Jeffrey Hackworth, R.Gp, P.G.

FPM group — Engineering and Environmental Science

Mr. Hackworth is a registered, senior geophysicist with over 21 years of environmental/engineering geophysics and UXO experience. He has conducted and managed geophysical surveys at U.S. Department of Defense (DOD) and Department of Energy (DOE) sites and commercial/industrial sites throughout the U.S., Caribbean, Pacific Region, and Southeast Asia. In addition to his geophysical work, Mr. Hackworth is currently the Project Manager on several USAF and USACE MMRP Site Inspections (SI) and MEC/UXO Removal Actions (RA), and serves as the sales/marketing representative and proposal coordinator for FPM's Geophysical & UXO Services group. Mr. Hackworth's geophysical experience includes site investigations using magnetic, gravity, spontaneous potential (SP), time- and frequency-domain electromagnetic (EM) induction, very low frequency (VLF) EM, ground penetrating radar (GPR), electrical resistivity, induced polarization (IP), p-wave and shear-wave seismic reflection, seismic refraction, spectral analysis of surface waves (SASW), multi-channel analysis of surface waves (MASW), controlled-source audiofrequency magnetotellurics (CSAMT), sub-bottom profiling, side-scan sonar, bathymetric, and borehole geophysical logging techniques. His experience also includes seismic vibration/blast monitoring, seismic refraction tomography, seismic reflection data processing, land surveying using conventional total station, robotic total station (RTS) and RTK global positioning systems (GPS), and software development.

Functional Role	Title	Years of Experience
Senior Geophysicist	Branch Manager	24

Personal Data

Education
B.S./1983/Geophysics; Boise State University
Graduate Studies/1983-1984/Geophysical Engineering; Montana Tech

Registrations/Certifications
Registered Geophysicist: California No. GP 979; 1992
Registered Professional Geologist: Tennessee No. TN 3345; 1994
Registered Environmental Assessor: California No. 02679; 1991
Certified Radiological Worker II: DOE No. 553193694; 1993, updated 1996
Certified Real-Time Kinematic Global Positioning System Surveyor (Trimble No. 5569), 1998

Employment History

2004 to Present	FPM Group, Ltd.
2001 to 2004	Blackhawk Geoservices
1990 to 2001	IT Corporation
1984 to 1990	Western Geophysical

Detailed Experience

- **Senior Geophysicist/Manager Southeast Division (FPM Geophysical & UXO Services), San Antonio, TX and Oak Ridge, TN**

Responsible for managing the technical, budgetary, and scheduling aspects of geophysical site assessments, MEC/UXO SIs and remedial/removal actions, managing diverse group of geophysical and UXO professionals, managing MMRP/MEC removal projects, and serving as a sales/marketing representative and proposal coordinator for the division. This includes planning, organizing, implementing, and managing the corporate geophysics and UXO staff in support of RCRA, CERCLA, and commercial projects. The work has included geophysical survey design, field data acquisition, and data processing/interpretation for surveys located throughout the U.S. on the following select projects:

- **Barksdale AFB, Bossier City, LA**

  Project Manager / Senior Geophysicist for a $2.1M unexploded ordnance (UXO) and munitions and explosives of concern (MEC) Site Inspection (SI) at 10 bomb range AOC's covering over 6,900 acres. The project objectives on this ongoing contract with AFCEE are to detect and categorize medium and large UXO and ordnance and explosives (OE) items located within the upper 10-15 feet of subsurface and determine possible explosive / environmental hazards on the public and receptors. Work includes managing and performing a Land and Marine Geophysical Prove-Outs (GPO), developing a UXO/OE work plan and health & safety plan (HASP), developing a MEC sampling & analysis plan (SAP) and explosives safety submission (ESS), managing a crew of geophysicists and EOD technicians, performing high-resolution G-858G magnetic and EM61-HP electromagnetic (EM) surveys using a survey-grade RTK-GPS and robotic total station (RTS) for positioning, performing marine geophysical surveys, conducting GPS-based anomaly relocating and follow-on soil sampling for munitions constituents (MC), developing UXO/OE conceptual site models (CSM) and munitions response site prioritization protocol (MRSPP) rankings, and building a geographical information system (GIS) database of the investigation results compliant with the USAF GEOBASE and SDSFIE standards.

