

**Table 2-1
Reported Uses of Data Generated by Field Analytical and Site Characterization Technologies**

Technology	Site Screening	Site Characterization	Cleanup Monitoring	Compliance Monitoring	Confirmation Sampling	Enforcement	Health and Safety Monitoring	Waste Characterization	Risk Assessment
<i>Chemical Technologies</i>									
Biosensor	✓		✓	✓					
Colorimetric test strip	✓	✓	✓	✓					
Cone penetrometer mounted sensor	✓	✓							
Fiber-optic chemical sensor	✓	✓							
Fourier-transformed infrared spectrometry		✓	✓	✓			✓		
Gas chromatography	✓	✓	✓		✓				
Immunoassay	✓	✓	✓	✓	✓			✓	
Mercury vapor analyzer		✓					✓		
X-ray fluorescence	✓	✓	✓	✓	✓	✓			✓
<i>Geophysical Technologies</i>									
Bore-hole geophysical		✓							
Direct-push electrical conductivity	✓								
Electromagnetic induction		✓							
Ground penetrating radar	✓	✓							
Magnetometry		✓							
Seismic profiling	✓	✓							
<i>Radionuclide Technologies</i>									
Gamma radiation detector	✓	✓							
Passive alpha detector	✓	✓					✓		

**Table 2-1
Reported Uses of Data Generated by Field Analytical and Site Characterization Technologies
(continued)**

Technology	Site Screening	Site Characterization	Cleanup Monitoring	Compliance Monitoring	Confirmation Sampling	Enforcement	Health and Safety Monitoring	Waste Characterization	Risk Assessment
<i>Sampling and Sampler Emplacement Technologies</i>									
Closed-piston soil sampling		✓							
Direct-push prepacked well screen		✓		✓					
Low-flow ground-water pumping	✓	✓		✓					
Soil gas sampling		✓							✓
Vertical ground-water profiling		✓		✓					
Vibrating well installation	✓	✓							

**Table 2-2
Reported Uses of Technologies by Medium and Analyte (continued)**

Technology	Analyte Medium	Inorganics			Explosives		Radio-nuclides		Pesticides		Geophysical							
		Ground Water	Soil	Air	Soil	Ground Water	Soil	Sediment	Ground Water	Soil	Depth to Ground Water	Soil Type	Bedrock Stratigraphy	Conductivity	Buried Ferrous Metals	Temperature	Redox Potential	pH
Biosensor					✓	✓												
Colorimetric test strip		✓	✓		✓	✓												
Cone penetrometer mounted sensor											✓	✓		✓		✓	✓	✓
Fiber-optic chemical sensor																		
Fourier-transformed infrared (FTIR) spectrometry																		
Gas chromatography									✓	✓								
Immunoassay		✓	✓						✓	✓								
Mercury vapor analyzer				✓														
X-ray fluorescence		✓	✓															
Bore-hole geophysical											✓		✓	✓				
Direct-push electrical conductivity												✓	✓	✓				
Electromagnetic induction														✓				
Ground penetrating radar											✓		✓		✓			
Magnetometry															✓			
Seismic profiling											✓	✓	✓					
Gamma radiation detector							✓	✓										
Passive alpha detector							✓	✓										
Closed-piston soil sampling												✓						
Direct-push prepacked well screen											✓							
Low-flow ground-water pumping		✓																
Soil gas sampling																		
Vertical ground-water profiling																		
Vibrating well installation																		

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Chemical Technologies											
Biosensor											
Umatilla Army Depot-Hermiston, OR: explosives washout lagoon, open burn/open detonation (OB/OD) area, small arms incinerator, explosives in ground water	10	Research International, Inc.	Soil, ground water, composite residues (biotreatment monitoring)	Military explosives (TNT, RDX, HMX)	15 months	10-30 samples per day	Site screening, cleanup monitoring, compliance monitoring	Not provided	Real-time data; lower cost compared with analytical laboratory; higher sampling density at same cost	Not provided	Harry Craig (EPA) 503/326-3689
Colorimetric Test Strip											
Agra PWS-Agra, KS: grain fumigation, pesticide and fertilizer production	7	Merck, Ltd. (purchased from Thomas Scientific, Inc.)	Soil (ex situ), ground water	Nitrate	5 days	Soil: 10 minutes per sample Water: 2 minutes per sample	Site screening, site characterization	\$10 per sample, including labor	Very fast; easy to use; low cost; used on site to guide investigation	Check for interference caused by nitrite; creation of soil slurry necessary to achieve performance	Darrell Hamilton (Tetra Tech EM Inc. [Tetra Tech]) 913/894-2600 Scott Alberg (KDHE) 913/296-1541
Naval Submarine Base Bangor-Silverdale, WA: open burn and open detonation area	10	Strategic Diagnostics, Inc. (SDI) (RDX soil test kit)	Soil (ex situ)	Explosives (TNT, RDX)	3 months	5 samples per hour	Site characterization	\$20 to \$25 per sample, plus accessory kit	High sampling density and collection of real-time data; less expensive than laboratory data	Not provided	Harry Craig (EPA) 503/326-3689
Umatilla Army Depot-Hermiston, OR: explosives washout lagoon, OB/OD area, small arms incinerator, explosives in ground water	10	SDI	Soil, ground water, composite residues	Military explosives (TNT, RDX, HMX)	15 months	10-30 samples per day	Site screening, cleanup monitoring, compliance monitoring	Not provided	Real-time data; lower cost compared with analytical laboratory; higher sampling density at same cost; worked exceptionally well with target analyte	Not provided	Harry Craig (EPA) 503/326-3689

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensor											
Site unidentified-Netherlands: landfill and refinery	Not applicable	Delft Geotechnics (Chemoprobe)	Soil, ground water, soil gas	Geophysical data (pH, redox potential, specific conductivity, hydraulic conductivity), LNAPL	Not provided	Measurements in 4 minutes; 0.5 hour to 1 hour for a complete sounding	Site characterization	Not provided	Much quicker and more cost-effective than conventional methods; more accurate measurements; allows three-dimensional mapping	Not provided	J.J. Olie (Delft Geotechnics)
Central Landfill 1-RI	1	Not provided	Soil (in situ)	DNAPL	Not provided	Not provided	Cleanup monitoring	Not provided	Rapid sampling; greater accuracy	Subsurface cobbles; not too sensitive	John Courzler (EPA) 617/573-5779
Hanscom Air Force Base (AFB)-MA	1	Not provided	Soil	Not provided	Not provided	Not provided	Site characterization, cleanup monitoring	Not provided	Rapid sampling; greater accuracy	Subsurface cobbles; not too sensitive	Bob Lim (EPA) 617/223-5521
Industriplex 1-MA	1	Not provided	Soil	Not provided	1994	Not provided	Site characterization	Not provided	Rapid sampling; greater accuracy	Subsurface cobbles; not too sensitive	Joe Lemay (EPA) 617/573-9622
Loring AFB-ME	1	Not provided	Soil (in situ)	Not provided	Not provided	Not provided	Cleanup monitoring	Not provided	Rapid sampling; greater accuracy	Subsurface cobbles; not too sensitive	Mike Nalipinski (EPA) 617/223-5503
Silresim 1-MA	1	Not provided	Soil, ground water	VOCs	Not provided	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Almerinda Silva (EPA) 617/573-9627
Stamina Mills 1-RI	1	Not provided	Soil (in situ)	TCE	Not provided	Not provided	Cleanup monitoring	Not provided	Technology minimizes vertical migration	Not provided	Neil Handler (EPA) 617/573-9636
Union Chemical 1-ME	1	Not provided	Soil (in situ)	VOCs	Not provided	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Terry Connelly (EPA) 617/573-9638

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensor (continued)											
Naval Weapons Station Earle- Colts Neck, NJ	2	U.S. Navy (SCAPS)	Soil (in situ)	BTEX, nonhalogenated VOCs, nonhalogenated SVOCs,	Not provided	4 per hour	Site characterization	Not provided	Quick turnaround of results and fingerprinting capability; good for measuring the extent of free product in soils	Not provided	Jeffrey Gratz (EPA) 212/637-4320 John Mayhew (U.S. Navy) 610/595-0567 x125 & x146
Freedom Textile Chemicals Co.- Charlotte, NC: landfill contaminated with VOCs and SVOCs	4	Not provided	Soil (in situ), sludge	Halogenated and nonhalogenated VOCs and SVOCs	Not provided	Not provided	Site characterization	Not provided	Not provided	Not provided	Joseph Alfand (EPA) 404/562-8496 Phillip Pelp (Freedom Textile Chemicals Co.) 704/393-0089
Naval Air Station New Orleans- New Orleans, LA: fuel farm and piping	6	Navy Research and Development (NRaD) (SCAPS)	Soil (in situ)	PAHs (JP-5 aviation fuel)	1/26/96-1/27/96	41 LIF pushes (296 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 Hal Bolinger (LDEQ) 504/765-0232
Sandia National Laboratory- Albuquerque, NM	6	NRaD (SCAPS)	Soil (in situ)	PAHs (diesel fuel)	8/16/95-8/18/95 and 11/1/95-11/8/95	18 LIF pushes (905 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 John Wesnousky (California Environmental Protection Agency [CalEPA]) 916/322-2543 Steve Billets (USEPA National Environmental Research Laboratory-Las Vegas [NERL-LA]) 702/798-2232

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensor (continued)											
Site unidentified- Location not provided: former manufactured gas plant, coal tar wastes	7	TriServices SCAPS program	Soil (in situ), ground water	PAHs, TPH	10 days	208 feet per day	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Continuous, real- time data; quick decontamination; no soil cuttings	Limited by rough terrain, tight spaces, and subsurface cobbles	Greg Stenback (Iowa State University) Dr. Al Bevolo (Ames Laboratory) 515/294-5414 Kathy Older (USACE)
Site unidentified- Lexington, NE: manufacturing site, use of solvents, cutting oils, motor fuels, hydraulic fluids, and heating oil	7	Unisys Corporation (Rapid Optical Screening Tool [ROST™])	Soil (in situ)	Aromatic petroleum hydrocarbons	3 days	Cone penetro- meter is advanced at 2 centimeters per second or 290 feet per day	Site characterization	\$7,000 per day, or \$500 per push, or \$24 per foot	Faster and less expensive than traditional techniques; continuous and real-time data; no soil cuttings; quicker decontamination than other methods	Difficult to correlate fluorescence intensity with TPH data	Kevin Earley and Keith Rapp (Unisys)
Department of Defense Housing Facility- Novato, CA: exchange gas station	9	NRaD (SCAPS)	Soil (in situ)	PAHs (diesel fuel and gasoline)	5/15/96- 5/22/96	15 LIF pushes (178 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 John Pfister (NAVFAC EFA- West) 415/244-2568
Guadalupe Oil Field- CA:	9	NRaD (SCAPS)	Soil (in situ)	PAHs (kerosene)	8/23/94- 9/8/94	36 LIF pushes (1,327 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 Richard Aleshire (California Central Coast Regional Water Quality Control Board) 805/542-4631

