Response to Request for Proposal

The Minnesota Pollution Control Agency and Minnesota Department of Agriculture

Professional / Technical Master Contract

Category A: Petroleum, Superfund, MDA, and Closed Landfill Program Environmental Services

April 11, 2018

Prepared by:
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April 11, 2018

Robert M. Karls
President

John R. Estes
Consultant

Jacob Knapp
Project Manager

Table of Contents

Tables

Appendices

1.0 COVER LETTER

April 11, 2018

Ms. Mary Henninger
Minnesota Pollution Control Agency
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

Subject: **The Minnesota Pollution Control Agency**
Remediation Master Contract
Category A: Petroleum, Superfund, MDA, and Closed Landfill Program Environmental Services

Dear Ms. Henninger:

Antea®Group is pleased to provide the attached proposal in response to the Minnesota Pollution Control Agency (MPCA) February 28, 2018 Request for Proposal for Category A: Petroleum, Superfund, MDA, and Closed Landfill Program Environmental Services.

Antea Group is an international engineering and environmental consulting firm specializing in full-service solutions in the fields of environment, infrastructure, urban planning and water. By combining strategic thinking and multidisciplinary perspectives with technical expertise and pragmatic action, we do more than effectively solve client challenges; we deliver sustainable results for a better future. In the simplest terms, we help clients reduce their environmental footprints, mitigate safety risks, protect against engineering failures and minimize social impacts. With more than 3,000 employees in over 100 offices around the world, we serve multi-national clients ranging from global energy companies and manufactures to national governments and local municipalities.

In the United States, we are building on the strength and experience of our 25-year legacy brand Delta Consultants, incorporated in Minnesota in 1986. In 2008, Delta Consultants was acquired by Oranjewoud N.V., a Dutch publicly traded, engineering and environmental consulting firm. In 2011, Delta Consultants, along with the Belgian and French operations of Oranjewoud N.V., came together under one common brand and are now known in the marketplace as Antea Group. Since then, Antea Group has acquired a 110-person engineering and environmental consulting company in Colombia and a 32-person company in Brazil, expanding our reach into Latin America. In the Netherlands, engineering and environmental consulting services continue to be offered under the Oranjewoud name. Each of our home country operations (Belgium, Brazil, Colombia, France, Netherlands and USA) are managed by country CEO's and operate as separate profit and loss centers.

The added value Antea Group brings to the MPCA includes our experience in working with the MPCA as a multi-site State Contractor for 25 years. Our highly qualified and experienced staff of are equipped to promptly and effectively

support the MPCA and MDA with the entire scope of services for the Category A: Petroleum, Superfund, MDA, and Closed Landfill Program Environmental Services.

Mr. John Estes is the Antea Group designated MPCA proposal coordinator. As a Consultant located in our St. Paul office, Mr. Estes is usually in the office coordinating project activities and is knowledgeable of the capabilities of the technical personnel who will be working on the Contract. Consequently, it is likely that he will be reachable by one of the following forms of communication to interact with the MPCA's Contract users.

John R. Estes
Direct Phone: 651 697 5245
E-Mail: john.estes@anteagroup.com
Website: www.us.anteagroup.com/en-us

In the event Mr. Estes is unavailable or out of the office for an extended period of time, Mr. Jacob Knapp at 651.697.5253 is an alternative contact. It is Antea Group's intent to utilize 100% Minnesota local staff on this Contract, however we have the ability and flexibility to bring in expert resources from across the country should the need arise. The number and staff classifications of local personnel to be available are included in the enclosed staff matrix and accompanying resumes. In addition, Antea Group has two employees located in our St. Paul office that have current National Radon Proficiency Program training and are both Residential Measurement and Mitigation Providers.

Antea Group has reviewed the proposed Contract issued as an attachment to the RFP along with the associated Classification Levels and Rates (Schedule 1 and 2) and the Equipment and Supplies List. The terms and conditions of the Contract are acceptable. We also accept the Classification Levels and Rates and the Equipment and Supplies List used to perform services with prices.

Antea Group is not seeking veteran owned preference and as such the included Attachment I, has been marked not applicable.

If you have any questions or comments regarding the requested contract modifications, please contact Mr. Estes. We invite you to review the attached proposal and look forward to hearing from you regarding your Consultant selections.

Sincerely,

Bob Karls
President
651.639.9449
Bob.Karls@AnteaGroup.com
Antea Group

John R. Estes
Consultant
651-697-5245
john.estes@anteagroup.com
Antea Group

2.0 QUALIFICATIONS AND CAPABILITIES

2.1 Overall Company Capabilities

Antea Group is an international engineering and environmental consulting firm specializing in full-service solutions in the fields of environment, infrastructure, urban planning and water. By combining strategic thinking and multidisciplinary perspectives with technical expertise and pragmatic action, we do more than effectively solve client challenges; we deliver sustainable results for a better future. In the simplest terms, we help clients reduce their environmental footprints, mitigate safety risks, protect against engineering failures and minimize social impacts. With more than 3,000 employees in over 100 offices around the world, we serve multi-national clients across diverse industries including automotive, chemical, energy, food & beverage, government, manufacturing, pharmaceutical, technology and transportation.

In the United States, we are building on the strength and experience of our 25-year legacy brand Delta Consultants, incorporated in Minnesota in 1986. In 2008, Delta Consultants was acquired by Oranjewoud N.V., a Dutch publicly traded, engineering and environmental consulting firm. In 2011, Delta Consultants, along with the Belgian and French operations of Oranjewoud N.V., came together under one common brand and are now known in the marketplace as Antea Group. Since then, Antea Group has acquired a 450-person engineering and environmental consulting company in Colombia, expanding our reach into Latin America. In the Netherlands, engineering and environmental consulting services continue to be offered under the Oranjewoud name. Each of our home country operations (Belgium, Brazil, France, Netherlands and USA) are managed by country CEO's and operate as separate profit and loss centers.

Antea Group can offer the capabilities of trained and experienced environmental professionals who appreciate the particular needs and concerns of the State. Antea Group has over 700 employees in 42 offices across the United States who are available to assist the State with its program needs. Our staff includes environmental and chemical engineers, health and safety specialists, environmental management consultants, training and performance consultants, hydrogeologists, information management consultants, toxicologists, environmental scientists, and air specialists.

Antea Group's focus is to first understand the State's environmental problems and project goals, then develop and provide timely, cost-effective services that meet those goals. This will be accomplished through frequent and open communication with the MPCA and MDA on project issues.

Antea Group's project managers consider effective and continual communication with our clients to be a prime responsibility. Our professionals pride themselves in responding quickly and efficiently to our client's needs. Antea Group professionals listen to our clients; we ask questions, study the problem, and review several possible options before recommending a particular course of action. Antea Group keeps our clients involved in every step of a project, seeking their input and suggestions and incorporating their concerns along the way.

Antea Group endeavors to develop client relationships that give feedback and knowledge necessary to shape our organization and consulting capabilities to best help our client's reach their goals. We pride ourselves on not only having exceptional technical expertise to develop custom-tailored solutions for our clients, but also having the

sensitivity to make sure that Antea Group performs and presents work in a manner compatible with our client's culture and expectations.

Antea Group holds the safety of its clients and employees as a core value in the operation of our business. Our employees are OSHA trained and certified and we conduct routine refresher courses for our employees. Our employees have a "work safely" motto engrained into their daily tasks. Our employees have a full understanding of Antea Group's performance goals, project quality assurance and quality control procedures, and health and safety concerns. "Work safely" is not just a catch phrase at Antea Group – it is how we do business.

Antea Group specializes in providing innovative, yet practical, environmental remediation design, due diligence services, and operation and maintenance services. Antea Group is a solution-oriented company that provides safe, timely, cost-efficient, and risk-based solutions that provide successful remediation at hazardous substance and non-hazardous waste sites. The key to Antea Group's success is in the planning and skilled management of time, resources, and budget. Whether the situation dictates the need for a Phase I assessment, or a more intrusive Phase II assessment involving soil, groundwater, or air investigations, the primary goal is to provide solutions to the State's environmental problem sites. Antea Group identifies solutions by analyzing objectives and designing a remediation system to efficiently meet those needs. The State's needs involve: not only achieving the site cleanup objectives, managing the site safety concerns, and financial constraints, but also maintaining public awareness and involvement throughout the process. Time constraints, life cycle costs, availability of long- or short-term operation and maintenance resources, public image, and the State's specific final plans for use of the impacted property are all vital to the efficient solution to remediation needs.

Antea Group believes that the information provided in this response demonstrates the extent of our experience, the value of our resources, and our commitment to understanding and meeting the State's needs. Antea Group's qualifications and capabilities for providing services to the MPCA and MDA Programs are included in the following sections.

2.2 Staff Resumes and Matrix Table

The staff matrix illustrated in the attached Table 1 summarizes the personnel who will be assigned to this contract. The matrix includes staff classification, OHSA certification, years of service with Antea Group, summary of educational experience, work experience, licenses and certifications held by each employee assigned to the Contract, and the work location of each individual. Profiles of each staff member are included in Appendix A of this proposal package.

2.3 Location of the firm's headquarters, local facilities and satellite offices

Our US Facility Headquarters and the Minnesota local facility are both located at the following address:

5910 Rice Creek Parkway, Suite 100
Saint Paul, MN 55126
Phone: +1 651 693 9449
USA Toll-Free: + 800 477 7411

Fax: +1 651 639 9473
http://us.anteagroup.com/

We also have satellite offices located in Alexandria and Annandale, Minnesota.

2.4 Experience with Federal, State and Local Agencies

Antea Group, and its heritage company Delta Consultants, has experience in working with the MPCA as a multi-site State Contractor for over 20 years. We have held a number of contracts with state and local government agencies and departments including state Superfund, LUST, city redevelopment and county property services contracts. A summarized listing of state contract experience follows:

State of Minnesota Superfund and Petroleum Storage Tank Investigation and Remediation Multi Site Contract

Minnesota Pollution Control Agency and Department of Agriculture

Contact: Ms. Sarah Larsen, Mr. Tom Higgins, and Mr. Eric Pederson

Contract Duration: 2003 through present

Contract Nature:

Antea Group has been providing environmental services for the MPCA under a Multi-Site State Contact since 1988. Our experienced staff utilizes comprehensive experience with the MPCA risk-based remediation program, which includes the Hazardous Substances Remediation Programs (HSRP) which comprises Superfund, Site Assessment, RCRA Cleanup, and the VIC and the Petroleum Remediation Program (PRP).

Our MPCA consulting services include but are not limited to: project management (scope development, schedule, budget and resource management, etc.), generating Work Plans/Sample Analysis Plans, subcontractor coordination and collaboration of multiple contractors and/or stakeholders, bid solicitation, field activity oversight and sampling, communication with government officials (Federal, State and Local), investigation and remedial corrective action activities and technical report preparation.

In addition, based on our close working relationships and comprehensive services, during the Fiscal Year 2013 Antea Group has also managed projects for the Closed Landfill Program, conducted Division Wide Groundwater Policy Review and Development, provided litigation support in enforcement legal proceedings, and continues to prepare 5 year reviews for Superfund projects.

State of Minnesota Superfund – Multi Site II and III Contracts

Minnesota Pollution Control Agency – Site Response Section

Contact: Mr. Dave Douglas, Ms. Jayne Stilwell Lamb

Contract Duration: 1988 through 2003.

Contract Nature:

Focus of contract is to conduct site assessments, remedial investigations and feasibility studies, interim response actions, prepare remedial action plans, remedial action oversight, and long-term operation and maintenance

activities at sites where there has been a release or threatened release of hazardous substances, pollutants, or contaminants. Work is performed for both the MPCA and the Minnesota Department of Agriculture (MDA) at sites regulated under Minnesota Environmental Response and Liability Act (MERLA).

State of Minnesota Tank Release Investigation and Cleanup – Multi Site II and III Contracts

Minnesota Pollution Control Agency – Tank and Spills Section

Contact: Ms. Jayne Stilwell Lamb

Contract Duration: 1991 through 1998.

Contract Nature:

Level of effort contract for petroleum release sites. Most sites orphaned or disputed as to responsible party. Focus on sites with imminent threat to public health or the environment. Services provided include project management; investigation; remediation design, contracting, and installation oversight; operation and maintenance; risk analysis; responsible party designation; and legal support.

State of Minnesota Department of Transportation

Office of Environmental Services

Contact: Alyssa Boock, Hydrogeologist; Michelle Waters, Hydrogeologist

Contract Duration: 2006 through present

Contract Nature:

Antea Group has participated in MnDOT's Consultant Pre-Qualification Program since early 2006 in the Work Types for Contaminated Property Investigations. We have provided Phase I ESA, Phase II Drilling Investigation, Response Action Plan (RAP) Development and Oversight of RAP Implementation during road reconstruction. Most of these projects have involved communications and reporting to either or both of the MPCA VIC or PBP programs and concerns and contaminates include petroleum, VOCs, SVOC, PAH, PCB Pesticides and Metals across a wide spectrum of property uses. Media include soil, groundwater, air and waste. Services also include development of Health and Safety Plans, work zone and work zone perimeter monitoring for protection of workers and the public.

We were more recently approved in the Pre-Qualified Program in early 2012 in MnDOT's Work Type for the highest level of Wetland Services. This work type covers wetland inventories, delineation, and wetland permits required by the Army Corp of Engineers Standard Individual Permits.

A brief outline of the Contaminated Property projects we have performed to-date is shown below:

Antea Group Phase I, Phase II, RAP and RAP Implementation Project List to Date:

Highway 22, St Peter, MN – Phase 1 ESA

Northfield, MN – Phase I ESA / Phase II

Wolverton, MN – Phase I ESA / Phase II

State of Texas

Texas Commission on Environmental Quality (TCEQ) Drinking Water Compliance Sampling program

Contact: James LaManna, TCEQ

Contract Duration: September 1, 2013 through August 31, 2018

Contract Nature:

At the beginning of fiscal year 2005 (September 2004), the TCEQ awarded a state-wide contract to Delta (Antea Group) for the coordination and collection of over 36,000 drinking water quality samples per year on a multiple-year contract. The first contract ran from September 1, 2004 through August 31, 2008. The second contract awarded to Antea Group ran from September 1, 2008 through August 31, 2013. The third contract term is listed in the heading above. We are currently going through the competitive procurement process for the next contract, which will begin on September 1, 2018. The objective of the Drinking Water Sampling Program is to collect entry point, distribution system, and source water samples from TCEQ-selected Public Water Systems (PWS) for compliance with the Safe Drinking Water Act (SDWA). In addition, Antea Group has been responsible for assisting the TCEQ with the collection of Initial Distribution System Evaluation (IDSE) samples since 2006. From January 2008 through December 2020, Antea Group, in close coordination with the Environmental Protection Agency (EPA), Great Lakes Environmental (EPA contractor), and Texas-wide PWSs, has been collecting Unregulated Contaminant Monitoring Regulation (UCMR2, 3, and 4) samples at selected small and large PWSs across the state. Antea Group works closely with the TCEQ in the execution of the drinking water compliance sampling contract.

State of Wyoming

Department of Environmental Quality (DEQ)

Contact: Ms. Karen Halvorsen, P.E.

Contract Duration: Award through work completion

Contract Nature:

The WDEQ Storage Tank Program (STP) has elected to manage all LUST sites directly. The consulting firms (Engineer) are pre-qualified for as-needed Engineering Services through a Statement of Interest which is renewed every five years. As needed, The STP selects three firms from the prequalified list to provide a Technical Proposal/Cost Estimate for the investigation and design phases of potential single or multi-site remediation projects. The WDEQ reviews the submittals and award a contract based upon a ranking that includes the firm's unique qualifications, scope of work approach, project team organization, proposed schedule and costs. The contracts cover the subsurface investigation, remedial action plan, remedial design, preparation of plans and specifications, construction oversight, ground water monitoring, operation and maintenance, and project closeout phases. Antea Group has been providing services to the WDEQ STP since 1994, and currently has projects in Fort Bridger, Rock Springs, Evanston, Kemmerer, Green River, Lander/Hudson, Powell, Sheridan, Buffalo, Cheyenne, Laramie, Platte County, Upper Platte Valley, and Shoshoni/Lysite Wyoming.

In addition, Antea Group manages one project for the WDEQ Voluntary Clean Up Program (VCUP). The Evanston Round House Project in Evanston, Wyoming was awarded through a technical proposal and interview process in

2017. The project includes subsurface investigation, remedial action plan, remedial design, preparation of plans and specifications, construction oversight, ground water monitoring, operation and maintenance, and project closeout phases.

2.5 Knowledge of the MPCA Risk Based Site Evaluation Manual, Underground Storage Tank (UST) and Aboveground Storage Tank (AST) Release Cleanup Guidance and Fact Sheets, Voluntary Investigation and Cleanup (VIC), MERLA, CERCLA, RCRA and NOHSCP and Pertinent State and Federal Regulations

PETROLEUM

Antea Group, formerly known as Delta Consultants, was incorporated in Minnesota in 1986. Since inception, we have adhered to the Minnesota Pollution Control Agency (MPCA) and State petroleum guidance requirements and submitted thousands of reports to the variously-named MPCA petroleum programs utilizing MPCA published report templates. We also understand all applicable definitions stated in Minnesota Statutes § 115C.01 – 115C.13 as well as other statutory regulations that govern the development of the Petroleum Remediation Program. Our extensive variety of clients in which petroleum investigations are performed include the MPCA fund-financed sites, responsible parties and volunteers for petroleum-impacted properties, current or prior property owners, current or past storage tank owners or operators and local or state governments.

We value the MPCA Petroleum Remediation Program (PRP) mission to investigate petroleum releases and to evaluate and remove risks to human health and the environment resulting from those releases. We recognize the PRP priorities of prompt investigation, cleanup, and closure of petroleum tank release sites. Antea Group ensures the investigations, cleanups, and closures are completed in a timely manner without compromising the MPCA mandate to protect human health and the environment.

Antea Group shares the PRP objective in all of our work conducted in the State of Minnesota to ensure clean drinking water supplies, prevention of exposure from petroleum vapors, addressing surface water petroleum impacts, and prevention of dermal contact with contaminated soil. We attempt this by eliminating pathways linking contaminant sources to receptors.

We utilize site management decisions based on existing land use. Where risks to receptors are high, we understand the program works to make the risk low. Where risks to receptors are low, or where a high-risk plume is converted to a low-risk plume (by eliminating pathways linking contaminant sources to receptors), we recognize the program relies on natural attenuation for long-term risk reduction.

The robust MPCA PRP Guidance Documents (GD) provide a structure in which we conduct all petroleum investigative and remedial work in the State. Report submittals are documented utilizing the format of scope-specific activities (example: PRP GD 4-06 Investigation Report Form). In addition, as directed by MPCA Project Managers, PRP Corrective Action GD's are utilized for other State Programs such as Superfund, Brownfields and VIC. We implement risk-based approaches to petroleum-related investigations and corrective action according to risks targeted by the PRP and in accordance with all current PRP GD's.

MERLA

Antea Group understands that the Minnesota State Superfund Program, governed by the Minnesota Environmental Response and Liability Act (MERLA) and the supplementary rules, and the federal superfund program, governed by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) and the federal regulations in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) work together to clean up various types of sites. We have worked extensively in Risk-Based Site Evaluation (RBSE) regulatory programs across the country and are very familiar with the tiered approach to evaluating risk to human health and the environment at sites impacted by hazardous substances.

Working together with the MPCA Superfund and Voluntary Investigation Cleanup (VIC) Programs, we utilize the RBSE tiered process for evaluation of risks to human health and the environment. Exposure pathways to receptors are evaluated separately in the tiered evaluation process, which allows for identification of salient risks via a certain pathway, and elimination of other pathways. Sediment, soil leaching to groundwater, ambient air, groundwater, surface water, and the food chain are exposure pathways recognized and measured in the RBSE process.

Antea Group has worked within MPCA's RBSE system since the program was initiated in the 1990s. We have steered dozens of sites, large and small, through the RBSE process. Antea Group understands the strength of the program centered in the elements of site specificity, clear identification of risk and receptors, defined cleanup goals, and the availability of institutional controls to achieve realistic closure criteria.

We have experience working with each of the two integrated MPCA Brownfield Programs: the Petroleum Brownfields Program under the Petroleum Tank Release Cleanup Act (Minn. Stat. § 115C) and the Voluntary Investigation and Cleanup (VIC) Program under Minnesota's Environmental Response and Liability Act (Minn. Stat. § 115B).

Due to our extensive experience working in the Brownfields and VIC Programs we are familiar with the Land Recycling Act of 1992 to assist with determination of future liability protection when investigation or cleanup actions are voluntarily undertaken. We understand the importance of evaluating existing environmental conditions and development of strategies for brownfields site cleanup that are protective of public health and the environment, economically viable and reflective of the community.

Site investigation and risk evaluation activities on Petroleum Brownfields projects are conducted in accordance with the PRP Guidance Document 1-01 and other applicable PRP guidance documents. The RBSE tiered process for evaluation of risks to human health and the environment and associated reporting is conducted for VIC projects.

The RBSE Manual provides a structure in which we conduct all investigative and remedial work in the State under the Superfund and VIC Programs. The RBSE Manual, and associated individual documents, is utilized to assist in the process of site characterization, community involvement, evaluating the risk to human health and the environment posed at a site, and how to address that risk. In addition, as directed by MPCA Project Managers, PRP Corrective Action Guidance Documents are utilized for certain MERLA State Programs such as Superfund, Brownfields and VIC.

In Minnesota soil and or groundwater cleanup under RCRA Corrective Action is conducted by the Site Remediation Division. Antea Group has demonstrated experience in the two types of sites that are subject to RCRA Corrective

Action (hazardous waste treatment, storage, or disposal facilities and interim status hazardous waste treatment, storage, or disposal facilities). We understand that investigation and cleanup under Minnesota's RCRA Corrective Action Program is required to be consistent with the MPCA RBSE Process.

Minnesota Department of Agriculture's AgVIC program is funded through MERLA and is designed to provide rapid response and specific expertise for voluntary actions, including property transfers. The program is specific to the site, and needs of the voluntary party and is the MDA counterpart to MPCA's VIC program. Partial reimbursement of incurred costs through the Agricultural Chemical Response and Liability Act (ACRRA) is an attractive element of this program.

Agricultural chemical contamination sites not entered into the voluntary program are addressed by the MDA incident program which uses a risked-based approach to determining cleanup requirements. As with the MPCA program, potential contamination pathways and receptors are assessed on a site-specific basis. Cleanup goals are determined by the *potential* threat of contamination at a particular site and given the nature of the COCs, releases can be remediated via passive degradation, assuming there are no threats to potential receptors. MDA prioritizes ag-chem release sites both quantitatively and qualitatively, an approach to remediation that is consistent with the environment and the culture of the agricultural community. EPA's Hazard Ranking System (HRS) Preliminary Assessment (PA) Scoresheet provides a systematic, but general risk measurement tool for assessing risk for particular exposure pathways. The qualitative approach is implemented by MDA staff which considers other factors such as quantity of products used at the site, period of operations, extent and magnitude of contamination, and the amount and quality of data.

Antea Group is familiar with the MDA published Incident Response Unit Guidance Documents GD-1 through GD-29 which provide a robust framework for the sequential approach for conducting investigations and cleanups associated with agricultural chemicals. Report submittals are documented utilizing the format of scope-specific activities (example: GD-15 Corrective Action Report).

2.6 Describe Two Remedial Investigations Conducted by the Proposer

RI Example 1:

Project Name: Leak 17590 – Holiday Stationstore #29
Client: Holiday Stationstores, LLC
Client Contact: Ms. Camie Pederson
952-830-8899

Site Description:

Project Name & Location:	Leak 17590 – Holiday Stationstore #29 320 3rd Avenue East Alexandria, Minnesota

Client Contact:	Camie Pederson Environmental Manager Holiday Stationstores, LLC Contact: 952-830-8899
Brief Site Description:	The site is an active petroleum retail service station. Leak No. 17590, the current release, was opened in May 2009 after a vehicle hit a dispenser island and ruptured a gasoline supply line. A prior release, Leak No. 2192 was opened in December 1989 with the discovery of contaminated soil during the excavation and replacement of the USTs at the Site. Approximately 500 cubic yards of contaminated soil were excavated, and treated by landfarming off-site. Closure was received on December 20, 1990. An initial Limited Site Investigation was performed in 2009, with the advancement of five soil borings. A revised Limited Site Investigation was performed in 2011, with the advancement of three additional soil borings. An additional six soil borings, including one drilled into the regional drinking water aquifer, were advanced as part of this 2015-2016 Remedial Investigation, and were converted to groundwater monitoring wells. The groundwater samples collected at the site indicate that only MW-2, located in the source area, has exceedances of BTEX and 1,2-DCA. The investigation at a leak site across the street indicated decreasing detections of 1,2-DCA to the northeast in the right-of-way in the shallow aquifer. Two deep wells are planned to be installed to the northeast to determine the extent of 1,2-DCA.
Tasks that were subcontracted out	Subcontracted tasks included: advancement of push probes, installation of monitoring wells, and soil and groundwater laboratory analyses.
Outcome achieved	The site is in the process of gaining off-site access to install additional deep downgradient monitoring wells to delineate the extent of 1,2-DCA to the northeast of the site.
Personnel who performed each task	▪ Project management: Chris Tufts ▪ Field activities: Molly Partridge, Jarrod Cicha, Jacy Christenson ▪ Data evaluation and report preparation: Chris Tufts, Molly Partridge

RI Example 2:

Project Name: Leak 18101 – Holiday Stationstore #369
Client: Holiday Stationstores, LLC
Client Contact: Ms. Camie Pederson
952-830-8899

Site Description:

Project Name & Location:	Leak 18101 – Holiday Stationstore #369 7472 Excelsior Road Baxter, Minnesota
Client Contact:	Camie Pederson Environmental Manager Holiday Stationstores, LLC Contact: 952-830-8899
Brief Site Description:	The site is an active petroleum retail service station. A release was discovered in July 2010 when the automatic tank gauging system indicated a line failure in the gasoline system beneath a product dispenser. An unknown amount of gasoline was released prior to repairs to the system by a petroleum service company. Antea Group was retained by the responsible party to provide environmental services associated with the release. A remedial investigation was performed at the site, which included the installation of several monitoring wells. A small amount of free product was observed in the source area monitoring well, and a sheen was observed on the bank of the drainage ditch located in the right-of-way due east of the site. A focused investigation was performed in 2015. A total of 42 Laser Induced Fluorescence (LIF) borings were advanced at the site to delineate the extent of LNAPL at the site. The LIF data depicted an area of smear zone thickness of up to approximately 7 feet, and an average thickness of 5.2 feet, with the UST area as the plume center. The cross sections of the site indicated that the smear zone generally aligned with the historic minimum and maximum depth to groundwater at the site. Based on the results of the focused investigation and a subsequent review of corrective action options in the conceptual corrective action design (CCAD) report, a pilot test of *in-situ chemical oxidation* (ISCO) was recommended. The product chosen for the pilot

	test was PetroCleanze™. The ISCO pilot test was conducted in May 2017. The results of the post-ISCO groundwater monitoring showed favorable results, and a full-scale ISCO injection was recommended for the site.
Tasks that were subcontracted out	Subcontracted tasks included: advancement of push probes, installation of monitoring wells, soil and groundwater laboratory analyses, and ISCO injection work.
Outcome achieved	Antea Group recommended the performance of a full-scale injection of PetroCleanze™ at the site. It is anticipated that a Remediation System Detailed Corrective Action Design Report (SDCAD) will be prepared in the near future to design the full-scale injection work, which will likely take place Fall 2018 or Spring 2019.
Personnel who performed each task	▪ Project management: Chris Tufts ▪ Field activities: Molly Partridge, Jarrod Cicha, Layne Kortbein, Jacy Christenson ▪ Data evaluation and report preparation: Jack Sheldon, Chris Tufts, Molly Partridge

3.0 SCOPE OF SERVICES

3.1 Prepare Engineering Evaluation Costs Analysis (EECA)

Engineering Evaluation Costs Analyses (EECA) have been prepared by Antea Group at many sites to evaluate remedial alternatives (RA), evaluate engineering options, and provide a cost analysis for a project situation that requires corrective action. Antea Group has performed EECAs at sites with many different contaminant challenges: including petroleum hydrocarbons, metals, and chlorinated solvents. The EECAs have been developed to identify relevant and appropriate RAs and provide a general evaluation of each alternative including effectiveness, feasibility of implementation, advantages and disadvantages, and approximate total cost.