- **Barksdale AFB, Bossier City, LA**
  Project Manager / Senior Geophysicist for a $500K Phase I MEC Investigation at two sites totaling 144

acres in support of planned residential construction under the Barksdale Housing Privatization program. Phase I, under contract to AFCEE, required 100% coverage high-resolution DGM surveys to map anomalies to a depth of 10 feet and MC sampling with the objective of obtaining DDESB-approved clearance that allows for unrestricted / residential reuse following Phase II remediation. Work included managing and conducting DGM surveys implementing a towed array of six G-858 magnetic sensors coupled to RTK-GPS for positioning, developing a UXO/OE work plan and HASP, developing a MEC SAP, managing a crew of geophysicists and EOD technicians, performing detailed VR surveys, conducting GPS-based anomaly relocating with GPR and follow-on soil sampling for MC, developing UXO/OE CSMs, and building a GIS database of the investigation results compliant with the USAF GEOBASE and SDSFIE standards.

- **Barksdale AFB, Bossier City, LA**
  Project Manager / Senior Geophysicist for $3.9M Phase II MEC Removal Action (RA) at two parcels totaling 144 acres in support of planned residential construction of ~560 single family units under the Barksdale Housing Privatization program. Phase II, under contract to AFCEE, required developing an Explosives Safety Submission (ESS), Work Plan and MEC/UXO Safety Plan, site demolition of several light structures and fencing, excavating and removing two hardfill landfill areas ~4.6 acres (~30,000 cubic yards), relocating, excavating and removing ~8,700 magnetic targets, performing 100% coverage QC DGM surveys w/ magnetics coupled to RTK-GPS, preparing a MEC After Action Report (AAR) and Certificate of Clearance for each parcel showing MEC/UXO remediation to a depth of 10 feet below final grade allowing for site designation through the Air Force Safety Center (AFSC) and DDESB as "unrestricted/residential reuse." The work included managing a crew of 4 geophysicists and 17 EOD technicians.

- **Commercial Site, Camden, AR**
  Managed and conducted a two-part $51K geophysical reconnaissance survey (P-wave seismic reflection, electrical electrical, time-domain electromagnetic [TDEM] soundings and frequency-domain electromagnetic [FDEM] profiling) to determine the presence or absence of a clay aquitard at depths ranging from 35 to 100 feet and to accuately map its depth where identified. A secondary objective was to estimate its thickness. Based on the data collected, several additional suspect areas will be funded using the most applicable technique(s). From the data collected, both EM methods were successful at determining the clay aquitard continuously occurs beneath the site, and the TDEM soundings allowed for a reasonable estimate of the aquitard thickness.

- **Commercial Site, Tuscumbia, AL**
  Managed and conducted a $20K geophysical investigation (P-wave seismic refraction tomography, electrical resistivity and induced polarization [IP]) to map bedrock topography and identify fractures and solutioning features (e.g., sinkholes and voids) that control groundwater migration. A secondary objective was to directly detect LNAPL contaminants at depth. A highly irregular bedrock surface was known to occur at a depth of 40 to 70 feet. Seismic refraction, resistivity and IP data were collected along 6 profiles, each approximately 100 meters in length. The project was successful in mapping subsurface structures that control groundwater migration.

- **Commercial Site, Northwest Louisiana**
  Managed and conducted a $34K MEC/UXO geophysical investigation and follow-up RA at a 3.5-acre commercial site. The site was located in the area of a former USAF bomb range and the work conducted in support of oil/gas exploration and drilling. Work included a 100% coverage high-resolution DGM survey using a G-858G magnetic system and RTS to map anomalies to a depth of 10 feet, magnetic target analysis and anomaly re-locate work, and over 90 exploratory test pit excavations to remove potential MEC/UXO. The project was successful and no UXO safety incidents were recorded during planned O/G drilling or mud pit excavation work.

- **Tennessee State Capitol, Nashville, TN**
  Managed and conducted a $6K geophysical investigation (GPR) within 5 areas of the State Capitol complex to locate and determine potential source areas of accumulating ground water leaking into a tunnel connecting the TN State Capitol Building with the Legislative Building. The specific project objective was to locate voids and/or zones of water accumulation or increased moisture content behind tunnel walls. The GPR survey included using 4 different frequency antennas. Signal penetration was limited in most of the areas surveyed, however, several anomalies potentially representing accumulations of water were proposed for follow-up intrusive sampling.

