INEL site covers 890 square miles on the Eastern Snake River Plain, which forms a broad northeast-trending, crescent-shaped trough with low relief composed primarily of surface basaltic flows. This high desert plain features thin, discontinuous, and interbedded deposits of wind-blown loess and sand, water-borne alluvial fan, lacustrine and floodplain alluvial sediments and rhyolitic domes. The vadose zone consists of surface sediments (primarily clay and silt, with some sand and gravel) and many relatively thin basaltic lava flows, with some sedimentary interbeds. Thick surficial deposits occur in the northern part of the INEL site.

Annual precipitation: 9.1 inches

Temperature (in degrees F):

summer: 65 average 50-88 range (min-max)
winter: 19 average 3-28 range (min-max)

Unique site features relevant to demonstration opportunities: Deep ground water; presence of radioactive material; vadose zone transport of volatile organics (*i.e.* wells may out-gas at concentrations exceeding allowable standards).

Approximate distance to the nearest airport: 70 miles to Idaho Falls Airport

PERMITTING AND REGULATORY REQUIREMENTS

A joint permit application between the technology developer, Lockheed Martin Idaho (the contractor operating the site), and DOE-Idaho is necessary to conduct demonstrations. LM Idaho shares liability for operations with DOE, and LM will participate in any demonstration agreement. Federal and state regulations apply. Permission to add injectants for remediation may be granted on a case-by-case basis by the State of Idaho.

Note: The INEL is designated as one of five National Environmental Research Parks where scientists conduct ecological studies. Grazing leases also have been assigned, and the Blackfoot Tribes consider portions of the site sacred. All test plans must be reviewed with these stakeholders.

Permitting contact:
Idaho Department of Health and Welfare
450 W. State Street, 10th Floor
Boise, ID 83720-0036
208-334-5500

ON-SITE CONTACT

Kathleen Hain
850 Energy Place, MS 111B
Idaho Falls, ID 83401
208-526-4392; Fax: 208-526-0160
e-mail: hainke@inel.gov

Oak Ridge Subsurface Weirs, Oak Ridge, TN

HISTORIC AND CURRENT SITE USES

Melton Branch:

This is an uncontaminated site. It has been used for a variety of storm driven subsurface flow and transport studies involving inorganic and organic tracers and natural isotopic tracers.

Walker Branch:

This site is contaminated with tritium, strontium-90, a variety of DNAPLs, and toluene. Long-term multi-component ground-water tracer studies have been conducted here to investigate advective and diffusive mass transfer of contaminants in the fractured shale bedrock. Studies will be conducted through 1999. Other investigators can “jump in” with specific experiments if they are nondisruptive.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ and *ex situ* characterization, or monitoring of soil and ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

None

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: Extensive radioanalytical and tracer analysis facilities, consisting of: 1) four on-line high purity intrinsic germanium (HPGE) low-level gamma-ray detectors; 2) two on-line intrinsic germanium planar detectors for quantification of low energy gamma-emitters; 3) two sodium iodide detectors for laboratory labeling experiments; and 4) three liquid scintillation counters for field and laboratory radionuclide quantification. There are facilities to detect and quantify virtually any tracer used in subsurface science research. These include IC, AA, HPLC, GC, GC-MS, on-line gas tracer methods, ICP, etc. Technology developers are permitted to do their own analysis using available facilities.

SITE CONTAMINATION PROFILE

Melton Branch:

No contaminants present. This is a research facility for investigating the effect of chemical, physical, and microbial processes on solute transport in unsaturated soils.

Walker Branch:

Tritium:	100-350 microCi/Liter, 10 to 40+ ft depth: in ground water and bedrock
Strontium-90:	20+ microCi/Liter, 0 to 40 + ft depth: in soil, ground water and bedrock
TCE, DCE, VC:	ppb-ppm range, 10 to 40 + ft depth: in ground water and bedrock
Toluene:	50+ ppm range, 10 to 40+ ft depth: in ground water and bedrock

SITE CHARACTERISTICS

Depth to ground water: Walker Branch: 65 to 98 ft; Melton Branch: 10 to 39 feet

Hydrogeology/soil types:

Melton Branch:

This is primarily an unsaturated site with ground water from 10 to 39 feet below the surface. The soils and saprolites, primarily illitic clays coated with Fe and Mn-oxides, are interbedded with weathered shale and massive clay lenses derived from limestone. These systems are highly fractured, and perched water tables develop during storm events. Soils and saprolites are underlain by Maryville Limestone formation which is a series of interbedded lenses of limestone, siltstone and shale.

Walker Branch:

Soils are nearly the same as at Melton Branch. The extensively fractured shale bedrock is entirely in the saturated zone, while the soils are partially saturated and unsaturated. Flow and transport are preferential along geologic strike. Forty five percent of all infiltrating rainfall results in surface water recharge, and five percent results in ground-water recharge.

Annual precipitation: about 47 inches

Temperature (in degrees F):

summer:	75 average	61-88 range (min-max)
winter:	37 average	25-50 range (min-max)

Unique site features relevant to demonstration opportunities: Installations are designed for investigation of 1-, 2-, and 3-dimensional flow and transport processes in unsaturated subsurface environments. Facilities allow for quantifying nutrient and contaminant fluxes in soils with spatially variable physical and chemical characteristics. Subsurface drainage can be collected and monitored from 8.2 feet depth by trenches excavated across the outflow regions of the subwatersheds.