Antea Group has many licensed professional engineers with many years of experience in these fields that perform this work. Criteria utilized for the evaluation of RA include: effectiveness, implementability, and total estimated durational cost. The estimated capital, annual operation and maintenance, monitoring, and/or future costs can be expressed as present values. Present value costs account for annual inflation and depreciation rates and are typically evaluated assuming a five percent discount rate. A summary of the advantages and disadvantages of each RA are presented also.

The process that Antea Group utilizes for EECAs is to develop a life-cycle cost estimate of all project costs that will be incurred during design and implementation of a final corrective action, including costs for any ongoing interim corrective action, complementary corrective actions, site investigation, and site monitoring. Cost estimates are based on the most likely costs for each corrective action being evaluated using present-day costs or present value costs. Antea Group's assumptions are outlined to support the estimates for each corrective action alternative. Antea

Group refines the cost estimate for the selected corrective action alternative after key milestones in the project life cycle (such as pilot testing). In order to evaluate the cost effectiveness of each alternative, Antea Group compares the life-cycle cost estimates while considering their probability of meeting the corrective action goal within a reasonable time frame.

An example of using EECAs to determine the best approach for a site is the evaluation of the different forms of excavation as a remedial alternative. Excavation of impacted soils has been utilized as a remediation activity employed by Antea Group when appropriate. The process involves removing the contaminated soil, transporting it to a permitted disposal facility or treating the soil on site and returning the treated soil to the excavation. Antea Group has used excavation as a treatment technique on soils impacted with a wide variety of contaminants including petroleum hydrocarbons, chlorinated organics, metals, and agricultural chemicals. Antea Group's experience has encompassed varying depths, shoring, stockpiling, stabilization and hazardous/non-hazardous disposal issues.

Antea Group has used a variety of soil disposal and treatment techniques including:

- Excavation and soil disposal at a licensed landfill.
- Excavation and soil landfarming at a permitted landfarming facility.
- Excavation and soil treatment by biological treatment in an engineered biopile.
- Excavation and soil treatment by thermal desorption.

Each of these different excavation alternatives were subjected to an engineering evaluation and cost analysis in order to help select the most viable alternative for remediating the various sites.

Example: **Class 1 Railroad Rail Yard**
Des Moines, IA

Contamination: Soil and groundwater on the Site are impacted with diesel fuel. The maximum concentration of diesel found at the Site was 31,000 mg/kg, which exceeds the Iowa Soil Standard of 3,800 milligrams per kilogram (mg/kg)

Alternatives Reviewed:

- Soil Excavation with Various Disposal/Remediation Alternatives:
  - Landfill disposal;
  - On-site thermal desorption;
  - On-site treatment with Fenton's Reagent;
  - Limited excavation with land use controls
- LNAPL Source Area Excavation in Conjunction with:
  - Monitored Natural Attenuation;
  - Injection of catalyzed persulfate;
  - Air Sparge/Soil Vapor Extraction;

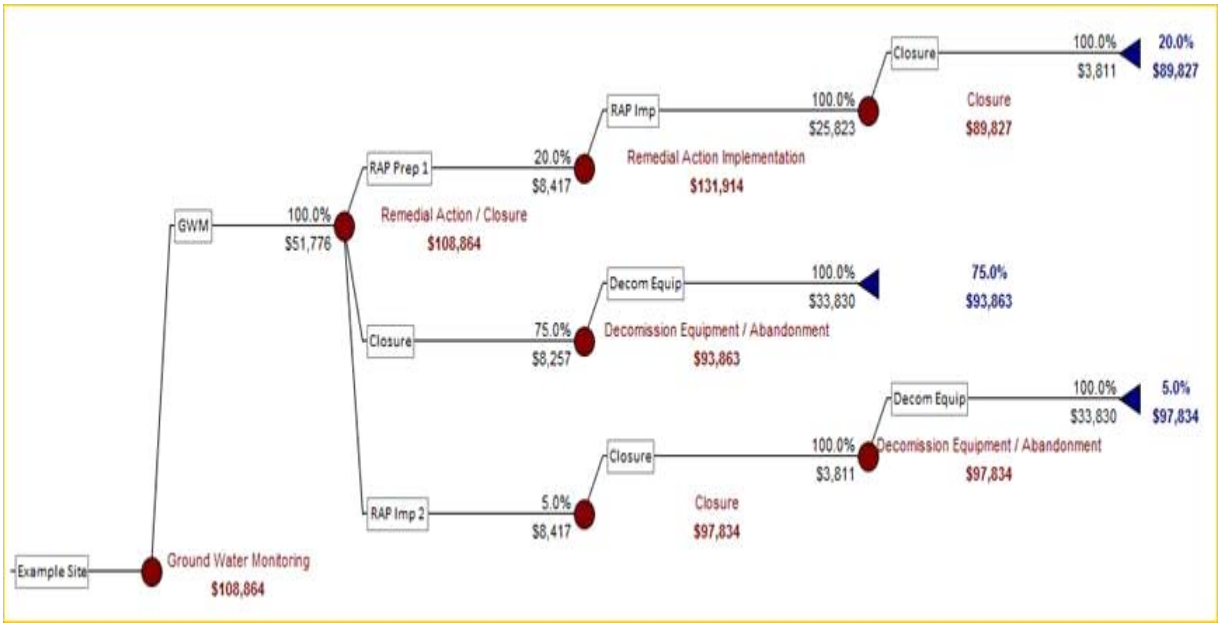
- LNAPL Source Area Dual-Phase Extraction in Conjunction with:
  - Air Sparge/Soil Vapor Extraction;
  - Full-Scale Steam Injection.

Several other technologies were considered for application at the site, but were not deemed appropriate for varying reasons. The most cost effective option that met the technical requirements of the project was chosen (Limited excavation with land use controls) and successfully implemented.

Antea Group has specialized experience in addressing uncertainty around environmental reserves through cost modeling, decision analysis and stakeholder communication to help evaluate risks, enhance efficiencies in the decision-making process, and put numbers to hard-to-quantify business drivers.

Antea Group works with our clients to model potential choices for uncertain situations through a decision analysis combined with Monte Carlo simulation and other innovative tools. Our process is fit for purpose: it starts with identifying those uncertain variables, assigning value ranges to those variables and using scenario planning to help understand the available options and finally validating the process with industry experts. The process leads to focusing decisions and quantifying uncertainties with output as a communication tool for your teams and leadership.

Unlike linear cost estimation, we use a well-defined and proven probabilistic modeling process that incorporates both scope and cost variability into a decision tree framework, letting you visually map out complex, multi-layered decisions in a sequential and organized manner. We follow current Best Practices set by ASTM E2137 for Estimating Monetary Costs and Liabilities for Environmental Matters.



Antea Group has specialized experience in addressing uncertainty around environmental reserves through cost modeling, decision analysis and stakeholder communication to help you evaluate risks, enhance efficiencies in the decision-making process, and put numbers to hard-to-quantify site management decisions.

Antea Group will work with you to model potential choices for uncertain situations through a decision analysis combined with Monte Carlo simulation and other innovative tools. Our process is fit for your purpose: it starts with identifying those uncertain variables, assigning value ranges to those variables and using scenario planning to help understand the available options and finally validating the process with industry experts. The process leads to focusing decisions and quantifying uncertainties with output as a communication tool for your teams and leadership. Our cost modeling services can be applied to many scenarios including portfolio optimization and remediation planning.

3.2 Oversee or conduct pilot testing of remediation systems

Antea Group has extensive experience designing and overseeing pilot testing of remediation systems in the US and abroad. Once a technology is selected for testing, Antea Group works to select an area on the site to complete the test. The objectives of all pilot tests are to demonstrate the efficacy of the respective technology under field conditions (technical feasibility), that all aspects of the technology is scalable to a full scale corrective action at the site (both from a technical and economic perspective), develop design information, and reduce contaminant mass in the test area to the extent practical during the test. The pilot test is also completed to test equipment; understand injection rates, pressures, flows, duration, and radius of influence; develop amendment mixing protocols as needed, and develop a monitoring program for the selected technology.

For pilot testing activities conducted in Minnesota, a Pilot Test Work Plan utilizing MPCA PRP GD 7-05 is submitted to propose a pilot test for a remediation system or other in situ remediation technology for approval prior to implementation. Upon completion of a pilot test, documentation of the results are submitted utilizing the Pilot Test Report form provided by MPCA PRP GD 7-06.

Antea Group sets site specific pilot test objectives with respect to technical feasibility that are based on the general overall remediation pilot test objectives that are outlined in the MPCA GD's. First, does the technology correctly address the site specific target zone identified within the CCAD? Second, will the piloted technology be able to achieve the intended subsurface response across the target zone? Third, can the technology handle and, if necessary, treat recovered wastes to meet any disposal, emission, or discharge limitations and full-scale system efficiency goals?

One of the important factors that Antea Group documents in the Pilot Test Work Plan is to define the criteria that will be used to determine if the pilot test is successful. If more than one technology is to be tested, criteria is defined for each. Criteria used to judge the success of the pilot test can be both detailed site specific criteria (i.e. was the radius of influence greater than a defined distance) and more of a general nature (were all emissions captured). Feasible technologies need to demonstrate during the pilot test the ability to influence the target zone. In addition, if waste generation will occur during the full scale implementation, the data collected during the test must indicate both the technical and economic feasibility of waste treatment.

Antea Groups pilot test methods utilize the processes outlined in the MPCA GD's.

- The pilot test is completed in three sequential steps: preparing the *Pilot Test Work Plan*, completing the test, and reporting the results in Guidance Document 7-06 *Pilot Test Report*.
- Evaluate major technological assumptions identified in the CCAD during the pilot test.
- Conduct the pilot test with equipment and in a configuration and location consistent with that envisioned for the full-scale system.
- Pilot testing is usually conducted over three distinct periods: pre-system operation, system operation, and post-system operation, referred to as baseline, system operation, and rebound, respectively. Baseline and rebound monitoring are used to evaluate the extent and magnitude of changes due to controlled and documented operation of the system versus changes due to natural or other background conditions.

If a combination of technologies is intended to be tested or characteristics across a site differ, pilot testing may occur in stages. Each stage is tested independently to address the differences. Oftentimes, AS/SVE tests are done in stages to determine the parameters associated with each technology and both technologies operating simultaneously. Stages differ from steps in that a step consists of adjusting a parameter or variable such as induced vacuum on an SVE pilot test. Typically, three steps will be conducted to get a range of results for a given variable. Steps are often used to precisely define parameters needed for equipment selection (such as pumps or blowers). Stages and steps of pilot tests are run until the data collected stabilizes.

During the evaluation of a pilot test, the technical feasibility of a technology is confirmed against the assumptions used to complete the CCAD. If the technology does not demonstrate feasibility during the pilot test for whatever reason, the alternative corrective actions that were previously considered are re-evaluated.

If pilot test data demonstrate technical feasibility, the data are used to verify or update the assumptions used for the conceptual design presented in the CCAD. Pilot test data is used to design the full-scale system parameters, waste treatment/disposal, and equipment. Another important aspect of the pilot test results is that the operational strategy and duration needed to achieve the measurable performance objectives and remediation endpoints is adjusted.

Example 1: **WR Grace, Sao Paulo, Brazil**

July 2012 – Present

Antea Group oversaw the completion of a Pilot Test of *In situ* Chemical Reduction (ISCR) using the specialized amendment EHC® (FMC Environmental Solutions – formerly Adventus) during a 180 day period. ISCR was identified in the Remedial Investigation/Focused Feasibility Study (RI/FFS) as the preferred technology to address the source area at the property. Following a baseline sampling event consisting of soil and groundwater chlorinated volatile organic compounds (CVOC) analysis, measurement of field parameters, and geochemical analysis, 4,000 kg of EHC® amendment was mixed with water to form a 30% wt/wt slurry. The slurry was injected in equal portions to eight

direct push points spaced approximately 8-feet apart in an approximately 540-feet^2 test area incorporating three source area monitoring wells. Direct push injection was supplemented with pneumatic fracturing at several locations to improve distribution of the amendment. Soil core samples were obtained at various distances from the injection points and were visually inspected and tested with a magnet to show the distribution of the iron component of the EHC® amendment and to evaluate the radius of influence of the amendment.

Three post-injection monitoring events were conducted at 45, 90, and 180 days. Field parameters were measured and groundwater samples were collected and analyzed for CVOC's and geochemical parameters. Soil samples were collected and analyzed for CVOCs.

Data from the three monitoring wells demonstrated changes indicative of chemical reduction and biological reductive dechlorination. Total iron and total organic carbon (TOC) were observed to increase at each monitoring location and were generally sustained through the test period. Ethene/ethane was also observed, which are the ultimate by-products of chemical reduction and biological reductive dechlorination. CVOC concentrations decreased at two monitoring wells, while increases were observed at the other location due to groundwater elevation fluctuation into pockets of higher CVOC mass and from influence of upgradient groundwater moving into the pilot test area.

Overall, the pilot test demonstrated the efficacy of the amendment as a remediation technology that is viable for full-scale application. The test provided information on mixing and injection protocols for the amendment, injection point spacing, and loading of the amendment. Results showed EHC® remains a good option for a full scale application in the lower portion of the aquifer, however; due to high concentrations of CVOC observed in the upper horizon, other options such as excavation, soil mixing and chemical oxidant along with EHC® will be taken in consideration for this specific zone. Supplementary investigation is warranted and will aid in technology selection for the upper portion of the aquifer.

Example 2 (petroleum): Former Arco Service Station #5318
Las Vegas, NV
January 2012 – Present

Antea Group completed the first application of a sodium persulfate based technology in the state of Nevada. A source area associated with the UST basin at the site was the target area for a pilot test. The initial goal of the pilot test was to simply evaluate the chemical and physical effects of injecting a chemical oxidizer into the groundwater but a second goal was to develop a reasonable methodology to physically penetrate the underlying solid caliche layers to perform the injection work.

After several failed drilling attempts, a methodology was developed that consisted of drilling each injection point with an 8.25-inch hollow stem auger (CME 85 rig) and then setting the injection tooling into each location using the same methodology as if setting a monitoring well. Each injection location boring was advanced to the injection zone, 30 to 40 feet below grade, the injection tool was placed in the boring and backfilled with silica sand surrounding the injection point and then hydrated bentonite sealed the boring to the surface. A total of 2,325 gallons of 12% slurry consisting of 2,385 lbs. of Klozur® CR was injected into the eleven injection points around the UST area in proximity

to two monitoring wells. Klozur® CR is a 50/50 mixture of sodium persulfate and calcium peroxide prepared as a slurry with water. Klozur® CR has a tri-oxidation mechanism where it directly oxidizes contaminants through an alkaline activated persulfate, but also releases sulfate for anaerobic biological oxidation, and oxygen for aerobic biological oxidation of contaminants. Effects are both short and long term. The slurry was injected beneath the caliche layer into relatively low impacted sand, silt sediments.

Key responses to the Klozur® CR pilot test injections included:

- DO levels at the monitoring locations dramatically increased from baseline to the 30-day post-injection and were sustained through the 90-day monitoring period.
- The sulfate data showed a dramatic spike at the 30-day post-injection sampling to 13,000 mg/L (sulfate) indicating persulfate decomposition which provides an abundant source of sulfate for anaerobic biodegradation and remained elevated for 90 days.
- Field measured pH levels increased from 6.7 to above 12.0, thus proving alkaline activation of the persulfate and presence of the calcium peroxide component of the injectate, which releases oxygen.
- Redox measurements rose from approximately -300 to > +100 mv levels at both monitoring locations.
- Specific conductivity from approximately 3 ms/cm to >20 ms/cm, which indicates additional validation of the distribution of the injectate.
- Temperature elevations of 3-5 °C were observed at the 90 days post-injection monitoring event, a possible result from the impact of calcium peroxide encountering contaminant mass and/or natural organic material.
- Dissolved sodium rose to 6,300 mg/L indicating persulfate decomposition to form powerful sulfate radicals. The sodium becomes diluted and some binds with the soil matrix, so it only remains temporarily elevated.

Significant decreases in benzene were observed; other constituents rose, but may be further effected as the full range of treatment runs its course.

3.3 Operate and maintain remediation systems

Antea Group has effectively operated, maintained, and monitored hundreds of soil and groundwater remediation systems in Minnesota and throughout the United States. Operation and maintenance (O&M) for this purpose refers to the routine inspection and operation of an operating soil and or groundwater remediation system. Some of the remediation system technologies that Antea Group has provided O&M services for are as follows:

- Ground Water Extraction
- Soil Vapor Extraction
- Multi-Phase and High-Vacuum Extraction
- Active and Passive Product Recovery
- Bioventing
- Biosparging
- Air Sparging

- Vapor Phase Treatment
- Liquid Phase Treatment
- Steam Injection/Thermal Remediation
- Ozone Injection
- Sub-Slab Depressurization

Typical remediation system O&M tasks performed:

- Perform maintenance actives as prescribed by equipment manufacturers and the design engineer in the O&M manual
- Clean system components as required
- Collect all required system and site data
- Track system performance and evaluate against the project closure goals
- Determine operational efficiency and make necessary system operational adjustments as to optimize performance and efficiency.
- Monitor and reevaluate site conditions and suitability of the selected technology on an ongoing basis
- All other required O&M activities and site-specific requirements

It is Antea Group's philosophy that the properly operating remediation system should experience minimal down time, be operated effectively, and achieve the project closure goals as timely and efficiently as possible.

3.4 Prepare corrective action design documents (e.g., CAD design reports, pilot test reports, installation notification reports, monitoring reports, plans, and as-built reports)

Antea Group prepares all reports for submittal to the MPCA in accordance with MPCA Guidance Documents, particularly the corrective action Guidance Documents 7-01 through 7-10. Antea Group has conducted over 2,500 corrective actions, including the preparation and evaluation of corrective action design documents including CAD design reports, pilot test reports, installation notification reports, monitoring reports, plans and as-built reports for more than 500 remedial systems on both Superfund and petroleum sites. Antea Group has prepared and evaluated corrective action design documents on over 150 systems in Minnesota. Antea Group's St. Paul office and Iowa office specialize in corrective action design and remediation systems and have a wealth of remediation technology experience. That experience is leveraged throughout the country and abroad and we are frequently called upon by our sister divisions and Inogen partners for support.

Antea Group also utilizes our internal Engineering Assurance Process (EAP) for every site that proceeds past a site assessment phase. The EAP requires that the project team include a registered engineer and geologist to review relevant plans and reports as well as the project objectives, schedule and projected costs. The technical reviewers are usually not part of the project team to allow for an unbiased review of the project plan. The EAP requires that the project team technical reviewers sign off on their review and approval to proceed to the next phase of the project. This Antea Group process provides assurance that the appropriate level of technical expertise is provided

to each of our projects, this includes the regulatory required registered professional's participation on the project. These assurances allow us to effectively manage the risks at these sites for our clients and ourselves.

The contaminants of concern at these corrective action sites included petroleum hydrocarbons, chlorinated solvents, pesticides, herbicides, fertilizers, landfill leachate, heavy metals, wood treatment chemicals, mineral spirits, perchlorate, and sodium chlorate. These projects have ranged in size from small systems with a skimmer pump in one well to large multi-acre sites utilizing the following corrective actions:

- Air sparging (AS)
- Soil vapor extraction (SVE)
- Vacuum Enhanced Total Fluids Extraction
- Excavation
- Pump and treat
- Steam injection
- Dual phase extraction
- Enhanced fluid recovery
- Reactive barriers
- Chemical oxidation
- Bioremediation
- Chemical reduction
- Surfactant flushing
- Phytoremediation
- Monitored Natural Attenuation

Antea Group has prepared numerous corrective action designs that address remediation of soil, groundwater, and free phase product. Using the MPCA CAD approval process flow chart (MPCA PRP GD 7-01), a determination is made for the need of interim corrective action. If needed and following site investigation a final corrective action decision is presented. The project team evaluates if this action is a "simple" or "complex" action. If the corrective action is "complex", a focused investigation might be needed, then pilot testing of the selected remedy is completed. If the pilot testing confirms the effectiveness of the remedy, then final corrective action design can begin.

Once a final remedy is selected, a detailed corrective action design report is prepared which includes the following (in accordance with Guidance Document 7-07a): site conceptual model update, detailed corrective action design overview, target zone identification and description, remediation and monitoring points, system equipment, process flow and system controls, process material chemistry (sampling locations), water generation handling and disposal, installation activities, operation strategy and performance objectives, operation monitoring plan, data evaluation and cost-effectiveness evaluation.

Antea Group staff, under the direct supervision of a licensed professional engineer, complete all corrective action design document preparation and reporting. Antea Group's senior remediation team has extensive experience in both traditional and innovative corrective actions. A senior engineer who is experienced in the remedy being applied reviews every CAD-related report that Antea Group produces.

Antea Group's corrective action experience includes:

Example: HB Fuller – Sorocaba, Brazil
2011 to present

Antea Group, is currently working in Brazil, to investigate and remediate two soil and groundwater plumes impacted with carbon tetrachloride and chloroform at a water based and hot melt adhesives manufacturing facility. The regulatory body in Brazil, CETESB, has requested an ongoing framework of reports that allows them to understand key aspects of the project at specific times. The types of reports that were prepared include:

- A Site Investigation report that includes methods, results shown in tables/figures, and a 3D model of the site impacts that can be further updated as remediation was implemented. Antea Group contracted with a specialized data management firm in the US to establish and update the model.
- A Health Risk Assessment Report documenting potential receptors and evaluating risk across the site using models and calculations required by CETESB in their regulations.
- Groundwater monitoring reports are prepared on a semi-annual basis and include methods used and tables/figures showing results. Over 100 on-site and off-site wells are gauged, field parameters measured, and samples collected and sent for analysis during each event.
- A report of a 180-day pilot test of in situ chemical reduction was prepared and included the description of the technology, the test plan, and test objectives. A pilot test design layout was prepared for the report and data collected at baseline, 30, 60, 90, and 180 days post-injection was tabulated and presented on figures. A discussion of the injection process and amendment mixing was included. Results of the monitoring were discussed and recommendations for a path forward were made.
- A Remedial Action Summary Report was prepared that included discussion on all site work involving soil removal by excavation and injection of chemical reductant spanning a one year period. The report also discussed civil works completed as part of site restoration. The report included waste inventories and figures/photos documenting locations and activities in each phase of work.

Antea Group has previously designed and installed remediation systems at two MPCA fund-financed sites, Clark Oil and Isanti-Schumacher. The Clark Oil site had an AS/SVE system. The Isanti-Schumacher site had a SVE system. The following MPCA corrective action design documents have been prepared for both remediation systems;

- PRP Guidance Document 7-05 Pilot Test Work Plan
- PRP Guidance Document 7-06 Pilot Test Report
- PRP Guidance Document 7-08 Remediation System Operation Monitoring (RSOM) Report
- PRP Guidance Document 7-02 Conceptual Corrective Action Design Report
- Additionally, the Air Emissions Screening Spreadsheet (7-09b) was utilized to evaluate the air discharge requirements.

These systems operated until remedial effectiveness reached asymptotic recovery levels and have since been decomissioned. Monitoring following system decommissioning determined that minimal rebound to groundwater

concentrations in the source areas and downgradient had occurred. Based on the results of operation of these systems these sites have since been closed.

3.5 Prepare Health and Safety Plans (HASPs)

The Health and Safety Plan (HASP) is a document designed to describe the hazards that may be encountered during the course of fieldwork and specifies protective equipment, work procedures, and emergency information, including emergency phone numbers and the route to the nearest hospital. Antea Group's HASP is designed to meet hazard communication requirements and employee emergency preparedness requirements for Antea Group employees performing work at a variety of commercial, industrial, and environmental work sites. Completion and use of this plan is essential for the protection of personnel working in hazardous environments. The HASP addresses site specific hazards and tasks and is consistent with the requirements of U.S. Environmental Protection Agency (EPA) Occupational Health and Safety Manual and all applicable State and federal rules and regulations as warranted.
Antea Group prepares site specific HASPs for all Antea Group projects. Fieldwork cannot begin on an Antea Group project until the HASP is written, reviewed and approved. Antea Group's Site Health and Safety Assessments and Plans program outlines the procedures and responsibilities for completing and implementing the HASP on-site. The site project manager is responsible for ensuring that the HASP is written for the site. Project managers are accountable for the approval process of all HASPs. Health and Safety Specialists support the project managers in the development of the HASP.

Antea Group's site specific HASP include, but are not limited to, the following: identification of the site safety officer (on-site Antea Group personnel responsible for reviewing the HASP with all members of the field crew, including Antea Group employees and subcontractors and any visitor(s) on-site); planned site activities and associated hazards; local emergency telephone numbers and driving directions and map to the local hospital; emergency contacts; evacuation route and meeting location; site characterization information; general facility description; regulatory contacts; waste characterization information; remediation system information, when applicable; hazard evaluation data; personal protection and monitoring equipment guidelines and; safety standard operating procedures.