- **Various Locations, NJ/SC/TN/TX**
  Managed and conducted over 20 pipeline/utility mapping and near-surface infrastructure projects at commercial sites totaling >$80K. The projects involved locating and mapping utilities, product lines, concrete thickness, and post-tension cables with ground penetrating radar (GPR) and EM utility locator techniques in support of planned drilling/trenching work. The projects were successful in mapping existing pipelines and cables with no safety incidents recorded.

- **Commercial Site, Middle Tennessee**
  Managed a $7K geophysical investigation (EM31

and magnetics) at two confidential commercial sites totaling 1 acre to determine if buried railcars existed in a heavily wooded area. The project was successful in mapping large buried metal objects at one site with a magnitude and dimensions typical of a buried railcar.

- **Griffiss AFB, Rome, NY**
  Managed a $35K geophysical investigation (Electrical Resistivity/IP, EM31, EM61, and GPR) at three sites to map near-surface geology to approximately 40 feet, locate free product, and to clear two areas for buried pipelines where horizontal well installation was planned. The project was successful mapping variations in geology to the targeted depth; the results showed interpretations of hydrocarbon free-product in the electrical resistivity data correlated well with available direct-push intrusive data.

- **Louisiana Army Ammunition Plant, Doyline, LA**
  Managed and conducted an $8K UXO geophysical investigation (EM31 with RTK-GPS) across one site totaling 12 acres to map pits and trenches containing UXO. The project was successful in mapping several pits and trenches in areas not previously suspected and determining that some portions of the site were absent of buried metal.

- **Former Pole Mountain Target and Maneuver Area, Cheyenne, WY**
  Managed a $65K two-month UXO geophysical investigation (EM61-MKII wit RTK-GPS) performed across several remote range areas totaling over 50 acres to provide high-resolution detection and mapping of UXO.

- **McAlester Army Ammunition Plant, McAlester, OK**
  Managed a $7K UXO geophysical investigation (EM31 wit RTK-GPS) across one site totaling 5 acres to map pits and trenches containing UXO. The project was successful in mapping several pits and trenches in areas not previously suspected and determining that some portions of the site were absent of buried metal.

- **Savanna Army Ammunition Depot, Savanna, IL**
  Managed a $25K two-month UXO geophysical investigation (EM61-MKII, TM-5 EMU, and TM-4) and anomaly relocation work. The project was conducted across several range areas to provide high-resolution

  detection and mapping of UXO and support on-going intrusive investigation.

- **Commercial Site, Sheffield, AL**
  Managed a $4K geophysical investigation (EM61 and GPR) at a radio tower site to locate and map possible underground storage tanks (UST). The project was successful in determining no UST's exist in the area investigated.

- **Y-12 Plant, Oak Ridge National Laboratory (ORNL), TN**
  Managed an $11K geophysical well-logging (natural gamma and borehole deviation) project to map targeted stratigraphic horizons and bedrock features.

Senior Geophysicist / Division Manager, Blackhawk GeoServices, Oak Ridge, TN

Responsible for managing the technical, budgetary, and scheduling aspects of geophysical site assessments. This included planning, organizing, implementing, and managing the corporate geophysics staff in support of RCRA, CERCLA, and commercial projects. Duties also included large-scale MEC/UXO remedial/removal actions, and serving as a senior sales/marketing representative and proposal coordinator. Geophysical work included survey design, field data acquisition, and data processing/interpretation for surveys conducted throughout the U.S. and Hong Kong on the following select projects:

- **Disneyland, Penny's Bay, Hong Kong**
  Managed a $4.6M DGM and RA project for detection and remediation of UXO/MEC on an approximately 200-acre land reclamation parcel that would serve as the future Disneyland, Hong Kong. The project, performed in conjunction with construction activities, required clearance for small UXO items located within the upper 1 meter of subsurface and larger UXO items located within the upper 3 meters of subsurface. The work included managing a crew of 6 geophysicists and 28 EOD technicians, performing high-resolution G-858G magnetic surveys using survey-grade GPS for positioning, conducting GPS-based anomaly relocating, and supervising EOD remediation efforts. Approximately 15M magnetic data points were recorded and an estimated 24,000 ferrous metal targets were remediated. The project was successful in screening the upper few meters for ferrous metallic items potentially representing UXO.

- **Y-12 Plant, Oak Ridge National Laboratory (ORNL), TN**
  Managed and conducted an $8K geophysical logging investigation to identify possible fracture flow within one open borehole to a depth of 200 feet using 3-arm caliper, natural gamma, EM induction, normal resistivity, SP, temperature, heat-pulse flowmeter, and borehole deviation probes. The project was successful in determining that fracture flow did not exist in most of the borehole and was minimal in those areas where fractures are present.