The field facility is designed to perform ground-water tracer injection experiments in fractured shale bedrock. The site is equipped with numerous multi-level sampling wells and wells designated for continuous water pressure head monitoring. Sampling from rock matrix and fracture regimes along the entire flow field is possible. Injection set-up is computer driven and designed to deliver transient or steady-state tracer concentrations into rock matrix or fractured regime. The site is conducive to studying advection and diffusion in shale bedrock.

Approximate distance to the nearest airport: 20 miles

PERMITTING AND REGULATORY REQUIREMENTS

A permit may be required to conduct demonstrations. Permit applications, when required, are filed by developers and the facility. It takes several months on average to obtain a permit. State regulations apply.

Permitting contact:
Terry Bonine
Office of Environmental Compliance and Documentation
Building 2001, Mail Stop 6049
Oak Ridge National Laboratory
Oak Ridge, TN 37831
423-574-7363

ON-SITE CONTACT

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Sandia National Laboratories/California Site, Livermore, CA

HISTORIC AND CURRENT SITE USES

In 1996 approximately 60,000 gallons of #2 diesel fuel leaked into the ground from an above-ground storage tank. Currently, the spill is being remediated using *in situ* bioremediation in a pilot area, which is scheduled for enlargement to include the entire site in 1998.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ remediation, characterization, or monitoring of soil or ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

In situ bioremediation

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: On-site facilities are not available. Technology developers must arrange for their own analysis off-site. There are private laboratories available for use in the area.

SITE CONTAMINATION PROFILE

Site is contaminated with BTEX compounds, primarily benzene. Borehole samples indicate that the plume of diesel fuel contamination in the unsaturated zone has a radius of approximately 30-100 feet from the spill point and varying depths to 100 feet. The greatest areal extent of contamination is at the 100-foot depth. Data indicate that when diesel contamination reached the water table it migrated laterally along the surface of the ground water.

SITE CHARACTERISTICS

Depth to ground water: 80-100 feet

Hydrogeology/soil types: The site is situated on alluvial deposits composed of clay, silt, sand and gravel.

Annual precipitation: 18 inches

Temperature (in degrees F):

summer: 85 average 70-105 range (min-max)
winter: 55 average 35-60 range (min-max)

Unique site features relevant to demonstration opportunities: There are many existing monitoring wells and geophysical logging wells.

Approximate distance to the nearest airport: 5 miles to Livermore Regional Airport; 40 miles to Oakland Airport

PERMITTING AND REGULATORY REQUIREMENTS

A permit is not required to conduct demonstrations. Permission to add injectants for remediation may be granted on a case-by-case basis.

ON-SITE CONTACT

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510-294-3303 (phone/fax)
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Sandia National Laboratories/New Mexico Site, Albuquerque, NM

HISTORIC AND CURRENT SITE USES

Current site activities include production of weapon components and medical isotopes. Some environmental restoration efforts have been conducted on landfills, contaminated ground-water plumes, and hazardous wastes. Demonstrations may be conducted at the Chemical Waste Landfill (CWL), which has a large TCE vapor plume, low-level ground-water contamination and a fairly well-defined source.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ remediation or monitoring of soil or ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

None

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: GC/RS, Geoprobe, mobile lab. Technology developers are permitted to do their own analysis using available facilities.

SITE CONTAMINATION PROFILE

The demonstration site contains numerous sources of subsurface contamination in buried pits. The vadose zone is thick (500 feet). Liquid waste has not penetrated to the water table; however, a vapor phase plume has developed over the years and has impacted ground water to low ppb levels. The vapor phase plume consists of 10-20 VOCs with maximum total VOC concentration near the pits of about 5,000 ppm. Principal VOCs present are TCE, TCA, PCE, DCM, CT, BTEX, DCA, and ketones. The concentrations decline rapidly with depth to approximately 5-50 ppm level at 400 feet.

SITE CHARACTERISTICS

Depth to ground water: about 500 feet

Hydrogeology/soil types: The site is situated on alluvial fill. Soil is mostly decomposed granite and sandy silts with caleche clays of varying percentages.

Annual precipitation: 8-10 inches

Temperature (in degrees F):

summer: 85 average 60-100 range (min-max)
winter: 50 average 0-75 range (min-max)

Unique site features relevant to demonstration opportunities: Arid environment, relatively thick vadose zone.

Approximate distance to the nearest airport: 5 miles

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. Permit applications are filed by the facility. It takes one to two years on average to obtain a permit. Federal and state regulations apply. Permission to add injectants for remediation may be granted on a case-by-case basis.

Permitting contact:
New Mexico Department of the Environment
1190 St. Francis Drive
Santa Fe, NM 87502
505-827-4300

ON-SITE CONTACT

Dick Fate, Manager
ER for Landfills and Test Areas
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Savannah River Site, Aiken, SC

HISTORIC AND CURRENT SITE USES

For over forty years, SRS produced tritium and other nuclear materials for defense purposes. The hazardous waste byproducts of these activities are now managed as 430 waste management units, including basins, pits, waste piles, burial grounds, sewer lines, and underground storage tanks. Production at SRS has resulted in the release of solid and liquid hazardous and mixed wastes to air, water, soil, and sediment.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ or *ex situ* remediation, characterization, or monitoring of soil or ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

In situ bioremediation
In situ air-stripping
In situ radiofrequency heating
Electrical resistance tomography
Colloidal borescope measurements
Vapor phase sampling and sensing
Vacuum extraction
Off-gas treatment techniques
Cone penetrometer

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: SRS offers a wide range of technical support to technology developers. Fixed and portable systems include GC/MS, FTIR, VOC headspace analyzers, immunoassays, ICP, atomic absorption spectrophotometer, X-ray fluorescence and diffraction, scanning electron microscopy, and various microbiological analysis capabilities. Mobile field facilities capable of on-site vapor, water, soil, and microbiology analyses also are available. Technology developers are permitted to do their own analysis using available facilities.