Each Antea Group team member, subcontractor employee and visitor(s) must review, sign and date the HASP before they can commence work at the project site. A signature on the HASP denotes that an individual will comply with all safety procedures outlined in the plan. The HASP is kept in the field for the duration of the project and returned to the project file upon completion of field activities. The HASP is updated whenever new hazards and control practices are identified, new project team members begin working on the project, or the scope-of-work changes. At a minimum, the HASP is reviewed annually by the project manager to verify that the plan content remains appropriate for the planned activities.

As presented in the site-specific HASP, all field crew members, including Antea Group staff and subcontractors, working in the contamination zone or who may be exposed during the course of the work are required to have completed the OSHA 40-hour HAZWOPER and annual refresher training (29 CFR 1910.120), CPR training, and First Aid training.

3.6 Oversee site investigation services for soil boring advancement, and monitoring well installation using both standard drilling methods, and direct push methods

Antea Group has completed hundreds of remedial investigations for various clients in Minnesota utilizing conventional drilling methods and/or push probes. These investigations include Superfund, Resource Conservation and Recovery Act (RCRA), and petroleum sites. Antea Group has worked with the MPCA Petroleum Remediation Program, Site Assessment, Brownfields, Voluntary Investigation and Cleanup (VIC), Petroleum Brownfields Program (formerly VPIC), and Emergency Response during these investigations.

Site investigations typically utilize push probe, hollow stem auger, air/mud rotary, and rotosonic drilling methods, as appropriate, and depending on site conditions. Prior to conducting a subsurface investigation, Antea Group reviews geologic maps and local well logs to evaluate site hydrogeologic conditions. Conditions that influence drilling method selection include soil type, depth to bedrock, and the projected vertical extent of the soil and groundwater impacts. Based on the various site conditions and the project objectives, an appropriate drilling method is selected. In many situations, Antea Group utilizes both push probe and conventional drilling technologies in conjunction during the investigation phase. The push probe is typically utilized to delineate the horizontal and vertical extent of soil, soil vapor and groundwater impacts prior to installing permanent monitoring wells or permanent vapor sampling points. Utilizing this approach, monitoring wells and vapor sampling points can be optimally positioned to monitor plume migration, groundwater quality trends and soil vapor conditions, thus minimizing project costs associated with unnecessary monitoring wells or poorly placed wells and sampling points. Likewise, when drilling in bedrock, Antea Group often utilizes packer tests to identify preferential fracture flow pathways in an effort to position open hole wells optimally for efficient delineation of impacts. During subsurface investigations, Antea Group's geologists carefully log soil conditions and screen for the presence of contaminants using photoionization detectors equipped with appropriate ionization potential bulbs. Antea Group also utilizes the MPCA risk-based guidance for selecting the appropriate drilling methodology.

During investigations in southeastern Minnesota, Antea Group evaluates the potential that karst conditions may be present and conducts the investigation to appropriately address the situation. Multi-level sampling bedrock wells may need to be installed to evaluate multiple potential fracture pathways.

Antea Group is proficient utilizing direct sensing Geoprobe™ technologies: laser induced fluorescence (LIF), membrane interface probe (MIP), and soil conductivity results for completing site investigations. LIF directly senses free product in the soil and groundwater while MIP can directly sense volatile organic compounds in the soil and groundwater. Soil conductivity probes are used to measure soil conductivity for determination of soil lithology and potential preferential flow pathways.

Antea Group does not own drilling or push probe equipment, which promotes competitive bidding and provides the best service for our clients. Antea Group utilizes Minnesota Department of Health licensed well drillers for the installation of push probes, soil borings, and monitoring and recovery wells. Following installation, all wells are surveyed to a common datum to determine site coordinates and the elevation of the top of casing.

Example: Former Gasoline Station
Two Harbors, Minnesota

Antea Group utilized previously obtained data to determine appropriate locations to place monitoring wells to monitor a groundwater plume originating from two separate source areas at a former gasoline station which had been converted to a residential building. Prior to installation, each monitoring well location was investigated utilizing direct push methods for stratigraphy and sampling purposes. Monitoring wells were then installed utilizing hollow stem auger methods at each location. Following analysis of data collected during the well installation, Antea Group completed further investigation utilizing MIP technologies to define the extent of petroleum saturated soil and direct push methods to further define the extent of soil, soil vapor and groundwater impacts.

Upon completion of defining the extent and magnitude of petroleum saturated soil and dissolved phase impacts, Antea Group completed an excavation of the two separate source areas where approximately 863 tons of petroleum saturated soil was removed and transported off-site for disposal. During the excavation activities Antea Group discovered the presence of a previously unknown drain tile extending from one of the source areas to the area of a nearby wetland. The backfill of the drain tile was observed to be petroleum saturated and the drain tile and backfill was excavated to the extent feasible to the approximate edge of the wetland. Following the completion of the excavation Antea Group installed two additional monitoring wells utilizing hollow stem auger techniques to monitor the success of the excavation.

Following excavation Antea Group conducted further investigation of the drain tile within the wetland utilizing direct push methods. The results of the push probe investigation indicated that additional investigation within the wetland was not necessary and impacts were defined near the remaining drain tile. Following confirmation groundwater sampling and delineation of the drain tile area Antea Group achieved regulatory closure for this site.

This site demonstrates Antea Group's capability of utilizing push probes, traditional drilling techniques and advanced technology for investigation, remedial design and corrective action to achieve remedial goals.

Example: Crude Oil Pipe Line Leak
Tioga, North Dakota

Antea Group was contracted by an integrated oil company to provide emergency response oversight, remediation strategies and implementation oversight to a pipeline release of approximately 800,000 gallons of Bakken crude oil. The release occurred on a geographic high point resulting in oil spreading in multiple directions.

Antea Group provided immediate response to investigate the vertical and horizontal extent of crude oil impacts and develop an interim remedy. Antea Group provided initial delineation of the release area by advancing more than 125 direct push probes and installing groundwater monitoring wells using hollow stem auger. The interim remedy included installation of a network of oil collection trenches and vertical recovery points. The interim remedy provided a rapid transition from emergency response to remedial investigation and corrective action.

Antea Group developed a remedial investigation strategy employing multiple investigation techniques including: direct push probes and real-time laser induced fluorescence (LIF) evaluation to quickly provide the information required it aid in the development of the site remedial strategy. Real time site updates to the entire project team

during the LIF investigation reduced cost, number of probes advanced and provided the client with continuous updates.

The site remedy selected was remediation by excavation and onsite exsitu thermal desorption. During the excavation, several high permeability zones were encountered where oil had migrated away from the main body of impacted soil. To integrate this information into a more refined site conceptual model additional investigations were proposed. Additional investigation included rotosonic borings and passive soil gas sampling to identify discrete sand lenses where migration of crude had occurred.
Routine three-dimensional modeling and data visualization incorporating data collected from probes, LIF, sonic borings and excavation data provided an ongoing understanding of remedial progress and provide a budget planning tool for the ongoing remediation.

The comprehensive site investigation and remediation strategy development has provided the client with a comprehensive understanding of the site with respect to the extent, magnitude and transport mechanisms of the crude oil release.

The remedial treatment at the site is ongoing. Antea Group continues to work with the client, remediation contractors, regulatory agencies and property owners to reduce costs while working to restore the property to its original use.

Antea Group worked with the client and remedial contractors to reduce costs by continuous evaluation of remediation technologies, excavation methods and screening protocols.
Fate and transport modeling performed by Antea Group has also assisted in negotiation of a site-specific cleanup goals for the project.

Antea Groups rapid response provided project continuity through all phases of the project and provides a solid basis for the client's site management decision

3.7 Conduct ground water, soil, surface water, sediment, and air sampling and monitoring

PETROLEUM ENVIRONMENTAL SERVICES

Antea Group has extensive experience sampling multiple media types inclusive of groundwater, soil, surface water, sediment and air and associated ongoing monitoring as appropriate. Antea Group's field staff receives extensive training and carefully follows MPCA guidelines when collecting groundwater, soil, surface water, sediment, and air samples. Proper collection of samples is important to ensure the accuracy of the results. The following provide an overview of our various sampling qualifications.

Groundwater Sampling

Antea Group conducts groundwater sampling in accordance with MPCA Guidance Documents 4-01 and 4-05. Groundwater sample collection is often performed during push probe advancement or after monitoring wells have been installed, developed, and allowed to equilibrate with the ambient aquifer conditions. While groundwater sampling can be performed from direct-push probes, the results are not reproducible and consequently are utilized

only for screening purposes. Groundwater samples are often also collected from water supply wells to assess potential impacts to human health and to further evaluate the magnitude of impacts extending over a regional area. Based on suspected sources and site operational history, a list of contaminants of concern (COC) is identified and utilized to determine appropriate Data Quality Objectives (DQO) and preparation of a Quality Assurance Project Plan (QAPP). Once the DQO and QAPP are in place, a site sampling plan is prepared which details the sampling sequence, sample nomenclature, stabilization criteria, analytical sample requirements, quality assurance / quality control (QA/QC) sampling requirements, and chain-of-custody protocol. Antea Group then mobilizes to the site to perform the following activities: 1) measure water and product elevations; 2) purge each monitoring well a minimum of three well volumes until the groundwater is stabilized for pH, specific conductance, dissolved oxygen, oxidation-reduction potential, and temperature; and 3) collect groundwater sample(s) in appropriate laboratory grade glassware.
The MPCA guidance provides specific methods for groundwater sampling and the preference for different methods. The highest quality samples are collected by purging with a bladder pump, utilizing a flow through cell to determine when a well is stabilized and collecting a discrete sample using a clean disposable bailer. Groundwater samples are collected in the appropriate sample bottles, preserved and shipped to a prequalified laboratory for analysis. During each monitoring event, all groundwater conditions are recorded on field sampling forms. The data collected is entered into a project database for data storage and evaluated for data trends.

Groundwater samples are collected by Antea Group geologists and/or field technicians, or in some cases, by our subcontractors if it is more cost effective. Antea Group has all the necessary equipment to collect groundwater samples unless unique field conditions require the use of a subcontractor with specialized equipment. Groundwater samples are typically analyzed in the field for natural attenuation parameters and groundwater samples collected for laboratory analysis for petroleum volatile organic compounds (PVOC), gasoline range organics (GRO), and diesel range organics (DRO) and / or other specific COC, as appropriate or prescribed by MPCA guidance.

Example: **Former Retail Petroleum Facility**
Duluth, Minnesota

Antea Group has developed and implemented a groundwater sampling program for a fund-financed site located in Duluth, Minnesota. The well network consists of five groundwater monitoring wells at or near the subject site. The monitoring wells are sampled quarterly. Groundwater elevations are gauged quarterly at all monitoring wells to evaluate groundwater flow at the subject site. Water samples collected are submitted for laboratory analysis of petroleum volatile organic compounds (PVOC), by EPA Method 8260B, and GRO and DRO, each by the Wisconsin modified method.

Soil Sampling

Antea Group has conducted soil sampling activities at a wide variety of sites. Our experience includes soil sampling for various chemicals of concern. We have experience collecting soil samples from surface and subsurface samples utilizing a wide variety of compositing techniques. For subsurface sampling Antea Group has experience collecting samples using hand augers, direct-push drill rigs, hollow-stem auger rigs, sonic drilling methods, coring machines, and other sampling equipment. We have conducted soil sampling in excavations and designed detailed confirmation sampling plans. In addition, we have experience collecting samples and obtaining laboratory results for grain size

analysis, permeability, porosity, total organic carbon, and bulk density to evaluate the physical parameters of the soil and its characteristics for contaminant transport.

Antea Group staff utilizes MPCA Guidance Documents 3-01, 4-01 and 4-04 as guidance for collecting soil samples. Upon collecting a soil sample, the Antea Group geologist or field technician first records the geologic description. Then a portion of the sample is screened with a photoionization detector to collect an organic vapor reading and the results are recorded. A soil sample is collected and placed in the appropriate laboratory container and submitted to the laboratory for analysis according to MPCA Guidance Documents. During a Limited Site Investigation or initial site investigation at least three soil samples from different locations are collected for grain size analysis. Sampling equipment is cleaned and/or replaced between each sample to avoid cross contamination.

Air Sampling

Antea Group has conducted numerous Vapor Intrusion Assessments (VIA) involving indoor air, ambient air, sub-slab air and subsurface air sampling. Antea Group follows MPCA best management practices (BMP) for all VIA investigations.

Indoor and Ambient Air Sampling

Indoor air samples are generally collected using Summa® canisters (individually certified by the laboratory) with 24 hour regulators concurrently with ambient (outdoor) air samples. Summa® canisters placed in indoor spaces are generally placed with the canister intake within the breathing zone and in a central part of the room. The Summa® canisters can be analyzed for a wide variety of contaminants, but most often VOCs utilizing United States Environmental Protection Agency (EPA) Method TO-15 for compounds on the Minnesota soil gas list and total hydrocarbons (THC). Prior to collection of indoor air samples Antea Group performs a *Vapor Intrusion Interior Building Survey* following MPCA Guidance 4-01a and MPCA vapor intrusion best management practices (BMP). During the air monitoring and sampling activities, Antea Group personnel will document the following:

- Building foundation type and integrity;
- Number and location of windows, outdoor air exchangers, or other air intakes;
- Building use and population, including identification of sensitive populations, disadvantaged populations, and potential exposure pathways;
- Potential sources located within buildings which may interfere with sample integrity;
- Any requests made to building occupants to limit potential sample interference;
- Any actions taken to limit potential interference (i.e. sealing doors to attached garages, removing gasoline or paint cans from buildings),
- Potential off-site sources of contaminants, including ambient outdoor and indoor emission sources.

Air quality is also monitored when remediation systems such as a soil vapor extraction (SVE) system are discharging vapors directly into the atmosphere. Emission rates for each compound detected are calculated and compared to the significant emission rate (SER) or other applicable discharge criteria, to assure that vapor discharges are not exceeding established limits. On all its sites with air emissions, Antea Group generally collects air bag samples for laboratory analysis to monitor air quality, but may use Summa® cans depending upon site analytical requirements.

Sub-Slab Air Sampling

Sub-Slab air sampling is conducted following MPCA BMP for vapor intrusion investigations and include: Installing the appropriate number of vapor sampling ports depending on the building use and size of the building footprint; performing water dam leak tests, shut in testing to ensure sample train integrity, use of individually certified Summa® canisters, and; collection of micromanometer readings to gauge pressure differential between the indoor and sub-slab air. Shut in testing is performed by affixing valves and a gauge to the sample train following protocols in the MPCA VIA BMP. After shut in test connections are made a vacuum of approximately 30 inches of mercury is applied to the sample train and is held for five minutes to ensure that leaks in the sample train are not present.

Sub-Slab samples are submitted for laboratory analysis by EPA method TO-15 for compounds on the Minnesota soil gas list and THC. Results of sub slab samples are compared to the MPCA intrusion screening values (ISV) and/or the appropriate MPCA soil gas value based on building use (occupants) and building and/or slab condition, as appropriate.

Subsurface Air Sampling

Subsurface air sampling is conducted following MPCA Guidance Document 4-01a. The depths of the probes are determined by the proximity to buildings with basements. Soil gas probes are advanced either utilizing direct push technology or manual methods to the required depth. Each sampling point is fitted with new/unused polyethylene inert tubing and purged a minimum of three volumes via a graduated syringe. An in-line moisture trap is installed prior to obtaining each air sample. One soil vapor sample is collected from each soil vapor intrusion probe and submitted for laboratory analysis utilizing EPA method TO-15 (full scan) for compounds in the Minnesota Soil Gas List and THC. Each soil vapor sample is accompanied by a PID scan from the sampling depth.

Air samples are collected by attaching the top of inert tubing to a Summa® canister. The air samples are monitored via a vacuum gauge to evaluate the collection progress of each sample and to assure that canisters retain some vacuum at the conclusion of the sample collection. After obtaining the sample, the Summa® canister valve is closed. The inert tubing is then connected to a portable PID to record the relative volatile organic content of the sample. The PID measurement is recorded on the chain-of-custody form. Each form records the following information: project name and location, project number, shipped by, shipped to, sampling point and location, field identification number, sample depth, vacuum of the Summa® canister (start and end), date and time collected, sample type, number of containers, analysis required and the sampler's signature. Following sampling, each probe is abandoned utilizing a bentonite grout in accordance with MDH guidelines.

Where previously observed soil gas sampling laboratory analytical results indicate elevated contaminant constituents, Antea Group has installed permanent vapor sampling points either in areas surrounding the site or within the buildings in which vapor intrusion presents a risk in accordance with MPCA Guidance Document 4-01a and MPCA BMP.

Example: **Former Gasoline Station**
Two Harbors, Minnesota

Antea Group utilized previously obtained data to determine appropriate locations to place monitoring wells to monitor a groundwater plume originating from two separate source areas at a former gasoline station which had been converted to a residential building. Prior to installation each monitoring well location was investigated utilizing direct push methods for stratigraphy and sampling purposes. Monitoring wells were then installed utilizing hollow stem auger methods at each location. Following analysis of data collected during the well installation, and quarterly groundwater monitoring, Antea Group completed further investigation utilizing LIF technologies to define the extent of petroleum saturated soil and direct push methods to further define the extent of soil, soil vapor and groundwater impacts.

Antea Group also utilized direct push methods to investigate potential off-site impacts on a neighboring property. Here soil, groundwater and soil vapor samples were collected utilizing direct push methods following appropriate MPCA Guidance. Soil and groundwater samples collected indicated that petroleum impacts were not present on the neighboring property. Soil vapor samples collected indicated the presence of petroleum related compounds above regulatory action levels near a residential building on the neighboring property. In coordination with the property owner, Antea Group collected indoor air, and ambient air samples following MPCA Guidance 4-01a, *Vapor Intrusion Assessments Performed During Site Investigation*, to further evaluate the potential for a completed vapor intrusion pathway. Indoor air and ambient air samples collected did not indicate the presence of a completed vapor intrusion pathway at the neighboring property.

Vapor intrusion pathways related to the on-site residential building were also investigated utilizing sub-slab and indoor air samples. An elevated groundwater table near the on-site residential building did not allow for soil vapor probes to be advanced near the slab-on-grade building. Antea Group collected indoor air samples from locations in the on-site residential building and evaluated data collected from sub-slab and other indoor air locations by others to evaluate the potential vapor intrusion pathway. Sub-slab and indoor air samples collected and evaluated indicated that the presence of residual soil impacts remaining at the site was not affecting indoor air quality within the on-site residential building.

Surface Water Sampling

In situations where a release may discharge and/or migrate to a surface body of water, Antea Group staff will collect a surface water sample to evaluate potential impacts. Antea Group has conducted surface water sampling at a wide variety of sites. We have completed stream, wetland, lake, spring/seep, and sinkhole sampling. Our approach has been to work from downstream collecting samples upstream to minimize any disturbance of the surface water or sediments prior to collecting the sample.

Antea Group has also conducted surface water sampling in the karst area of southeastern Minnesota in seep areas and in springs.

Sediment Sampling

Sediment samples may be collected in wetlands, rivers, and lakes where releases may be impacting these water bodies. Sediment samples can be collected by hand with a hand core tool or in deeper water situations utilizing sediment samplers.

Example: Crude Oil Pipeline Release
Lockport, Illinois

Antea Group conducted a sediment sampling program and surface water sampling program at a crude oil pipeline release. The release had flowed beneath railroad tracks and into a wetland. The wetland drained into nearby river, and the regulatory agencies required that surface water samples be collected along the flow paths in the wetland. Surface water was collected daily for 60 days at fifteen locations and analyzed for Volatile Organic Compounds (VOC), Semi-volatile Organic Compounds (SVOC) and Priority Pollutant Metals. The analytical results from the surface water sampling indicate that dissolved phase petroleum constituents have migrated beyond the boundaries of the spill containment area and appear to be flowing along a pathway to the northwest. Dissolved phase petroleum constituents, including benzene, ethylbenzene, toluene and xylenes (BTEX) have been identified at surface water sampling points in decreasing concentrations along the surface water flow path.

Sediment samples were collected weekly for 2 months at fifteen locations and analyzed for VOC, SVOC and Priority Pollutant Metals. The analytical results from the sediment sampling indicated that petroleum constituents were not present in the sediment beyond the boundaries of the spill containment area.

SUPERFUND/CLOSED LANDFILL ENVIRONMENTAL SERVICES

Groundwater Sampling

Antea Group has successfully completed a wide range of groundwater sampling projects involving volatile organic compounds (VOCs), pesticides/herbicides, metals, semi-volatile organic compounds (SVOCs), inorganics, polychlorinated biphenyl's (PCBs), polynuclear aromatic hydrocarbons (PAHs), and many types of petroleum contaminants. Antea Group has experience sampling groundwater through direct-push sampling equipment, monitoring wells, domestic wells, industrial wells, and municipal wells.

Groundwater sample collection is often performed during push probe advancement or after monitoring wells have been installed, developed, and allowed to equilibrate with the ambient aquifer conditions. While groundwater sampling is performed from push probes, the results are not reproducible and consequently are used only for screening purposes. Groundwater samples are often also collected from water supply wells to assess potential impacts to human health and to further evaluate the extent of contamination extending over a regional area. Based on the suspected sources and site operational history, a list of contaminants of concern (COC) is identified and used to determine the appropriate Data Quality Objectives (DQO) and prepare a Quality Assurance Project Plan (QAPP). Once the DQO and QAPP are in place, a site sampling plan is prepared which details the sampling sequence, sample nomenclature, stabilization criteria, analytical sample requirements, QA/QC sampling requirements, and chain of custody protocol.

A typical approach to groundwater monitoring includes allowing the monitoring wells to equilibrate prior to initial groundwater sample collection. Antea Group would then mobilize to the site to perform the following activities: 1) measure water and product elevations; 2) purge each monitoring well until the groundwater is stabilized for pH, specific conductance, dissolved oxygen, oxidation-reduction potential, and temperature and; 3) collect groundwater sample(s) in appropriate laboratory grade glassware. The MPCA guidance provides specific methods for groundwater sampling and the preference for different methods. Additionally, Antea Group utilizes low flow sampling procedures

following appropriate EPA guidance where project goals require low flow sampling. Low flow stabilization data is logged electronically and transferred to the project file following each sampling event. The highest quality samples are collected by purging with a bladder pump, using a flow through cell to determine when a well is stabilized and collecting a discrete sample using a clean bailer pump. Groundwater samples are collected in the appropriate sample bottles, preserved and shipped to a pre-qualified laboratory for analysis. During each monitoring event, all groundwater conditions are recorded on field sampling forms. The data collected is entered into a project database for data storage and use in evaluating data trends.

Antea Group has extensive experience collecting groundwater samples for field or laboratory analysis for inorganic parameters for evaluation of natural attenuation of dissolved phase chlorinated solvent and petroleum plumes. Antea Group has all the necessary equipment to collect groundwater samples and perform the appropriate field analysis.

Soil Sampling

Antea Group has conducted many soil sampling activities at a wide variety of sites. Our experience includes soil sampling for VOCs, SVOCs, PAHs, metals, PCP, pesticides/herbicides, nitrate/nitrite/ammonia, DDT, PCBs, and petroleum compounds. Antea Group has experience collecting samples using a wide variety of compositing techniques. For subsurface sampling, we have experience collecting samples using hand augers, direct-push drill rigs, hollow-stem auger rigs, sonic drilling methods, coring machines, and other sampling equipment. We have conducted soil sampling in excavations and designed detailed confirmation sampling plans. In addition, Antea Group has experience collecting samples and obtaining laboratory results for grain size analysis, permeability, porosity, total organic carbon, and bulk density to evaluate the physical parameters of the soil and its characteristics for contaminant transport.

Antea Group also has experience collecting soil analytical and lithology data through direct measurement technology including membrane interphase probe (MIP) for VOC detection and laser induced fluorescence (LIF) for free phase petroleum. Both MIP and LIF technologies are advanced with electric conductivity sensors which are able to provide data to determine lithology during direct sensing investigations.

Air Sampling

Antea Group has conducted numerous Vapor Intrusion Assessments (VIA) involving indoor air sampling. Indoor air samples are generally collected using Summa® canisters with 24 hour regulators concurrently with ambient (outdoor) air samples. The Summa® canisters can be analyzed for a wide variety of contaminants, but most often for VOCs utilizing United States Environmental Protection Agency (EPA) Method TO-15. Prior to collection of indoor air samples Antea Group performs a *Vapor Intrusion Interior Building Survey* following MPCA best management practice (BMP). During the air monitoring activities, Antea Group personnel will document the following:

- Building foundation type and integrity;
- Number and location of windows, outdoor air exchangers, or other air intakes;
- Building use and population, including identification of sensitive populations, disadvantaged populations, and potential exposure pathways;

- Building heating, water heating, and air venting components
- Potential sources located within buildings which may interfere with sample integrity;
- Any requests made to building occupants to limit potential sample interference;
- Any actions taken to limit potential interference (i.e. sealing doors to attached garages, removing gasoline or paint cans from buildings),
- Potential off-site sources of contaminants, including ambient outdoor and indoor emission sources.

Air quality is also monitored when remediation systems such as a soil vapor extraction (SVE) system are discharging vapors directly into the atmosphere. Emission rates for each compound detected are calculated and compared to the significant emission rate (SER) or other applicable discharge criteria, to assure that vapor discharges are not exceeding established limits. On all its sites with air emissions, Antea Group generally collects air bag samples for laboratory analysis to monitor air quality, but may use Summa® cans depending upon site analytical requirements.

Sub-Slab Air Sampling

Sub-Slab air sampling is conducted following MPCA BMP for vapor intrusion investigations and include: Installing the appropriate number of vapor sampling ports depending on the building use and size of the building footprint; performing water dam leak tests, shut in testing to ensure sample train integrity, use of individually certified Summa® canisters, and; collection of micromanometer readings to gauge pressure differential between the indoor and sub-slab air. Shut in testing is performed by affixing valves and a gauge to the sample train following protocols in the MPCA VIA BMP. After shut in test connections are made a vacuum of approximately 30 inches of mercury is applied to the sample train and is held for five minutes to ensure that leaks in the sample train are not present.

Sub-Slab samples are submitted for laboratory analysis by EPA method TO-15 for compounds on the Minnesota soil gas list and THC. Results of sub slab samples are compared to the MPCA intrusion screening values (ISV) and/or the appropriate MPCA soil gas value based on building use (occupants) and building and/or slab condition, as appropriate.