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensors (continued)											
Marine Corps Air Station, Site 13-Gallarnd, CA: leaking USTs, refinery wastes	9	U.S. Navy (SCAPS)	Soil (in situ)	TPH	2 weeks	4 cone penetrometer testing (CPT) soundings per day (depends on depth)	Site characterization	\$3,500 per day	Real-time profile; quick understanding of site; allows focusing of CLP sampling	Expensive; requires a lot of equipment; naturally occurring fluorescence material can lead to false positives	Rachael Simon (EPA) 415/744-2383
Marine Corp Air Station-29 Palms, CA	9	NRaD (SCAPS)	Soil (in situ)	PAHs (JP-5 [aviation fuel], diesel fuel, waste and heating oil)	8/23/95-8/25/95	8 LIF pushes (220 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172
Marine Corps Base-Camp Pendelton, CA: ground control approach facility	9	NRaD (SCAPS)	Soil (in situ)	PAHs (diesel fuel)	6/27/94-7/6/94	25 LIF pushes (335 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 Vickie Church (San Diego County, California) 619/338-2243
Marine Corp Air Station-Yuma, AZ: firefighter training area and fuel bladders	9	NRaD (SCAPS)	Soil (in situ)	PAHs (JP-5 [aviation fuel], diesel and gasoline fuel)	5/17/94-6/9/94	29 LIF pushes (1169 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Minor mineral fluorescence, spectrally indistinguishable	Tom Hampton (NRaD) 619/553-1172 Davis Mangold (Navy Facilities Command Southwest Division [NAVFACSW-DIV]) 619/532-2534

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensors (continued)											
Marine Corp Recruit Depot- Yuma, AZ: fire training area, disposal of aircraft cleaning fluids (solvents), landfill, sewage lagoon	9	U.S. Navy (SCAPS)	Soil (in situ)	PAHs (diesel and gasoline fuel)	1/30/95-2/9/95 and 2/21/95-3/1/95	25 LIF pushes (514 feet) 21 LIF pushes (318 feet)	Site characterization	Not provided	Enhanced site delineation	Not provided	Tom Hampton (U.S. Navy) 619/553-1172 Vickie Church (San Diego County) 619/338-2243
Naval Air Station, Site 13- Alameda, CA: former refinery	9	NRaD (SCAPS)	Soil (in situ), ground water	PAHs (refinery waste)	3/17/94-4/6/94	45 LIF pushes (808 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 Lt. Mike Petouhoff (Base Environmental) 510/263-3726
Naval Air Station North Island- CA: leaking UST	9	NRaD (SCAPS)	Soil (in situ)	PAHs (diesel fuel)	7/25/94-8/4/94	25 LIF pushes (701 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation; data was used to support the closure of USTs	Not provided	Tom Hampton (NRaD) 619/553-1172 Richard Mach (NAVFAC SWDIV) 619/556-9934
Naval Complex- Long Beach, CA: multiple UST sites	9	NRaD (SCAPS)	Soil (in situ), ground water	PAHs (diesel fuel, gasoline, and waste oil)	9/16/96-9/27/96, 10/7/96-10/18/96, and 10/28/96-11/8/96	121 LIF pushes (1667 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation; assisted with plume delineation; site closure with minimum sampling; obtained regulatory closure of 16 sites with LIF data and limited confirmation sampling of soil and ground water by a fixed laboratory	Minor mineral fluorescence, spectrally indistinguishable	Tom Hampton (NRaD) 619/553-1172 Hugh Marley (Los Angeles Regional Water Quality Control Board) 213/266-7669 Gary Simon (NAVFAC SWDIV) 619/532-2537

Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensors (continued)											
Naval Radio Receiving Facility- Imperial Beach, CA	9	NRaD (SCAPS)	Soil (in situ)	PAHs (fuel oil)	3/6/95- 3/22/95	36 LIF pushes (813 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation; obtained regulatory closure of 2 UST sites with only 1 confirmatory soil boring each	Petroleum UST cleanups are moving toward risk-based closure; therefore, the screening-level data from SCAPS is becoming less valuable	Tom Hampton (NRaD) 619/553-1172 Richard Mach (NAVFAC SWDIV) 619/556-9934
Naval In Service Engineering/West- San Diego, CA: hydraulic pump pit	9	NRaD (SCAPS)	Soil (in situ)	PAHs (hydraulic oil)	7/22/96- 7/23/96	8 LIF pushes (56 feet)	Site characterization	\$2,300 to \$4,60 per day for an average push rate of 200 feet per day	Enhanced site delineation; rapid delineation with limited confirmatory soil and water sampling; permitted regulatory approval of site reuse	Not provided	Tom Hampton (NRaD) 619/553-1172
Naval Training Center- San Diego, CA: exchange service station and hobby shop	9	NRaD (SCAPS)	Soil (in situ)	PAHs (gasoline and waste oil)	10/24/94- 11/8/94, and 11/15/94- 11/16/94	33 LIF pushes (593 feet) 16 LIF pushes (214 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation; provided data to develop and implement site remediation and closure	Not provided	Tom Hampton (NRaD) 619/553-1172 Thomas Macchiarelli (NAVFAC SWDIV) 619/532-3808
Naval Weapons Station- China Lake, CA	9	NRaD (SCAPS)	Soil (in situ)	PAHs (JP-5 [aviation fuel], diesel fuel, gasoline, and waste oil)	8/29/95- 8/30/95	12 LIF pushes (224 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensors (continued)											
Naval Outlying Landing Field- Imperial Beach, CA: fuel depot	9	NRaD (SCAPS)	Soil (in situ)	PAHs (JP-5 [aviation fuel], diesel fuel and gasoline)	11/30/94-12/15/94	38 LIF pushes (698 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation; data was used to support the closure of 2 USTs	Not provided	Tom Hampton (NRaD) 619/553-1172 Richard Mach (NAVFAC SWDIV) 619/532-1156
Naval Station- San Diego, CA: Bldg. 279	9	NRaD (SCAPS)	Soil (in situ)	PAHs (gasoline)	8/12/96-8/15/96	20 LIF pushes (177 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172
Naval Station- San Diego, CA: firefighter training facility	9	NRaD (SCAPS)	Soil (in situ)	PAHs (JP-5 [aviation fuel], gasoline)	1/11/94-2/8/94	22 LIF pushes (313 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 Rick Bassinet (NAVFAC SWDIV) 619/532-1636
Naval Construction Battalion Corps- Port Hueneme, CA: hydrocarbon national test site and exchange gas station	9	NRaD (SCAPS)	Soil (in situ)	PAHs (diesel fuel)	4/4/95-4/11/95, 5/16/95-5/22/95, and 5/28/96-5/30/96	24 LIF pushes (472 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation; vertical resolution of 2 inches; enhanced vertical resolution	Not provided	Tom Hampton (NRaD) 619/553-1172 John Wesnousky (CalEPA) 916/322-2543 Steve Billets (USEPA NERL-LV) 702/798-2232
Naval Air Station North Island- Coronado, CA: fuel tank depot	9	NRaD (SCAPS)	Soil (in situ)	PAHs (JP-5 [aviation fuel], marine diesel fuel)	7/14/93-7/15/93, 8/18/93-8/31/93, and 10/5/93-10/8/93	40 LIF pushes (708 feet)	Site characterization	\$2,300 to \$4,600 per day for an average push rate of 200 feet per day	Enhanced site delineation; vertical resolution of 2 inches; data used to develop site remediation system	Not provided	Tom Hampton (NRaD) 619/553-1172 Richard Mach (NAVFAC SWDIV) 619/556-9934

Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Cone Penetrometer Mounted Sensors (continued)											
Naval Amphibious Base-Coronado, CA: abandoned fuel farm	9	NRaD (SCAPS)	Soil (in situ)	PAHs (gasoline and diesel fuel)	2/15/94-3/1/94	22 LIF pushes (274 feet)	Site characterization	Not provided	Enhanced site delineation	Not provided	Tom Hampton (NRaD) 619/553-1172 Kevin Heaton (San Diego County, California) 619/338-2243
Fiber-optic Chemical Sensor											
Site unidentified-Northeast United States (specific location not provided): two leaking UST sites	1	ORS Environmental Systems (ChemSensor)	Ground water	VOCs (TCE), SVOCs, BTEX, TPH	Not provided	10 minutes per measurement	Site screening, site characterization	Not provided	Easy to use; rapid, inexpensive data; very portable	Concentration of contaminants affects response time	John Hanshaw (ORS Environmental Systems) 800/228-2310
Savannah River Site-Aiken, SC: TCE used as degreasing solvent	4	Lawrence Livermore National Laboratory (TCE sensor)	Soil gas, ground water	VOC (TCE)	Not provided	Continuous measurement	Site screening, site characterization	Not provided	Capable of in situ measurements; less expensive than off-site analysis; rapid measurements	Possible interference from other chlorinated VOCs	Joe Rossabi (Westinghouse Savannah River Company) 803/725-5220
Site unidentified-Las Vegas, NV: leaking UST site	9	FCI Environmental, Inc. (PetroSense® PHA-100)	Ground water	TPH	Not provided	Not provided	Site characterization	Not provided	Can be used in situ; real-time data; easy to use; less expensive than off-site analysis	Results affected by bailing method and amount of water bailed	Devinder P.Salini (FCI Environmental, Inc.) 702/361-7921
Fourier-transformed Infrared (FTIR) Spectrometry											
French Limited Superfund Site-Crosby, TX	6	Not provided	Air	BTEX, PAHs, methane, carbon monoxide	4 days	Continuous measurement	Cleanup monitoring (to evaluate bioremediation), health and safety monitoring	Not provided	Not provided	Water vapor presents a potential interference for the absorption features of toluene, benzene, and naphthalene	Jim Sealy (ManTech Environmental Technology) 405/436-8658