SITE CONTAMINATION PROFILE

The site is contaminated with VOCs, metals, radionuclides (tritium, cesium, strontium, cobalt, technetium, iodine, uranium, plutonium), fuel hydrocarbons, pesticides, and PCBs. VOC contamination exists in soils and ground water. Typical concentrations of contaminated source areas are 100 ppm to 1,000 ppm, with the highest concentrations measured in silty and clayey layers. VOCs in the soil zone are typically 50 to 90 percent TCE with lesser amounts of TCA. Below the water table, VOCs are present in two forms: as a dissolved plume, and as DNAPL. Concentrations in the dissolved plume range from a few ppb to values near 1,000 ppb. This plume covers about 1,200 acres, has a thickness of about 150 feet, and is typically 75% TCE with lesser amounts of PCE and TCA. At several sites, concentrations of heavy metals in the ground water and uppermost aquifer exceed drinking water standards by typical factors of 2 to 10. Ground water near chemical processing facilities contains up to 5 ppb mercury, 100 ppb lead, 50 ppb cadmium, and other metals. Ground water near coal piles and other tailings areas contains lead, 2,000 ppb chromium,

4,000 ppb nickel, and other metals. Tritium is the most significant radionuclide because of its quantity and mobility. Maximum tritium concentrations in ground water range from 10 to 100 nCi/mL. The remaining radionuclides have typical maximum concentrations ranging from 10 to 100 pCi/mL.

SITE CHARACTERISTICS

Depth to ground water: 10 to 150 feet

Hydrogeology/soil types: The site consists of various combinations of moderately sorted fine-to-coarse-grained sands interbedded with silty clays, clayey sands and thin, discontinuous clay beds. Hydraulic conductivity ranges from 1.42 to 141.8 ft/day in the sandy zones and from 2.84×10^{-3} ft/day to 1.42 ft/day in the clayey zones. Hydrogeology is complex due to heterogeneities in the multilayer aquifer system and discontinuities in sand and clay layers. Horizontal flow in the water table is approximately 15 to 100 feet per year, generally toward local streams. Vertical flow profiles have downward trajectories near streams where ground water discharges to wetlands. Except in the northern part of SRS, the typical vertical plume trajectory starts at the water table, ranges down to 20-40 feet below the table, then returns to it near the stream. Vertical flows in the northern areas of the site have resulted in plume migration into aquifers 300 to 500 feet below ground surface.

Annual precipitation: 47.5 inches

Temperature (in degrees F):

summer:	85 average	75-90 range (min-max)
winter:	48 average	35-60 range (min-max)

Unique site features relevant to demonstration opportunities: SRS has a number of well-characterized test platforms with a variety of soil types and contaminants. Among the platforms are: VOC/Organics/ DNAPLs, Multipurpose Pilot Plant Campus, sOILS facility, Miscellaneous Chemicals Basin, Metals, Landfill Cover Test Site, and Field Hydrogeology Test Facilities. Seven horizontal wells at the VOC/ Organics/DNAPLs test platform and more than 500 monitoring wells at various other platforms have been installed to support characterization, monitoring and treatment of contaminated soil and ground water. Data derived from these activities and other investigative techniques have allowed for the development of a three-dimensional conceptual model of the test platforms, including ground-water behavior and contaminant profiles.

Approximate distance to the nearest airport: 10 miles to Aiken Municipal Airport; 35 miles to Columbia Metropolitan Airport

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. SRS assists technology developers in obtaining permits by working with EPA Region 4 and the South Carolina Department of Health and Environmental Control (DHEC). Permit applications are filed by the facility. Permission to add injectants for remediation may be granted on a case-by-case basis.

ON-SITE CONTACT

Christine Spanard
Program Manager-Federal Programs
Westinghouse Savannah River Co.
Building 773-41A
Aiken, SC 29808
803-725-1021; Fax: 803-725-5103
e-mail: christine.spanard@srs.gov

Ground-Water Remediation Field Laboratory, Dover Air Force Base, DE

HISTORIC AND CURRENT SITE USES

The 3.5 acre Ground-Water Remediation Field Laboratory (GRFL) site for contained release studies is in a previously unimpacted area that has been an open field since the base started. GRFL also oversees other areas at Dover Air Force Base available for remediation demonstrations.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ remediation, characterization, or monitoring of soil or ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

Air sparging of VOCs, bioslurping, natural attenuation of solvents, cross-flow air stripping
pulsed pump and treat

Co-oxidative bioventing of JP-4 and TCE and accelerated anaerobic bioremediation are underway.

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: On-site: HP 6890 Gas Chromatograph with Electron Capture Detector (ECD) and Flame Ionization Detectors (FID) set up for chlorinated hydrocarbon and BTEX analyses; pH/ion selective electrode meter; trailer-mounted Cone Penetrometer for sampling; Hydrolab H20G for down hole or surface analyses of water samples for water quality parameters. Delaware State University, located about 5 minutes from Dover AFB in Dover, has a new analytical chemistry facility with capabilities for both organic and inorganic analyses. Technology developers are permitted to do their own analysis using available facilities.