Subsurface Air Sampling

Subsurface air sampling is conducted following MPCA Guidance Document 4-01a. The depths of the probes are determined by the proximity to buildings with basements. Soil gas probes are advanced either utilizing direct push technology or manual methods to the required depth. Each sampling point is fitted with new/unused polyethylene inert tubing and purged a minimum of three volumes via a graduated syringe. An in-line moisture trap is installed prior to obtaining each air sample. One soil vapor sample is collected from each soil vapor intrusion probe and submitted for laboratory analysis utilizing EPA method TO-15 (full scan) for compounds in the Minnesota Soil Gas List and THC. Each soil vapor sample is accompanied by a PID scan from the sampling depth.

Air samples are collected by attaching the top of inert tubing to a Summa® canister. The air samples are monitored via a vacuum gauge to evaluate the length of time to collect each sample and to assure that canisters retain vacuum after the sample collection. After obtaining the sample, the Summa® canister valve is closed. The inert tubing is then connected to a portable PID to record the relative volatile organic content of the sample. The PID measurement is

recorded on the chain-of-custody form. Each form records the following information: project name and location, project number, shipped by, shipped to, sampling point and location, field identification number, sample depth, vacuum of the Summa® canister, date and time collected, sample type, number of containers, analysis required and the sampler's signature. Following sampling, each probe is abandoned utilizing a bentonite grout in accordance with MDH guidelines.

Where previously observed soil gas sampling laboratory analytical results indicate elevated petroleum constituents, Antea Group has installed permanent vapor sampling points either in areas surrounding the site or within the buildings in which vapor intrusion presents a risk in accordance with MPCA Guidance Document 4-01a.

Example: **Former Dry Cleaning Facility**
Farmington, Minnesota

Previous investigations have identified the suspected source of the groundwater impacts as a former dry-cleaning facility located in a commercial area of the city. The contaminant of concern associated with the site is tetrachloroethene, or PCE. Groundwater monitoring has indicated a plume extending from the area of the former dry-cleaning facility through a residential area towards a small river.

Groundwater monitoring for this site is conducted utilizing low flow sampling techniques which involve minimal draw down of the water column in the well during purging and collecting stabilization parameters through a flow cell to determine when water from the formation is being removed from the well. Groundwater conditions at the site have improved to the point where Antea Group has been able to reduce the sampling schedule and to remove wells from the groundwater monitoring network.

Previously granular activated carbon (GAC) treatment systems were installed at two residences with impacted potable supply wells. Based on concentration detections below laboratory method detection limits the GAC system at one of the properties has been removed. Additional monitoring of multiple private groundwater wells where low concentrations have been present historically is also conducted. Analytical data indicates that groundwater with concentrations exceeding regulatory action levels is not being used for drinking water.

Antea Group has also conducted additional source area investigations for evaluation of a potential continuous source area. Antea Group conducted a passive soil vapor survey which deployed 23 passive soil vapor samplers to identify the relative location of the highest VOC impacts near the release site property. Passive soil gas surveys provide a qualitative analysis of subsurface conditions which compare contaminant mass absorbed by the sampler over a set time period to neighboring samplers in place over the same time period. By utilizing passive soil vapor samplers Antea Group was able to determine approximate locations of two "hot spot" areas where the most contaminant mass was observed and was able to develop an investigation strategy for these areas.

The developed investigation plan included investigation through direct sensing technology utilizing a MIP/EC to identify the vertical extent of contaminant distribution in the two "hot spot" areas. Following the MIP/EC advancement a probe was advanced to collect soil and groundwater from the interval demonstrating the highest MIP response for confirmation and evaluation of the MIP data collected. Continuous soil samples were also collected from the probe to verify lithology observed by the EC sensor. Direct sensor and soil probe data collected indicated

that any potential source remaining was limited in extent and potentially confined to below the foot print of the on-site building.

Vapor intrusion pathways related to the PCE release have also been evaluated at the on-site building. Sub-slab soil gas samples have been collected on multiple occasions indicating the presence of soil gas concentrations in excess of 33 times the vapor intrusion screening value (ISV). Follow up indoor air sampling and inspection of an air exchanger installed within the building indicated there were no VOC concentrations above the MPCA ISV within the building and that the air exchanger was functioning properly to continuously circulate air throughout the building. Additional investigation regarding vapor intrusion was conducted throughout the footprint of the groundwater plume. Sub surface investigation was conducted in city and county right-of-way (ROW) to define the extent and magnitude of the vapor plume associated with impacted groundwater downgradient of the site. Antea Group advanced 28 soil gas probes within public ROW to evaluate whether additional receptor specific investigation was needed. Upon evaluation of data collected from the soil gas probes it was determined that additional receptor specific sampling was necessary.

Antea Group completed observation of an EPA investigation of receptor specific sub-slab and indoor air sampling at approximately 23 individual properties in March 2015. EPA later followed up with sampling from an additional 11 properties in June 2015. Based on results of their sampling, EPA determined that a completed vapor intrusion pathway was not present at any of the homes within the groundwater plume footprint. Private supply well sampling and groundwater monitoring activities for this site are ongoing.

3.8 Conduct vapor/air monitoring for health and safety and air quality criteria

Prior to the start of field work, Antea Group performs a health and safety risk assessment of the project site and the work to be performed to understand what hazards workers and the general public may face during the duration of the project. Antea Group uses the information learned from the risk assessment to prepare a Site Health and Safety Plan (HASP) to outline the potential hazards and the actions to be taken to mitigate them.

Vapor/air monitoring is an important part of Antea Group's HASP as inhalation of airborne contaminants of concern (COCs) is often a primary exposure pathway for site workers. Prior to site mobilization, the project personnel evaluate the potential COC so that the proper monitoring/sampling equipment and site control measures are selected. Knowing both the potential types of contaminants and their potential concentrations are critical to understanding how to protect workers. From this, a site-specific air monitoring plan is developed within the HASP to outline the appropriate number and location of monitoring/sampling points, the types of monitoring/sampling equipment, and parameters to monitor or sample for.

Antea Group performs air quality monitoring and sampling to continuously evaluate air quality at environmental investigation and remediation sites. Air monitoring can be conducted with photoionization detectors (PIDs), organic vapor monitors, explosimeters (multi-gas meters), personal air quality monitoring devices and detector tubes, depending on the potential contaminants of concern (COCs) at the site. Air samples are collected in the field via sampling pumps or monitoring badges; samples can be collected in air bags, charcoal sampling tubes, passive badges

or Summa canisters. These samples are analyzed by a laboratory to identify specific compounds and evaluate exposure criteria.

Antea Group uses the American Conference of Governmental Industrial Hygienists ACGIH Threshold Limit Values TLVs for determining safe air quality levels and protective action levels when controls must be implemented. In the absence of ACGIH values, the most stringent applicable regulatory values are used (e.g. OSHA permissible exposure levels).

Antea Group follows the hierarchy of first trying to eliminate hazardous air conditions via engineering controls (e.g. dust suppression or ventilation). If the hazard cannot be eliminated, Antea Group implements administrative controls (e.g. site control/exclusion zones, stop work criteria) and/or uses personal protective equipment (e.g. Level C or B PPE) to protect workers from potential exposures.

Air quality is also monitored when remediation systems such as a soil vapor extraction (SVE) system are discharging vapors directly into the atmosphere. Emission rates for each compound listed are calculated and compared to the Significant Emission Rates (SER) or other applicable discharge criteria, to assure that the vapor discharges are not exceeding the established limits. On all sites with air emissions, Antea Group collects samples for laboratory analysis to monitor air quality.

3.9 Conduct and/or oversee site assessment activities (Phase I and Phase II), limited site investigations and remedial investigations

Phase I Environmental Site Assessments

Antea Group staff performs more than 100 Phase I Environmental Site Assessments (ESA) each year. Many of these are done in conjunction with large industrial sector merger and acquisition activities occurring across North America and worldwide. At a minimum, the objective of the Phase I ESA is to identify recognized environmental conditions associated with a property according to the (ASTM) International E 1527-13 *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.* A typical ATSM E 1527-13 standard scope of work would include:

- **Task 1 – Review Existing Subject Property Information**

  This task is intended to identify past property use and activities that may be relevant in identifying potential environmental risks associated with the subject properties. The records review would at a minimum include the following searches:

  - Review of available historical data which reflect property and surrounding property use which may include but are not limited to, the following items: aerial photographs, Sanborn fire insurance maps, plat maps, topographic maps and city directories.
  - Review of available, pertinent state, county, and city governmental agency records which may include, but are not limited to: fire department, municipal planning/zoning office, building department, county/local environmental health departments, tax assessor.

- Review of available, site-specific geology and hydrogeology, published regional geologic and hydrogeologic information and water well records.
- Inquiry with the EPA, the MPCA, or county departments for locations of abandoned and existing solid and hazardous waste landfills.
- Inquiry with EPA, state, and appropriate local bodies for the existence of recorded past or pending enforcement actions against the subject property, compliance status of the subject property, and spill notification reports involving the subject property.
- Review of commercially available public databases concerning permit applications or issued permits and inspection reports concerning hazardous waste activities, waste water discharges; and underground storage tank registration at the subject and surrounding properties.
- Review of facility operational records to identify materials used during operations, documentation of spills and cleanup, citations, and other pertinent forms. The site contact must provide these documents or arrange for Antea Group representatives to have access to them.

- **Task 2 – Subject Property Reconnaissance**

Prior to conducting a subject property visit, a Health and Safety Plan would be prepared. The subject property reconnaissance would include a visual survey of the accessible areas of the subject property. Adjoining land use would be surveyed from the subject property. Antea Group employee's familiar with applicable regulations and standard environmental assessment procedures would conduct the subject property reconnaissance.

The subject property reconnaissance will include the following activities:

- Interview with the current and past site employees and owner concerning historical and current uses of the subject property.
- Review of design drawings, as-built drawings, and subject property surveys (when available) for septic systems, underground storage tanks, storm drains, and drains leading to municipal sewers.
- Visual observations of the subject property for evidence of historic and present use that may contribute to environmental risks. Observe conditions that suggest a past or potential release of hazardous substances (i.e. stressed vegetation or soil staining) and note any chemical use, storage, treatment, or disposal practices occurring on site.
- Visual identification of equipment and structures that are commonly known to contain polychlorinated biphenyls (PCBs) including electrical and hydraulic equipment.
- Observation and description of current land uses on adjoining properties to assess potential environmental impacts to the subject property. A subject property location map would be included in the final report.
- Photograph current subject property activities.
- Preparation of site diagram.
- If requested Antea Group will conduct or coordinate, visual identification of potential asbestos-containing building materials, evaluate for presence of radon, sample for lead based paint, wetland delineation, evaluate regulatory compliance, evaluate site ecological resources, evaluate the site for endangered species, evaluate site indoor air quality, evaluate the site for cultural and historical resources, evaluate site health and safety practices and industrial hygiene.

- **Task 3 - Prepare Phase I ESA Report**

Following review of the existing subject property information and subject property visit, Antea Group would prepare a Phase I ESA Report. The report would contain a discussion of the subject property with associated appendices. Antea Group would provide the client with requested hard copy reports along with an electronic version of the report. The report would address the following items:

- Scope-of-work for the Phase I ESA
- Discussion of the subject property reconnaissance. A summary of information gathered from the records review including past and present subject property owners/operators; interviews; and reasonably attainable Federal, State, and local records involving the subject property
- A summary of all potential environmental risks discovered during the assessment. A qualitative evaluation of the potential environmental liabilities associated with the subject property

In addition to performing Phase I ESA in accordance to ASTM 1527 E, Antea Group has conducted many ESAs in accordance with guidance for brownfield redevelopment projects (Guidance Document #8, Phase 1 Investigation). For certain Phase I's conducted in Minnesota, if required or requested, Antea Group has experience with utilizing ASTM 1527 E Phase I standards and augmenting them as applicable (i.e. review of Minnesota Department Transportation files, review of Minnesota Department of Natural Resources observation well monitoring network data, review of historic land appraisals, review of corporate reports and newspaper searches etc.). Antea Group's Phase I ESA experience includes but is not limited to: multi-site manufacturing facilities worldwide, dry cleaners, battery manufacturing facilities, gasoline stations, refineries, petroleum repackaging facilities, petrochemical manufacturing and bulk storage facilities, petroleum terminals and pipelines, scrap metal yards, residential lawn care and chemical manufacturing companies, bulk storage agricultural chemical facilities, shingle manufacturing facilities, industrial dry cleaning/laundering facilities, food processing facilities, photograph development and processing facilities, bulk storage liquid feed facilities, specialty metal plating facilities, foundries, ore processing facilities, high rise office buildings, paper and cardboard manufacturing facilities, paper industry sawmills, landfills, offset and lithographic printing facilities, commercial properties, and agricultural properties.

Phase II Environmental Site Assessments

Performing Phase I and II ESAs are primary services in Antea Group's Transaction Support Practice. The majorty of our Phase I ESAs are performed in accordance with the current ASTM 1527-13 Standard. We are tracking the updates already approved by ASTM that are anticipated to be approved later this year by EPA, and formalized as ASTM 1527-13. Our staff have applied the ASTM Standard 2600-15 for *Vapor Encroachment Screening on Property Involved in Real Estate Transactions*. We use the ASTM-1527 and all appropriate inquirary (AAI) protocols in researching the often long history of developed use in areas where industrial activities take place.

Antea Group has an experienced team, specializing in due diligence, project management and meeting client expectations. The majority of Antea Group's team members are qualified as environmental professionals under the United States Environmental Protection Agency's (US EPA's) All Appropriate Inquiry (AAI) definition. Since our inception in 1986, environmental due diligence has been a core practice area of Antea Group. Antea Group staff participated on the American Society of Testing and Materials (ASTM) committee that promulgated the Phase I

Environmental Site Assessment (ESA) standards in 1992, 2000 and 2005, and Antea Group staff has conducted thousands of Phase I ESAs in accordance with these standards. Antea Group has also developed alternative due diligence methods where Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) protection is not sought, and assessed properties for additional criteria such as sensitive receptors, hazardous building materials, radon, vapor intrusion and earthquake and fault zones. In order to provide more reliable estimates of environmental liabilities (costs) on contaminated properties, Antea Group has developed sophisticated probabilistic cost modeling practices following ASTM-E2137. We have worked with public and private organizations through all of the contaminated property asset lifecycles from Phase I historic use assessments through remediation and redevelopment.

Of the hundred plus Phase I ESA Antea Group conducts each year, approximately 30 percent require Phase II Environmental Site Assessments. The purpose of the Phase II ESA is typically to; a) verify the presence of soil and groundwater impacts resulting from spills or the potential of spills or releases of hazardous substances on the subject property, b) identify source areas and chemicals of concern, c) identify potential receptors and migration pathways, d) determine horizontal and vertical extent of release(s) and, e) collect sufficient data necessary to propose a corrective action if necessary.

Prior to initiating subsurface activities, and if not already previously done, Antea Group would evaluate the subject property history to determine locations of chemical handling, locations of historic spills, etc. In addition, Antea Group would prepare, if requested to do so, a Phase II Investigation work plan in accordance with applicable portions of the State's Risk Base Site Evaluation manual (i.e. Site Characterization and Sampling Document and Risk Based Site Evaluation Checklist).

Antea Group has successfully completed Phase II ESA investigations across Minnesota, the United States and the World. Like their Phase I ESA counterparts, Antea Group has completed Phase II ESA on a wide variety of properties, from retail petroleum facilities, chemical manufacturing facilities, bulk chemical agricultural facilities and industrial laundry/dry cleaning facilities, etc. Antea Group has professional staff knowledgeable in the following skill areas that are commonly called upon when conducting a Phase II ESA.

- Oversight of soil boring and test pits
- Logging of soil and rock core borings
- Soil sample collection from, hand auger, direct push soil borings, hollow stem auger and rotosonic borings
- Groundwater sample collection from groundwater monitoring wells and soil borings
- Collection of surface water and sediment samples
- Oversight and documentation of groundwater monitoring well installations and abandonments
- Monitoring well development and surveying
- Conducting vapor surveys
- Conducting groundwater and surface water surveys
- Hydrogeologic evaluations (i.e. rising and falling head slug tests, steady state and step pump tests)
- Data evaluations (comparison of data to soil leaching values, soil residual values etc.)

- Analytical data validation
- Report preparation

Limited Site Investigations

Antea Group conducts Limited Site Investigations (LSI) to evaluate the extent and magnitude of a known release and evaluate potential risk to nearby receptors. Antea Group conducts LSI in accordance with all applicable MPCA guidance documents, including:

4-01 Soil and Groundwater Assessments Performed during Site Investigations (c-prp4-01)

4-01a Vapor Intrusion Assessments Performed during Site Investigations (c-prp4-01a)

Vapor Intrusion Interior Building Survey Form

4-01c Intrusion Screening Values (c-prp4-01c)

4-02 Risk evaluation and site management decision at petroleum release sites (c-prp4-02)

4-04 Soil Sample Collection and Analysis Procedures (c-prp4-04)

4-05 Groundwater sample collection and analysis procedures (c-prp4-05)

4-06 Investigation Report (c-prp4-06)

4-09 Groundwater investigations in Karst areas (c-prp4-09)

Assessment of sensitive groundwater conditions (c-prp4-18)

Investigation Requirements for Ethanol-blended Fuel Releases

Prior to initiating subsurface activities, and if not already previously done Antea Group evaluates the subject property history, to determine locations of chemical handling, locations of historic spills, etc. In addition, Antea Group prepares, if requested to do so, an Investigation work plan in accordance with applicable client requirements or state guidance.

Antea Group has successfully completed limited site investigations across Minnesota, the United States and the World. Antea Group has completed LSI on a wide variety of properties, from retail petroleum facilities, chemical manufacturing facilities, bulk chemical agricultural facilities and industrial laundry/dry cleaning facilities, etc. Antea Group has professional staff knowledgeable in the following skill areas that are commonly called upon when conducting a LSI.

- Oversight of soil boring and test pits
- Logging of soil and rock core borings
- Soil sample collection from, hand auger, direct push soil borings, hollow stem auger and rotosonic borings
- Groundwater sample collection from groundwater monitoring wells and soil borings
- Collection of surface water and sediment samples
- Oversight and documentation of groundwater monitoring well installations and abandonments

- Monitoring well development and surveying
- Conducting vapor surveys
- Conducting groundwater and surface water surveys
- Hydrogeologic evaluations (i.e. rising and falling head slug tests, steady state and step pump tests)
- Data evaluations (comparison of data to soil leaching values, soil residual values etc.)
- Analytical data validation
- Report preparation

Antea Group's approach to site investigations is to determine if there are any immediate impacts to potential receptors and evaluate site conditions to determine if impacts at the release site could result in completed receptor pathways. If completed receptor pathways are present or if there is unacceptable risk based on site conditions Antea Group will address any immediate receptor exposure and continue to evaluate the site by performing a Remedial investigation.

Remedial Investigations

Antea Group has 30+ years of proven experience achieving site incident closures by providing sustainable strategies for soil and groundwater remediation challenges. We have designed, specified, installed, operated and decommissioned thousands of remedial solutions for automotive, chemical, energy, manufacturing, mining, pharmaceutical and transportation sector clients. We are considered a leader in petroleum, chlorinated solvents, pesticides and metals remediation due to our comprehensive understanding of industry operations, client-dedicated project teams, local regulatory knowledge and cost-effective, yet technically innovative solutions.

Our site investigation and remediation professionals utilize a project management framework that provides consistency and quality assurance to facilitate the most applicable and effective technology to meet project-specific goals.

- Appraise – Assess the extent of impact and evaluate the potential receptors and pathways to define risk
- Select – Identify the best remedial technology options based on site conditions, cost, risk, likelihood of success, and alignment with asset management objectives
- Define – Complete the design and define the scope of the remedial strategy
- Execute – Implement the remedial strategy with efficiency and safety
- Operate – Eliminate the risk and monitor technology performance

Setting us apart from our competitors, we adhere to a formal engineering assurance process that ensures a consistent level of engineering competence to each remediation project, provides audit and review structure, and reduces potential for engineering error. Antea Group strives to maintain best in class relationships with all key stakeholders in the permitting and regulatory review process allowing us to advance projects quickly and cost effectively through both formal submittals and informal meetings and site visits.

Antea Group performs remedial investigations in accordance with applicable MPCA Guidance Documents depending on the specific site conditions and site management decisions.

3.10 Conduct surface water, ground water, air and vapor receptor surveys

Antea Group completes surface water, groundwater and vapor receptor surveys to evaluate potential receptors and risk at sites in accordance with MPCA Guidance Document 4-02 *Risk Evaluation and Site Management Decision at Petroleum Release Sites* and Guidance Document 2-07 *Petroleum Release Notification Follow Up.*

Surface Water Survey

Antea Group completes surface water receptor surveys by identifying all water bodies within ¼ mile of the release site. Surface waters are identified utilizing aerial photography, United States Geological Survey (USGS) topographical maps and a 500-foot walking survey. Other features that may be less visible on aerial photographs and maps (ditches, drain tiles, storm sewers, etc.) are also identified during the 500-foot walking survey. Results of surface water surveys are reported by developing a detailed scaled map and table which identifies the location of the surface water feature and distance and direction from the release site.

Surface water survey results are utilized to develop sampling locations, sampling plans, evaluate risk to nearby surface waters based on geologic conditions and to develop recommendations for additional investigation or corrective action.

Groundwater Receptor Survey

Antea Group performs groundwater receptor surveys to identify water wells near a release site that may be at risk due to contaminant impacts. Additional information regarding geology and groundwater use near the site is also evaluated during a groundwater receptor survey. The following tasks are completed during a groundwater receptor survey:

a) A walking survey is conducted consisting of:
   a. A base map illustrating property boundaries and relevant features such as buildings, roads, rivers, etc. within 500 feet of the source and a corresponding table is generated. The table generated includes:
      - Whether the property has a water supply well;
      - Connection to public water supply, and confirmation with the local municipality;
      - How was the information obtained (visual observation, personal contact, returned postcard);
      - Presence of basements
      - Presence of sumps,
      - Presence of possible petroleum or contaminant sources on site;
      - And comments specific to a property.
   b. Contacting residents, property owners, tenants, business owners, and other stakeholders within 500 feet of the source to determine whether water wells basements or sumps exist on each property. Contact is first attempted in person, followed by leaving a stamped self-addressed questionnaire, brief letter or postcard or by telephone. Letters, postcards and questionnaires include questions which correspond with items listed above, a brief explanation that the purpose of the request is to evaluate risk to nearby water wells and properties, and a statement that if no reply is received in a set time period it will be assumed that there are no wells, basements or sumps at the property.
   c. Identifying and documenting the location of wells on the properties within the survey area.

d. Identifying and documenting the location of subsurface structures, such as basements, utilities, manholes and catch basins within the survey area, manholes, catch basins and other utility access points are screened for vapor intrusion criteria during a walking survey.
e. Identifying and documenting the location of obvious surface water features such as creeks, rivers, ponds and lakes within the survey area.
f. Identifying and documenting the location of possible petroleum or other contaminant release sources, such as underground storage tanks, above ground storage tanks, etc. within the survey area.

b) Public Water Supply Confirmation
   a. A list of all properties within the survey area is submitted to the city utility billing department to confirm the status of water supply to those addresses.

c) Well Records Search and review
   a. The Minnesota Department of Health county well index is accessed to obtain well construction records.
   b. Municipalities are contacted to determine location and construction of municipal wells within ¼ mile of the release site, where applicable.

d) Assessment of Sensitive Groundwater Conditions
   a. Sensitive groundwater assessments are completed following MPCA Guidance Document c-prp4-18 and include:
      - Determining whether the site is located within a protected area of a public water supply; if so
      - Determining if the site is within a shallow bedrock area
      - Determining if a sole-source aquifer is present
      - Determining if the site is located within an area with a shallow sand and gravel aquifer.
   b. If any of the sensitive groundwater conditions are present Antea Group
      - Assesses risk to the public water supply aquifer, and;
      - Reports findings of the public water supply risk assessment and follow necessary appropriate and actions.

Completion of an air and vapor receptor survey

Antea Group completes vapor receptor surveys by identifying the location and type of nearby potential vapor receptors and vapor migration pathways within 500 feet of a source. Potential vapor receptors include basements, crawl spaces, sanitary and storm sewers, utility conduits and other subsurface structures where contaminant vapors could accumulate. Backfill of buried utility structures can provide preferential flow paths for vapors to migrate or accumulate. Following MPCA GD 4-02, utility manholes, catch basins and access points are screened with a photoionization detector and four-gas meter (hydrogen sulfide, methane [LEL], oxygen and carbon monoxide), and mapped during the 500-foot walking survey. Utility owners are also contacted for information as part of a vapor receptor survey to obtain utility construction information including:

- Utility material;
- Depth;
- Elevation;
- Liquid flow direction;
- Condition

Occupants of potentially impacted buildings are contacted during the 500-foot walking survey to determine whether they have noticed odors within their buildings. Potential vapor receptors and migration pathways within 500 feet are mapped and reported in MPCA Guidance Document 4-06 *Investigation Report Form.*

In addition to the above-mentioned screenings as part of MPCA Guidance Document 4-02, Antea Group conducts water line intrusion screening when necessary.

3.11 Oversee construction to mitigate vapors and conduct non-construction mitigation measures such as using fans, etc.

Antea Group has provided design and oversight of a wide variety of projects where vapor mitigation has been necessary. Many of these projects have included periodic vapor monitoring followed by an assessment of the data to determine the potential risk to public health and safety. Antea Group's experience includes designing and installing soil vapor extraction systems at numerous petroleum and non-petroleum volatile organic compound release sites, installation of vapor barriers for new construction projects, installation of passive and semi-passive soil venting systems, or a combination of multiple mitigation methods. Antea Group has also provided oversight of sites utilizing vapor mitigation technologies through sub slab depressurization techniques.

Example: **Chemical Distribution Warehouse**
St. Paul, MN

As part of ongoing remedial actions at a chemical distribution warehouse Antea Group designed and installed a sub-slab depressurization system in the site building and at a nearby daycare. Sub slab concentrations of chlorinated solvents (PCE and TCE) at both the site building and daycare indicated vapor mitigation was necessary, especially given the sensitive receptor at the day care property.