- **Commercial Site, Knoxville, TN**

Managed and conducted a $32K geophysical investigation (Multi-channel Analysis of Surface Waves [MASW], radial seismic refraction tomography, and GPR) to locate and map possible voids, sinkholes, and zones of weakened soils adjacent to and beneath several large above ground gasoline storage tanks at a 4.5-acre tank farm. The project was successful in determining that no sinkholes exist and that three anomalies likely contain weakened and/or fissured soils potentially representing precursors to sinkhole development.

- **MacDill AFB, Tampa, FL**
  Managed and conducted a $6K geophysical investigation (GPR) to locate and map a concrete pipeline for approximately 1,200 feet, estimate its depth, and identify other nearby utilities. The project was successful in mapping the pipeline, estimating its depth, determining changes in pipeline construction properties, and mapping other subsurface utilities near the main target pipeline.

- **Commercial Site, Lenoir City, TN**
  Managed and conducted a $24K geophysical investigation (Spectral Analysis of Surface Waves [SASW], electrical resistivity, and GPR) to locate and map possible voids, sinkholes, and zones of weekend soils near groundwater recovery wells at three sites totaling 0.6 acres. The project was successful in determining no sinkholes exist at the sites and that four acres likely contain weakened and/or fissured soils potentially representing precursors to sinkhole development.

- **Comprehensive Everglades Restoration Project (CERP), North Palm Beach, FL**
  Managed an $85K geophysical method feasibility study (shear-wave seismic reflection and electrical resistivity) within a residential area of North Palm Beach to identify and map lateral variations and possible voids/sinkholes in limestone and overlying formations to a depth of approximately 100 feet to provide engineering characteristics beneath planned canal and construction works. Data acquired included a total of one mile of electrical resistivity and one mile of high resolution s-wave seismic using the patented Bay MicroVibrator. The project was successful in determining that the near-surface is generally uniform and a deeper unit (~75 feet) contains significant limestone dissolution features, such as voids or sinkholes.

- **DOE – Paducah Gaseous Diffusion Plant, Paducah, KY**
  Managed and conducted a Phase I $220K geophysical investigation (P-wave and shear-wave seismic reflection, borehole velocity and natural gamma logging, and GPR) at a proposed landfill site to identify and map quaternary faults along the bedrock surface at a depth of 350 feet using the P-wave technique, acquire S-wave data to better resolve the near-surface expression of select faults to a depth of approximately 10 feet, provide detailed velocity and lithologic information in two deep boreholes, and conduct a GPR pilot test to determine the feasibility of the method for shallow fault detection. A total of 16,000 linear feet of P-wave were acquired using a P-wave Minivib source and 2,300 feet of shear-wave data were acquired using a MicroVibrator S-wave energy source. The project was successful in determining faults and fractures existing beneath the site.

- **Commercial Site, Oak Ridge, TN**
  Managed and conducted a multi-phase $11K geophysical investigation (GPR) to clear several indoor locations for possible buried pipelines and utilities within and beneath a concrete slab. The project was successful in mapping several utilities within the proposed boundaries of renovation activities.

- **Comprehensive Everglades Restoration Project (CERP), Lake Okeechobee, FL**
  Managed and conducted a $150K geophysical method feasibility study (P-wave marine seismic, shear-wave land seismic reflection, electrical resistivity, time-domain EM soundings [TDEM], and frequency-domain EM profiling [EM31]) within agricultural areas south of Lake Okeechobee to identify and map lateral variations and possible voids/sinkholes in limestone and overlying formations to a depth of approximately 50 to 60 feet that might provide conduits for surface water leakage from planned agricultural reservoirs. Data acquisition included a total of 5 miles of marine seismic reflection, 1 mile of electrical resistivity, 0.5 miles of high-resolution s-wave seismic reflection using a MicroVibrator energy source, and 16 TDEM soundings. The project was successful in determining that the subsurface if generally uniform, consisting of generally flat-lying formations, and that a few sinkholes do exist in the near surface that were backfilled during original grading work.