SITE CONTAMINATION PROFILE

GRFL is an uncontaminated site in which studies of controlled releases can be conducted in sheetpile-enclosed cells. Other areas at Dover AFB available for remediation demonstrations contain BTEX and halogenated VOCs in soils and ground water.

SITE CHARACTERISTICS

Depth to ground water: 15 to 25 feet

Hydrogeology/soil types: Water table aquifer is predominately silty medium to fine sands with discontinuous layers of gravelly sands, silts, or clays. Average hydraulic conductivity is 13.5 ft/day.

Annual precipitation: 42 inches

Temperature (in degrees F):

summer: 77 average 65-86 range (min-max)
winter: 33 average 27-45 range (min-max)

Unique site features relevant to demonstration opportunities: The GRFL, one of the Strategic Environmental Research and Development Program's (SERDP) National Environmental Technology Test Sites (NETTS), maintains the only permitted facility in the U.S. where technology developers may conduct controlled releases of chlorinated solvents or other contaminants into an uncontaminated portion of the water table aquifer. The test area consists of double walled cells that are keyed into the underlying aquitard.

Approximate distance to the nearest commercial airport: 45 miles to Wilmington airport

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. Permit applications are filed by the facility and the technology developer. It takes 90 days on average to obtain a permit. Federal and state regulations apply.

Permitting contact:
Alex Ritberg
Delaware Department of Natural Resources and Environmental Control
Hazardous Waste Branch
P.O. Box 1401
Dover, DE 19903
302-739-3689; Fax: 302-739-5060

ON-SITE CONTACT

Dr. Mark Noll
Ground Water Remediation Field Laboratory
Bldg 459, P.O. Box 02063
Dover AFB, DE 19902-2063
302-678-8284; Fax: 302-677-4100
e-mail: mnoll@aca.com

McClellan Air Force Base, Sacramento, CA

HISTORIC AND CURRENT SITE USES

The base has been engaged in a wide variety of operations involving the use, storage, and disposal of hazardous materials. These include industrial solvents, caustic cleaners, electroplating chemicals, heavy metals, diesel and jet fuel, PCBs, low level radioactive wastes, and a variety of fuel oils and lubricants.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ and *ex situ* remediation, characterization, or monitoring in soil and ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

Soil vapor extraction, dual-phase extraction, co-metabolic enhancement

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: On-site facilities are not available. Technology developers must arrange for their own analysis off-site. There are several nearby private laboratories available for use.

SITE CONTAMINATION PROFILE

There are 254 confirmed contaminated sites in the 11 Operable Units (OUs) on base. This number may change as the Remedial Investigation continues. Most contamination exists in ground water, although each OU also has contaminated soil. Approximately 800 acres of ground water are contaminated above MCLs. Contamination is greatest 97-137 feet below ground surface, but contamination exists to a depth of about 400 feet. Each technology demonstration proposed will be matched with one or more suitable sites after a thorough evaluation of available data by McClellan technical staff.

The following contaminants have been consistently detected in ground-water samples at concentrations greater than federal drinking water standards:

Benzene
Carbon Tetrachloride
Chloroform
Trichloroethene
1,2-Dichlorobenzene
1,1-Dichloroethene
1,2-Dichloroethene
1,2-Dichloroethane
1,1,1-Trichlorethane
Vinyl chloride
Phenol
Xylene

The following contaminants, for which there are no federal drinking water standards, have been regularly detected in ground water samples:

1,1-Dichloroethane
2-Butanone
Acetone
4-Methyl-2-pentanone
Toluene

The following contaminants have been consistently detected in ground-water samples at concentrations below federal drinking water standards:

Bromodichloromethane
Trichlorofluoromethane (Freon 11)

SITE CHARACTERISTICS

Depth to ground water: 90 to 105 feet

Hydrogeology/soil types: Alluvial plain created by the deposition of sediments. Soils are derived from principally granitic material and consist of sandy silt and silty sands with clay lenses.

Annual precipitation: 20 inches

Temperature (in degrees F):

summer: 93 average 75-110 range (min-max)
winter: 53 average 45-70 range (min-max)

Unique site features relevant to demonstration opportunities: There is a centralized treatment facility for extracted ground water in OUs C and D.

Approximate distance to the nearest commercial airport: 20 miles

PERMITTING AND REGULATORY REQUIREMENTS

This is a CERCLA site. All remediation activities are exempt from permitting. All regulatory and base interface is through a single point of contact (see below). Permission to add injectants for remediation may be granted on a case-by-case basis by the Regional Water Quality Control Board.

ON-SITE CONTACT

Philip H. Mook
5050 Dudley Boulevard, Building 269E
McClellan AFB, CA 95652-1389
916-643-5443; Fax: 916-643-0827
e-mail: mook.phil@sma1.mcclellan.af.mil

National Center for Integrated Bioremediation Research and Development
Wurtsmith Air Force Base, MI

HISTORIC AND CURRENT SITE USES

Wurtsmith AFB has been in existence since the early 1920s. The base was decommissioned in 1993 and is being converted to civilian use. Contamination at Wurtsmith resulted from waste management practices associated with aircraft refueling and maintenance. Current operations include a few light industrial operations and a large airline maintenance facility.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ remediation, characterization, or monitoring of soil and ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

Conventional air stripping and intrinsic bioremediation (natural attenuation)

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: There is a well-stocked, on-site laboratory with lab and field GCs (PID/Hall detectors), an IC (anions), wet chemistry capabilities, and Geoprobe equipment for gathering soil gas, ground water, and soil samples. Capabilities available through cooperative agreements with the University of Michigan, Ann Arbor, include a full range of analytical equipment such as IC, GC, GC/MS, LC/MS, TOC analyzer, HCN detector, HPLC, AA, FTIR, etc. Technology developers are permitted to do a limited amount of their own analysis using available facilities by special arrangement.