Based on the analytical results from sub-slab sampling and the size of the site building it was determined that partial building mitigation was necessary. Antea Group worked with a radon mitigation subcontractor to perform initial pressure field extension (PFE) testing on potential fan and blower options. Based on the findings of the initial PFE diagnostics, it was determined that the portion of the building affected could be mitigated using four large suction pits and a single blower mounted on the roof of the building. Additional optimization of the system was achieved through pipe dampers and a variable frequency drive to optimize influence and reduce power consumption. Mitigation of potential vapor intrusion at the daycare building was accomplished using three suction pits with three separate, smaller radon fans.

The approach taken at each building was optimized in order to provide effective mitigation considering the limits and use of each building. At the site building the open floor plan allowed for larger piping, larger suction pits and a more robust blower to achieve the mitigation goal. While the constraints of the floor plan and limitations of the building at the daycare required a different approach using multiple, smaller systems to achieve the mitigation goal.

3.12 Install stainless steel soil gas sampling ports using an electric drill to bore through floor slabs

Antea Group completes property specific vapor intrusion investigations by installing, when necessary, stainless steel soil gas sampling ports. Antea Group prefers to install self-sealing Vapor Pin™ stainless steel sampling ports. Antea Group installs Vapor Pin sampling ports following the manufacturer's instructions and tests each port installed for leaks using water dam testing procedures. Vapor Pin sampling ports are self-sealing in that they use a silicon sleeve surrounding the sampling port which compresses during installation to hold and seal the sampling port to the surrounding concrete. Using self-sealing sampling ports eliminates the need for a concrete seal and thus the need to wait for the concrete to cure prior to sample collection.

Antea Group installs sampling ports using a Bosch RH850VC rotary hammer drill. Sampling ports are installed using a 5/8-inch bit drilled through the thickness of the slab. Dust and debris is removed from the drilled hole continuously with a multipurpose utility vacuum cleaner to prevent binding while the hole is drilled and to minimize dust released during the drilling. If recessed mounting is completed a 1-1/2-inch bit is used prior to the 5/8-inch bit to over drill the upper portion of the sample port location. The over drilled portion is used for water dam leak testing and houses the Vapor Pin allowing space for a stainless-steel cover to protect the sample port while not in use.

When non-recessed installations are used, Antea Group, uses a 5/8-inch bit to drill a hole through the thickness of the slab and installs the self-sealing sampling port so that the upper access portion rises above the slab. The sampling port is sealed with a vinyl cap to seal off the sub slab and indoor air pathway. A water dam test is performed using a section of polyvinyl chloride piping surrounding the sample port and sealed to the floor with non-VOC clay. Water dam leak testing is performed following manufacturer's instructions and the MPCA best management practices.

Following the manufacturer's instructions, Antea Group prefers to install sampling ports recessed into the slab to provide normal, unimpeded use of the area when the sample port is not in use. Vapor Pins installed recessed into the concrete are sealed using a vinyl cap and then a stainless-steel cover is threaded onto the sampling port. The stainless-steel cover provides a flush surface with the surrounding concrete which eliminates trip hazards, provides protection for the sampling port and provides security for the sampling port. The stainless-steel covers require a special tool from the manufacturer to remove the cover and access the Vapor Pin below.

Antea Group is also familiar with the installation of other designs of vapor sampling ports when slab conditions do not allow for the use of Vapor Pins. Conditions which wouldn't allow installation of Vapor Pins include thin, crumbling or porous slabs that are easily damaged at the drilling location using a hammer drill. In these cases, Antea Group installs an alternative stainless-steel sampling point which uses cement to seal and hold the sampling port into the slab. The cement also seals any damage created by the hammer drill surrounding the sampling port.

3.13 Oversee construction to complete sediment sampling and conduct non-construction sediment sampling as needed.

When there is potential for sediments to be impacted, Antea Group staff will collect sediment samples to evaluate potential impacts. Sediment samples may be collected in wetlands, rivers, lakes, and ponds where releases may be impacting these water bodies. Sediment samples can be collected by hand with a hand core tool or in deeper water situations by sediment samplers. We have completed sediment sampling in streams, wetlands, and lakes. When appropriate, our approach has been to work from downstream collecting samples upstream to minimize any disturbed sediment from contaminating samples collected at downstream locations.

Example: **Retention Pond**
Eddyville, IA

A chemical plant in Iowa experienced a release of hydrochloric acid into their on-site retention pond. This dropped the pH of the pond to approximately 2.0. Antea Group oversaw the neutralization of the pond water and its transportation off site for treatment. After the acid-impacted water was removed, Antea Group sampled sediment from the wet pond bottom and soil from the edges of the pond.

Antea Group personnel wore disposable nitrile gloves, approached the bottom of the north side of the pond, getting as close as possible without stepping into the residual muck at the bottom, and filled two 4 oz. soil jars of the loose pond sediment for analysis of VOCs by EPA method 8260B and pH by EPA method 9045. Antea Group personnel donned a clean pair of nitrile gloves, then moved approximately 1 foot uphill to collect two 4 oz. soil jars of the native soil from 1-foot bgs to determine if native soils were impacted. The soil samples were collected by digging 1-foot bgs with a trowel. The trowel was decontaminated before and after sample collection. This process for sediment and soil sample collection was repeated at the east, south, and west edges of the pond.

3.14 Conduct or oversee operation and maintenance on remedial systems

Diligent operation and maintenance of remedial systems is critical in moving the project site to closure. Antea Group staff performs operation and maintenance (O&M) activities on the remedial systems that we install, ensuring that consistent operation is achieved and the system functions as designed. Our scientists, engineers and technicians work together to successfully evaluate and operate our remediation systems.

Antea Group has a national program for an annual review of every one of our remediation systems. This remedial system check is referred to as the Optimize Audit program. Every fall, each of our remedial system sites is checked to confirm that permit compliance is maintained, simple operating functions of high alarms, site signage, fire extinguishers have been maintained, health and safety plans are updated, cold weather protection is in place and working, maintenance records are updated and equipment is protected from weather and unauthorized access. These checks are done during regular operation and maintenance visits. Additionally, each site is reviewed by a registered engineer who is not part of the regular project team. This allows a different technical review by someone who will audit the operational effectiveness, cost effectiveness of the system as installed, confirm the basic schedule is being met, confirm permit compliance, assure adequate system up time is being met and evaluate any client

specific requirements are being accommodated. These reviews provide Antea Group and our clients a level of assurance that our remedial sites are being effectively managed and the appropriate level of technical expertise is being applied to these projects. Auditors of active remediation sites share best practices they have identified during these audits and share audit findings as well to allow all remediation management teams the opportunity to learn from the findings.

Field O&M activities typically include monthly site visits to remedial systems to perform monitoring and routine maintenance activities, and troubleshooting as needed. O&M schedules are adjusted for each project to ensure proper operation of each system. Remediation systems can also employ telemetry systems via a modem or cellular connection to evaluate operation on a daily or weekly basis from the office.

During O&M visits, Antea Group staff collects system performance and operational data that is used to track trends and determine whether system modifications are necessary to maximize performance. Treatment discharge samples required by the MPCA or other governmental agencies are collected to monitor the system's discharge criteria, mass removal, and system performance. After the O&M visit, the collected data is entered into a project database for tracking and trend analysis. In many cases, field parameters and groundwater monitoring are also used to confirm the success of the system's operation.

Office O&M activities typically use the database to track the performance of key operational and monitoring data. Following each field visit, Antea Group staff will evaluate the data collected to gauge the effectiveness and efficiency of each system. Remediation progress is continually compared to the remedial objectives. The project team meets as needed, typically monthly or quarterly, to evaluate the system and discuss operational changes that may be needed in order to reach the remedial objectives. During these meetings, the remedial objectives are discussed to validate the current technology and effort.

Antea Group focuses on meeting the remedial objective in order to minimize project costs and duration. Quarterly project updates and annual operation and maintenance reports are prepared by Antea Group to update our clients on system performance. Antea Group also works closely with the State and other stakeholders to communicate system performance and progress toward site closure. Antea Group utilizes the Remediation System Operation Monitoring Report (RSOM) guidance document 7-08. These reports contain the following site-specific information:

- General information (site contact, accountable person, site background);
- System installation information;
- Operation monitoring – sampling frequencies and schedule, data points, system configurations, etc.;
- System performance evaluation – duration of remediation, wastes, contaminants removed, costs; etc.;
- Post-shutdown monitoring – describe duration of system critical dates, shut down monitoring;
- Site conceptual model update; and
- Recommendations – continued operation, rebound test, permanent shutdown, or additional site information needed.

The Antea Group technical team will review these reports with the state to determine the effectiveness of the remedial systems. The goal is to operate the systems safely and cost effectively while removing the site contaminants completely or to an acceptable risk level at which time active remediation can stop.

Example: Pipeline Release – Constantine, Michigan
2016 to present

Antea Group oversaw system installation and currently oversees the operation, maintenance and monitoring of an air sparge system at the subject site. A release of unleaded gasoline occurred in 2010 at the above-mentioned site. The LNAPL and dissolved phased plume has been defined and groundwater flow is to the south. In order to mitigate downgradient impact, off site migration and potential discharge to a ditch on the south boundary of the site, an air sparge curtain system comprised of 12 air sparge wells was installed in 2016. Based on the performance and maintenance requirements of this system, operation and maintenance visits are performed quarterly along with groundwater gauging and sampling and product gauging to monitor the system effectiveness and site conditions. Antea Group performs field monitoring and annually completes a full safety audit of the system.

3.15 Arrange for transportation, storage, and proper management of wastes

In its 30+ years in business, Antea Group has been involved in hundreds of projects involving the sampling, characterization, removal, transportation, storage, and disposal of waste. This experience is as varied as it is numerous and allows Antea Group to provide its clients with a comprehensive suite of waste handling services.

These services include:

- *Waste Sampling* – Antea Group maintains staff knowledgeable in the sampling of liquid and solid waste.
- *Waste Characterization* – Antea Group can determine if a waste is non-hazardous waste, hazardous waste, special waste, or a universal waste. This may involve evaluating the origin of a waste to determine if it is a Resource Conservation and Recovery Act (RCRA) listed hazardous waste. TCLP testing may also be necessary to determine if the waste exhibits one or more of the characteristics of a hazardous waste (toxicity, ignitability, corrosivity, and/or reactivity). Antea Group prides itself in helping its clients meet their goals of waste reduction, and is continually evaluating options for reuse, recycling, or remanufacturing of waste products (i.e., thin spreading of agricultural chemical impacted soils at an appropriate application rate, thus eliminating need for land filling and preserving landfill space).
- *Waste Removal* – Antea Group has overseen the removal of wastes by properly trained, licensed, and reputable subcontractors and maintains contact with those subcontractors that are located throughout the state and country. If the situation warrants, Antea Group will prepare emergency response or contingency plans to address any spills or releases that may occur during waste removal.
- *Waste Transportation* – Antea Group can coordinate and oversee the proper transportation of waste. This may include ensuring containers are sturdy, leak-proof, and have no material defects; containers have a Hazardous Materials (HM) designation (DOT packaging specification) that is appropriate for the hazards of the waste being stored and shipped; containers are appropriately sized; and if the contents are hazardous waste and it has not already been done, Antea Group will apply a hazardous waste label on the storage

containers that identifies general information about the facility (name, address, EPA ID#, and the EPA waste number), type of waste, DOT shipping name of waste, and start date for waste accumulation. Antea Group will also assure, and properly label containers with non-hazardous waste contents that identify, name of waste, name and address of facility and start date for waste accumulation. In addition, Antea Group can ensure that shipping papers and waste manifests are accurately and consistently completed.

- *Storage and Disposal* – If a material cannot be reused, recycled, or remanufactured, the waste will be shipped to a reputable treatment, storage and disposal (TSD) facility that is previously agreed to by the client. Antea Group shall ensure that the generator obtains the generator copies of the waste manifests and assurances of proper disposal or recycling offered by the TSD or recycling facility.

Example: **Former ConocoPhillips Refinery**
Wrenshall, Minnesota

The Wrenshall Products Terminal is located on property formerly occupied by a petroleum products refinery located in Wrenshall, Minnesota. The property is currently maintained and operated as a petroleum pipeline terminal, including several aboveground storage tanks, refined petroleum product lines and a truck loading rack. Antea Group's completed remedial efforts were part of the overall response actions being undertaken at the site.

The east-central portion of the facility contained a holding basin which consisted of a shallow, water-filled impoundment underlain by between four to six feet of petroleum-impacted sediment. The sediment was underlain by varying thicknesses of petroleum-impacted soil. The surface of the impoundment lies approximately 20-25 feet below surrounding grade and is surrounded by steep slopes.

A Technical Specification Document was prepared to provide Contractors a basis for submitting a proposal to perform the treatment, excavation, hauling, and disposal of approximately 15,000 cubic yards of sediment and soil impacted with petroleum hydrocarbons and metals. The primary focus of the work was to eliminate all visually-impacted sediment within the holding basin through stabilization/treatment followed by excavation and offsite disposal. In addition, a similar quantity of underlying petroleum-impacted soil was to be excavated, stockpiled, and either land-applied within one of two on-site land treatment areas, or processed for offsite disposal.

The scope of work consisted of the following:

- Site Preparation;
- Pond Dewatering and Stormwater Management;
- Excavate and Stockpile Clean Land Treated Backfill Material;
- Treat, Excavate, Stockpile, Load, Transport and Dispose of Impacted Sediment;
- Excavate, Stockpile, Load, Transport and Dispose of Petroleum-Impacted Soil;
- Furnish, Place and Compact Clean Backfill;
- Tilling of Land Treatment Areas;
- Site Restoration, Cleanup and Demobilization.

As proposed in the supplemental remedial action plan, the impacted sediment and soil was mixed in place during the excavation activities utilizing dried Portland cement mix as a reduction agent for the elevated lead levels in order to pass paint filter testing for approval for landfill disposal.

Due to the surface of the impoundment lying approximately 20-25 feet below surrounding grade, which was surrounded by steep slopes, a staging area for loading the excavated material was necessary for transport to the landfill. A pre-existing landfarm on-site was utilized to stage the excavated material and subsequent loading and transportation to the landfill.

Example: Retention Pond
Eddyville, IA

In 2015, a chemical plant in Iowa experienced a release of hydrochloric acid into their on-site retention pond. This dropped the pH of the pond to about 2.0. Antea Group oversaw the neutralization of the pond water and its transportation off site for treatment. Approximately 3.2 million gallons of pond water was neutralized and transported for offsite disposal as non-hazardous waste. After the acid-impacted water was removed, Antea Group sampled sediment from the wet pond bottom and soil from the edges of the pond to determine the extent of impacts and for waste characterization purposes. Approximately 18 cubic yards of sediment from the pond was filter pressed and containerized and transported to an approved landfill for disposal as non-hazardous special waste.

3.16 Evaluate the need for and oversee the implementation of alternative drinking water supply, including point-of-use treatment (i.e. filtration)

Antea Group has evaluated groundwater impacts based on human exposure and use standards such as the Maximum Contaminant Level (MCL) established by the EPA and the Health Risk Limit (HRL) established by the Minnesota Department of Health (MDH) for hundreds of release sites in Minnesota. Antea Group has experience evaluating alternative drinking water options for sites where drinking water has been impacted or is imminently threatened by the release of petroleum related compounds, chlorinated volatile organic compounds and other contaminant threats to drinking water.

In an emergency situation, a bottled water service can be initiated until a more cost effective and long-term alternative can be selected. For short-term needs, an alternative temporary water supply (large tanks connected to a buildings plumbing service) or point of entry treatment is identified to provide affected residents with clean drinking water. For long-term needs, an alternative analysis is conducted to determine the best method for obtaining a clean water supply. Alternatives typically analyzed include wellhead treatment (i.e. activated carbon treatment), installation of a new residential, municipal or rural supply well or purchasing water from another source with an adequate supply.

Example: **Pipeline Release**
Suburban Milwaukee, Wisconsin

As part of an emergency response to a release of gasoline, Antea Group evaluated and provided oversight to arrange for alternative temporary drinking water supplies for approximately 70 residential properties in response to a "Flush Only" water use restriction issued near the release. Temporary water supplies included installation of approximately 10 large holding tanks for residential and agricultural purposes which were connected to the plumbing of the residential building and bottled water service for affected residences. As part of the response to the release Antea Group evaluated available data and provided oversight for installation of point-of-entry carbon treatment systems at approximately 70 residential properties, including those with temporary water supplies, in order to protect drinking water use at properties which had been affected by or in the immediate vicinity of the contaminant release.

Example: **Former Gas Station**
Bradford, Minnesota

During quarterly monitoring a release at a former gas station was found to be impacting a downgradient residential water supply well above drinking water standards. At the time that elevated impacts were discovered Antea Group arranged for a bottled water delivery service to provide the residential property with a temporary water supply. Additional investigation at the site property and the downgradient residential property indicated that groundwater impacts were limited to the upper aquifer which is separated from a deeper, unimpacted, groundwater zone by clay till.

Based on the results of the additional investigation, Antea Group installed a new drinking water supply well at the impacted downgradient property and at the site property to provide a long-term water supply for these properties. The new drinking water wells were installed with a protective casing set into the clay till to isolate the intake of the new well in the deeper groundwater. The installation and protective construction of the new supply wells provides a long-term protective solution to the residential properties.

3.17 Evaluate, monitor, design, and remediate contaminated sediment and other necessary restorative actions

Below is a project description illustrating Antea Group's experience as it relates to evaluation, monitoring, design and remediation of contaminated sediment and subsequent remedial action.

Example: **Tank Truck Chloride release**
Halliday, ND

Antea Group responded to an oil field production water release from a tanker truck that overturned on a rural highway. The production water was determined to contain high concentrations of chloride. The spill occurred on the east side of the highway and traveled along the eastern ditch, under the highway through a culvert and into a marsh adjacent to a livestock pond.

Initial response resulted in installation of a fence to prevent livestock from consuming chloride impacted water, flushing with vacuum recovery of the culvert and blocking the culvert to limit remobilization of residual chloride. Following initial response, a shallow excavation along the eastern ditch was conducted to remove chloride impacted soil. Field screening for electric conductivity (EC) was performed to determine the depth and extent of excavation. Upon reaching field screening results similar to background, samples were collected for laboratory analysis of specific conductance, calcium, magnesium, sodium, sodium adsorption ratio (SAR), chloride and sulfate. Following excavation on the east side of the highway the area was backfilled with clay and topsoil and restored by seeding and placement of straw erosion mats.

Initial water sampling of various locations of the pond indicated that chloride impacts were limited to the marsh and had not affected the pond or downstream locations. Water recovery by vacuum truck was performed within the marsh to limit further spread of chloride impacted water into the pond, however, continued screening during recovery indicated that chloride impacts had adsorbed into sediments within the marsh. Based on concentration trends observed throughout the day during the vacuum recovery efforts, Antea Group determined that sediments within the marsh and within the plant root zone were contributing as an ongoing source of chloride. Antea Group used EC readings of sediments and field screening for chloride content in water to determine the extent and depth of impacted sediments. Antea Group provided oversight of a limited excavation of marsh sediments. Confirmation sampling of the excavation floor determined that chloride impacts were limited to the sediments and plant root zone and had not affected the clay soil present approximately one foot below ground surface. Following excavation, the marsh was restored by placement of topsoil and reseeding with an approved seed mix and straw erosion mats.

Confirmation sampling of the marsh and pond water indicated that chloride concentrations were similar to background concentrations of the region one month after the excavation was complete. The site achieved regulatory closure within nine months of the release.

Example: **Former ConocoPhillips Refinery**
Wrenshall, Minnesota

In response to the detection of visually-impacted sediment in three facility surface water ponds at a refinery site located in Wrenshall, Minnesota, a preliminary pond sediment assessment was completed. The goal of the assessment was to gather initial information regarding the approximate magnitude and extent of impacted sediment associated with the ponds; develop preliminary order-of-magnitude cost scenarios for future pond sediment remediation; and to provide sufficient information from which to develop a scope of work for a detailed investigation.

A total of 41 direct push borings were advanced within three investigated ponds. Representative samples were obtained at selected depths from a subset of borings within each pond, and submitted for laboratory analysis. The analytical suite requested included the following: volatile organic compounds; semi-volatile organic compounds; pesticides; polychlorinated biphenyls (PCBs); RCRA metals; total petroleum hydrocarbons; and waste characteristics. Impacted sediment generally correlated with visual indications: where the sediment was predominantly black in color, the sediment was classified as petroleum-impacted. Confirmatory samples confirmed that petroleum constituents were elevated for one or more analyzed constituents in these visually-impacted samples.

Two forms of related impacted media were identified during the delineation efforts:

1) Petroleum-Impacted Sediment – Approximately 5,000 cubic yards of visible waste material within and beneath two of the ponds. The thickness of impacted sediment was highly variable, and ranged from one foot to a thickness of over 10 feet in isolated areas.
2) Petroleum-Impacted Soil – Approximately 1,000 cubic yards of petroleum-impacted soil underlying the above impacted sediment areas.

A cleanup standard was developed for the impacted media through discussions with the MPCA. A Supplemental Remedial Action Plan (SRAP) was prepared and subsequently approved by the MPCA for the sediment proposing excavation followed by offsite transport and disposal of the sediment, and excavation followed by on- or off-site treatment for associated petroleum-impacted soil underlying the sediment.

The proposed response action included excavation and stockpiling of clean overburden; excavation and stockpiling of petroleum-impacted sediment; on-site land application of suitably-classified impacted soil; offsite transport and disposal of petroleum-impacted sediment; furnishing, placement and compaction of clean backfill; construction of temporary diversion structures and otherwise providing for drainage control and dewatering; providing erosion control; securing the site; and restoration of excavation areas.

- All petroleum-impacted sediment requiring remediation within one pond area was excavated and processed for offsite disposal. The total amount of impacted sediment excavated, transported and disposed was 5,758 tons to Voyageur Landfill. An additional 215 tons of impacted sediment was transported and disposed at Elk River Landfill.
- All petroleum-impacted soil requiring remediation within one pond area was excavated and processed for offsite disposal or was treated within the onsite land treatment area. The estimated quantity of impacted soil that was treated in this manner was approximately 250 cubic yards.
- The SRAP Amendment implementation activities were undertaken voluntarily by the Responsible Party (RP) and were completed ahead of the schedule required under the SRAP.
- All water recovered as a result of implementation activities was collected, stored, treated and discharged in accordance with the facility NPDES Permit.
- All waste characterization and disposal permitting requirements were strictly adhered to. Antea Group and the RP worked with Waste Management Company and the MPCA to properly characterize, approve, and manifest all impacted sediment requiring offsite disposal.
- No impacted soil or sediment exhibiting constituent levels above regulatory standards remains within the pond area.

3.18 Coordinate remedy planning, restoration planning, and end use planning

Coordination of remedy planning, restoration planning, and end use planning is most successful when these items are active components of the earlier project phases, especially the remedy design phase. Antea Group emphasizes that the success of an environmental project, whether remediation occurs by soil excavation, chemical injection, monitoring natural attenuation, or any number of viable alternatives, is determined by more than attainment of a

cleanup standard alone. Equally important are such items as the degree to which a site can be restored to a pre-release condition, the long-term benefit to the stakeholders, or any number of end use contingency considerations. Solutions that look at the big picture, and include evaluation of such parameters as life cycle cost and sustainability, have the potential to provide more value than those that simply rely on remediating soil, groundwater, or surface water to a given target concentration.

Stakeholder involvement is another important component that contributes to the success of the remedy, restoration, and planning phases. Frequently stated, "early and often" is a good manner by which to involve stakeholders. Failure to involve stakeholders before the remedial implementation phase can detract from the success of the project. An example of successful project planning, including the remedy, restoration, and end use, is provided below:

Example: Former Railroad Yard
Des Moines, Iowa

The property had been a railroad repair and maintenance facility for at least 90 years. The property use included a switch yard, locomotive and car maintenance, and locomotive fueling activities. Commercial and industrial facilities resided on all four sides of the property, along with a city park and lake to the north. Investigation activities at the site detected light non-aqueous petroleum liquid (LNAPL), total extractable hydrocarbons (TEHs), polynuclear aromatic hydrocarbons (PNAs), volatile organic compounds (VOCs), and RCRA metal concentrations in soil and/or groundwater. The VOCs, PNAs, and TEHs had migrated off-site onto the adjacent city park property. During the investigation phase, the city purchased the property for future use as a transportation corridor for vehicle and pedestrian traffic.

During the property sale negotiations and continuing throughout the project, Antea Group solicited input from the stakeholder groups concerning potential end use for the various areas of the former rail yard. This input was instrumental towards assembling a remedy that was tailored to the contaminants, risk, and end use at the various locations within the former rail yard. The end uses include a four-lane expressway, recreational trail, and incorporation into the adjacent city park property. Remedy selection included the following technologies:

- Excavation for removal of RCRA metal impacts in shallow depth soils;
- Placement of an institutional covenant and use restrictions to limit and manage exposure to hydrocarbon, VOC, and PNA impacts in soils at deeper intervals;
- Groundwater modeling and risk assessment, followed by quarterly groundwater monitoring, to demonstrate stability of the groundwater impacts;
- LNAPL modeling, risk assessment, and performance of a pilot test to corroborate the modeling and demonstrate that LNAPL recovery was not technologically feasible.

Regulatory approval for the remedies has been received. All active remediation has been performed.

Example: **Crude Oil Pipe Line Leak**
Tioga, North Dakota

Antea Group was contracted by an integrated oil company to provide emergency response oversight, remediation strategies and implementation oversight to a pipeline release of approximately 800,000 gallons of Bakken crude oil. The release occurred on a geographic high point resulting in oil spreading in multiple directions over agricultural land.

Antea Group provided immediate response to investigate the vertical and horizontal extent of crude oil impacts and develop an interim remedy. Antea Group provided initial delineation of the release area by advancing more than 125 direct push probes and installing groundwater monitoring wells using hollow stem auger. The interim remedy included installation of a network of oil collection trenches and vertical recovery points. The interim remedy provided a rapid transition from emergency response to remedial investigation and corrective action.

Antea Group developed a remedial investigation strategy employing multiple investigation techniques including: direct push probes and real-time laser induced fluorescence (LIF) evaluation to quickly provide the information required to aid in the development of the site remedial strategy. Real time site updates to the entire project team during the LIF investigation reduced cost, number of probes advanced and provided the client with continuous updates.

The site remedy selected was remediation by excavation and onsite exsitu thermal desorption. During the excavation, several high permeability zones were encountered where oil had migrated away from the main body of impacted soil. To integrate this information into a more refined site conceptual model additional investigations were proposed. Additional investigation included rotosonic borings and passive soil gas sampling to identify discrete sand lenses where migration of crude had occurred.

Routine three-dimensional modeling and data visualization incorporating data collected from probes, LIF, sonic borings and excavation data provided an ongoing understanding of remedial progress and provide a budget planning tool for the ongoing remediation.