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Fourier-transformed Infrared (FTIR) Spectrometry (continued)											
Bliss Ellisville-Wild Wood, MO: dioxin-contaminated oil sprayed on site, buried drums of industrial waste, and uncontained waste	7	Not provided	Air	VOCs	4 months	40-50 measurements over a 4-month period	Health and safety monitoring	Not provided	Real-time data; portable system; compound-specific	QA/QC methods not well developed	Wood Ramsey (EPA) 913/551-7382 Mark Thomas (EPA) 913/551-7937 Randy Scheidermann (E&E) 913/432-9961
Site unidentified-Location not provided	7	None - developed by universities	Air	VOCs	1 day	Measurements every 12 minutes	Compliance monitoring (for air emissions)	Not provided	Precision and accuracy similar to accepted Method TO-14; adequate detection levels; fast, on-site data	Not appropriate for a high degree of spatial resolution in ambient air monitoring	Jody Hudson (EPA) 913/551-5064
Gas Chromatography											
Site unidentified-Jard, VT	1	Not provided	Not provided	Not provided	12/31/91-11/11/92	Not provided	Cleanup monitoring	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Mary Ellen Stanton (EPA) 617/573-9670
Beede Waste Oil-NH	1	PE Photovac, Inc., Thermo Instrument Systems, Inc.	Soil	VOCs, PCBs	11/93-12/93	Not provided	Site characterization	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768
Connecticut Building Wrecking-CT	1	PE Photovac, Inc.	Air	VOCs	12/23/91	Not provided	Site characterization	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768
Indian Line Farm-MA	1	PE Photovac, Inc., Thermo Instrument Systems, Inc.	Soil	VOCs, PCBs	2/27/92-5/28/93	Not provided	Site characterization, cleanup monitoring	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Gary Lipson (EPA) 617/223-5584

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Gas Chromatography (continued)											
Site unidentified- Leicester, MA: landfill	1	PE Photovac, Inc., Thermo Instrument Systems, Inc.	Air	VOCs	1/22/92	Not provided	Site characterization	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768
Pichillo Farm Superfund Site-Coventry, RI	1	TMA	Soil (ex situ), soil gas	VOCs, SVOCs	6/96-12/96	2 soil samples per hour	Site characterization	Not provided	On-site real-time results	Not provided	Anna Kraskow (EPA) 617/573-5749 Richard Willy (EPA) 617/573-9639 Alan Peterson (EPA) 617/860-4607
Resolve 1- MA	1	PE Photovac, Inc.	Air	VOCs	6/93-7/94	Not provided	Compliance monitoring	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Instrument calibration requires a significant amount of time	Joe Lemay (EPA) 617/573-9622
Site unidentified- Stratford, CT	1	Thermo Instrument Systems, Inc.	Soil	PCBs	6/17/93	Not provided	Cleanup monitoring	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Mike Jagingici (EPA) 617/573-5786
Three C- MA	1	Thermo Instrument Systems, Inc.	Soil	PCBs	8/8/95- 8/26/95	Not provided	Site characterization, cleanup monitoring	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768
Toka-Renbe Farm- MA	1	PE Photovac, Inc., Thermo Instrument Systems, Inc.	Soil	VOCs, PCBs	7/7/94	Not provided	Site characterization, cleanup monitoring	Not provided	Avoided downtime; data quality effective for determining final sampling locations	Not provided	Lisa Danek (EPA) 617/573-5707

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Gas Chromatography (continued)											
Site unidentified- Location not provided: active manufacturing facility	3	PE Photovac, Inc. (10S70GC with photoionization detector)	Soil (ex situ)	Halogenated and nonhalogenated VOCs	Not provided	120 samples per day with 3 GCs	Cleanup monitoring	\$35 per sample	On-site data used to guide investigation; less costly than off-site analysis; high sample throughput; saved costs for the removal action	Not provided	David Catherman (Environmental Resources Management, Inc.) 610/524-3500
Site unidentified- Illinois: contamination from old compressors that used PCB-containing oils	4	Hewlett Packard (5890 Series II GC)	Soil (ex situ), sediment (ex situ)	PCBs	Not provided	20 minutes per sample	Cleanup monitoring	Not provided	Good correlation between on-site and off-site data; reduced cost; quick data	Modified extraction time required to obtain consistent results	Brad Anderer (TRC Environmental Corporation)
Koppers-Morrisville-Morrisville, NC: wood treatment operations	4	Shimadzu (14AGC)	Soil (ex situ), ground water, air	SVOCs (PCP), dioxin	3 weeks	2 samples per hour	Cleanup monitoring, health and safety monitoring	\$13.50 per sample for expendables; \$23,214 to purchase GC system; \$1,500 per month to rent GC system	On-site data used to verify performance of remediation technology; quick-turnaround data; less expensive than formal analysis	Petroleum carrier solvent for PCP caused interference problems, resulting in poor recovery for some soil samples	Darrell Hamilton (Tetra Tech) 913/894-2600
Florida Department of Transportation - Fairbanks, FL: contaminated landfill	4	Not provided	Soil (ex situ)	PAHs	1 year	Not provided	Site screening, site characterization, cleanup monitoring, confirmation sampling	Not provided	Allows for quick separation of soil into clean or dirty groups when removing large volumes of soil	Operator must be familiar with equipment	Wesley S. Hardegree (EPA) 404/562-8486 Steve Spurlin (EPA) 404/562-8743

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Gas Chromatography (continued)											
Pig's Eye Landfill- St. Paul, MN: municipal solid waste landfill (also contains industrial wastes)	5	Tekmar-Dohrmann, Inc. (HSA) Shimadzu (14AGC)	Soil (ex situ), ground water, soil gas	Halogenated and nonhalogenated VOCs, solvents, BTEX	3 weeks	20 samples per day	Site screening (to determine extent of contamination), site characterization	\$50 per sample	Technology was less expensive than off-site laboratory analysis; achieved low detection limits, especially for chlorinated VOCs; data used to guide investigation; only one mobilization	Not provided	Patrick Splichal (Tetra Tech) 913/894-2600
Hastings Superfund Site-NB: landfill, contaminated ground water	7	Not provided (GC used with electron capture detector)	Soil (ex situ), ground water	Halogenated VOCs	6/97	Not provided	Site characterization, cleanup monitoring	Not provided	Real-time data; CLP equivalent; no purge and trap required	Technology requires mobile laboratory	Diane Easley (EPA) 915/551-7797
Kinsley Airport- Kinsley, KS: pesticide formulation, spraying, and tank and applicator cleaning	7	Hewlett Packard	Soil (ex situ), ground water	Pesticides, herbicides (containing chlorinated and nitrogen compounds)	1 week	Not provided	Site screening, site characterization	Approximately \$100 per sample	Ability to detect compounds at MCL concentrations; technology produced quick results at about one-third the cost of off-site analysis	Simultaneous elution of 3 target pesticides hinders ability to meet detection limits	Darrell Hamilton (Tetra Tech) 913/894-2600
Site unidentified- Location not provided: drum recycling site	8	Viking Instruments Inc. (GC/MS)	Soil gas, air	VOCs	Not provided	Not provided	Cleanup monitoring, health and safety monitoring	Not provided	Data correlated well with off-site data; data could be used to guide the removal action; portable system; data could be used to monitor public safety	Not provided	Alan Humphrey (EPA) 732/321-6748 Steven Hawthorn (EPA) 303/312-6061

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Gas Chromatography (continued)											
Mount Olivet Cemetery-Salt Lake City, UT	8	PE Photovac, Inc.	Soil (ex situ)	VOCs (Pentachloroethane [PCE])	Ongoing	Not provided	Site screening (plume tracing)	Not provided	Time savings; cost savings	Not provided	Luke Chaved (EPA) 303/312-6512 Barry Hayhurst (URS Greiner, Inc.) 303/291-8270
China Lake NAWS-Ridgecrest, CA: laboratory wastes and petroleum wastes from refueling operations and leaking USTs	9	Hewlett-Packard (5890 GC)	Soil (ex situ), ground water	TPH-extractable, PAHs, PCBs, phthalates, light nonaqueous phase liquids (LNAPL)	6 weeks	20 samples per day	Site screening, site characterization	Rental cost of \$3,000 per month; \$5,000 for expendable supplies for 450 samples	Quick turnaround data; reduced number of samples sent off-site for analysis; reduced costs	Lack of positive identification because there was no mass spectroscopy or second column confirmation; requires operator experience; TPH interference	Darrell Hamilton (Tetra Tech) 913/894-2600
Moffett Field-Mountain-View, CA: leaking USTs and pipelines at fuel farm	9	Shimadzu (14A GC) Tekmar-Dohrmann, Inc. (headspace analyzer)	Soil (ex situ), ground water	TPH-purgeable, BTEX	2 weeks	25 to 30 samples per day	Site screening, site characterization	Equipment can be rented for about \$2,500 per month	Simultaneous analysis for BTEX, as well as several fuels; inexpensive; no solvent waste	Poor extraction of diesel fuel from soils with high organic matter	Patrick Splichal (Tetra Tech) 913/894-2600 Jean Barranco (Tetra Tech) 303/295-1101
Piper Aircraft Corporation-Vero Beach, CA	9	Sentex Systems, Inc. (portable GC - Sentograph™)	Soil (ex situ), sediment (ex situ), ground water	VOCs (TCE)	8/23-8/26/92	25 samples per 4 days	Site characterization	Not provided	Real-time data	Library of components limited	Roger E. Carlton (EPA) 706/355-8609 Bill Bokey and Arthur Lee (Piper Aircraft Corporation) 706/355-8604
Garden City Ground Water-Garden City, ID: ground water contamination	10	Not provided (sample extracted using mobile laboratory equipment and analyzed with field GC)	Soil (ex situ), ground water, soil gas	VOCs, solvents	5 weeks	2 samples per hour	Site screening, site characterization, enforcement	Not provided	Quick turnaround time; allowed sampling of a large area for a low cost	Not provided	David Bennett (EPA) 206/553-2103