SITE CONTAMINATION PROFILE

There are over 70 Installation Restoration Program sites at Wurtsmith with contaminated soil and ground water. At least four plumes have interactions with open water systems (lakes, wetlands, etc.). Contaminants include constituents of JP-4 jet fuel (BTEX), PCE, TCE, DCE, vinyl chloride, TCA, trimethylbenzenes, chlorobenzene, dichlorobenzenes, pesticides, fire-fighting agents, and landfill leachate. These contaminants are usually found as mixed plumes, but JP-4 and chlorinated compounds may be encountered as unique plumes. The plume areas range from 2000 square feet to 1000 acres. Technology demonstrations may be conducted within almost any plume.

SITE CHARACTERISTICS

Depth to ground water: 8 to 22 feet

Hydrogeology/soil types: Wurtsmith is situated on an alluvial plain of medium-coarse sand 60 feet deep interspersed with layers of clay 1-3 feet thick. The average thickness of the aquifer is 45 feet. The aquifer is underlain by a clay aquitard that is 150 feet thick. Hydraulic conductivity in the sandy aquifer varies between 75 to 310 ft/day.

Annual precipitation: 30 inches

Temperature (in degrees F):

summer:	69 average	50 to 90 range (min-max)
winter:	21 average	10 to 40 range (min-max)

Unique site features relevant to demonstration opportunities: There are opportunities to study intrinsic phytoremediation processes at several sites. Aqueous solutions of mixtures of the contaminants found on-site may be injected for controlled experiments. There are three operational air strippers for direct technology comparison.

Approximate distance to the nearest airport: Wurtsmith AFB airport is fully operational. The nearest commercial airport is in Saginaw, Michigan, about 1.5 hours drive.

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. Permit applications are filed by the facility. It takes about 1 to 4 weeks on average to obtain permits. Federal, state, and local regulations apply. Permission to add injectants for remediation may be granted on a case-by-case basis. Chemical additions (with the exception of tracer compounds) must be in aqueous phase. Only those contaminants found at Wurtsmith may be introduced.

Permitting contact:
James Janiczek, Chief Hydrologic Review Unit
Michigan Department of Environmental Quality
Ground Water Programs Section, Waste Management Division
P. O. Box 30241
Lansing, MI 48909
517-373-7262; Fax: 517-373-4797

ON-SITE CONTACT:

Mark Henry
4140 E. California, Building 1845
Oscada, MI 48750
517-739-0185; Fax: 517-739-0186
e-mail: markheh@engin.umich.edu

Naval Construction Battalion Center, Port Hueneme, CA

HISTORIC AND CURRENT SITE USES

Military vehicle use and maintenance and various other facility activities have contaminated the area with fuels and oils, pesticides, detergents, acids, solvents, and heavy metals. PCBs are present from transformer fluids. Fire fighting activities at training burnsites have added other contaminants.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ and *ex situ* remediation, characterization, or monitoring of soil, ground water and sediments

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

In situ: for fuel hydrocarbons: air sparging, ground-water recirculation well, site characterization and analysis penetrometer (SCAPS)

for PCBs and pesticides: solvated electron chemistry

Ex situ: bioremediation, hot-air vapor extraction

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: No facilities are available for use on-site, but there are several commercial laboratories certified by the State of California within a 45-minute drive of the base.

SITE CONTAMINATION PROFILE

Primary contaminants are diesel, gasoline and waste oil. Secondary contaminants are pesticides, transformer fluid containing PCBs, metals (As, Be, Mn, Ni, Sb), acids, and solvents. Contaminants identified in harbor and canal water and sediments include waste oils, detergents, solvents, PCBs, metals (Cu, Zn), benzoic acid, and pesticides.

SITE CHARACTERISTICS

Depth to ground water: 8 to 12 feet
ENDFIELD

Hydrogeology/soil types: Ground surface is relatively flat, and is underlain by approximately 300 feet of unconsolidated clay, silt, sand, and gravel that overlie clay, shale and sandstone deposits. The geology within 30 feet of the surface consists of unconsolidated sands, silts, and clays with minor amounts of gravel and fill material. A semi-perched aquifer is the uppermost ground water unit present. The aquifer is contained within the first three depositional soil units, consisting of an upper silty sand unit, an underlying

fine-to-coarse-grained sand unit, and a basal clay unit. In general, ground water within this aquifer flows southwest with gradients of about .001 to .003 ft/day.

Annual precipitation: 11.6 inches

Temperature (in degrees F):

summer: 62 average 55-75 range (min-max)
winter: 62 average 55-75 range (min-max)

Unique site features relevant to demonstration opportunities: Several isolated sites have been identified for *in situ* demonstrations of characterization and remedial technologies for contaminated soil, ground water, harbors, canals, and wetlands. A three dimensional monitoring network with long-term data retrieval is available for data comparison.

Approximate distance to the nearest airport: 3 miles to Oxnard; 75 miles to Los Angeles (LAX)

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. Permit applications are filled out by the technology developer and filed by the facility. It takes 60 days on average to obtain permits. Federal, state, and local regulations apply. Permission to add injectants for remediation may be granted on a case-by-case basis by the Regional Water Quality Control Board.