- **Commercial Site, Seneca, SC**
  Managed and conducted a $19K geophysical investigation (GPR) at the Duke Power Company's Oconee Nuclear to locate voids and sinkholes beneath and along the aprons of a concrete drainage ditch. The GPR survey consisted of investigating 3 separate areas for a total of 14,530 linear feet of surface coverage. The project was successful in mapping the lateral extent of a large, nearly continuous void beneath the concrete pad and identifying 19 acres along the concrete aprons where voids were likely present.

- **DOE – Paducah Gaseous Diffusion Plant, Paducah, KY**
  Managed a Phase II $110K geophysical investigation (shear-wave seismic reflection) at an

alternate proposed landfill site to identify and map quaternary faults along the bedrock surface to a depth of 100 feet using the S-wave seismic reflection technique. A secondary objective was to determine the near-surface expression of anomalies potentially caused by faults and determine if they might be quaternary in age. A total of 3,100 linear feet of S-wave data were acquired using a MicroVibrator shear-wave seismic source. Several anomalies potentially caused by faults were recommended for intrusive confirmation.

- **Lake Lanier, GA**
  Conducted a $75K marine geophysical investigation using sub-bottom profiler, side-scan sonar, and bathymetric instrumentation coupled to a RTK-GPS). The high-resolution engineering geophysical survey was conducted over a 350 acres of Lake Lanier, a USACE managed facility. The survey included acquiring approximately 180 linear miles of data to map variations in sediment thickness and depth to bedrock, and map underwater obstructions that might interfere with planned pipeline construction. The project was successful in determining that lake-bottom topography varied significantly across the site, sediments overlying bedrock were generally quite thin and uniform, and significant underwater forests occur over some portions of the site.

Senior Geophysicist/Corporate Geophysics Group Manager, IT Corporation (now Shaw Environmental), Knoxville, TN

Responsible for managing the technical, budgetary, and scheduling aspects of environmental and engineering geophysical site assessments. This included planning, organizing, implementing, and managing the corporate geophysics staff and subcontractors in support of RCRA, CERCLA, and commercial projects. Much of the work was conducted under various USACE Total Environmental Restoration Contracts (TERC). The work included geophysical survey design, field data acquisition, and data processing/interpretation for investigations conducted at DOD sites located in 23 States and U.S. Territories; DOE sites located in 8 States; Commercial sites in 11 States and Argentina. Managed and conducted geophysical surveys on the following select projects:

Engineering

- **Commercial Site, Greenville, TN**
  Managed and conducted a $13K geophysical investigation (GPR) at the Alltrista Zinc Processing Company Facility to locate voids and sinkholes beneath various types of concrete slabs. The GPR survey consisted of investigating 17 separate areas for a total of 12,100 linear feet of data. The project was successful in mapping the lateral extent of a large, known sinkhole and verifying most other suspect areas were free of voids.

- **Dynamite Site, Sisseton, SD**
  Managed and conducted a $35K geophysical investigation (EM61, magnetics, GPR, seismic vibration / blast monitoring) at the approximately 2-acre Sisseton Dynamite burial site. The project was conducted under the USACE Rapid Response contract to locate a deep pit containing 50 cases of dynamite, and provide seismic vibration "blast" monitoring during the planned detonations. Of the geophysical anomalies identified, one was determined to be the most likely location for the pit containing dynamite and selected for detonation. Visual inspections of blast craters confirmed the geophysical results. Seismic vibration "blast" monitoring was successful in determining one nearby structure could have sustained structural damage from the seismic and acoustic energy released.

- **DOE – Waste Isolation Pilot Plant (WIPP), Carlsbad, NM**
  Managed and conducted a $30K emergency response geophysical investigation (GPR) for Westinghouse Corporation to detect and map fractures within salt bedrock that might present mine safety hazards.

Near-Surface Environmental / UXO DGM

- **Great Swamp National Wildlife Refuge, NJ**
  Managed a $35K geophysical investigation (EM31, magnetics, and GPR) under the USACE, Omaha District Rapid Response Contract. The work was performed to screen a 5-acre site for buried drums in support of planned Level B remediation. The project was successful in identifying hundreds of anomalies the size of drums or larger.

- **Air Force Plant 74, West Palm Beach, FL**
  Managed a $25K geophysical investigation (EM61, magnetics, and GPR) for the USACE, Jacksonville District to map individual buried drums, landfill pits, and other buried metal items at 2 sites totaling 5 acres. The project was successful in mapping large burial areas and individual drum-sized objects throughout the site.