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Gas Chromatography (continued)											
Preston Ground Water-Preston, ID: gas station with a leaking UST, causing ground-water contamination	10	Hewlett Packard (HP 5890)	Soil (ex situ), ground water	VOCs, BTEX	1 month	3 samples per hour	Site screening, site characterization	50 percent of the cost of CLP data	Real-time data to help direct the field program; tracking of the plume; cost-effective; high quality results	Not provided	Chris Field (EPA) 206/553-1674
Immunoassay											
Industrial Buildings-Location not provided	Not specified	ImmunoSystems, SDI (EnviroGard)	Wipe samples from solid surfaces	PCBs	Not provided	20 samples per 2 hours	Cleanup monitoring, health and safety monitoring	Not provided	Reduced cost per sample; rapid analysis; on-site data	Better control needed for heterogeneity of PCB distribution; possible interference from PCB cleansers	Craig Kostyshyn (SDI) 215/860-5115 (contact obtained from Vendor FACTS database)
Site unidentified-Location not provided	Not specified	BioNebraska (BiMelyze Mercury Assay)	Soil (ex situ), sediment (ex situ), ground water	Mercury	Not provided	Not provided	Site characterization	Not provided	Convenient; cost-effective; real-time data; highly selective for mercury; data correlates well with those obtained by other methods	Not provided	Craig Schweitzer (BioNebraska) 800/786-2580 (contact obtained from Vendor FACTS database)
CYRO Industries-Location not provided	1	SDI	Soil	PAHs	10/95-11/95	Not provided	Site characterization	Not provided	Low cost; 90% accuracy	10% false positives	Ernest Waterman (EPA) 617/223-5511
Site unidentified-Norwood, MA	1	SDI	Not provided	PCBs, PAHs	12/94-8/95	Not provided	Cleanup monitoring, health and safety monitoring	Not provided	Low cost; rapid	Not provided	John LeMay (EPA) 617/573-9622

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
Nyanza Chemical Waste Superfund Site- Ashland, MA: dye manufacturing facility, mercury contamination in soils and sediments	1	BioNebraska, Inc. (BiMelyze Mercury Assay)	Sediment, soil (ex situ)	Mercury	9/94-10/94	70 split samples per day	Site screening	\$35 per sample	Results showed acceptable correlation with laboratory results; mercury concentrations ranged from less than 0.5 parts per million (ppm) to greater than 100 ppm	Not provided	Greg Morin (U.S. Army Corps of Engineers [USACE]) 617/647-8232 Pam Shields (EPA) 617/573-9632
Pine Street 1- VT	1	Not provided	Soil	PAHs	Not provided	Not provided	Cleanup monitoring	Not provided	Rapid, low cost	Extraction problem caused by soil moisture content	Ross Gilleland (EPA) 617/573-5766
Pinette's- ME	1	Not provided	Soil	PCBs	Not provided	Not provided	Cleanup monitoring	Not provided	Rapid, low cost	Not provided	Ross Gilleland (EPA) 617/573-5766
Raymark 3- CT	1	Not provided	Soil	PCBs	9/93-9/97	Not provided	Cleanup monitoring	Not provided	Rapid, low cost	Not provided	Mike Jasinski (EPA) 617/573-5786
Resolve 1- MA	1	SDI	Soil	PCBs	Not provided	Not provided	Cleanup monitoring	Not provided	Low cost; 90% accuracy	10% false positives	Joe Lemay (EPA) 617/573-9622
Resolve 2- MA	1	SDI	Soil	PCBs	Not provided	Not provided	Cleanup monitoring	Not provided	Low cost	False positives	Joe Lemay (EPA) 617/573-9622
Resolve 1 & 2- MA: PCB-contaminated sites	1	SDI	Soil (ex situ)	PCBs	2 months	3 per hour	Cleanup monitoring	\$10 per sample	Results more conservative than laboratory (confirmation sampling)	No major problems encountered	Joe Lemay (EPA) 617/573-9622

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
General Electric Corp. (GE) Site No. 5- NY: industrial landfill	2	SDI (EnviroGard)	Soil (ex situ)	PCBs (Aroclor 1260)	Not provided	80 samples per day	Site characterization (technology evaluation performed by GE)	\$18 per sample	Low rate of false positives results	Not provided	L.A. Socha (GE)
General Motors, Central Foundary Division Site-Massena, NY	2	SDI (PCB RISC™)	Soil (ex situ), sediment (ex situ)	PCBs	2-3 months on 2 occasions	4 samples per hour	Cleanup monitoring, compliance monitoring	Not provided	Large savings in time and analytical costs; savings in labor and equipment costs; real-time data aided in guiding excavation activities	No official report on verification procedures	Lisa Jackson and Anne Kelly (EPA) 212/637-4274 Jim Hartnett (GMC) 315/764-2239
Aberdeen Proving Ground- Aberdeen, MD: military activities	3	New Horizons Diagnostic Corp. (The SMART Test)	Soil, sediment (ex situ)	Bacteria	7/93-7/97	Not provided	Not provided	\$6 per sample	Not provided	Not provided	Peter Stopa (U.S. Army)
Delaware Sand and Gravel- New Castle, DE: landfill drum pit	3	OHM	Soil (ex situ)	PCBs	Not provided	Not provided	Site screening	Not provided	Real-time monitoring	Not provided	Eric Newman (EPA) 215/566-3237
Former Coal Gasification Site-Georgetown, DE: coal gasification wastes	3	SDI (RaPID® Assay)	Soil (ex situ), ground water	VOCs, BTEX, PAHs	Not provided	40 samples per day	Site screening, site characterization	BTEX-\$20 per sample PAHs-\$25 per sample	Not provided	Not provided	Robert M. Schulte (Delaware Department of Natural Resources)
Saunders Supply- VA: wood treating facility	3	Not provided	Ground water	SVOCs (PCP)	2 days	Not provided	Site characterization	Not provided	Fast results	Not provided	Andy Palestini (EPA) 215/566-3223
Woodbridge Research Facility- Woodbridge, VA: former radio transmission facility/research lab	3	Not provided	Soil (ex situ)	PCBs	1994	Not provided	Site characterization	Not provided	Not provided	False positives detected	Jack Porosnak (EPA) 215/566-3362 Jeff Waugh (Earth Tech) 410/671-1615

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
Agricultural Cooperative-South-central, WI: herbicide and pesticide manufacturing	4	SDI (RaPID® Assay)	Soil (ex situ)	Pesticides (atrazine)	Not provided	20 samples per day	Not provided	\$50 per sample	Not provided	Not provided	Dr. Kirsti Sorsa (RMT, Inc.)
American Creosote Works-Jackson, TN: wood preserving facility	4	SDI (EnviroGard)	Soil (ex situ)	PAHs	Not provided	80 samples per day	Site characterization (technology evaluation)	\$18 per sample	Good agreement with results produced by EPA Method 8270	Not provided	Dennis Revell (EPA) 703/355-8807
Transformer and Refurbishing Facility-MI: utility wastes	5	SDI (RaPID® Assay)	Soil (ex situ), ground water	PCBs	Not provided	Not provided	Not provided	\$25 per sample	Not provided	Not provided	P. Berlinski (Delta Environmental, Inc.) 916/638-2085
Arnesor Timber-Steelville, MO: lumber treatment	7	SDI	Soil (ex situ)	SVOCs (PCP)	3 days	25 samples per day	Site characterizations	\$225 per kit	Cost-effective; quick turnaround time for results; helped to direct sampling efforts; reduced the number of samples needed to characterize the site	Sufficient reagent was not provided; only 60 of the 70 samples collected produced valid results	Paul Doherty (EPA) 913/551-7924
Farmland Refinery-Coffeyville, KS: refinery (petroleum waste)	7	SDI (RaPID® Assay)	Soil (ex situ), ground water, surface water	PAHs	5 days	20 samples in 2 hours	Site characterization	\$50 per sample exclusive of labor	Easy to use; low detection limits; rapid data	Interference caused by high concentration of petroleum; cannot identify individual PAHs	Patrick Splichal (Tetra Tech) 913/894-2600 Scott Ritchey (EPA) 913/551-7641
Former Manufactured Gas Plant- Marshalltown, IA: coal gasification	7	SDI (D Tech)	Soil (ex situ), sediment (ex situ), ground water	TPH (coal tar and coal gasification wastes), dense nonaqueous phase liquids (DNAPL)	Not provided	50 samples per day	Site characterization	\$12,855 to complete project and report	Results of the survey showed the area of DNAPL contamination	Conditions of interference affected the data	Dr. Al Bevolo (Ames Laboratory) 515/294-5414

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
Kinsley Airport-Kinsley, KS: washing of pesticide application rigs	7	SDI (Envirogard)	Soil (ex situ)	Toxaphene	3 days	12 soil samples in 3 hours	Site screening, site characterization	\$50 per sample exclusive of labor	Cost savings; portable; quick turnaround times; detection limits capable of meeting action levels	High percentage of false negative results when compared with results from confirmation laboratory	Keith Brown (Tetra Tech) 913/894-2600 Susan Stover (KDHE) 913/296-5531
Osage Metal-Kansas City, KS: metal salvage yard, recycling of car batteries and transformers	7	SDI	Soil (ex situ)	PCBs	5 months	50 samples	Cleanup monitoring, confirmation sampling, waste characterization	Not provided	Saved time; produced usable results	Unsure of specific detection limits of the test	Wood Ramsey (EPA) 913/551-7382
Roanoke Apartments-Kansas City, MO: gasoline service station with a leaking UST	7	SDI (D Tech)	Soil (ex situ), sediment (ex situ), ground water	TPH, LNAPL	Not provided	50 samples per day	Site characterization	\$13,345 to complete project	Allowed definition of migration pathways	Not provided	Craig Kostyshyn (SDI) 215/860-5115 (contact obtained from Vendor FACTS database)
Whiteman AFB-MO: gasoline service station with a leaking UST	7	SDI (D Tech)	Soil (ex situ), sediment (ex situ), ground water	Fuel oil	Less than 1 month	50 samples per day	Site characterization	\$22,981 to complete site characterization	Allowed straight-forward definition of 2 plumes confirmed by FID readings	Not provided	Craig Kostyshyn (SDI) 215/860-5115 (contact obtained from Vendor FACTS database)
Crows Landing-Patterson, CA: burn pit, landfill area	9	SDI (PETRO RISC™)	Ground water	TPH	2 weeks	10 samples in 2 hours	Site screening, site characterization	\$194 for 4 tests; \$400 per week for spectrophotometer	Cost-effective; easy to use; very portable; quick turnaround times	Test kit gave false negative results because fuel oil was degraded	Todd Bechtel (Tetra Tech) 303/295-1101