A State University was contacted to conduct research at the site on the acceptability of treated soils, impacted soils and native soils and the effect of remediation on future agricultural use at the property. Based on the research completed, remedial actions have provided valuable data for reuse of the property for agricultural purposes that can also be used at other potential releases.

The remedial treatment at the site is ongoing. Antea Group continues to work with the client, remediation contractors, regulatory agencies, and property owners to reduce costs while working to restore the property to its original use.

Throughout this project the regulatory agency, university, landowner, responsible party and their contractors have worked together to return the affected land to agricultural use. Site management decisions are made with landowner input and an on-site working culture focused on returning the land to agricultural use.

3.19 Search, gather, and evaluate bathymetric data

Bathymetry is the study of underwater lake or ocean floors. In other words, bathymetry is the underwater equivalent to topography. Bathymetric charts are typically produced to support safety of surface or sub-surface navigation, and usually show seafloor relief or terrain as contour lines (called depth contours or isobaths) and selected depths (soundings), and typically also provide surface navigational information.

Typically gathering bathymetric data is done through various available resources such as Minnesota Department of Natural Resources "Data Deli" where multiple and various types of spatial data are available. This includes bathymetric data. Additionally, there are multiple other locations to collect already generated spatial data such as the National Oceanic and Atmospheric Administration (NOAA) – Digital Coast site, where there are existing and available data sets for areas on the Great Lakes, i.e. the "2009 USACE Great Lakes Topo/Bathy Lidar: Duluth Area" data set.

Antea Group would typically search out existing resources, such as those listed above for use. If a more detailed survey is required or a survey for a new location, we would subcontract that specialty service.
Once the data is available Antea Group then works with our data visualization group to refine the information and produce various figures and outputs related to the project needs.

3.20 Evaluate, coordinate, and cooperate with other state-contracted services such as sampling and analytical, emergency response contractors, and hazardous waste services

In managing and coordinating project activities on literally hundreds of projects, Antea Group's St. Paul project team understands the importance of communicating and working with a variety of subcontractors, other vendors contracted directly by our clients and other state contractors. Antea Group staff work with the state-contracted laboratories on a daily basis and we are fully aware of the emergency response, hazardous waste and drilling firms under contract to the State of Minnesota. We will work with the MPCA/MDA project managers and other state contractors, as necessary or requested, to achieve the project objectives in a safe, timely, and cost-effective manner. It is our goal to provide seamless delivery of all services to the MPCA/MDA staff by coordinating and cooperating with the subcontractors, and vendors.

Our staff is also well experienced in working with other regulatory agencies and multiple other environmental service providers contracted by others on large complex projects. Recent examples include lead emergency response management consultant on multiple pipeline releases in the region (e.g. Tesoro Pipeline release near Tioga North Dakota) and as a Health and Safety and Environmental Sampling oversight consultant on the Deepwater Horizon response team in the Gulf of Mexico.

3.21 Arrange for geophysical activities

Antea Group staff design and oversee geophysical testing utilizing qualified subcontractors to perform the actual geophysical field work. Geophysical techniques that Antea Group has utilized include seismic reflection and

refraction, electrical resistivity surveys, downhole logging by natural gamma rays, resistivity, and ground penetrating radar. Antea Group also uses downhole video cameras to inspect open bore holes, well screens and casings. Antea Group also subcontract the use of direct sensing technologies such as, laser induced fluorescence (LIF), ultraviolet fluorescence (UVF) membrane interface probe (MIP), and soil conductivity techniques. LIF and UVF directly sense free product in the soil and groundwater, while MIP can directly sense volatile organic compounds in the soil and groundwater. Soil conductivity probes are used to measure soil conductivity to determine soil lithology.

PETROLEUM ENVIRONMENTAL SERVICES

Example: ConocoPhillips Former Service Station – Phillips Store #1647
St. Paul, Minnesota

In order to evaluate remedial technologies to remove residual product at this site, an understanding of the volume remaining was imperative. Antea Group submitted a recommendation to the MPCA to conduct a free product recoverability study to gain a better understanding of volume remaining. LIF and cone penetrometer testing (CPT) technologies were proposed to help define the horizontal and vertical extent of product. The MPCA agreed with Antea Group's recommendation and Antea Group subsequently proceeded with the work. The investigation yielded the following results: the network of probes completed during this investigation was sufficient to adequately define the horizontal and vertical extent of known free product accumulations at the site. Determining this extent and volume was the primary focus of the investigation. Readings indicative of elevated levels of gasoline-type hydrocarbon impact were identified in five of the eight probes. Fluorescence readings indicative of gasoline-type free product were identified in two of the eight probes. The remaining probe, in which elevated fluorescence readings were not observed, served to define the southeastern perimeter of the hydrocarbon-impacted area.

SUPERFUND ENVIRONMENTAL SERVICES

Example: Crude Oil Pipeline Release
Lockport, Illinois

Antea Group oversaw a geophysical survey at a crude oil pipeline release. The release had flowed beneath a railroad track and into a wetland. Depth to bedrock in the area is shallow. The purpose of the geophysical survey was to map depth to bedrock, potential fluid migration pathways using seismic refraction/earth resistivity and to locate several abandoned pipelines.

Refraction surveys were conducted along two survey lines, one in the drainage ditch between the road and the railroad tracks, and the second to the west of the tracks along the edge of the brush line and wetland. Each survey line was 750 feet long. A magnetic survey was conducted and used to identify additional pipelines in the area.
Antea Group was able to use the results of the surveys to help design a remediation system for intercepting the crude oil and dissolved phase petroleum constituents.

3.22 Oversee subcontractors and state contractors during investigation and cleanups and tank removals

Antea Group has extensive experience in providing oversight of State contractors. Prior to overseeing work, we ensure that all subcontracted personnel that will be conducting work on site has completed the required and appropriate health and safety training in accordance with all OSHA requirements and any other applicable laws. Verification of certificates of completion are reviewed for accuracy and assurance that all field personnel training is in compliance.

Antea Group prepares health and safety plans (HASP) as part of pre-field work preparation. All Antea Group and subcontractor personnel are required to adhere to the Antea Group HASP. In the event Antea Group staff are working with contractors that have been hired by other entities, a robust communication plan is formulated that involves all of the project stakeholders. It is Antea Group's corporate policy that in the event any unsafe act or condition is identified during any work-related activity, all site personnel are authorized to issue stop work authority. If stop work authority is issued, the Antea Group Project Manager immediately notifies the client Project Manager.

As a current Multi-Site Contractor, we have comprehensive experience utilizing the MPCA Contractor and Subcontracting Purchasing Manual (purchasing manual) and adhering to all requirements of the manual. In accordance with the MPCA purchasing manual, Antea Group first determines if there is a State Contract available for the required subcontractor work. If a State Contract is not available, Antea Group secures a subcontractor following the requirements of the purchasing manual.

Example: **Former Bradford Garage**
Bradford, Minnesota

Volatile organic compounds (VOC), specifically benzene and 1,2-dichloroethane (1,2-DCA), were historically detected in a private water supply well located on the east-adjoining downgradient property. This well supplied water to the residence, which was also a multi-tenant living space, and to a small office building on the property.

Due to the VOC present in the off-site private well, and the potential for impacts from the site to both the on-site commercial workshop and residential wells, all three wells were replaced with two deeper water supply wells (one on each property) and appropriate supply connections. By providing replacement wells constructed utilizing methods to case off the impacted aquifers, both residences were provided with acceptable alternative water supplies, thus eliminating the receptors and risk associated with site impacts.

Antea Group provided field oversight of the boring advancements for both supply wells that were advanced to a depth of 105 feet below grade surface (bgs) via rotosonic techniques coupled with advancement of outer protective casings to prevent vertical migration of contamination from the shallow aquifer.

Oversight activities consisted of observing installation of the replacement wells and piping for connection of the new on-site well to the residence and on-site workshop via directional drilling techniques. The piping for connecting the new off-site well to the residence was connected utilizing an extension to existing water supply piping from the

former supply well via traditional trenching. Antea Group also oversaw the final electrical and all associated well connections to the new well.

Tank Removals

Antea Group has performed, managed or participated in hundreds of underground and aboveground storage tank decommissioning and removal projects in Minnesota. Our primary experience has been as project managers or environmental consultants. In these roles, we have worked with numerous MPCA Certified Tank Removal Contractors to remove tanks from 265 to 30,000 gallon capacity. We have also decommissioned several Petroleum Tank Terminal facilities in Wisconsin, Illinois and other states. Our experience covers tanks that stored the range of petroleum products including leaded, unleaded and ethanol blend gasoline, aviation fuel, diesel and heating oil including #6 fuel oil. We have managed projects and sampled sites where USTs have been closed in place with permission from the local or State Fire Marshall.

Tank removals have the potential to create unsafe conditions. Safety is our top priority during tank removals and Antea Group staff is trained to recognize potential safety issues. We work closely with the Certified Tank Removal Contractor to ensure that the client's and our safety requirements are met. Antea Group works with MPCA Certified Tank Removal Contractors to:

- Ensure that 10-day advance notification is given
- Excavation is conducted under the supervision of a Competent Person as required by OSHA
- Tanks are properly purged of explosive vapors
- Other site safety concerns including oxygen deficient environments and confined space entry are properly managed
- Applicable MPCA Guidance is followed concerning sample collection and any excavation, management and disposal of contaminated soil

During excavation to remove tanks, lines and dispensers, Antea Group staff field screen soil for evidence of a tank release using the Field Screening Procedures in MPCA Guidance Documents 3-01 and 4-04. These procedures include PID headspace analysis and the petroleum sheen test. These field screening procedures provide good qualitative measures of the presence and degree of petroleum and other volatile contaminants, and along with visual evidence indicate whether a tank release has occurred.

In addition to field screening, UST closure requires that the soil around tank system components are assessed by collecting soil samples following the requirements outlined in Guidance Document 3-01 "Excavation of Petroleum Contaminated Soil" and laboratory analyzed as provided in Guidance Document 4-04 based on the product type of the tank contents. Antea Group follows the requirements for sampling for contamination when removing an AST in MN Rules 7151.8400 Contamination Determination, and incorporates many of the Guidance protocols for USTs.
If a leak is detected during a tank removal, we assess its extent and notify our client. The leak is immediately reported to the Minnesota State Duty Officer. Antea Group field staff and Project Manager evaluate the site conditions for the approximate volume of contaminated soil, presence of petroleum saturated soil, whether groundwater has been impacted, how recent the release appears, if the site was a previously closed Leaksite and whether there are other

high-risk conditions present. Using these conditions outlined in Section II *Excavation during tank system removals or installations* of Guidance Document 3-01, we determine, often in consultation with the MPCA Project Leader, whether or not contaminated soil should be excavated in conjunction with the tank removal. If contaminated soil is removed, soil samples are collected from the sidewalls and bottom of the excavation following Section III, *Soil sampling requirements during tank or tank system component removal,* of MPCA Guidance document 3-01 to provide data documenting contamination remaining in place. Contaminated soil is also properly managed, including an impermeable barrier beneath and covering any stockpile, and proper transport and disposed in accordance with the soil Treatment and Disposal Guidance Documents 3-03 through 3-15.

When petroleum contamination is encountered during an excavation, Antea Group completes Guidance Document 3-02 "General Excavation Report Worksheet" to document the actions, data and site conditions. In instances where no evidence of a petroleum release is detected, Antea Group prepares a Tank Closure Assessment letter report to document the tank removal actions and required soil sampling results for the tank owner to retain. We also work with the Certified Tank Removal Contractor and the Tank Owner to complete, sign and submit the "Notification of Installation or Change in Status" form to the MPCA UST Program within 30 days of completing the tank removal.

Our experience in oversight of tank decommissioning and removal, and conducting closure assessments has documented the site conditions after tank removal and accomplished closure through targeted excavation at minimally contaminated sites. It has also collected data to document contamination remaining to support limited site investigations and full remedial investigations. One example of oversight of UST removal at a closed retail petroleum facility is profiled below.

Example: Retail Petroleum Facility Canopy and UST Removal
Leaksite 18365 - Wells, Minnesota

Antea Group performed a Limited Site Investigation at this retail facility in Wells, Minnesota and had concluded that although soil and groundwater impacts had been adequately delineated and presented minimal risks to area receptors, further soil vapor assessment was warranted. When the tank owner decided to close the facility, and remove the UST system, they retained Antea Group to manage the removal of the canopy and the UST System.

Antea Group's Project Manager defined the scope of work, solicited bids from four MPCA Certified Tank Removal contractors and conducted a pre-bid meeting on-site. The scope of work included an option to remove and dispose of up to 150 cubic yards of petroleum contaminated soil (PCS) in the event that removal of soil would address the remaining soil vapor risk. The contractors were instructed to present this option and related costs on Minnesota Petrofund Bid forms. Questions that arose in the pre-bid meeting were addressed, contractor bids were evaluated and Antea Group recommended that the tank owner contract for the services of one of the contractors.

Prior to the tank removal, the two dispensers were removed by the owner. The dispensers were located beneath a canopy which was positioned partially over the two USTs. The USTs were of 10,000 and 6,000-gallon capacity, both containing gasoline. The canopy was raised and the concrete pavement over the USTs was removed. The USTs were removed the following day. One closure assessment sample was taken beneath each of the former dispenser locations prior to excavating to remove the tanks. Soil samples around the excavation were field screened using a

PID and headspace protocols. Based on the PID readings and visual observations of significantly contaminated tank backfill material in the south end of the basin but minimal impact to the native soil, it was determined that most of the significantly contaminated soil could now be removed. After consultation with the MPCA Project Manager, approximately 70 cubic yards of significantly impacted and petroleum saturated soil was excavated and transported to a landfill for proper disposal. Arrangements had been made previously with the Landfill to accept the PCS for use as daily cover. To document closure assessment and contamination remaining, one soil sample was collected beneath the 6,000 gallon UST, two samples were collected beneath the 10,000 gallon UST and two soil samples were also collected from the south excavation sidewalls. All were submitted for laboratory analysis by the WI Modified GRO Method.

Conditions observed and analytical results from samples collected during the tank removal and soil excavation confirmed that the excavation of PCS had successfully reduced the remaining risks presented at the site. The site management recommendation to conduct additional soil vapor intrusion assessment was no longer supported, and the site was issued file closure.

3.23 Prepare and evaluate reports (e.g., investigation reports, monitoring reports, free product recovery reports)

Petroleum Remediation Program:
Antea Group prepares all reports for submittal to the MPCA in accordance with MPCA Guidance Documents and the Petroleum Remediation Program General Policies. In addition, other reports (e.g. National Pollutant Discharge Elimination System (NPDES) Reports) are prepared and submitted in accordance with State and Federal requirements. The list of MPCA Guidance Documents Antea Group has prepared and submitted to the MPCA include, but are not limited to, the following:

- 1-03a Spatial Data Collection at Petroleum Remediation Sites
- 2-03 Light Non-Aqueous Phase Liquid Recovery Report
- 2-05 Release Information Worksheet
- 3-02 General Excavation Report Worksheet
- 3-02a Corrective Action Excavation Report Worksheet
- 4-06 Investigation Report Form
- 4-08 Monitoring Report
- 7-02 Conceptual Corrective Action Design Report
- 7-03 Focused Investigation Work Plan
- 7-04 Focused Investigation Report
- 7-05 Pilot Test Work Plan
- 7-06 Pilot Test Report
- 7-07a Remediation System Detailed Corrective Action Design Report
- 7-07b Excavation Detailed Corrective Action Design Report (EDCAD)
- 7-08 Remediation System Operation Monitoring Report (RSOM)

SUPERFUND:
Antea Group prepares all reports for submittal to the MPCA in accordance with MPCA Guidance and Policies of the Superfund Program. The documents are prepared and submitted in accordance with State and Federal requirements relating to releases to the environment under the Minnesota Environmental Release and Liability Act (MERLA). For certain sites in which corrective action is taking place, and as requested by the MPCA Project Manager, reports utilizing the PRP Corrective Action Guidance Documents 7-01 through 7-10 are submitted as appropriate.
When appropriate, Antea Group includes items related to vapor intrusion BMP in our reports where vapor investigation of individual properties and mitigation has occurred. Items related to VI BMP include:

- Vapor Intrusion Building Survey Form
- Vapor Intrusion Maps on the MBP Vapor Intrusion Map Templates
- Pre-Mitigation Diagnostic Checklist
- Active Mitigation System Installation Checklist
- Post-Mitigation Diagnostic Checklist
- Post-Mitigation Confirmation Sampling Checklist
- Property Summary Report

3.24 Evaluate invoices

During every billing cycle, Antea Group's corporate accounting department provides Project Managers with prebilling analysis reports (PBR's) for every project. The PBR's provide an itemization of all costs (labor, expense, subcontractor charges, etc.) specific to each project during that billing cycle. The PBR's also contain summaries for each site-specific task including the current fee, previously billed amount, remaining budget available to bill, and budget balance. The PBR's are reviewed for accuracy and changes made as applicable prior to the issuance of a final invoice to the client. Budget spreadsheets are completed each month for each project to assure all projects are being completed in a cost-effective manner. Both the schedule and budget are updated monthly and compared with the project's projected percent completion to evaluate budget and resource capacity.

All subcontractor (example: drilling or laboratory services) and expenses (example: vehicle mileage or per diem costs) billed to a project are reviewed by the Project Manager prior to processing. Subcontractor invoices are referenced to proposals and cost itemizations provided by the subcontractors prior to completing the work.

Invoices are submitted to a client on a monthly basis for work completed during the prior month, unless no costs were incurred during that billing cycle. Documentation itemized on the submitted invoices include, but are not limited to, the following: Contractor name, work order/project/contract number, invoice number and date, invoicing period, itemized list of work performed and associated labor rates and staff classifications, supplies and equipment utilized, itemized expenses and associated backup documentation/receipts (example: hotel receipts), subcontractor invoices and associated backup documentation, budget status reports and an update of tasks completed for the submitted invoice.

3.25 Collect and manage field and laboratory data for electronic submittal in a format specified by the MPCA

For more than 10 years, Antea Group has employed EarthSoft's Environmental Quality Information System (EQuIS) database to store, report, and export field and laboratory analytical data for over 30 facilities in Minnesota in addition to multiple facilities and portfolios of sites across the country. Antea Group's project teams populate field data collection forms, or electronic data deliverables (EDDs), using a data collection device or manually once back in the office for importing into EQuIS. Once the project team completes the data collection, they submit the EDDs to Antea Group's Capture, Analyze, Visualize electronically (CAVe) team. The CAVe team reviews the EQuIS Data Processor (EDP), if there are no errors the data is loaded into EQuIS. Laboratories submit analytical result EDDs to the CAVe team who then review the EDD in EDP and if there are no errors, load the data into EQuIS.

Antea Group has extensive experience managing data deliverables in formats specified by the MPCA, from Excel table formats to electronic databases. Utilizing EQuIS's EDP, the CAVe team has created both field and analytical EDDs for submission to the MPCA.

Examples:

MPCA SW Fridley Site: Antea Group received gauging and analytical data from participating facility operators in various formats. The Antea Group CAVe team compiled the data provided by the various responsible parties in various formats and loaded it into Antea Group's EQuIS database. Antea Group provided EDDs to the MPCA for loading into the MPCA's instance of EQuIS.

Farmington Site: Antea Group participated in the MPCA's Electronic Data Gathering Engine (EDGE) Pilot Program to record and submit field sampling information and generate chains of custody (COCs) in the MNCOC format. Staff populated field and analytical data into the MPCA's customized EDGE product and submitted the resultant field EDD to the MPCA. During this pilot program Antea Group provided feedback and evaluation of the MPCA EDGE users guide and evaluated processes to prevent double entry of data between the MPCA required format and Antea Groups database format.

3.26 Evaluate data quality and data verification reports

Data Quality Assurance/Quality Control (QA/QC) is assessed for all Antea Group projects in accordance with MPCA Guidance Documents 4-04 and 4-05. In addition, Antea Group reviews QA/QC issues reported by various laboratories in their reports.

Trip blanks and equipment blanks are used to evaluate potential cross contamination from sampling events. Duplicate samples are reviewed to check for sampling and analytical reproducibility.

Precision of laboratory data is assessed by comparing analytical results between matrix spike/matrix spike duplicates (MS/MSD), laboratory control sample/laboratory control sample duplicates (LCS/LCSD), and masked field duplicate samples.

Accuracy of laboratory data is assessed by reviewing the percent recoveries for surrogate samples, MS/MSD, LCS/LCSD and comparing them to the limits present within the laboratory report.
Laboratory precision and accuracy criteria are published in each laboratory report and used as the final acceptance criteria during review.

In addition, all laboratory reports are evaluated for:

- Completeness - a measure of the amount of valid data received compared to the amount expected to be received.
- Representativeness – a measure of the degree to which data accurately and precisely represents site conditions.
- Comparability – a measure of confidence with which one set of data can be compared to another.
- Sensitivity – a measure of the methodology's and laboratory instrumentation to meet or exceed the associated screening levels.

3.27 Arrange for site access

Antea Group staff routinely deals with the need for accessing site properties, or properties surrounding the site, for completion of various investigation activities. The properties may be privately owned, owned by the local municipality, the State, the Federal government, or on Reservation Property which exercises independent, sovereign, regulatory authority within its boundaries. Antea Group has negotiated property access at all levels of ownership and our staff has become astute at early identification of problematic issues.

A variety of access issues have been successfully dealt with by Antea Group staff, including: performance bonds, MNDOT right-of-way agreements, railroad access agreements (including associated insurance requirements, safety training, etc.), remote ownership and third-party agreements, multiple party agreements, data sharing agreements, and coordination of property purchase.
Antea Group has assisted the MPCA with obtaining access agreements through a variety of measures for State fund-financed projects. We have participated in and assisted MPCA Project Leaders through the process of utilizing the Minnesota Attorney General's Office on multiple site projects in order to obtain access. These activities included preparation and review of affidavits, meetings with property owners, MPCA Project Leaders and the Attorney General assigned to the project. We have participated in Court Orders from the beginning through obtaining the final agreement which were conducted in order to obtain site access.

Example: **Clover Valley Store**
Two Harbors, Minnesota

Antea Group, on behalf of the MPCA, conducted site investigation activities which included the installation of four groundwater monitoring wells on site, completion of one quarterly groundwater monitoring sampling event of the well network, sampling of the potable well located on-site and the off-site potable wells located south and west of the site, soil vapor intrusion assessment and sampling of a drainage ditch, due to observed product sheen, located immediately adjacent to the southeastern site property boundary. In addition, due to product sheen observed on

the surface water in the ditch located immediately adjacent to the southeastern site property boundary and elevated dissolved phase hydrocarbons detected, Antea Group conducted additional investigation utilizing laser induced fluorescence (LIF) to evaluate the vertical and horizontal extent of free product at the site.

Based on the limited delineation of the downgradient extent of the plume it was possible that groundwater impacts discharged to surface waters in both the unnamed wetland and the surface water found within the ditch located south and east of the site. Soil, groundwater and surface water data indicated petroleum impacts adjacent to the off-site property may be present at concentrations exceeding regulatory action levels and the downgradient extent of these impacts were undefined due to the denial of access to the off-site property.

Antea Group personnel worked with the MPCA Assistant Attorney General and the MPCA Project Leader to prepare an Affidavit for the State of Minnesota District Court, County of St. Louis, Sixth Judicial District, to assist in obtaining off-site access. Antea Group participated in a judicial hearing with the Attorney General, MPCA Project Leader and the site property owners in which an Administrative Inspection Order was issued granting site access.

3.28 Coordinate utility locates by contacting the appropriate entity and if applicable coordinate traffic control

The first task conducted by Antea Group at any site in Minnesota where intrusive work is to be performed is to contact Gopher One Call and a private utility locator (if necessary) to mark all public and private subsurface utilities.

In the event that traffic control is necessary, traffic control plans which conform to MnDOT and/or City/County right-of-way requirements are prepared and followed. Antea Group also references the Field Manual of MnDOT Minnesota Manual on Uniform Traffic Control Devices which describes temporary traffic control (TTC) standards. The goal of a TTC zone is to provide safe and efficient movement of traffic around a location where normal function of the roadway is temporarily suspended due to assessment and or corrective action activities. Prior to commencing work on any public road right-of-way permission is obtained from the governing road authority who approves the TTC plan prior to implementation.

Example: **Utility Backfill Investigation**
New Ulm, Minnesota

As part of a site assessment Antea Group investigated potential preferential flow pathways within subsurface utility backfill utilizing hydrovacuum and air knife techniques to expose various utility lines and collect backfill and groundwater samples. Antea Group first contacted the City of New Ulm to verify that the investigation was to be conducted within City right-of-way and to verify the depths and type of utilities present. Due to the investigation being conducted on a truck route located near a residential neighborhood the city requested a more extensive detour be utilized to limit truck traffic through neighborhood streets (for safety and street weight limit purposes).

Due to the nature of the utility investigation work Antea Group requested through Gopher One Call that a utility meet be scheduled so that locators and utility owners were aware of the nature of the work and provide accurate utility mark outs. The traffic control and utility mark out procedures implemented by Antea Group resulted in investigation goals being met safely.

3.29 Prepare and evaluate bid specifications

To provide cost effective solutions for complex remedial actions, frequently prepares and evaluates bid specifications for remedial activities including remediation of soil, groundwater and free phase product. Antea Group utilizes a process which organizes and integrates data collected during site investigations, results of feasibility and treatability studies, pilot tests and risk assessments to provide an alternative analysis and/or focused feasibility study. Alternatives analysis and focused feasibility studies also evaluate Applicable and Relevant and Appropriate Requirements (ARAR) for the site against remedial options in order assure that the designed remedy will meet the regulatory standards and clean up objectives.

Once a remedy is selected, a comprehensive remedial action design is prepared detailing the technical design, installation schedule and projected costs to remediate the site. Based on the design, Antea Group prepares a detailed specification and bidding package, which is submitted to qualified bidders for solicitation of bids. The bid specifications detail applicable codes or permitting, site health and safety, schedule, change order, insurance, contract and/or performance issues the subcontractor must follow. Antea Group provides a specific scope of work in the bid package to ensure there is no uncertainty as to the subcontractor's responsibilities. After the receipt of bids, a contractor is selected to conduct the specified work based on cost, qualifications and the ability to meet the project schedule.

Where applicable, a senior engineer who is experienced with the technology utilized in the designed corrective action reviews every design and specification package developed by Antea Group. When applicable, a licensed professional engineer supervises Antea Group staff preparation of bid packages involving remedial technology design services.