- **Redstone Arsenal, Huntsville, AL**
  Managed and conducted a $70K geophysical investigation (EM31, EM61, magnetics, and GPR) for the USACE, Savannah District at 5 sites totaling approximately 18 acres to map landfill pits and trenches, support UXO reconnaissance mapping, screen sites for past disposal of surface objects. The project also included providing surface and downhole drill hazard/utility clearance sampling locations.

- **Commercial Site, Wabash, IN**
  Managed and conducted a $20K geophysical

investigation (EM31, EM34, and magnetics) at the Wabash Landfill site consisting of two sites totaling approximately 17 acres. The survey involved mapping the perimeter of an existing landfill and determining if a leachate contaminant plume existed at another landfill. The project was successful in delineating the boundary of the known landfill and determining that no leachate plume existed at the other landfill.

- **Tinker AFB, Midwest City, OK**
  Managed and conducted a $150K geophysical investigation (EM31 and magnetics with GPS positing) at two sites totaling approximately 76 acres to map several landfill trenches and locate several undocumented disposal pits. The project was successful in mapping the target landfill pits/trenches and the technical approach of using GPS for geophysical station positioning was presented at the 1996 SAGEEP and published in the Proceedings.

- **Naval Air Station – San Juan, Puerto Rico**
  Managed a $75K geophysical investigation (EM, magnetics, and GPR) at the 10-acre Scrap Disposal area and the 3-acre Site 38 to map the extent of disposal activities and locate USTs and a possible tank farm, respectively. The project, conducted under a USACE, Jacksonville District contract, was successful in determining that buried debris at the Scrap Disposal area was much less than previously thought and that no tank farm existed at one of the two Site 38 areas surveyed.

- **Fort Ord, Seaside, CA**
  Developed a technical approach using geophysical techniques and data processing/analysis procedures for accurately locating and mapping UXO at sites within the jurisdiction of the USACE, Sacramento District, including Fort Ord. The project conducted under the TERC included researching and determining the most appropriate geophysical field sensors, surveying methods, and data processing techniques to use for detecting and interpreting various size UXO; Responsibilities also included developing a site-specific geophysics work plan for the Site 39 Ranges Ordnance and Explosives Program at Fort Ord.

- **Wake Island, U.S.**
  Managed and conducted a $250K geophysical (EM31, EM61, magnetics, and GPR) and GPS surveying investigation at Wake Island, a U.S. military installation in the Pacific. The project was conducted for the U.S. Navy in a known UXO environment and involved locating over 60 underground storage tanks (UST) at 45 sites and mapping approximately 35,000 linear feet of abandoned pipelines. Land surveying work was conducted at approximately 200 points across the island using a survey grade total station GPS. The geophysical surveys were successful in locating USTs at several sites and determining no USTs were present at other sites where previously they were thought to exist.

- **Agana Power Plant, Guam, U.S.**
  Managed and conducted geophysical surveys (EM, magnetics, and GPR) totaling $35K on the island of Guam for the U.S. Navy. The project was conducted in a suspected UXO environment and involved locating and mapping utilities at one site at the Agana Power Plant in support of a real-time PCB removal action and two U.S. “Big Navy” sites to map buried utilities ahead of ongoing earthwork. The project included data acquisition in a complex surface and subsurface environment, and the surveys were successful in mapping metallic and PVC pipelines at the sites.

- **Fort Sam Houston, San Antonio, TX**
  Managed and conducted a $70K geophysical investigation (EM, magnetics, resistivity, and IP) at the approximately 7-acre Pershing Firing Range. The project, conducted for the USACE Tulsa District, involved locating and delineating a landfill trench containing UXO, site screening for the presence of other burial areas, and estimating the thickness of select disposal pits and trenches. The project was successful in delineating disposal trenches and areas or buried metal, locating a leachate plume extending several hundred feet from one of the trenches, and estimating the thickness of several pits and trenches.

- **West Virginia Ordnance Works, Point Pleasant, WV**
  Managed and conducted a $20K geophysical investigation (GPR) for the USACE, Nashville District to locate and map an 8,000-foot long, 18-inch diameter clay pipeline historically used to discharge Red Water effluent to the Ohio River. The pipeline was interpreted from the GPR data to range in depth from approximately 6 to 14 feet. The pipeline was accurately mapped at depth by indirectly interpreting changes in GPR reflection properties of the pipeline backfill materials.

- **DOE – Tonopah Test Range, Tonopah, NV**
  Managed and conducted a $35K geophysical investigation (EM31 and magnetics) at three Cactus Springs sites, totaling approximately 7 acres. The project involved determining the possible presence of pits/trenches containing cloth shrouds used in animal research.