ON-SITE CONTACT

Ernest Lory
Naval Facilities Engineering Service Center
Port Hueneme, CA 93034
805-982-1299; Fax: 805-982-4304
e-mail: elory@nsesc.navy.mil

Volunteer Army Ammunition Plant, Chattanooga, TN

HISTORIC AND CURRENT SITE USES

The plant was used for manufacture of bulk TNT and is currently maintained in inactive status. TNT production ended in 1977. The area available for demonstrations contains the former batch nitration lines, the WWII landfill and burning ground, and the Redwater Treatment Plant Area.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ or *ex situ* remediation of soil or ground water

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: An on-site laboratory, validated by the U.S. Army Environmental Center, is equipped to perform: explosives analysis by Method 8330 via Hewlett-Packard HPLC; metals analysis by EPA Methods via Varian GFAA; nutrients by EPA Methods via Lachat Automated Ion Analyzer. Field screening equipment and capabilities: hach spectrophotometer for explosives and spectrace X-ray fluorescence and spectrophotometer for metals. Future capability will include selected analysis by GC. Technology developers may be permitted to do their own analysis using available facilities on a case-by-case basis. Nearby off-site full-service laboratories: Tennessee Valley Authority (TVA), Chattanooga, TN and Quanterra, Knoxville, TN.

SITE CONTAMINATION PROFILE

2,4,6-Trinitrotoluene: <1 to 5,700 ppm soils and <1 to 40 ppm ground water
2,4-Dinitrotoluene: <1 to 9,140 ppm soils and <1 to 70 ppm ground water
2,6-Dinitrotoluene: <1 to 630 ppm soils and <1 to 28 ppm ground water
Nitrotoluenes: <1 to 7,900 ppm soils and <1 to 475 ppm ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

Catalytic Ozonation, phytoremediation

SITE CHARACTERISTICS

Depth to ground water: 20 to 40 feet

Hydrogeology/soil types: Soil is strongly acidic (pH 5). Topsoil consists of 8 to 18 inches of cherty silt loam and subsoil consists of 10 to 32 inches of silty clay loam with slow internal drainage.

Annual precipitation: 51.9 inches

Temperature (in degrees F):

summer: 77 average 67-88 range (min-max)
winter: 40 average 27-46 range (min-max)

Unique site features relevant to demonstration opportunities: The site has karst geology with complex ground-water flow patterns overlain by tight clays at an average thickness of 30 feet. The contaminants present are restricted for the most part to TNT, DNT, and associated nitroaromatics from the manufacture of TNT.

Approximate distance to the nearest airport: 5 miles

PERMITTING AND REGULATORY REQUIREMENTS

No general permit is required for demonstrations. However, a specific activity may be subject to state or local permitting requirements. Permit applications are filed by the technology developer and the facility, depending on the type of permit: water discharge permits would normally be obtained by the facility; air emission permits are normally obtained by the demonstrator. It takes at least 6 months to obtain a state NPDES or sprayfield application permit; 2 weeks to 1 month for local POTW water discharge permits; 1 to 2 months for air emission permits. Federal, state and local regulations apply. Permission to add injectants for remediation may be granted on a case-by-case basis.

Permitting contacts:

County air permitting with state authorization:
Robert H.Colby, Director
Hamilton Co. Air Pollution Control Board
423-865-4321

Local POTW discharge permit:
Rick Tate
Moccasin Bend Wastewater Treatment Plant
423-757-5026

State NPDES or sprayfield application:
Philip L. Stewart, Field Office Manager
Tennessee Department of Environment and Conservation
Division of Water Pollution Control
423-634-5734

Hazardous waste storage and disposal:
Guy Moose, Field Office Manager
Tennessee Department of Environment and Conservation
Division of Solid Waste Management
423-634-5776

ON-SITE CONTACT

Elizabeth A. Jayne
ICI Americas Inc.
P.O. Box 22608
Chattanooga, TN 37422-2608 or:

The Volunteer Site
6703 Bonny Oaks Drive
Chattanooga, TN 37421
423-855-7250; Fax: 423-855-7270

Canadian Sites

Borden Demonstration Site, University of Waterloo, Ontario, Canada

HISTORIC AND CURRENT SITE USES

With permission of the Canadian Department of National Defence (DND), the University of Waterloo has been conducting ground-water technology field experiments at CFB Borden since the mid-1970s. Since the early 1980s, some of these experiments have included controlled releases of contaminants and subsequent remediation activities.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ remediation, characterization, or monitoring of soil or ground water

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: A broad range of analytical and experimental facilities and expertise is available and is coordinated by the University of Waterloo. Technology developers may be permitted to do their own analysis using available facilities by special arrangement (the University of Waterloo has had a role in all demonstrations/experiments to date).

SITE CONTAMINATION PROFILE

The site is relatively non-toxic. A landfill leachate plume contains low concentrations of priority contaminants, high TOC, and elevated concentrations of chloride and sulfate.

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

NAPL source zone remediation: chemical flushing for mass removal, chemical flushing for *in situ* contaminant destruction, passive interception and *in situ* treatment of plumes (chemical/biological), soil vapor extraction/air sparging

SITE CHARACTERISTICS

Depth to ground water: 0 to 3 feet

Hydrogeology/soil types: A fine to medium sand aquifer overlies a silt clay aquitard at depths ranging from 8 to 30 feet. Hydraulic conductivity is 4 to 6 inches per day.