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
Gila River Indian Reservation-Gila River Indian Community, AZ: storage, mixing, and application of pesticides	9	SDI	Soil (in situ)	Pesticides	3 months	1 sample every 20 minutes	Site screening, site characterization	\$20 per sample	Faster method of collecting reliable data; easier to use (can develop a generic sampling plan); cheaper; quick, reliable data; real-time data; flexible for use in the field	Not provided	Carolyn Douglas (EPA) 415/744-2343
Hickam Air Force Base-Honolulu, HI: leaking UST site	9	SDI (EnviroGard)	Soil (ex situ)	TPH (JP-4 aviation fuel)	Less than 1 month	10 samples in 1 day	Site screening, site characterization	\$18 per sample	Low rate of false positive results (one false positive result in 10 samples at a screening level of 1,000 ppm)	Not provided	Bryce Hataoka (Hawaii Department of Health)
McCormick and Baxter-Stockton, CA: wood treatment	9	SDI (RaPID® Assay)	Soil (ex situ)	Halogenated SVOCs (PCP), PAHs	10 days	233 samples	Site screening, site characterization	Not provided	Technology saved money by allowing reduction in the number of samples sent to the off-site lab	Not provided	Marie Lacey (EPA) 415/744-2236

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
Navajo Nation Dip Vats Project- AZ: toxaphene dip vats	9	SDI (EnviroGard)	Soil (ex situ)	Pesticides (toxaphene)	Ongoing	1 sample every 20 minutes	Site screening, site characterization (technology demonstration)	\$20 per sample	Good agreement with EPA Method 8081 (no false positive or negative results at 10-ppm level); faster method of collecting reliable data; easy to use cheaper; flexible for use in the field	Not provided	Carolyn Douglas (EPA) 415/744-2343 Stanley Edison (Navajo Nation) 520/871-6861
Naval Station, Treasure Island- San Francisco, CA: fire training area, fuel farms	9	SDI (PETRO RISC™, D Tech)	Soil (in situ), storm drain sediments	PCBs, BTEX, TPH (gas, diesel)	6 months	4 samples per hour	Site screening	\$30 per test	Real-time data; able to delineate and verify contamination in the field	Need better concentration range; operator must be certified to use kit	Gina Kathuria (California Regional Water Quality Board) 510/286-4267
Naval Station Treasure Island- San Francisco, CA: leaking USTs and pipelines	9	SDI (PETRO RISC™ and PCB RISC™)	Soil (ex situ), ground water	BTEX, PCBs, PAHs	5 months	4 samples per hour	Site screening, site characterization	Not provided	Not provided	Degraded fuels, which lacked aromatics, gave 15 to 20% false negative results, compared with results from formal laboratory; PAH test kits not useful	Thorsten Anderson (Tetra Tech) 415/543-4880 Gina Kathuria (California Regional Water Quality Board) 510/286-4267
NCS Stockton-Stockton, CA: pesticide storage, leaking drums containing pesticides	9	SDI (EnviroGard and RISC™)	Soil (ex situ), ground water	Pesticides (Dichlorodiphenyltrichloroethane [DDT])	2-3 weeks	4 samples per hour	Site screening, site characterization	Less than \$50 per sample	Field screening data showed good correlation with independent laboratory data	TPH interference required dilution and affected detection limit; peat or bog samples gave poor extraction efficiency	Beth Kelley (Tetra Tech) 916/853-4523
Sanders Aviation- Tempe, AZ: crop duster activities	9	SDI	Soil (ex situ)	Pesticides	2 weeks	10 samples in 1 hour	Site screening, site characterization	Not provided	Real-time data; cost-effective; identification of hot spots	Must be careful about setting up and defining ranges	Tom Dunkelman (EPA) 415/744-2294

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
Astoria Plywood-Astoria, OR: plywood mill operations	10	SDI (PETRO RISC™ and PCB RISC™)	Soil (ex situ)	PCBs, TPH	4 days	4 samples per hour	Site screening, site characterization	PCB-\$38 per sample; TPH-\$29 per sample; accessory kit rented for \$550 per week	Data for soil samples screened with PCB test kits showed reasonable correlation with analytical laboratory data	Data for soil samples screened with TPH test kits showed poor correlation with data from analytical laboratory; possible matrix interference from presence of hydraulic oil having higher molecular chains	Joe Mollusky (Tetra Tech) 206/587-4650
Battery Recycling Plant-AK:	10	BioNebraska, Inc. (BiMelyze Mercury Assay)	Soil (ex situ), sludge	Heavy metals (mercury)	Not provided	48 samples per day	Not provided	\$24 per sample	Operational mercury range up to 4,400 ppm for analysis of confirmation samples	Not provided	Mike Boykin (Ecology and Environment) 206/624-9537
Environmental Pacific Corp.-Amity, OR: abandoned battery recycling facility	10	BioNebraska, Inc. (BiMelyze(R) Mercury)	Soil (ex situ), ground water, dust, sludge, concrete residue	Heavy metals (mercury)	1 month	1-2 samples per hour	Site screening, compliance monitoring, verification sampling	Not provided	Cost-effective; real-time data; reproducible results	Not provided	Thor Cutler (EPA) 206/553-1673
Pacific Wood Treating-Ridge Field, WA: former wood treating facility	10	SDI (RaPID® Assay)	Soil (ex situ), ground water, surface water	SVOCs, PCBs, PAHs	1 month	1 sample every 2 hours	Site screening, site characterization, cleanup monitoring	Not provided	Quick turnaround, allowed for definition of extent of contamination; reduced analytical costs allowed for effective direction of field efforts	Not provided	Bill Langston (EPA) 206/553-1679 Mark Ader (EPA) 206/553-1808

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Immunoassay (continued)											
Reynolds Metal Co.- Troutdale, OR: aluminum reduction facility	10	SDI (RaPID® Assay)	Soil (ex situ), sediment (ex situ), ground water	PCBs, PAHs	3 months	51 samples per hour (after extraction and analysis in batches)	Site screening, cleanup monitoring, confirmation sampling	\$20 per sample	Quick turnaround allowed for definition of extent of contamination; provided oversight of the potentially responsible party's data collection efforts	Cannot distinguish individual PCBs	Chris Field (EPA) 206/553-1674
Umatilla Army Depot-Hermiston, OR: explosives washout lagoon, OB/OD, small arms incinerator, explosives in ground water	10	SDI (RaPID® Assay, D-TECH)	Soil, ground water, composite residues	Military explosives (TNT, RDX, HMX)	15 months	10-30 samples per day	Site screening, cleanup monitoring, compliance monitoring	Not provided	Real-time data; lower cost compared with analytical laboratory; higher sampling density at same cost	Not provided	Harry Craig (EPA) 503/326-3689
Mercury Vapor Analyzer											
Dewey Daggett-MA: landfill	1	Jerome Meter (mercury vapor analyzer)	Air	Heavy metals (mercury)	8/30/95	Not provided	Cleanup monitoring	Not provided	Avoided downtime; data quality effective for determining final sampling locations; fast analysis	Not provided	Not provided
Truman-St. Joseph, MO: mercury spill	7	Jerome Meter (mercury vapor analyzer), Gillian pump™	Air	Heavy metals (mercury)	6/96-7/97	Not provided	Cleanup monitoring, confirmation sampling, health and safety monitoring	\$60 per sample	Allowed for a real-time understanding of exposure; quick turnaround time on data	Learning curve associated with the operation of the technology; Gillian pumps™ did not work well if the pumps were not charged fully	Ken Rapplean (EPA) 913/551-7769
X-Ray Fluorescence											
Bristol Sandblasting-RI	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead)	10/19/94	Not provided	Site characterization, cleanup monitoring	Not provided	Effective in guiding final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
X-Ray Fluorescence (continued)											
Brockton Gas-MA	1	Not provided	Soil	Heavy metals (lead)	Not provided	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Dorrie Paar (EPA) 617/573-5768
Carroll Products-RI	1	Not provided	Soil, sludge	Heavy metals (lead)	Not provided	Not provided	Site characterization	Not provided	Not provided	Not provided	Bob Brackett (EPA) 617/573-5744
Cohen Property-MA	1	Not provided	Soil	Heavy metals (lead)	8/9/94	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Janis Tsang (EPA) 617/573-5732
Finberg Field-MA	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead)	6/8/95	Not provided	Site characterization	Not provided	Effective in guiding final sampling locations	Not provided	Frank Gardner (EPA) 617/573-5722
Goldfedders-CT	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead)	3/20/95-8/18/95	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Frank Gardner (EPA) 617/573-5722
Hatherway and Patterson-MA	1	Not provided	Soil	Heavy metals (lead)	Not provided	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Lisa Danek (EPA) 617/573-5707
Kearsarge-NH	1	Not provided	Soil	Heavy metals (lead)	9/26/90-4/17/91	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Dean Taglioferro (EPA) 617/263-5596
Lake Success Business Park, Remington Arms-Bedford, MA	1	Niton XL spectrum analyzer	Soil	Heavy metals (lead)	10/96-present	Not provided	Site characterization, cleanup monitoring	Not provided	Low cost; quick turnaround time for data; ease of use	Not provided	Stephanie Carr 617/573-5593 Niton, Inc. 800/875-1578
New Hampshire Plating Co.-Merrimack, NH: electroplating facility	1	Not provided	Soil (ex situ)	Heavy metals (cadmium)	1993	Not provided	Site characterization	Not provided	Not provided	Not provided	Dick Goehlevet (EPA) (617) 573-5742

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
X-Ray Fluorescence (continued)											
New Hampshire Plating Co.- Merrimack, NH: electroplating facility	1	Not provided	Soil	Heavy metals (lead)	6/93-6/94	Not provided	Cleanup monitoring	Not provided	Rapid analyses; low cost	Not provided	Jim DiLorenzo (EPA) 617/223-5510
Precision Chrome Plating Corporation- RI	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead, chromium)	4/24/95	Not provided	Site characterization	Not provided	Effective in guiding selection of final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768
RAE Battery- CT	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead)	Not provided	Not provided	Cleanup monitoring	Not provided	Speed and less down time	Not provided	Lisa Danek (EPA) 617/573-5707
Raymark- CT	1	Not provided	Soil	Heavy metals (lead)	Not provided	Not provided	Site characterization	Not provided	Not provided	Not provided	Mike Jasinski (EPA) 617/573-5786
Shapiro Site- MA	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals	6/14/95	Not provided	Site characterization	Not provided	Effective in guiding selection of final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768
Sparkling Fiber- NH	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead)	Not provided	Not provided	Site characterization	Not provided	Effective in guiding selection of final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768
Site unidentified- Stratford, CT	1	Not provided	Soil	Heavy metals (lead)	6/17/93	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Mike Jasinski (EPA) 617/573-5786
Surette Battery- NH	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead)	4/2/95-8/22/95	Not provided	Cleanup monitoring	Not provided	Effective in guiding selection of final sampling locations	Not provided	Frank Gardner (EPA) 617/573-5722
West Street Property- MA	1	TN Spectrace (Spectrace 9000)	Soil	Heavy metals (lead)	Not provided	Not provided	Site characterization	Not provided	Effective in guiding selection of final sampling locations	Not provided	Dorrie Paar (EPA) 617/573-5768