As a Multi-Site Contractor with the MPCA Antea Group is proficient at completing bid specifications and procuring subcontractors for services and construction projects which are less than $50,000 following the MPCA *Subcontractor Purchasing Manual* (Purchasing Manual) and MPCA specific bidding forms. The MPCA purchasing manual process is similar to the process utilized by Antea Group in purpose, detail and review by senior staff. Antea Group also utilizes Target Group/Economically Disadvantaged (TG/ED) when possible as a practice and following Purchasing Manual requirements. When utilizing the process described in the Purchasing Manual, Antea Group provides the MPCA with all applicable forms which detail the requested remedial design specifications or description of services and a complete package for posting on the Minnesota Department of Administration (MDA), Materials Management Division website for advertising the solicitation, as necessary. Following, posting and solicitation of bid specifications under the MPCA Purchasing Manual Process, Antea Group collects, tallies and evaluates the returned bids to recommend a contractor for the award of the work. The recommendation considers cost, qualifications and ability to meet the project schedule.

Antea Group also is proficient at completing the Minnesota Department of Administration bidding process for procuring subcontractors following MDA procurement procedures and forms for MPCA projects which cost $50,000 or higher. This process is similar to the MPCA Purchasing Manual process; however, bids are procured through MDA processes and forms rather than the MPCA Purchasing Manual process and forms. Antea Group has utilized either

the MDA process or MPCA Purchasing Manual process to procure more than a dozen contracts on behalf of and in cooperation with the State of Minnesota during the past several years.

3.30 Conduct and review human health and/or ecological risk assessments

Antea Group has experience in providing the MPCA with risk evaluation technical review assistance as it pertains to health or ecological risk criteria/standards. Below is an example of a project completed by Antea Group for the MPCA Voluntary Investigation and Cleanup (VIC) program.

Example: **Xcel Energy Black Dog Generating Plant**
Burnsville, Minnesota

The Xcel Energy (Xcel), Black Dog Generating Plant (Black Dog Plant) is located between Black Dog Lake and the south bank of the Minnesota River in Burnsville, Minnesota. The Black Dog Plant is located within the Minnesota Valley National Wildlife Recreation Area, which consists of open water, calcareous fen and native prairie area.

Antea Group provided technical support and evaluation to the MPCA VIC staff by reviewing and evaluating the adequacy of the ecological and human health risk assessment prepared for the decommissioning project proposed by a consultant working on behalf of Xcel Energy, at the Black Dog coal yard and ash ponds.

Antea Group reviewed documents pertaining to the site. Additionally, Antea Group evaluated the ecological and human health risk assessment for the site as applicable to current regulatory standards. Antea Group's technical support included evaluation based on understanding and interpretation of screening level risk results, toxicological reviews, groundwater and surface water chemistry, groundwater modeling and geochemical modeling.

3.31 Prepare and review quality assurance project plans (QAPP) and sampling and analysis plans (SAP) in accordance with state and federal requirements

Antea Group understands the importance of establishing clear data quality objectives and is experienced in preparing and coordinating dozens of Quality Assurance Project Plans (QAPP) and Sampling and Analysis Plans (SAP) in accordance with all State and Federal guidelines. Depending on the site complexity and the purpose of the data collection, Antea Group will consult with the MPCA to determine the appropriate level of planning required to ensure the data collection and laboratory analyses will provide an acceptable level of quality assurance / quality control (QA/QC). The primary purpose of a QAPP/SAP is to clearly define the scope of work, personnel responsibilities, lines of communication, field sampling protocols, laboratory methodology, and QA/QC procedures to reduce field sampling and laboratory error. Strict adherence to the QAPP or SAP provides a systematic approach to the sample collection and analysis process that will help ensure that the validated data meets the data quality objectives (DQO) and is usable for making project decisions.

Antea Group's experience in working with contract laboratories and the MPCA in preparing QAPPs and SAPs provide us with the appropriate level of knowledge and understanding to perform technical reviews of these plans on behalf of the MPCA.

Example: **NIROP Superfund Site**
Fridley, Minnesota

Antea Group has worked with the MPCA to review and prepare technical comments on QAPP addendums prepared in accordance with FFA Decision Documents by the Navy for the NIROP site. The QAPP addendums focus on the sampling methodologies, emerging contaminants of concern, and sampling/analysis for monitored natural attenuation parameters.

3.32 Perform feasibility and treatability studies

Antea Group will evaluate and select remedial action alternatives for the site to meet the established cleanup goals. Antea Group will prepare the remedial action alternative report with all required layouts, sketches and conceptual design criteria to clearly indicate the alternative solutions and methods available.

The selection of an appropriate remediation system design for the cleanup of petroleum and other contaminant type sites with impacted soil and groundwater is dependent on many variables. The hydrogeology of the site is arguably the most important factor. In general, sites with shallow groundwater and relatively high hydraulic conductivity can usually be addressed with soil vapor extraction/air sparge, and sometimes over-excavation if the area of the soil contamination is limited. In general, remediation of sites with lower hydraulic conductivity material typically requires more extensive remedial efforts, such as dual phase extraction or use of multiple remedial technologies. The presence or absence of free product strongly influences the potential remedial options. Potential receptors should always be considered during the remediation design.

Evaluation and selection of remedial alternatives at most petroleum sites can be limited to a few typical alternatives that may not require a full Feasibility Study to determine applicability to the site. In certain circumstances such as large-scale petroleum releases, sites with unique geologic conditions, or other contaminant types (CVOC's, pesticides, etc.), Antea Group may recommend a Feasibility Study and/or Treatability Study be performed.

In general, a Feasibility Study will contain:

- General site information (stakeholder involvement, history, hydrogeology, receptors, etc.)
- Site Conceptual Model
- Cleanup Objectives/Regulatory Framework
- Treatability Study Results (if any)
- Technology Descriptions (including No Action and Monitored Natural Attenuation – as applicable)
- Comparison of Technologies for Implementability, Cost, Duration, and Pros/Cons

- Technology(ies) Recommendation

When necessary and appropriate Antea Group is familiar with and evaluates remedial technologies with feasibility studies consistent with the evaluation criteria outlined in the National Contingency Plan (NCP). The nine evaluation criteria are:

A) Overall protection of human health and the environment
B) Compliance with Applicable or Relevant and Appropriate Requirements (ARAR)
C) Long term effectiveness
D) Reduction of toxicity, mobility or volume
E) Short term effectiveness
F) Implementability
G) Cost (Capital, annual and maintenance cost)
H) State acceptance
I) Community acceptance

Example: **76 Station #5663**
Huntington Beach, CA

Antea Group contracted with a specialized microbiology lab to provide troubleshooting services for an aerobic bioremediation approach that failed to perform following two rounds of an oxygen release compound in a site wide injection grid that included over 100 points. TPH-gasoline, BTEX, and MTBE/TBA were the target compounds. Four rounds of performance monitoring were completed following injection and included a full suite of biogeochemical parameters and field measurements. Most of the parameters showed no significant changes, which is highly unusual. Significant fluctuations of carbon dioxide and methane were observed. Antea Group theorized that the issue might be caused by microbiological divergence, a condition where an undesirable population of bacteria flourishes at the expense of all the others.

Groundwater samples were collected at monitoring locations upgradient, within the plume, and downgradient using special microbial sampling tools called Bio-filters. The Bio-Filters were sent to the lab (Microbial Insights – Rockford, TN) and were tested by quantitative polymerase chain reaction (qPCR – a molecular biological method that counts the densities of groups of bacteria that perform specific functions) using a DNA extraction technique. Antea Group requested the lab analyze the samples for total bacteria, gasoline degraders, MTBE/TBA degraders, methanogens (bacteria that produce methane while consuming organic carbon under anaerobic conditions) and methanotrophs (bacteria that degrade methane under aerobic conditions). Results showed the methanotrophs and methanogens were there in abundance while the other types of desired bacteria were overshadowed. As a result of this bench testing, Antea Group has been able to establish a new remediation approach to the site and now makes molecular biological testing standard on all bioremediation sites.

3.33 Design comprehensive remedial action remedies and remediation systems

Antea Group has conducted over 2,500 corrective actions, including the installation/ operation of more than 700 remedial systems on both Superfund and petroleum sites. Antea Group has designed, installed, and maintained over 100 systems in Minnesota. Antea Group's St. Paul office specializes in designing comprehensive remedial action remedies and preparation of bid specifications and has worked across the country providing these services.

The contaminants of concern at these remediation sites included petroleum hydrocarbons, chlorinated solvents, pesticides, herbicides, fertilizers, landfill leachate, heavy metals, wood treatment chemicals, and mineral spirits. These remediation projects have ranged in size from small systems with a skimmer pump in one well to large multi-acre sites utilizing steam injection, soil vapor extraction, and total fluids pump-and treat technologies.

Antea Group's extensive experience with a wide variety of remedial technologies, and its ability to utilize new and innovative remediation techniques, allows for flexible responses to sites that require active remediation. Antea Group utilizes a risk-based approach at all impacted sites with the objective of applying the most cost effective, scientifically sound technology that meets the site remedial objectives.

Our consultants will consider several different remedial alternatives for each site and implement a technology or combination of technologies that best suit the site objectives. Antea Group excels at providing the most cost-effective remedial methods for the following reasons:

- Antea Group has a team of engineers, hydrogeologists, and scientists available with expertise and extensive experience in a wide variety of remediation technologies.
- Antea Group has a corporate culture that encourages the evaluation and use of innovative technologies to obtain maximum site remediation success.
- Experience with a wide variety of remediation equipment and controls including extensive use of computer controls and telemetry. Telemetry effectively reduces operation costs for remote sites by allowing monitoring of system operations from our St. Paul office, limiting the number of necessary site visits.
- The ability to utilize an extensive array of computer models to assist with both the selection and design of remedial technologies. Models available include Visual Modflow, MT3D/RT3D, Visual Groundwater, BIOSCREEN, BIOCHLOR, MLAEM, and SLAEM.

Antea Group has prepared numerous remedial action designs that address remediation of soil, groundwater, and free phase product. First, data collected during site investigation activities, results of feasibility and treatability studies, pilot tests, and the completion of risk assessments is organized and integrated. An alternatives analysis/focused feasibility study is then performed to evaluate appropriate options, considering the Applicable or Relevant and Appropriate Requirements (ARAR) for the site. Once a final remedy is selected, a comprehensive remedial action design is prepared which details the technical design, installation schedule, and projected costs to remediate the site.

Based on the design, Antea Group staff will prepare a detailed specification and bidding package, which is submitted to qualified bidders for solicitation of bids. Antea Group will make a concerted effort to include targeted group and economically disadvantaged groups (TG/ED) vendors and other disadvantaged firms in the bidding process. The bid specifications detail any codes or permitting, site health and safety, schedule, change order, insurance, contract,

and/or performance issues the subcontractor must follow. In Antea Group's specification and bidding packages, a specific scope of work is written to ensure there is no uncertainty as to the subcontractor's responsibilities. After receipt of the bids, a contractor is selected to conduct the corrective actions based on cost, qualifications, and ability to meet the schedule and scope of work.

Antea Group staff, under the direct supervision of a licensed professional engineer, conduct all design services and preparation of bid specifications. Antea Group's remediation team has extensive experience in both traditional and innovative technology designs. A senior engineer who is experienced in the technology being applied reviews every design and specification package that Antea Group produces.

Antea Group's design experience includes:

- A 5,000-foot interceptor trench and cutoff barrier to stop migration and treat groundwater impacted with heavy metals, polychlorinated biphenyls (PCBs), chlorinated solvents, and petroleum products to a major river at an active primary steel mill.
- A dual phase extraction system to remove the phthalate DEHP (a plasticizer) at a chemical manufacturing facility.
- A vacuum enhanced pump and treat system to collect free phase petroleum product and dissolved phase impacts in a fractured bedrock environment at a bulk petroleum terminal.
- Numerous air sparge/soil vapor extraction systems designed to address petroleum soil and groundwater impacts at former UST sites.
- A soil vapor extraction system to address perchloroethene impacted soil under an industrial laundering/dry cleaning facility.
- Two separate air sparging systems to intercept MTBE plumes moving towards a water supply well and a surface water body near a petroleum pipeline transfer station.
- A large-scale steam injection, dual phase extraction, and soil vapor extraction system to reclaim diesel fuel from a former railroad terminal.
- A constructed wetland featuring a stepped aeration system to treat leachate from a commercial landfill.
- A nutrient injection and recirculation system to increase the in-situ bioremediation rates at an operating railroad facility.
- Installation of a bedrock petroleum vapor extraction system (75 wells) and pump and treat system (5 recovery wells) at a large petroleum pipeline release in Wisconsin.
- A large scale (1,000,000+ cubic yards) excavation with ex-situ thermal treatment to address a crude oil pipeline release into an agricultural field.

3.34 Conduct and oversee remedial investigation

Antea Group staff conducts and oversees all phases of the Superfund response action process; we have the experience and capability to take projects from start to finish, including Phase I ESAs, remedial investigation, feasibility studies, remedial design, remedial action, and operation and maintenance of remediation systems including the termination and decommissioning of these systems. We have worked on diverse sites including

chlorinated solvent storage and recycling and distribution facilities, hazardous waste storage facilities, fueling terminals (refinery's and bulk plants) and industrial sites with petroleum contamination, restricted wastes, hazardous wastes, and regulated wastes. We utilize our experience across the full range of these projects to inform the scoping and decision-making of projects. We function as a team with the client and regulatory agency, utilizing staff with the necessary experience and skill sets to attain project goals and objectives.

We are familiar and experienced in the Superfund process and have worked within the CERCLA Superfund process on numerous projects across the United States. Antea Group has worked on Superfund projects directly overseen by the United States Environmental Protection Agency (USEPA) and on Superfund projects under State oversight. Antea Group has utilized a wide variety of characterization, monitoring, and remedial technologies within the Superfund process. Antea Group's understanding and experience with the Superfund process enables continual evaluation of collected data and of data gaps as the project proceeds through the defined steps adding efficiency to the process and allowing the focus to remain on the end goal of site cleanup and project closure.

Often following the site discovery an emergency response action is required to mitigate imminent threats to human health and the environment. These actions typically include community involvement and feedback as do nearly all the Superfund process steps. Antea Group has a well-defined emergency response process used in conjunction with a 24-hour response call center. The call center identifies the Antea Group contacts based on geographic location and directs the call accordingly. Emergency response actions can occur at any time during the remedial investigation process as deemed necessary to address issues/contaminants and stakeholder concerns.

Characterization of the release truly begins with the Preliminary Assessment/Site Inspection (PA/SI) step which investigates the site conditions to preliminarily determine the impacts and site conditions. This initial step in the process is more a reconnaissance to determine if further emergency actions are needed to address immediate threats to human health and the environment than a characterization of the magnitude and extent of impacts. Following the PA/SI is when the site is evaluated for listing on the National Priorities List (NPL).

The Remedial Investigation/Feasibility Study determines the extent of impacts at the site and typically utilizes a wide variety of investigative tools and methods to completely define the extent of contaminants at the site. Data gathered must be reviewed, validated and evaluated for completeness and data gaps as all this information is used to assess the treatability of the impacts and evaluates the potential performance and cost of treatment technologies. Evaluation of remedial alternatives and technologies is an important step in the Superfund process. Antea Group has utilized numerous traditional and innovative technologies to address impacts and gain site closure. Development of a treatment "train" of technologies is often key to reaching the remedial goals and gaining site closure.

Following the development of the chosen remedial alternative, a Record of Decision is developed which fully explains the agreed upon remedial alternative to be used and clearly defines the remedial goals and conditions for site closure. The National Remedy Review Board reviews remedies that exceed 25 million dollars.

Once the ROD is completed a Remedial Design/Remedial Action plan is prepared which describes in detail the implementation and specifications for applying the remedial alternative. This stage of the Superfund process is typically where most of the cleanup is accomplished. This stage of the process often requires several years to

complete as remedial technologies and actions are accomplished along with monitoring and reporting. Substages within this stage of the process include Construction Completion and Post Construction Completion. Construction Completion identifies completion of the physical cleanup construction, although it does not necessarily mean the remedial goals have been achieved. Post Construction Completion ensures that the response and cleanup at the site provide for long-term protection of human health and the environment and includes Long-Term Response Actions (LTRA), operation and maintenance, Institutional Controls, Five-Year Reviews, and Remedy Optimization as the cleanup progresses towards the remedial goals. Once the response actions are completed and all identified remedial goals have been achieved, the site can be removed from the NPL and reuse of the property may begin.

Example: Former Refinery
Wrenshall, Minnesota

A former petroleum refinery, located immediately adjacent to a State Park, was closed in 1983 and was listed on the Minnesota Superfund list of priorities. The site had been undergoing investigation for over a decade, with only minimal progress toward site remediation and closure.

Antea Group's client's intent was to enter into a Stipulation Agreement with MPCA, obtain Superfund delisting, manage the cleanup in concert with the Large Facilities Section of the MPCA, and obtain a deed restriction on the property for industrial use.

Antea Group assisted the client in negotiating several complex regulatory hurdles and technical challenges in order to effectively structure the cleanup to meet differing objectives. Chief among these: the property is currently operated as a bulk petroleum terminal and loading facility, and the former refinery cleanup needed to have minimal impact on existing operations.

Antea Group met the challenge through effective negotiation with the regulatory agency, including development of Active and Inactive facility areas, and establishment of reasonable cleanup standards. Active areas of the facility, where operations are continuing today, were scheduled behind inactive facility areas in terms of cleanup. This resulted in cleanup of the former refinery operations, where impacts were greater, at a faster pace and without hindering the existing facility operations. Soil in former refinery areas requiring remediation was excavated, and either land treated on site or disposed of offsite. This approach enabled the agency to propose the site for Superfund Delisting.

3.35 Oversee installation of remedial actions and remedial systems

Antea Group oversees the installation of a variety of ex situ and in situ remediation systems around the world. Our oversight starts with thorough planning and communication with clients, regulators, subcontractors, and the public (as necessary). Safety is an important element of all we do and Antea Group ensures that a quality Site Specific Health & Safety Plan is in place and well understood by the project team. Project risks are evaluated upfront through various Engineering Assurance programs that use senior technical/engineering staff to identify and discuss potential issues. A project cannot proceed without this review.

In the field, Antea Group ensures that utilities have been located, marked and that proper clearances have been completed for any intrusive work or trenching. In addition, we ensure that tailgate safety meetings are held and that the on-site project team has signed off on the meeting. During remediation system installation, Antea Group observes safety practices and ensures that site logistics are well known. Antea Group watches to see that all field work is performed per the site-specific work plan. This includes proper well installation and development, mixing of remediation amendment in proper ratios, injecting amendments at appropriate pressures/flows, installation of trenches, completion of excavation (with shoring as needed), and installation of equipment with correct utility hook-up and shake down. Materials and equipment brought to the site are reviewed and evaluated to make sure that quality and level of performance/accuracy are present. Daily field notes document the entire work day at the site and photos are taken as needed. Antea Group communicates and manages any safety issues and reports those occurrences back to our corporate health and safety group both verbally and through our incident reporting system. Antea Group has overseen the installation of numerous corrective actions and remediation systems since its founding in 1986. Antea Group has overseen the installation and decommissioning of two remediation systems for MPCA fund-financed sites, Clark Oil and Isanti-Schumacher.

The Isanti-Schumacher remedial action involved the installation of an SVE system which consisted of 8 SVE wells, underground lateral connecting piping, and SVE equipment housed in a skid mounted building. Antea Group oversaw the selection and procurement of SVE system components from different MPCA remediation systems at other sites to re-use/recycle existing equipment and minimize further impact to the environment. Antea Group oversaw all aspects of the system installation including well drilling, underground trenching and piping, system integration, equipment and building placement, system connections and testing, and contractor oversight. Following completion of the remedy, Antea Group provided oversight of the system decommissioning and removal from the property.

Antea Group oversaw the installation of an AS/SVE remediation system at the Clark Oil site. The system consisted of 20 AS wells, 15 SVE wells and underground piping connecting each well to a system equipment building including the use of previously installed underground structures where practical. Activities overseen included well drilling, underground trenching and piping, system integration, equipment and building placement, system connections and testing, and contractor oversight. Antea Group provided oversight of the system decommissioning in 2015.

3.36 Conduct surface water, ground water, and hydrodynamic modeling

Antea Group is familiar with and utilizes a variety of analytical and numerical models (steady state and transient) to evaluate groundwater flow at sites across the United States. Typically, the questions to be answered, the level of site complexity, and available site data dictate the type of model that will be utilized. For example, evaluating the horizontal capture zone dimensions at a single well under uniform hydrogeologic conditions could be performed using a relatively simple analytical calculation or an analytical 2-D model such as CAPZONE. For more complex sites involving multiple geologic layers and vertical components of groundwater flow, a three-dimensional numerical model would likely be required.

For larger three-dimensional numerical modeling projects, Antea Group begins by meeting with the project stake holders to understand the objectives of the modeling effort and to outline the modeling steps and data compilation

requirements. Antea Group's modeling team utilizes GIS and database technologies for the compilation, management and interfacing with the modeling software for both model input and output. This allows for model-ready formats and streamlines output evaluation. Model development begins with a conceptual site model (CSM) which is a summary of the major components of the flow system and the processes that link them together. The CSM identifies the aquifers and their extent, the associated water bodies, the stresses of pumping and recharge, and the physical process of water moving through porous media. In designing the model domain Antea Group attempts to utilize natural groundwater flow divides or discharge areas to establish boundary conditions sufficiently beyond the focus area of the modeling project to minimize potential boundary effects during modeling. A grid is superimposed over the model domain with more detailed discretization in the areas of interest.

Aquifers and aquitards are represented by unique model layers to correlate with the CSM. Likewise, boundary conditions are designed to represent the natural boundaries incorporated into the model domain (i.e., streams, lakes, rivers, wells, and recharge). Once the model is constructed with topographic features and is running, it is evaluated to assess mass balances of flow through the various model layers and is critically compared with the CSM to ensure the model can adequately replicate the natural system. Assuming the model mass balances are acceptable, Antea Group will initiate model calibration using known head target elevations, stream base flow fluxes, and hydraulic gradients. Calibration can be performed both manually, by trial and error, and using automated inverse solutions, such as PEST. Antea Group attempts to achieve calibration manually before employing PEST which can be used to identify modifications to the model's aquifer properties to improve model calibration statistics. Sensitivity analysis is performed to identify the key (i.e., most sensitive) model input parameters. Stochastic MODFLOW is also used to evaluate the uncertainty of the model predictions using Monte Carlo techniques which automatically adjust selected model parameters using a minimum and maximum parameter range, specified data distribution types, and associated statistical characteristics during multiple (i.e., hundreds to thousands) of model simulations.

Once the model uncertainty is evaluated, the model can be used for predictive purposes with the uncertainty of the results communicated to the stake holders. Antea Group will document the model purpose, development and findings in a comprehensive report that presents the model output in graphical and map form typically using GIS data management software.

Antea Group uses models to help answer a variety of groundwater flow questions used in decision making that can range from wellhead protection to optimization of remedial systems. Consequently, with any modeling effort, a clear understanding of the site conceptual model and the selected model's limitations and the uncertainty associated with the model input and output need to be revisited throughout the modeling process.

Antea Group has experience working with the following unsaturated and saturated flow models:

- HYDRUS – 1D
- VS2DTI – 2D
- SESOIL – 1D
- VLEACH – 1D
- ATRANS V2
- RISC 4.3b

- CAPZONE – 2D
- VISTAS 6 – 3D MODFLOW

3.37 Perform asbestos identification and if necessary oversee asbestos abatement and removal

Antea Group field personnel are trained to recognize potential asbestos containing materials (ACM). In accordance with the National Emission Standard for Hazardous Air Pollutants (NESHAP), if potential ACM is identified during onsite field activities, Antea Group's procedure is to contact a certified licensed asbestos contractor that specializes in ACM for abatement activities.

Below is a project example in which Antea group provided identification of and subsequent ACM abatement oversight during a MPCA remediation system installation project.

Example: **Clark Oil**
St. Paul, Minnesota

During remediation system underground trenching activities, presumably insulation from old boilers, roofing material, piping insulation, and gaskets, was observed in the subsurface trenches. Due to the potential asbestos and safety concerns, and in agreement with the subcontractor's asbestos awareness requirements, site work was stopped.

Antea Group field personnel collected four potential ACM samples which were submitted for laboratory analysis utilizing EPA Method 600/R-93/116, 1993. Laboratory analytical results indicated chrysotile percentages ranging from 60 – 95% which confirmed the presence of ACM.

In accordance with the NESHAP, a certified licensed asbestos contractor was contracted to be present in order to proceed with the excavation and abatement of the ACM. Antea Group provided oversight during the segregation of the ACM, testing and disposal of the material.

3.38 Conduct third party review and analysis of technical information for the purpose of providing conclusions and recommendations to the state

Antea Group's collective team of engineers, hydrogeologists and scientists have the knowledge and experience to provide the MPCA with third-party reviews of various documents which include, but are not limited to HASP, site investigation reports and work plans, QAPP, SAP, field testing, response action plans, feasibility study, pilot test, remedial action, system monitoring reports, risk assessments, and Five-Year Review reports.

Depending on the technical document(s) that Antea Group is asked to review, we will assign the appropriate resources with the technical expertise and experience to adequately review and analyze the document information for purposes of rendering conclusions and recommendations that meet the current professional standard of care. Antea Group routinely provides comments, recommendations and suggestions following third party review and technical evaluation of documents as well as responses addressing comments received.

Example: **NIROP Superfund Site**
Fridley, Minnesota

Antea Group is currently serving as a third party technical reviewer on behalf of the MPCA for the NIROP Superfund Site in Fridley Minnesota. Since 2008, Antea Group technical staff has reviewed all technical documents issued by the Navy and/or its consultants/contractors. Following review of technical documents Antea Group compiles technical comments and questions for incorporation into MPCA response letters often involving multiple iterations. These technical documents have included: Annual Monitoring Reports (AMRs), Aquifer Performance Testing Plans and Reports, System Design Modification Plans, Recovery Well Installation work plans and Reports, Monthly System O&M Reports, USGS – NIROP Groundwater Flow and Transport Model Report, Source Investigation Draft Work Plans, Source Investigation QAPP/SAP, Five-Year Reviews and remedy optimization reports. In addition, the technical resources assigned to the NIROP project participate on behalf of the MPCA during Partnership Technical Team conference calls and meetings with the Navy and EPA technical teams to collaborate and provide technical input. Antea Group also provides technical support for MPCA during conference calls and meetings with local stakeholders including the City of Fridley.