Annual precipitation: 36 inches

Temperature (in degrees F):

summer:	75	average	65-85	range (min-max)
winter:	20	average	10-30	range (min-max)

Unique site features relevant to demonstration opportunities: Well-characterized and relatively simple surficial aquifer/shallow aquitard system.

Approximate distance to the nearest airport: 60 miles

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. Permit applications are filed by the technology developer and the facility. It takes several months on average to obtain a permit. National and provincial regulations apply. Applications are coordinated through University of Waterloo, which has an on-going agreement with the Canadian Department of National Defence. To date, the University has been the only proponent of experiments and demonstrations; the involvement of others has always occurred through collaboration with the University.

Permitting Contact:
David Smyth, Manager, Solvents-in-Groundwater Research Program (see below)

ON-SITE CONTACT

David Smyth
Department of Earth Sciences
University of Waterloo
Waterloo, ON N2L 3G1
519-888-4567 X2899; Fax: 519-746-5644
e-mail: dsmyth@sciborg.uwaterloo.ca

Smithville Phase IV Bedrock Remediation Program, Smithville, Ontario, Canada

HISTORIC AND CURRENT SITE USES

PCB wastes were stored at the site between 1978 and 1985. Chlorobenzenes dissolved the PCB and served as the "carrier" fluid. Old transformers were possibly "spent" and overheated; thus conversion to dioxins and furans seems reasonable. The transformers were cleaned at the site with a chlorinated solvent believed to be trichloroethene. Presence of other chlorinated solvents may be breakdown products or used industrial-grade solvents. Contaminant releases were discovered at the facility in 1985. An estimated 8,000 gallons of DNAPLs have migrated to the underlying bedrock about 19.7 feet below ground surface. By 1993, the surface of the site had been restored through the use of an on-site mobile incinerator. Research is underway to restore the fractured carbonate bedrock that was used as a local drinking-water supply.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ or *ex situ* remediation, characterization, or monitoring of soil, ground water, or fractured rock

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: A full service commercial analytical laboratory on contract to the site is about 25 miles away. The laboratory, Zenon, has been accredited by the States of New York, Virginia, and Washington, and the Department of the Army among others. Equipment includes GC/MS, GC, and HPLC. Technology developers are permitted to do their own analysis using available facilities.

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

Active pump and treat dissolved-phase plume containment system using GAC columns

SITE CONTAMINATION PROFILE

Principal contaminants in DNAPL by weight are PCB (30 to 45%), chlorobenzenes (9 to 13%) and trichloroethene (2 to 3%). Minor contaminants include: chloroethenes, chloroethanes, BTEX, petroleum hydrocarbons, trihalomethanes, vinyl chloride, dioxins, and furans. The depth of the DNAPL is not known exactly, but it is believed to reach about 40 feet below ground surface. The dissolved-phase plume has migrated to depths of at least 85 feet.

The TCE dissolved-phase plume is about 2,500 feet long. The width of the contaminant area is estimated to be about 600 ft. Concentrations as high as 6,000 ppb have been measured in the core of the plume. The plume has "collapsed" since the source was contained. Residual contaminant levels remain at approximately 1 ppb, possibly due to matrix diffusion effects. Relative solubility limits dictate the dissolve-phase concentrations. In general, these aqueous concentrations are about 10% of the predicted solubility limit. Residual contamination of the deep overburden and bedrock exists, especially in the source area, which measures about 450 ft x 600 ft.

SITE CHARACTERISTICS

Depth to ground water: About 20 feet (Note: A potential perched condition between overburden and bedrock units may exist)

Hydrogeology/soil types: The site is covered by silt to a depth of about 20 feet. A discontinuous basal silty sand unit has been encountered above the bedrock. Flow in this zone fluctuates seasonally and is vertically downward via desiccation fracturing. The bedrock is a fractured carbonate (dolostone) that is flat-lying, porous, bedded and dips slightly (0.5%) to the south. The upper member within this formation is the Eramosa and is highly fractured and partially weathered. The surface topography undulates from glacial scouring. The lower portion of the Eramosa is more massively bedded. The next dolostone unit is a regional aquifer. It is thinly bedded and interconnected through dissolutioned gypsum nodules. Sheet fracturing is common in this area and provides the horizontal flow pathways. Jointing is vertical or sub-vertical. The porous rock matrix has sorbed the organic contaminants, retarding their movement.

Annual precipitation: 35 inches

Temperature (in degrees F):

summer: 75 average 65-79 range (min-max)
winter: 14 average 0-25 range (min-max)

Unique site features relevant to demonstration opportunities: The site has excellent data available and work is in progress to model site conditions with a 3-D fracture flow model called FRAC3DVS. The site is located within the Michigan Basin and is composed of relatively simple “pancake” geology (stratigraphic profile). The local community supports clean-up efforts and there is no current litigation.

Approximate distance to the nearest airport: 30 miles

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. Both the technology developer and the facility must submit applications. The length of time it takes to obtain a permit depends on the type of demonstration proposed. National and provincial regulations apply. Permission to add injectants for remediation may be granted on a case-by-case basis. If a passive containment system is constructed to isolate contaminants, it may be possible to consider addition of other chemicals.