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
X-Ray Fluorescence (continued)											
Vega Baja Solid Waste Disposal Site-PR	2	TN Spectrace (model number not provided)	Soil (in situ), soil (ex situ)	Heavy metals	7 days	350 samples	Site characterization	\$17 per sample	Effective use of time and resources, resulting in further cost savings; identification of hot spots	Research needed to determine how effective an analytical tool technology would be for non-screening purposes	Dennis Munhall (EPA) 212/637-4343 Juan Davila (EPA) 212/637-4341
Hebelka-Location not provided	3	Not provided	Soil (ex situ)	Heavy metals (lead)	2 months in 1992	Not provided	Not provided	Not provided	Not provided	Not provided	Fred MacMillian (EPA) 215/566-3201
Mid-Atlantic Wood Preserves-MD: wood treatment facility	3	Not provided	Soil (in situ)	Heavy metals (copper, chromium, arsenic)	Not provided	200 samples per 3 days	Cleanup monitoring	Not provided	Fast verification during response action; good correlation with lab samples	May want to use concentration range to allow flexibility in decision making	Eric Newman (EPA) 215/566-3237
Palmerton Zinc-Palmerton, PA: wall paint	3	Outokumpu Electronics and Princeton Gamma Tech	Solid walls	Heavy metals	6 months in 1991	200 hours	Site characterization	Not provided	Not provided	Penetration depth was limited	Fred MacMillan (EPA) 215/566-3201
Site unidentified-Location not provided: active manufacturing facility	3	TN Spectrace (Spectrace 6000)	Soil (ex situ)	Heavy metals (chromium, copper, nickel)	4 months	954 samples per 4 months	Cleanup monitoring	\$146 per sample	Less expensive than off-site analysis; no waste generated; nondestructive method; real-time data; reduced cost of cleanup	Not provided	David Catherman (Environmental Resources Management, Inc.) 610/524-3500
Lockheed Martin Advanced Recorders-Sarasota, FL: ground-water and soil contamination	4	Not provided	Soil (ex situ)	Heavy metals	5 days	Not provided	Site characterization	Not provided	Not provided	Analysis of metals other than lead may be suspect	Wesley S. Hardegree (EPA) 404/562-0486
Old Citgo Refinery-Bossier City, LA: petroleum refinery operations	6	TN Spectrace (Spectrace 9000)	Soil (ex situ), sludge	Heavy metals (chromium, lead)	1 week	Collected and analyzed 200 to 300 samples	Site screening	Approximately \$4,000 per week	Time and cost savings	Not provided	Paul Dubois (Tetra Tech) 214/740-2012

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
X-Ray Fluorescence (continued)											
St. Charles Metal Finishing Company- St. Charles, MO: plating wastes	7	HNU Systems, Inc. (SEFA-P)	Soil (ex situ)	Heavy metals (lead and chromium)	5 days	10 samples per hour	Site characterization	\$55,000 to purchase SEFA-P; rental charge of \$2,000 for 2 weeks	Less expensive than off-site analysis; quick turnaround time; data used to guide investigation; can handle multiple analytes simultaneously; little sample preparation	Detection limits for chromium at least 200 milligrams per kilogram; instrument weighs 50 lbs and is not very portable; requires liquid nitrogen	Ruben McCullers (EPA) 913/551-7455
Tri-State- Jasper County, MO: airborne emissions deposited from smelter	7	Metorex (X-MET-880)	Soil (in situ), soil (ex situ)	Heavy metals	1 year	10,000 samples	Site screening, site characterization, cleanup monitoring, confirmation sampling	\$10 to \$20 per sample (exclusive of labor cost)	Real-time data to guide excavation; quick turnaround; portable	Equipment malfunctioned	Dave Williams (EPA) 913/551-7625
Site unidentified- Location not provided: 15 abandoned or inactive smelter sites	8	TN Spectrace (Spectrace 9000)	Soil (ex situ)	Heavy metals	Not provided	Not provided	Site characterization	Not provided	Rapid on-site data; inexpensive; little sample preparation; no solvent waste; can handle multiple analytes simultaneously	Not provided	Lawrence Kaelin (RF Weston) Steve Hawthorn (EPA) 303/312-6061
California Gulch Superfund Site- Leadville, CO: old mining and smelter operations	8	Metorex (X-MET 880)	Soil (ex situ)	Heavy metals (lead)	3 months	10 samples per hour; analyzed 3,700 soil samples	Site characterization	Not provided	Field-portable XRF data correlated well with CLP data; faster and less expensive than off-site analysis; data used to guide investigation; nondestructive method	Need to pulverize the quality control check sample instead of using loose soil	C.A. Kuharic and W.H. Cole (Lockheed Martin)

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
X-Ray Fluorescence (continued)											
China Lake NAWS-Ridgecrest, CA: laboratory wastes discharged to drainage ditches and lagoons	9	TN Spectrace (Spectrace 9000)	Soil (ex situ), soil (in situ), sediment (ex situ), sediment (in situ)	Heavy metals	1 month	12 samples per hour	Site characterization	Leased for \$6,000 per month	Easy to use; portable; can perform in situ measurements; no solvent waste; provides rapid data; little sample preparation	High detection limits (200 mg/kg) for chromium; field portable XRF barium data did not compare well with confirmatory data	Bryce Smith or Scott Schulte (Tetra Tech) 913/894-2600
Concord Naval Weapons Station-Concord, CA: storage and distribution of military munitions	9	Not provided	Soil (ex situ)	Heavy metals	Fall 1995	30-50 samples per day (no preparation) 20 samples per day (with preparation)	Site characterization	Not provided	Quick screening of sites; identification of hot spots	Detection limits not low enough to meet ecological concerns; matrix interference; results only indicate surface conditions and therefore may not provide adequate information for remediation purposes	Barbara Smith (EPA) 415/744-2366
Defense Distribution Region West, Sharpe Depot-Lanthrop, CA: storage and distribution of military munitions	9	Not provided	Soil (ex situ)	Heavy metals	2 weeks	3 samples per hour	Site characterization	Not provided	Quick turnaround time; cheaper than use of CLP laboratory; good results	Data not comparable to laboratory data	John Guzman (Defense Logistics Agency) 209/982-2093 Mike Wolfram (EPA) 415/744-2410
Defense Distribution Region West-Location not provided	9	Not provided	Soil (in situ), soil (ex situ)	Heavy metals	Not provided	Not provided	Site characterization	Not provided	Can collect more samples per area because of cost savings; allows for identification of trends in the field; saves time and money	Lack of guidance on data validation procedures	Marlon Mezquita (EPA) 415/744-1527

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
X-Ray Fluorescence (continued)											
Mare Island Naval Shipyard-Vallejo, CA: naval submarine and ship repair, maintenance, and construction facility	9	TN Spectrace (Spectrace 6000)	Soil (ex situ), sediment (ex situ)	Heavy metals	Ongoing	Not provided	Site characterization	Not provided	Rapid turnaround time; lower cost; flexibility in the field; consistent quality control, instead of inconsistencies that arise when various laboratories are used	Analytical biases for certain metals; difficulties in obtaining sufficiently low detection limits because of matrix interference	Tom Huetteman (EPA) 415/744-2384
Sacramento Army Depot-Sacramento, CA	9	Not provided	Soil (in situ), soil (ex situ)	Heavy metals	9 months	Not provided	Site characterization, cleanup monitoring	Not provided	Can collect more samples per area because of cost savings; allows for identification of trends in the field; saves time and money	Lack of guidance on data validation procedures	Marlon Mezquita (EPA) 415/744-1527
Verdesse Carter Park-Oakland, CA: lead acid waste, disposal of batteries	9	Not provided	Soil (in situ), soil (ex situ), (paint and dust)	Heavy metals (lead)	2 years	50 samples per day	Site screening, site characterization, cleanup monitoring	Not provided	Saves time and money; non-destructive (therefore the same sample analyzed in the field can be analyzed in the laboratory)	No EPA Region 9 standard operating procedures	Mike Bellot (EPA) 415/744-2364 Loran Henning (EPA) 415/744-1305
McCarty's Pacific Hide and Fur-Pocatello, ID: metal salvaging yard and lead acid battery storage	10	Outokumpu Electronics	Soil (in situ)	Heavy metals (lead)	10 days	Not provided	Site screening, site characterization, cleanup monitoring, confirmation sampling	Not provided	Transportable; capable of screening 6 elements simultaneously; data correlated well with laboratory data	Not provided	Ann Williamson (EPA) 206/553-2739 Lorraine Edmond (EPA) 206/553-7366 David Frank (EPA) 206/553-4019

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
X-Ray Fluorescence (continued)											
Umatilla Army Depot-Hermiston, OR: explosives washout lagoon, OB/OD area, small arms incinerator, explosives in ground water	10	TN Spectrace (model number not provided)	Soil	Heavy metals (lead)	15 months	10-30 samples per day	Cleanup monitoring, compliance monitoring	Not provided	Real-time data; lower cost, compared with cost of using analytical laboratory; higher sampling density at same cost	Not provided	Harry Craig (EPA) 503/326-3399
Geophysical Technologies											
Bore-hole Geophysical											
Loring AFB-Limestone, Maine: fuel oil release area, blasting conducted to support recovery of fuel oil	1	Mala Geo-Sciences, Inc. (Terra Plus bore-hole GPR)	Soil (bedrock)	Bedrock stratigraphy	6/95-present	Not provided	Site characterization	Bore-hole radar \$250,000	Produces "picture" of bedrock planes to 25-50 meter radius of the bore-hole	Not provided	Pete Haeni (United States Geological Survey [USGS] - Connecticut) 860/240-3299 Richard Willy (EPA) 617/573-9639
New Hampshire Plating Co.-Merrimack, NH: electroplating facility	1	Geonics Ltd. (EM-39 bore-hole electromagnetic induction unit used in conjunction with natural gamma log survey)	Soils (in situ), ground water	Electrical conductivity	1994	Continuous readout	Site characterization	\$25,000 per unit	Technology delivered good results	Can be used only in open bore-holes/PVC with diameter > 2", (non-metallic wells)	Richard Willy (EPA) 617/573-9639 Thomas Mach (USGS) 603/226-7805
Letterkenny Army Depot-Letterkenny, PA	3	Geophex (bore-hole acoustic equipment)	Ground water	Depth to ground water	5/95-6/97	1 hole per day	Site characterization	\$120,000 per unit	Produces superior data; produces picture of bedrock fractures; real-time data	Post-processing of data is expensive	Paul Stone (USACE) 717/261-6863

Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Bore-hole Geophysical (continued)											
Limestone Rd.-Cumberland, MD: ground water contamination	3	USGS	Soil (bedrock)	Bedrock fracture identification, temperature	7/93	3 bore-holes per day	Site characterization	Not provided	Better understanding of ground-water flow	Bore-hole size and terrain may limit equipment	Andy Sochanski (EPA) 215/566-3370 Leslie Brunner (EPA) 215/566-3239 Dan Phelan (USGS) 410/828-1535
Direct-push Electrical Conductivity											
Salina North-Salina, KS: industrial area, solvent use and disposal, grain fumigation, chemical manufacturing	7	Geoprobe® Systems (Direct Image® soil conductivity logging system)	Soil (in situ)	Site subsurface lithology (to define subsurface geologic and hydrogeologic, conditions)	3 days	11 logs to 65 feet in 3 days	Site characterization	\$14,000 per unit	Capable of identifying stratigraphic layers that conventional methods missed; very fast; less expensive than standard methods; no soil cuttings	Susceptible to operator error; experienced operator needed to calibrate and interpret logs	Curt Enos (Tetra Tech) 913/839-8515 Wes McCall (Geoprobe Systems, Inc.) 913/825-1842 Susan Stover (KDHE) 913/296-5531
Electromagnetic Induction											
Holtrachem-Location not provided	1	VLF Electromagnetic Survey equipment	Bedrock	Not provided	1994	Not provided	Site characterization	Not provided	Not provided	Not provided	Ernest Waterman (EPA) 617/223-5511
Bliss Ellisville-Wild Wood, MO: buried drums containing dioxin	7	Geonics, Limited (EM-31)	Soil (in situ)	Buried ferrous metal	2 months	7 acres	Site characterization	Not provided	Not provided	Overhead power lines caused interference	Wood Ramsey (EPA) 913/551-7382
Letterkenny Army Depot-Letterkenny, PA: landfill	3	Geophex (multifrequency conductivity instrument)	Soil (in situ)	Disposal trenches	6/97	12 acre site per week	Site characterization	\$10,000 per acre	Quick turnaround time; ease of use, portable	Large metal objects can introduce noise	Paul Stone (USACE) 717/261-6863 Eric Powers (Geophex) 919/839-8515

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Ground Penetrating Radar											
Ciba-Geigy-Cranston, RI	1	Not provided	Till, bedrock	Structure contours	1991	Not provided	Site characterization	Not provided	Nonintrusive	Poor identification of buried utilities	Frank Battaglia (EPA) 617/573-5747
General Electric-Pittsfield, MA	1	Not provided	Till	Structure contours	1995-present	Not provided	Site characterization	Not provided	Nonintrusive	Not provided	Bryan Olsen (EPA) 617/573-5747
Gilson Road-Nashua, NH: former waste disposal site (1960-70s)	1	Not provided	Subsurface	Water table, bedrock stratigraphy	Not provided	Continuous profile	Site characterization	Not provided	Information pertaining to depth of water table and bedrock compared favorable with GFR data; produced a picture of the bedrock plane	Not provided	Thomas Mack (USGS, New Hampshire) 603/226-7805
Dupont-Newport-Newport, DE: contamination in riverbed	3	OceanSystems, Inc. (GPR with dual frequency sounding and side-scanning sonar)	Soil (in situ) (river bottom)	Sediment layers	Not provided	Continuous profile	Site characterization	Not provided	Focused sample location mapping	Fine grain analysis more expensive	Randy Sturgeon (EPA) 215/566-3227
Magnetometry											
Naval Air Engineering Station-Lakehurst, NJ	2	Geo-Centers, Inc. (Surface-Towed Ordnance Locating System [STOLS])	Soil (in situ)	Buried ferrous metals	Not provided	0.75 acre per hour	Site characterization	\$8,600 per acre	Relatively quick survey of terrain	Limited by field conditions (mud, severe weather, foliage, and deeply located anomalies); equipment tends to underestimate number of targets compared with hand-held devices; signals from extraneous metals must be filtered out	Jeffrey Gatz (EPA) 212/637-4320 Greg Bury (Naval Air Engineering Station Lakehurst) 908/323-1014

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Magnetometry (continued)											
Bliss Ellisville-Wild Wood, MO: buried drums containing dioxin	7	Geonics Limited (proton magnetometer, G-856)	Soil (in situ)	Buried ferrous metal	2 months	7 acres	Site characterization	Not provided	Not provided	Overhead power lines caused interference	Wood Ramsey (EPA) 913/551-7382
Seismic Profiling											
Allegany Ballistics Laboratory-Rocket City, WV: TCE disposal pit, drum storage area	3	Resolution Resources, Inc. (three-dimensional seismic reflection technology)	Soil (in situ)	Bedrock stratigraphy	10/95-11/95	Not provided	Site characterization	Not provided	Cost-effective method for determining migration path for DNAPLs	Data return is very specific; trained technicians required	Jeff Kidwell (Navy Sea Systems Command) 757/322-4795
National Aeronautic and Space Administration (NASA) Kennedy Space Center-FL: former components cleaning facility for rocket parts	4	Resolution Resources, Inc. (three-dimensional seismic reflection technology)	Soil (in situ)	Soil type	12 days on site; 45 days for data assessment	2 months to sample and delineate seismic data for a 1,500' x 1,500' area	Site characterization	\$150,000 to develop subsurface, high resolution model	Very detailed image of soil stratigraphy that aids in the placement of wells; defines fractures within one foot	Removal of vegetation required	Jacqueline Quinn (NASA) 407/867-4265
Former Vickers Site-Omaha, NE: hydraulic pump facility	7	Resolution Resources, Inc. (three-dimensional seismic reflection technology)	Soil (in situ)	Depth to ground water, bedrock stratigraphy	5/12-5/20/97	62,000 sq ft per day	Site characterization, cleanup monitoring	\$100,000 per 500,000 sq ft	Portable unit; identified fractures in bedrock	Not provided	Paul Broormer (Unisys) 612/687-2673 Mike Westerheiv 612/687-2887
Naval Air Station Alameda-Alameda, CA: aircraft support operations	9	Resolution Resources, Inc. (three-dimensional seismic reflection technology)	Soil (in situ) (sediments, bedrock)	Bedrock stratigraphy	11/96-10 days	Not provided	Site screening	Not provided	Noninvasive; real-time; cost-effective; easy to use	Equipment requires direct contact with ground, which presents a problem in buildings; data require interpretation	Ken Spellman (Navy EFA West) 415/244-2539

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Seismic Profiling (continued)											
Lawrence Livermore National Laboratory-Livermore, CA: landfills, disposal pits, spills	9	EG&G, Inc. (Innovative Transducers)	Sediment, ground water	Depth to ground water, soil type, bedrock stratigraphy	1992-present	Not provided	Site characterization, cleanup monitoring	\$150,000 per unit	Rapid data collection; provides opportunity to properly design and install remedial system and determine migration pathways for contaminants	Works best where water table is shallow	Robert Bainer (Lawrence Livermore National Laboratory) 510/422-4635
Lawrence Livermore National Laboratory-Livermore, CA	9	Resolution Resources, Inc. (three-dimensional seismic reflection technology)	Sediments, bedrock	Subsurface stratigraphy (structure)	1-2 weeks	Not provided	Site characterization	Not provided	Information can be used to determine likely migration pathways	Not provided	Robert Bainer (Lawrence Livermore National Laboratory) 510/422-4635 Mary-Linda Adams (Resolution Resources) 540/349-9172 or 517/647-1832
Naval Air Station North Island-San Diego, CA: chemical waste dumping site	9	Resolution Resources, Inc. (three-dimensional seismic reflection technology)	Soil (in situ)	Bedrock stratigraphy	2 months	Not provided	Site characterization	\$250,000 for 40-acre site	Cost-effective method of obtaining detailed on-site stratigraphy, using minimal preexisting bore-hole data; able to identify fault zones (contaminant migration pathways), saving several months in field exploration	Not provided	Bill Collins (NAVFACSW-DIV) 619/556-8929

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Seismic Profiling (continued)											
Stringfellow hazardous waste site- Riverside, CA: Former hazardous waste landfill (1956-1972)	9	Resolution Resources, Inc. (three-dimensional seismic reflection technology)	Soil (in-situ)	Bedrock stratigraphy, fractures	1/97-6/97	11 acres (7,800 data points) per 30 days	Site characterization	Not provided	Used to locate groundwater extraction wells, minimizing drilling costs	Metal objects on surface (fence) caused interference, but did not prohibit use of equipment	Stewart Black (URS Greiner, Inc.) 916/929-2346
Radionuclide Technologies											
Gamma Radiation Detector											
Site unidentified- Texas City, TX: abandoned tin smelter facility	6	Ludlum, Inc. (Model 19 with a sodium iodide scintillation detector)	Soil (in situ), sediment (in situ)	Radionuclides	Not provided	Not provided	Site characterization	Not provided	Rapid, real-time data; portable system; data compared favorably with laboratory data; less expensive	Not provided	Warren Zehner (EPA) 281/983-2127 Joe Cornelius (E&E)
Ramp Industries Removal Action - Denver, CO: radioactive and mixed waste processor, transfer station, abandoned material at site, spills	8	Canberra (gamma spectrography)	Liquid waste (drummed)	Radionuclides	2.5 months	Not provided	Waste characterization	\$900 per wk rental, inspector at \$370 per wk	Identifies waste in the field before shipping and disposal	Expensive; requires trained operator; sensitive to power fluctuations; requires liquid nitrogen; needs protection from elements	Dave Christenson (EPA) 303/312-6645 Dave Hall (SEG) 423/376-8246
Naval Air Station Alameda, Hunters Point Annex- Oakland, CA	9	EG&G ORTEC (Micro Nomad)	Soil (in situ)	Radionuclides	9/95-11/95	Not provided	Site characterization	\$750 per week (minus laptop)	Ease of use; portability; much cheaper than conventional methods	Not provided	Kevin Taylor (Tetra Tech) 404/225-5505