Geology/Hydrogeology

- **Fort Detrick, Fredrick, MD**
  Managed and conducted a $90K geophysical investigation (EM31, EM34, controlled source VLF-EM, electrical resistivity, SP, and magnetics) at the Area B site for the USACE, Baltimore District to locate and map an erosional contact between Cambrian and Triassic age units at an

approximate depth of 60 feet in support of siting a Dye-Trace injection well. The project was successful in mapping anomalies thought to represent the erosional contact and other features representing potential zones of enhanced bedrock solutioning.

- **DOE – Waste Isolation Pilot Plant (WIPP), Carlsbad, NM**
  Managed and conducted an $80K immediate response geophysical investigation (TDEM, EM31, EM34, and GPR) for Westinghouse Corporation to locate and map a zone of perched water at an approximate depth of 60 feet and provide utility clearance in support of a hydrological assessment at the exhaust shaft. The project was successful in mapping conductive anomalies thought to represent perched water and providing utility clearance for planned exploratory boreholes. Drilling and de-watering work confirmed the findings of the geophysical survey.

- **Tinker AFB, Midwest City, OK**
  Managed and conducted a $160K 2D seismic reflection survey across the 220-acre southwestern quadrant site to identify groundwater migration pathways caused by sand channels and lenses to depths ranging from 40 to 150 feet. The seismic results were used to design an extraction well field. P-wave and s-wave field tests were performed, followed by acquisition of 18,000 linear feet of 2D p-wave seismic reflection data along eight survey lines using a hammer/plate source, collecting vertical seismic profiles (VSP) from two monitoring wells, generating synthetic seismic sections from sonic log data, and forward seismic modeling. The results of the Tinker seismic investigation were presented at the 1998 Symposium on the Application of Geophysics to Environmental and Engineering Problems (SAGEEP) and published in the Proceedings.

- **DOE – Amchitka Island, AK**
  Managed an $80K geophysical investigation at several Amchitka Island sites to map the thickness of drilling muds in several large freshwater ponds and to the thickness of gravel deposits at two quarry sites. The work was performed in support of planned drilling mud remediation work and to estimate the volume of gravel deposits and rippability. Responsibilities included survey design, technical and cost proposal development, and data analysis of marine GPR (freshwater ponds) and seismic refraction, electrical resistivity, and EM31/EM34 data (gravel quarries). The project was successful in showing drilling and thickness varied significantly across the ponds; the gravel quarry survey was marginally successful due to significant seismic and resistivity coupling problems caused by the tundra.

- **Victorville Sanitary Landfill, CA**
  Managed a $95K 2D seismic reflection survey at this Mojave Desert site to determine whether Holocene faults were present in bedrock and overlying sediments to depths of 200 feet beneath the proposed footprint of a landfill expansion. P-wave source tests using a hammer/plate and Betsy Seisgun charges were performed, followed by acquisition of 11,000 linear feet of 2D p-wave seismic reflection data along two reconnaissance survey lines using the hammer/plate source, VSP data acquisition from two monitoring wells, and forward seismic modeling.

- **Redstone Arsenal, Huntsville, AL**
  Managed a $120K geophysical survey at Operable Unit 14 for the USACE, Savannah District using seismic refraction, dipole-dipole electrical resistivity, VLF-EM, and EM31/EM34 techniques to map depth to bedrock and to locate fractures, sinkholes, and voids in the limestone bedrock. The geophysical results were used to provide recommendations on optimal placement of extraction wells.

- **Shaw AFB, Sumter, SC**
  Managed and conducted a $30K geophysical well-logging task for the USACE, Omaha District. The project included logging 20 PVC wells to depths of over 300 feet using the natural gamma technique. The project was successful in resolving lithologic variations and the complex hydrogeological environmental beneath the site.