Permitting Contact:
Mark Smithson
Ministry of Environment and Energy, West-Central Region
119 King Street W., 12th Floor
P.O. Box 2112, Hamilton, Ontario, CA L8N 3Z9
905-521-7819

ON-SITE CONTACT

Smithville Phase IV Bedrock Remediation Program
2769 Thompson Avenue
Smithville, Ontario, CA
L0R 2A0
905-957-4077; Fax: 905-957-4079

Ted O'Neill
Project Manager
toneill@niagara.com or:

David Ketcheson
Technical Manager
dketches@niagara.com

Other Sites

Environmental Simulation Laboratory, University of Wyoming

HISTORIC AND CURRENT SITE USES

The Environmental Simulation Laboratory (ESL) was constructed in 1987 and is designed to scale up bench-scale research or scale down field site research. Previous contamination is not relevant, as each new experiment is separate and controlled.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

Simulated *in situ* or *ex situ* remediation, characterization, or monitoring of soil or ground water

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

The ESL has been used to survey leaching from large retorted oil shale embankments under various climatic conditions.

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: Data collected from studies conducted in the ESL can be analyzed using all equipment normally found on a large university campus. Technology developers are permitted to do their own analysis using available facilities.

SITE CONTAMINATION PROFILE

Not applicable

SITE CHARACTERISTICS

Depth to ground water: 10 feet maximum

Hydrogeology/soil types: Can be custom-designed

Precipitation: Can be simulated up to 10 inches per hour in any storm distribution pattern and intensity

Temperature (in degrees F): Controllable range of -20 to 120 (plus or minus 2 degrees)

Unique site features relevant to demonstration opportunities: The ESL is unique because soil embankment studies can be carried out in two 24 ft x 10 ft x 10 ft deep lysimeters covered by a single environmental chamber which controls temperature within a range of -20 to 120 degrees F, rainfall

between 0 and 5 inches per hour, and relative humidity between 30 and 95 percent. Sunlight is simulated using metal halide lights which are sufficient to grow most vegetation. Ground-water movement can be simulated using a pumping system. The ESL essentially allows controlled research at a scale between bench and field.

Approximate distance to the nearest airport: 120 miles to Denver International; 10 miles to the local airport in Laramie

PERMITTING AND REGULATORY REQUIREMENTS

The ESL has not yet been used to study hazardous waste remediation, and the Wyoming Department of Environmental Quality was uncertain at the time of this writing whether a permit would be required or not. This would have to be investigated further at the time of application for such use of the facility. With regard to addition of chemicals, a treatment plant for water leaving the lysimeters has been designed, but has not yet been funded or built. The lysimeter walls are lined with an inert material. It would be the responsibility of the technology developer to remove and dispose of contaminated liners at a permitted hazardous waste disposal site.

Permitting Contact:
David Finley
Solid and Hazardous Waste Division
Wyoming Department of Environmental Quality
122 West 25th Street
Cheyenne, WY 82002
307-777-7753

ON-SITE CONTACT

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Groundwater Phytoremediation Test Facility, University of Washington

HISTORIC AND CURRENT SITE USES

The Groundwater Phytoremediation Test Facility (GWPTF) was constructed in 1994 in Fife, Washington. The facility covers about one-quarter acre and is equipped with 12 double-lined test beds, each 12 ft x 18 ft x 4.5 ft deep. The site has the equipment for handling, mixing, and delivering synthetically contaminated water and for decontaminating the effluent water using carbon adsorption units.

The GWPTF has been used to provide the first near-full-scale testing of phytoremediation of chlorinated hydrocarbons in ground water. The results were rapid, and nearly complete uptake of TCE and carbon tetrachloride by poplar trees was achieved with no detectable TCE or CT emissions. The GWPTF test beds allow easy monitoring of influent and effluent mass fluxes of chlorinated solvents.

TYPES OF DEMONSTRATIONS APPROPRIATE FOR THE FACILITY

In situ phytoremediation of chlorinated hydrocarbons in ground-water streams under controlled conditions

GROUND-WATER REMEDIATION TECHNOLOGIES PREVIOUSLY DEMONSTRATED

Phytoremediation of TCE by poplar trees

ANALYTICAL CAPABILITIES

Analytical facilities and equipment available on-site or nearby: Full analytical facilities (GC-FID, GC-MS, HPLC, etc.) are available at the University of Washington, about 50 miles away. Technology developers may be permitted to do their own analysis using the facilities under special arrangement.

SITE CONTAMINATION PROFILE

The GWPTF is equipped for testing phytoremediation of synthetically contaminated, artificial ground-water streams. Any common chlorinated hydrocarbons may be applied to selected test cells.

SITE CHARACTERISTICS

Depth to ground water: 4 feet

Hydrogeology/soil types: Soil may be brought in. Presently the soil is a sandy loam.

Annual precipitation: 35 inches

Temperature (in degrees F):

summer: 64 average 54 to 75 range (min-max)
winter: 41 average 37 to 50 range (min-max)

Unique site features relevant to demonstration opportunities: Facility allows control over influent chlorinated hydrocarbon composition. Tests can approximate mass balances of chlorinated hydrocarbons in influent and effluent water streams and measure transpired chlorinated hydrocarbons. Facility provides replicate cells and control cells without trees.

Approximate distance to the nearest airport: 25 miles

PERMITTING AND REGULATORY REQUIREMENTS

A permit is required to conduct demonstrations. Technology developers and the site manager work together to file the permit. It takes about six months to obtain a permit. State and local regulations apply. Permission to add injectants for remediation may be granted on a case-by-case basis.

Permitting Contact:
Washington Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600
360-407-6000; Fax: 360-407-6989

ON-SITE CONTACT

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