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Passive Alpha Detector											
Area 11B at the Nevada Test Site-Mercury, NV	9	Rad Electric, Inc. (electric ionization chambers and alpha track detectors made by Landuer, Inc.)	Soil (in situ)	Radionuclides, (uranium)	Not provided	Not provided	Site characterization, health and safety monitoring	\$25 per sample	Alpha track detectors have fewer potential interferences than electric ionization chamber; both techniques are fast, easy to use, and inexpensive	Not provided	C.S. Dudney and K.E. Meyer (Oak Ridge National Laboratory)
Sampling and Sampler Emplacement Technologies											
Closed-piston Soil Sampling											
Salina North-Salina, KS: industrial area, solvent use and disposal, grain fumigation, chemical manufacturing	7	Geoprobe Systems, Inc. (Marco-Core® closed piston soil sampler)	Soil (ex situ)	Not provided	2 days	Not provided	Site characterization	\$630 per unit	Can retrieve intact soil cores from below the water table (saturated materials); no cuttings; faster and less expensive than conventional drill rig	The sampler is designed for use only in soils and unconsolidated sediments; it generally is used at depths of less than 50 feet; if used for discrete interval sampling at depth, the bore hole must be preprobed to the top of the targeted sampling interval	Wes McCall (Geoprobe Systems Inc.) 913/825-1842 Susan Stover (KDHE) 913/296-5531
Direct-push Prepacked Well Screen											
Salina North-Salina, KS: industrial area, solvent use and disposal, grain fumigation, chemical manufacturing	7	Geoprobe (direct-push prepacked-screen monitoring well)	Ground water	Halogenated and nonhalogenated VOCs	1 week	3 hours to install one prepacked well to 65 feet	Site characterization, compliance monitoring	\$45 per 3-foot prepacked screen	Less expensive and faster than installing well by conventional methods; no soil cuttings	Depth limitations; wells cannot be placed in bedrock; small diameter of well creates difficulty in developing, purging, and sampling when large volumes of water are needed	Wes McCall (Geoprobe Systems Inc.) 913/825-1842 Susan Stover (KDHE) 913/296-5531

Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Low-flow Ground-water Pumping											
Auburn Road-NH: landfill	1	Not provided	Ground water	VOCs, heavy metals	4/95-4/96	Not provided	Cleanup monitoring	Not provided	Samples for inorganic water quality are more representative	Longer sampling time, increasing cost	Darryl Luce (EPA) 617/573-5767
Davis GSR-RI	1	Not provided	Ground water	VOCs, SVOCs, heavy metals	4/93-8/93	Not provided	Cleanup monitoring	Not provided	Samples for inorganic water quality are more representative	Not provided	Joe Lemay (EPA) 617/573-9622
Fort Devens-MA	1	Not provided	Ground water	VOCs, heavy metals	1/96-present	Not provided	Cleanup monitoring	Not provided	Fewer waste by-products; data quality	Not provided	Jim Byrne (EPA) 617/573-5799
Otis AFB-MA	1	Not provided	Ground water	VOCs, heavy metals	1993-present	Not provided	Cleanup monitoring	Not provided	Fewer waste by-products; data quality	Not provided	Carol Keating (EPA) 617/223-5594
Peterson/Puritan-RI	1	Not provided	Ground water	VOCs, heavy metals	5/95-present	Not provided	Cleanup monitoring	Not provided	Fewer waste by-products; data quality	Not provided	Dave Newton (EPA) 617/573-9612
Revere Textile-CT	1	Not provided	Ground water	VOCs, heavy metals	1993-present	Not provided	Cleanup monitoring	Not provided	Fewer waste by-products; data quality	Not provided	Leslie McVickar (EPA) 617/573-9689
Saco Land Fill-ME	1	Not provided	Ground water	Heavy metals	1992-1993	Not provided	Cleanup monitoring	Not provided	Fewer waste by-products; data quality	Not provided	Ron Jennings (EPA) 617/573-5794
Tibbetts-NH	1	Not provided	Ground water	VOCs, heavy metals	6/95-present	Not provided	Cleanup monitoring	Not provided	Fewer waste by-products; data quality	Longer sampling time, increasing costs	Darryl Luce (EPA) 617/573-5767
Ponders Corner (Lakewood)-South of Tacoma, WA: drycleaning and laundry operations	10	Brainard-Kilman	Ground water	Halogenated VOCs	7 days	Not provided	Site screening, site characterization, cleanup monitoring	Not provided	Minimizes sucking of soil and sediments into sampler	Not provided	Ann Williamson (EPA) 206/553-2739

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Soil Gas Sampling											
Site unidentified-eastern United States: former coal gas manufacturing plant	Not specified	W.L. Gore and Associates (GORE-SORBER SM)	Soil gas (also used to monitor soil and ground water)	PAHs, SVOCs	Exposure time of 3 weeks	Not provided	Site characterization	Not provided	Low-volatility compounds can be absorbed; can be used in situ; cost savings; good correlation with monitoring well data	Not provided	Mark Stutman and Mark Wrigley (W.L. Gore and Associates) 410/996-3406
Davis GSR - Smithfield, RI: landfill	1	Not provided	Soil gas	VOCs	4/92-8/92	Not provided	Site investigation	Not provided	Cost-effective; real-time data	Not provided	Joe Lemay (EPA) 617/573-9622
Sothersworth - NH: landfill	1	Petrex	Soil gas	VOCs	Not provided	Not provided	Cleanup monitoring	Not provided	Not provided	Not provided	Roger Duwart (EPA) 617/573-9628
Site unidentified-Location not provided	7	Not provided (Summa Canister)	Soil gas	VOCs (solvents)	Not provided	Not provided	Site characterization, cleanup monitoring, compliance monitoring, health and safety monitoring	\$658 per canister	Easy to collect a sample; portable system	Not provided	Harry Kimball (EPA) 913/551-5171
Sacramento Army Depot- Sacramento, CA	9	SEAMIST (equipment used in conjunction with soil gas monitoring wells)	Soil gas	Halogenated VOCs (TCE, PCE)	9 months	50 samples per well, 6 wells per day	Verification sampling	\$30,000 per well	Independent verification; versatility of application (can sample the ports desired); retractable (could move the wells)	Must customize technology to the site's lithology	Marlon Mezquita (EPA) 415/744-1527
Vertical Ground-water Profiling											
Pease AFB 3-NH	1	Waterloo Centre for Groundwater Research	Ground water	DNAPL	1/95-9/95	Not provided	Cleanup monitoring	Not provided	Vertical delineation of contaminants	Not provided	Mire Daly (EPA) 617/573-5783

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Vertical Ground-water Profiling (continued)											
Savage-NH	1	Waterloo Centre for Groundwater Research	Ground water	DNAPL	3/95-5/95	Not provided	Cleanup monitoring	\$350,000	Vertical delineation of contaminants	Not provided	Dick Goehlert (EPA) 617/573-5742
Wells G&H 1-MA	1	Waterloo Centre for Groundwater Research	Ground water	Not provided	8/94	Not provided	Cleanup monitoring	Not provided	Discrete fracture ground water samples	Not provided	Mary Garren (EPA) 617/573-9613
Sacramento Army Depot-Sacramento, CA	9	Not provided (BAT Probe)	Ground water	Halogenated VOCs	6 months	Not provided	Site characterization	Not provided	Cost-effective; enables vertical profiling; can target monitoring well zones; enables tracking of plume boundaries	Problems with data comparability; difficult to model migration of TCE	Marlon Mezquita (EPA) 415/744-1527
Vibrating Well Installation											
Town Garage/Radio Beacon-NH	1	Solinst, Inc. (Ground-water Packer) Mykro Waters, Inc. (Microwells)	Ground water	VOCs	1/91-7/97	Not provided	Cleanup monitoring	Not Provided	Discrete fracture ground water samples	Not provided	Jim Di Lorenzon (EPA) 617/223-5510
Yaworski-CT	1	Mykro Waters, Inc. (Microwells)	Ground water	VOCs (benzene)	9/97-present	Not provided	Cleanup monitoring	Not provided	Lower cost, rapid installation	Not provided	Anni Loughlin (EPA) 617/223-5575
Fletcher's Paint-NH	1	Mykro Waters, Inc. (Microwells)	Ground water	VOCs, inorganics	9/94	Not provided	Cleanup monitoring	\$1,000 per well	Lower cost, rapid installation	Not provided	Darryl Luce (EPA) 617/573-5767
Gallops Quarry-CT	1	Mykro Waters, Inc. (Microwells)	Ground water	VOCs, inorganics	9/94	Not provided	Cleanup monitoring	Not provided	Lower cost, rapid installation	Not provided	Leslie McVickar (EPA) 617/573-9689
New Hampshire Plating-NH	1	Mykro Waters, Inc. (Microwells)	Ground water	VOCs, SVOCs, inorganics	6/93-6/94	Not provided	Cleanup monitoring	Not provided	Lower cost, rapid installation	Not provided	Jim Di Lorenzo (EPA) 617/223-5510

**Table 2-3
Summary of Field Analytical and Site Characterization Technologies
Reported Data on Specific Technologies (continued)**

Site Description	EPA Region	Vendor/Product	Media Monitored	Contaminant/Parameter	Period of Use	Through-put	Data Use(s)	Cost	Technology Advantages	Technology Limitations	Contact(s)
Vibrating Well Installation (continued)											
Hastings Superfund Site-NE: landfill, contaminated ground water	7	Mykro Waters, Inc. (Microwells)	Ground water, soil	VOCs	6/97	Up to 2000 feet of well per day	Site characterization, cleanup monitoring	Not provided	Wells can be installed to approximately 100' without pilot hole and 200' with pilot hole; generates no drill cuttings; equipment can fit into tight spaces	Equipment overheats frequently; well screens clog easily in clay and other fine materials; requires welding 20' sections	Diane Easley (EPA) 913/551-7797 Randell Ross (ADA) 405/436-8611