Project Geophysicist, IT Corporation (now Shaw Environmental), San Bernardino, CA
Responsible for managing geophysical site assessments including technical and cost proposal developments, cost tracking and scheduling, field investigations, data processing and interpretation, and report preparation. Work included planning, organizing, implementing, and supervising geophysics staff and subcontractors in support of RCRA, CERLA, and commercial projects. Investigations were conducted at several DOD sites located in California; DOE sites located in 3 states; Commercial sites in 3 states. Managed and conducted geophysical surveys on the following projects:

- **DOE – Tonopah Test Range, Tonopah, NV**
  Managed and conducted a $160K geophysical investigation at 18 sites which involved: (1) locating and delineating landfills and trenches, high-explosives burn pits, and UXO sites containing submunitions (bomblet pits) and individual UXO, and chemical residue, (2) delineating sludge pits and associated subsurface contaminant migration, (3) locating and mapping several generations of septic leachfields and their associated septic tanks and pipeline structures, (4) locating several USTs and subsurface utilities and, (5) mapping near-surface soil contamination

plumes and near-surface geology. The project, conducted using EM31, magnetics, and GPR, was successful in mapping the targeted areas and providing information for future intrusive investigation.

- **DOE - Nevada Test Site, Mercury, NV**
  Managed and conducted an $80K geophysical investigation under the DOE Nevada Engineering Services Contract to map groundwater contamination plumes centered on two decontamination effluent pond sites totaling approximately 25 acres. The surveys were conducted using the fixed transmitter/receiver (Tx/Rx) and variable Tx/Rx separation "loop-loop" EM31/EM34 instruments.

- **Commercial Site, Munday, TX**
  Managed and conducted a $30K immediate response geophysical investigation at the Texas Superfund Thompson-Hayward Chemical Company Facility. The project involved locating an alleged trench containing several drums and providing general site reconnaissance screening for buried metallic debris.

- **Barstow Marine Corps Logistics Base, Barstow, CA**
  Supervised and conducted field geophysical investigations at several Nebo and Yermo Annex sites, under the Comprehensive Long Term Environmental Action Navy (CLEAN) contract. The 2-year, $1.4 million CERCLA-driven geophysics project was conducted at approximately 20 sites and involved: (1) locating and delineating landfills, pits, and trenches containing metallic and non-metallic debris including suspected chemical dump areas, (2) conducting geophysical reconnaissance screening, (3) locating USTs and subsurface utilities, (4) mapping conductive groundwater contamination plumes and near surface geology, and (5) conducting borehole and soil vapor probe clearance.

Project Manager/Geophysicist, IT Corporation (now Shaw Environmental), San Bernardino, CA
Responsible for hydrogeological and geophysical site assessments that included managing technical and administrative aspects of landfill water-quality remedial investigations and solid waste assessment tests (SWATs) for San Bernardino County sites, and supervising report of waste discharge/environmental monitoring programs (RWDs) for several San Diego and San Bernardino County municipal landfill sites. Work also included managing geophysical investigations at DOD sites and San Bernardino County landfill sites. Project Manager on several projects including the following:

- **County of San Bernardino, CA**
  Managed and conducted a $200K remedial investigation at the Apple Valley and Lenwood-Hinkley sanitary landfills. Responsibilities included developing the technical/cost proposal, geologic mapping, acquiring and interpreting seismic refraction, gravity, and electrical resistivity data, deign and preparation of drilling specifications, construction management of 7 groundwater monitoring wells to approximately 250 feet using direct-air rotary with drive casing/dual wall reverse air rotary methods, drilling through (using a hollow stem auger) and sampling materials and vadose zone gas within the active landfill, groundwater and vadose zone gas sampling and analysis from site monitoring wells, and report preparation.

Seismic Analyst, Western Geophysical Company (now WesternGeco), CO and MT
Responsible for planning and coordinating two-dimensional seismic data processing projects in relation to exploration for oil and gas. Responsibilities included digital processing of seismic data acquired from various regions of North America, including signal analysis, geophysical and geological interpretation of stratigraphy and shallow weathering zones using refraction statics and velocity modeling techniques, and use of migration and high-dip resolution programs. Work also included multiple step parameter optimization and presentations of intermediate and final seismic sections.

Field Geologist, Earth Research Associates, CA
Responsible for conducting geologic mapping of cut-slopes associated with large-scale earthwork construction and for performing soil compaction control testing.

Field Geologist/Civil Engineering Technician, Howard Consultants, ID
Responsible for managing soil geotechnical laboratory, performing geologic and geotechnical site assessments, logging stratigraphic and physical characteristics of geothermal wells, and conducting soil compaction control testing and building construction inspection.

Professional Affiliations

- Society of Exploration Geophysicists
- Society of Exploration Geophysicists, Near-Surface Exploration Section
- Environmental and Engineering Geophysical Society (EEGS)
- American Geophysical Union (AGU) – Near-Surface Focus Group