3.39 Provide support for the analysis and development of program policy and guidance, including developing health or ecological risk criteria/standards (including technical report production)

Antea Group has experience in being actively involved in collaborations with EPA and State regulatory programs, particularly UST/LUST and Drinking Water, to survey and collect groundwater cleanup, guidance, and MCL data. This data has been extensively utilized to collaborate with and educate the regulatory community, responsible parties, the oil and gas industry, and various other stakeholders in a variety of topic areas and issues related to management of contaminated sites.

Antea group conducts regulatory trend tracking and maintains an extensive contact database of information, and knowledge for tracking EPA/state regulatory trends in the following key issues: Institutional Controls and long-term risk management of residual contamination, primarily as a result of risk-based LUST site closures under RBCA or RBDM programs; State-specific Remediation by Natural Attenuation (RNA), or Monitored Natural Attenuation (MNA) approaches for LUST and chlorinated solvent sites. In collaborations with industry, API, and with regulatory programs, we utilize innovative tools and probabilistic decision analysis methods and tools for estimating LUST lifecycle costs. Inputs to the tools utilize site-specific, risk-based site characterization data and the site conceptual model (SCM) approach.

In addition, Antea Group has experience in providing the MPCA with risk evaluation technical review assistance as it pertains to health or ecological risk criteria/standards. Below is an example of a project completed by Antea Group for the MPCA Voluntary Investigation and Cleanup (VIC) program.

Example: **Xcel Energy Black Dog Generating Plant**
Burnsville, Minnesota

The Xcel Energy (Xcel), Black Dog Generating Plant (Black Dog Plant) is located between Black Dog Lake and the south bank of the Minnesota River in Burnsville, Minnesota. The Black Dog Plant is located within the Minnesota Valley National Wildlife Recreation Area, which consists of open water, calcareous fen and native prairie area.

Antea Group provided technical support and evaluation to the MPCA VIC staff by reviewing and evaluating the adequacy of the ecological and human health risk assessment prepared for the decommissioning project proposed by a consultant working on behalf of Xcel Energy, at the Black Dog coal yard and ash ponds.
Antea Group reviewed documents pertaining to the site. Additionally, Antea Group evaluated the ecological and human health risk assessment for the site as applicable to current regulatory standards. Antea Group's technical support included evaluation based on understanding and interpretation of screening level risk results, toxicological reviews, groundwater and surface water chemistry, groundwater modeling and geochemical modeling.

3.40 Conduct/perform five year reviews and site reviews

Antea Group has performed Five-Year Reviews at multiple Environmental Protection Agency (EPA) National Priority List (NPL) sites, also known as superfund within the past several years. Five-Year Reviews are required by EPA for NPL listed sites. Antea Group has performed Five-Year Reviews for sites within Minnesota which are in the EPA enforcement deferral pilot program in which the EPA has deferred to the MPCA as the lead regulatory agency for the site in question. Five-Year Reviews are performed following the EPA *Comprehensive Five-Year Review Guidance* (2001) and guidance or format updates as applicable to the site.

Antea Group completes all components of the comprehensive Five-Year Review process when conducting a Five-Year Review, including:

- File Review;
- Site Visit;
- Interviews with Stakeholders, Regulators, Responsible Parties (RP) as applicable;
- Draft, finalize and publish a public notice in a qualifying local newspaper;
- Review site decision documents including ROD, MEDD, ESD, Consent Orders, and RAP;
- Review historical and current site data;
- Evaluate current conditions against the selected remedy and remedial progress to date
- Evaluate institutional controls in place for the site
- Evaluate applicable or relevant and appropriate requirements (ARAR) for the site
- Identify Issues based on current site conditions, ARAR, changes to site conditions or area property use, and up to date professional or regulatory standards;
- Provide recommendations to resolve issues identified;
- Determine protectiveness based on the comprehensive review;
- Develop a Draft Five-Year Review and finalized document following comments from MPCA and EPA.

Antea Group also performs reviews of non-NPL sites in a similar manner to Five-Year Review following similar format to the EPA *Comprehensive Five-Year Review Guidance*, however, since non-NPL sites are subject to different administrative structure some portions of the guidance such as a public notice are not performed. Site reviews to

evaluate remedial progress are performed at sites that are not listed on NPL at the request of the regulatory agency. The scope of the review of non-NPL sites is developed prior to the review in cooperation with the regulatory agency. Antea Group has also provided technical evaluation of proposed remedial alternatives or proposed RAP modifications during a site review or Five-Year Review.

Antea Group has conducted Five-Year Reviews at the following sites: Oakdale Dump, General Mills/Henkel, Perham Arsenic Site, Reilly Tar and Chemical Corp., Long Prairie Groundwater Contamination Site, Koppers Coke, Kurt Manufacturing, FMC Corporation Site. Antea Group is also providing support to the MPCA in review of the Naval Industrial Reserve Ordinance Plant (NIROP) site Five-Year review being conducted by the Navy.

Example: **Reilly Tar and Chemical Corp. Superfund Site**
2015 Five-Year Review
St. Louis Park, Minnesota

The Reilly Tar and Chemical Corporation (Reilly) Superfund Site (Site) is located in St. Louis Park, Minnesota. The Reilly Tar Site operated as a coal tar distillation and wood preserving plant from 1917 through 1972. During the time that the Reilly facility operated, wastes containing coal tar and its distillates were disposed of into a ditch that emptied into a peat bog to the south of the Site. The discharge into the bog continued for the duration of the facility's operation. Consequently, many private wells and eventually municipal water supplies became contaminated with polynuclear aromatic hydrocarbons (PAHs).

Remedial action at the Site to address PAH-impacted groundwater is addressed through treatment and gradient control through pumping. Granular activated carbon (GAC) is utilized to treat PAH-impacted groundwater, from municipal wells, to meet drinking water standards prior to entering the City of St. Louis Park municipal water supply. There are five operable units (OU) in place at the site, all of which were evaluated in the 2015 Five-Year Review. Operable units describe a media (i.e. soil or groundwater) and/or specific portions of a site where a remedial action has been selected to address contaminants found within that portion of the site. Evaluation of the remedial progress of the site concluded that remedial actions at four of the five OU continue to be protective of human health and the environment. Protectiveness at OU2; however, was determined to be protective in the short-term due to additional data that needed to be collected and evaluated against ROD requirements. The 2015 Five-Year Review concluded that in order for the remedy to be protective in the long-term, the following actions, related to protectiveness of OU2, need to be taken: 1) Evaluate additional monitoring locations and increase gradient control in the Prairie du Chien Aquifer southwest of the Site; 2) Conduct additional groundwater modeling to evaluate plume boundaries and capture zones; 3) Develop and implement an institutional control (IC) study and IC plan; 4) Identify potentially leaky multi-aquifer wells in areas of the current Site plume not previously investigated.

3.41 Prepare draft decision documents and other documents such as grant applications, draft, institutional controls, and permit applications

Antea Group has provided assistance to regulators on project specific review, evaluating and summarizing adherence to regulatory requirements that is used to formulate decision documents. Our staff also has broad and deep experience

completing, submitting and receiving numerous environmental permits. We permit special and hazardous waste disposal; water discharge to sanitary sewers through POTW permits; discharge to surface water through site specific and general NPDES permits; air emission permits; as well as supporting well driller and construction trade subcontractors in securing well installation and various building permits for remediation system installations. We also are adept at securing off-site access agreements to perform investigation and remedial actions.

The Antea Group St. Paul staff has participated in numerous public information meetings related to environmnetal impacts in communities. We have prepared site fact sheets and worked with clients, cities and regulators to educate and respond to local residents over concerns and potential health risks in their community. Examples include public informational meetings regarding the significant West Shore Pipeline spill near Jackson, WI where we had 70 alternative water supply systems installed and informational meetings supporting the MPCA with community concerns with sites in the south west Fridley area.

Antea Group has prepared Draft Minnesota Environmental Decicion Documents (MDD) for MPCA managed and funded sites. Sites where Antea Group has provided Draft MDD include the Isanti Schumacher Site and the Mankato Plating Site. In addition to providing support to develop Draft MDD documents Antea Group has provided support to develop site document repositories and Draft Technical Memorandums sumarizing site investigations and remedial actions in support of site closure.

In order to achieve cost effective site remedies, Antea Group employs Engineering and Institutional Controls. Engineering controls include physical structures that manage the regulated substances in place often providing barriers to assure that contaminants of concern do not further contribute to receptor impacts or present exposure risk to human health through direct contact. Engineering controls are designed for continuous and long-term use, but must be maintained to ensure they function as planned. Common engineering controls include capping a site with pavement, an impermeable membrane or soil or aggregate to prevent dermal contact and/or precipitation infiltration and vapor migration. Fencing can also be used to limit site access. Institutional controls, such as limits to land use or access can be put in place to limit or prohibit site uses. Institutional controls, also referred to as “activity use limitations” (AULs), are often registered on the property deed or in another central database.

Antea Group also has experience with implementing area wide institutional controls for areas with multiple contributing release sites and/or extensive groundwater plumes. Antea Group has worked with the MPCA to draft documents required to implement a Minnesota Department of Health (MDH) Special Well and Boring Construction Area (SWBCA) for the south west Fridley area. A SWBCA affects a large area of concern and requires additional protection by requiring additional review of well permits in the area and requiring engineering controls to be implemented to prevent further contaminant spread and exposure to impacted groundwater.

While engineering controls such as capping and fencing are fairly simple to implement, deed restrictions and other land use controls are slightly more complex. Antea Group has had extensive experience with deed restrictions and land use controls. We have:

- Applied engineering controls to over 500 projects and received more than 400 regulatory closures.
- Developed and advocated programs with responsible parties, municipalities, regulatory agencies, and private third parties for engineering controls as remedial actions.

- Have piloted and continue to evaluate partnerships with permitting and utility locate companies who would participate in the notification of land use controls.
- Reduced overall remediation costs by 20% to 60% for active remediation projects by applying land use controls on residual impacted areas while focusing active remediation efforts on highly contaminated soils or liquid phase hydrocarbon groundwater sources.

3.42 Perform operation and maintainance system review and optimization

During O&M visits, Antea Group staff collects system performance and operational data that is utilized to track trends and determine whether system modifications are necessary to maximize performance. Treatment discharge samples required by the MPCA or other governmental agencies are collected to monitor the system's discharge criteria, mass removal and system performance. Subsequent to the O&M visit, the collected data is entered into a project database for tracking and trend analysis. In many cases, groundwater monitoring is also used to confirm the success of the system's operation.

Office O&M activities typically use the database to track the performance of key operational and monitoring data. Following each field visit, Antea Group engineers evaluate the data collected to gauge the effectiveness and efficiency of each system. Remediation progress is continually compared to the remedial objectives. The project team meets as needed, typically monthly or quarterly, to evaluate the system and discuss operational changes that may be needed in order to reach the remedial objectives. During these meetings, the remedial objectives are discussed to validate the current technology and effort. Antea Group focuses on meeting the remedial objective to minimize project costs and duration.

Quarterly project updates and annual operation and maintenance reports are prepared by Antea Group to update the State on system performance. Antea Group also works closely with the State and other stakeholders to communicate system performance and progress toward site closure.
Antea Group utilizes the MPCA PRP Remediation System Operation Monitoring Report Guidance Document 7-08 for documenting O&M activities of remediation system projects in the State of Minnesota.

Example: **Former Amoco Terminal No. 407**
Green Bay, Wisconsin

Antea Group operated a total-fluids recovery and treatment (TFRT) system with soil vapor extraction (SVE) at the Tilot Oil site beginning in May 2011. The system was designed to control the hydraulic level of groundwater and induce a negative vapor pressure gradient below the basement slab of Building D. Hydraulic control is achieved through a network of six extraction wells installed in the basement of Building D, each equipped with a pneumatic, total fluids pump designed to recover free product and groundwater from beneath the basement slab. A negative pressure gradient below the basement slab is created by applying a vacuum to each of the six extraction wells. The SVE system is driven by a regenerative vacuum blower in the treatment building.

Construction and installation activities for the system took place from November 2010 through May 2011. The system was started on May 31, 2011.

Prior to start up a set of baseline depth to groundwater, LNAPL thickness and vacuum data were taken from monitoring wells located in the basement of Building D and from wells located outside the basement of Building D.

Modifications were made to the recovery system to facilitate maintenance and ensure satisfactory system performance. These modifications include the replacement of system piping to fix leaks, changes to piping to facilitate cleaning, removal of piping to the previously removed product tank, and installation of a pressure gauge. Changes were also made to the organization of the control panel.

Operational, maintenance, monitoring, and optimization reporting forms and system data tables and charts are included in all reports, and system performance is monitored on a regular, periodic basis and reported to the state regulatory agency.

The purpose of the SVE system is to maintain a negative pressure beneath the basement slab of Building D to prevent potential vapor intrusion into the basement. Prior to system start up, vacuum was measured at the monitoring points. These baseline vacuum measurements at each monitoring point were zero. Since start up, the vacuum has been measured at these same monitoring points on a weekly basis. The results of these measurements confirm that the system has maintained a vacuum beneath the slab at Building D since system start up. The SVE system has successfully induced a measurable vacuum at all monitored points located within the basement of Building D and hydrocarbon recovery in the SVE vapors has averaged 0.71 pounds per day.

The purpose of the TRFT system is to prevent fluid intrusion into the basement of Building D by maintaining a drawdown such that the groundwater elevation is maintained below the base of the concrete slab elevation. The pump intakes are located two feet below the base of the basement slab. All data collected to date confirm that the system is successfully maintaining the groundwater elevation beneath the basement slab.

The TFRT SVE remediation system has met its operational design objectives. The effectiveness of the system was assessed by determining whether the system is preventing subsurface vapor migration and fluid infiltration into the basement of Building D.

3.43 Research, evaluate, and implement innovative technologies

Antea Group has recently developed several new and innovative remedial technologies. Two of these technologies have been awarded patents by the United States patent office.

Zero discharge soil vapor extraction system, Enhanced Concentrated Oxygen (ECO) SVE – A non-governmental organization (NGO) filed a lawsuit against an air quality regulatory district in Southern California that eventually resulted in a moratorium being placed on new emission permits starting in January 2009. This moratorium had a direct impact on those remediation projects in Southern California where remediation by Soil Vapor Extraction (SVE) with permitted emissions of treated air streams to the atmosphere was being planned. Under the moratorium, emissions allowances were essentially reduced to zero, and any emissions above this level would require the purchase of expensive emission-offsetting credits. The cost impacts to a typical remediation project in the region were immediately clear and Antea Group soon thereafter began working on the identification of technologies that could be applied to more cost-effectively treat emissions under the new regulatory conditions. In July 2012, Antea

Group was awarded Patent No. 8,210,772 B2 for the Enhanced Concentrating Oxygen (ECO) SVE system, a technology that is based on the separation of extracted air streams aboveground by pressure swing adsorber technology and the reinjection of oxygen back into the subsurface, to stimulate bioremediation. At the first site, the system was used the local air permitting regulatory agency stated that the treatment system is permit-exempt. The system is a re-circulatory system that does not have emissions to the atmosphere. Its operation costs are substantially smaller than traditional soil vapor extractions systems and the entire process is focused on bioremediation (in ground destruction) of the contaminants versus removal and treatment.

Sulfate Enhanced Bio Remediation - The opportunity to improve sulfate remediation technology was identified after working with conventional sulfate remediation technologies and gaining an understanding of the limitations of those technologies. After designing and modeling the improved technology, Antea Group secured regulatory approval to test it, and after successful deployment, secured a US Patent (No. 7,138,060), thus establishing the improved technology's unique position among remediation technologies. The technology is a simple application of Magnesium Sulfate in concentrations above 1,000 ppm to stimulate existing sulfate reduction mechanisms. The material is generally applied via gravity feed through groundwater wells or trenches. This simple application minimizes site disturbances and there are no long-term operation and maintenance requirements. The enhanced degradation processes occurs over weeks and months. Costs are minimal compared to traditional remedial techniques like pump and treat, air sparging, or dual phase extraction.

Plume Stop™ Capture and Treat - In 2012, Antea Group became the first consulting firm to evaluate a unique capture and treat technology. Plume Stop™ is comprised of water-soluble, non-toxic ingredients typically applied via direct push injection or into injection wells. This technology is protected by Regenesis patents and patents pending. It is an environmentally friendly, water-soluble composition that is injected into soil and groundwater. After the material is distributed in the subsurface, it undergoes a cross-linking process on the order of days to weeks which forms a sorbent network on the surface of soil without plugging the formation. Plume Stop™ reacts in situ to form a sorbent network throughout the contaminated zone. The intended function of the Plume-Stop™ technology is to; 1) Adsorb contaminants and reduce groundwater concentrations, 2) Inhibit transport of contaminants in groundwater, and 3) Provide a matrix for bacteria and contaminants to facilitate natural attenuation.
Recent laboratory and field studies on the Plume Stop™ technology indicate that it should have negligible impacts on groundwater oxidation-reduction potential (redox) and geochemistry. The sorbent network is intended to last in excess of a few years, and possibly 10 years or more. Laboratory studies have also shown that the biodegradation of the Plume Stop™ itself is negligible under both anaerobic and aerobic conditions for time periods of at least one year.

Carbon Footprint Calculator – In late 2008, during Antea Group's monthly technical-sharing WebEx series, Antea Group's European colleagues demonstrated an Excel-based beta-version tool for calculating the carbon footprint of remediation projects. The concept behind this tool generated considerable interest among Antea Group's US colleagues. Soon thereafter, the Europe and USA offices initiated collaboration on the development of a more comprehensive tool. During mid-2009 Antea Group won a 2009 contract from US EPA Region 9, funded by the state

of California, for development of the LUST (Leaking Underground Storage Tank) Cleanup Footprint Calculator (EPA Calculator). The EPA Calculator Design Specification was prepared specifically for California inputs, but can be readily adapted to any US state or other global geography with region-specific adjustment of calculation coefficients and factors as well as for reporting the calculations units in equivalent 'Metric Tons of CO2 Emissions.' The Design Specification was completed in mid-2010, and the web-based implementation of the EPA Calculator is available on line at the State of California web site http://www.ustcalc.com/ .

Example 1: ECO SVE

Former Retail Service Station, Simi Valley, CA

Antea Group began management of a typical retail service station hydrocarbon contamination site in 2009. At this time, the site had been an open leaking underground storage tank case for 20 years. Several different remedial techniques had been proposed for the site over the years but none were implemented. Antea Group proposed the installation of the ECO SVE to remediate the impacted groundwater and soil at the site. The system was installed in December of 2010. By May of 2011, the inlet concentrations of hydrocarbon extracted vapors were substantially reduced and the groundwater concentrations of benzene, MTBE and TPH particularly were lowered to or near non-detectable levels. The system was turned off for a rebound test. The rebound test indicated that the concentrations remained low, at this time several confirmatory soil borings were installed along with regular groundwater monitoring. Based upon the results of the soil samples and groundwater data the State regulatory agency granted no further action. The ECO SVE system had successfully remediated this site in under a year, with no air permit required for the remedial system.

Example 2: Sulfate Enhanced Bioremediation

Former Retail Service Station, Porterville, MI

Antea Group was selected to manage a leaking underground storage tank site after two documented releases. Prior to Antea Group's involvement several different remedial techniques such as total fluids recovery, biosparging, natural attenuation was attempted at this site with limited success. Groundwater at the site was shallow, one to two feet below ground surface, and was located near a sensitive receptor (wetlands). Data collected from the site indicates that natural sulfate concentrations in the plume were absent or very low as compared to other data points outside the plume. This helped Antea Group's technical team to implement a program of sulfate enhanced bioremediation. Hydrocarbon concentrations at the site remained elevated and were not acceptable to allow site closure. Antea Group created a plan to introduce four separate applications of sulfate solution into the subsurface over one year. Soon after the last application, the benzene, toluene, xylene and ethylbenzene concentrations were all substantially reduced and allowed the site to receive a no further action letter from the regulatory agency. The sulfate solution was applied through existing wells, cost less than $7,500, created no waste and supplemental utilities were not needed.

Example 3: **Plume Stop™ Capture and Treat**
Active Retail Service Station, San Jose, CA

Antea Group oversaw the site evaluation, injection, and monitoring of a new technology to address TPH-gasoline and BTEX impacts in a source area. TPH-gasoline in two source area wells averaged 4.4 mg/L. An injection of Plume Stop™ was designed and intended to partition hydrocarbons out of groundwater in the vicinity of these wells. The application injected 8,100 gallons of Plume Stop™ solution divided equally into 7 injection points. The groundwater was monitored monthly for TPH-gasoline and BTEX for three months after application in three source area wells, then again at six months.

Following the Plume Stop™ application, groundwater in the treatment area wells exhibited approximately a 10-fold increase in petroleum hydrocarbon concentration at the 1 month monitoring event, but at the 2-month monitoring event, petroleum hydrocarbon levels had declined significantly and remained stable. As expected, geochemistry was relatively unchanged through the test. Ultimate reductions of 60% TPH-gasoline and 90% of BTEX in the source area wells were observed after six months.

3.44 Prepare presentations and present information at meetings

Antea Group regularly makes presentations to clients, regulatory agencies, municipalities and at national conferences. Our staff is skilled in preparing presentations utilizing the most current electronic media via teleconferencing or in face to face situations.

Antea Group also provides public relations support often being a vital component of many projects. Through in-house public relations specialists, we have the expertise to establish and implement an effective public involvement program to complement a variety project and/or client needs.

Our staff has participated in numerous public information meetings and public hearings regarding a variety of environmental issues. We have partnered with many cities, educating local residents and responding to media inquiries and other concerns over potential health risks in their community.
We are very familiar with state and federal EPA public involvement requirements and programs, and work attentively to provide our clients with the appropriate level of support. Antea Group professionals have represented clients at numerous public information sessions, public hearings and press conferences. Our comprehensive services include needs in all areas:

- Community relations plan preparation.
- Public meeting representation/presentations.
- Media relations strategies.
- Coordination with state/federal regulatory agencies.
- Public notification (public notices, news releases).
- Risk communication or consensus building.
- Training / conferences.
- Educational material preparation.

Our staff has also designed and delivered workshops on various environmental technologies at statewide regulatory staff meetings, including coursework provided instruction on concepts of remedial technology, design criteria and

engineered alternatives. In addition, we have given several presentations at the EPA-sponsored and 50-states attended National UST/LUST Conference.

Antea Group has presented to MPCA hydrologists on advanced investigative tools and insitu remedial technologies during a March 2017 MPCA Hydrologist meeting.

3.45 Oversee stormwater program requirements during construction activities

Antea Group has extensive experience completing Erosion Control Plans, particularly as a component of storm water management projects. Storm water permits issued and managed by the MPCA require that facilities have sediment and erosion control measures in place to prevent the presence of solids in storm water runoff from facilities to waters of the state. Sediment and erosion control measures often include, but are not limited to: paved and swept surfaces, vegetation, rip rap, retention ponds, coir logs, straw wattles, silt fencing, and other filter media.

Examples of projects where Antea Group has prepared Storm Water Pollution Prevention Plans (SWPPPs) and implemented erosion control measures includes numerous railroad yards, food production facilities, and a large remedial excavation project. Implementation activities have included installation of erosion controls (e.g., coir logs, rip rap), preparation of erosion control maintenance documentation, site control after storm events, repairs of erosion controls, and decommissioning of erosion controls during shutdown of a temporary Site.

Erosion control measures are periodically reviewed and evaluated for each Site to determine if changes must be made to further prevent erosion at the Site. If construction occurs at a Site, erosion controls are evaluated and changed as needed to maintain effective erosion control throughout the Site. Additionally, as part of the MPCA industrial storm water permit, Antea Group has advised clients in evaluating sediment and erosion controls after storm water sample Total Suspended Solids (TSS) exceedances, including oversight of installation and maintenance of erosion control Best Management Practices (BMPs).

Example: **Oil Spill Site**
Tioga, North Dakota

Antea Group oversees and implements erosion control practices at the Tioga, North Dakota remediation project site. During initial remediation and excavation phases of the project, Antea Group developed an action plan to reduce storm water runoff from the project site in coordination with the State of North Dakota. This action plan utilizes sediment basins within the project site and coir logs around the perimeter of the site, preventing suspended solid migration and water runoff. Fiber coir logs are placed along parts of the property boundary of the project area to provide the same sediment-control capability as a sediment basin.

The coir log placement is chosen based on the surface drainage direction. The coir logs are inspected and maintained at least once every 14 days and within 24 hours of any rainfall event greater than 0.5 inches. The logs are cleaned out when sediment reaches 1/3 to ½ the height of the BMP or fabric logs. Previously, silt fencing was used for erosion control at the site; however, due to frequent destruction from strong winds, fiber coir logs have been installed as the preferred BMP.

Once inspection occurs and inadequacies are discovered, the revised SWPPP must implement these changes within 7 calendar days. Inspection reports summarize the scope of the inspections, names, and qualification of the inspector. In addition, they include inspection dates, major observations, and remedial actions taken. These records are retained as part of the SWPPP for at least 3 years after the date of inspection. Record keeping of precipitation events is also included in the project documentation logs.

3.46 Provide technical assistance to the state in the evaluation and interpretation of data and information

Antea Group provides technical assistance in the evaluation and interpretation of data for the State of Minnesota as well as other public and private clients. Data evaluation and interpretation is performed by qualified individuals in accordance with applicable guidance, regulations, and current professional standards and practices. Antea Group routinely provides technical evaluation of site data presented in reports and technical memorandums. Antea Group has demonstrated the ability to utilize advanced technologies in the collection and evaluation of data. Antea Group has utilized Geoprobe™ equipment equipped with Laser Induced Fluorescence (LIF) and Membrane Interphase Probes (MIP) to collect data for mapping free-phase petroleum (LIF) and to evaluate qualitative evaluation of chlorinated volatile organic compounds (VOC) in the subsurface (MIP). These technologies provide continuous data from the surface to the terminal depth of the probe which can be utilized to evaluate horizontal and vertical definition. Antea Group has experience pairing data collected through traditional methods and advanced data collection methods with various visualization, including three-dimensional visualization and data evaluation software to accurately interpret site geology and contaminant distribution. Antea Group selects the appropriate data evaluation and visualization software depending on site conditions, purpose of evaluation and remedial goals of the site.

Antea Group has provided technical assistance to the State of Minnesota for Federal Superfund, State Superfund, RCRA, VIC and petroleum sites as an MPCA Multi-site contractor. Technical assistance performed for the State of Minnesota includes evaluation and interpretation of data collected by Antea Group lead investigations as well as technical review of work plans, reports, proposals and investigation derived data collected by others and reported to regulatory agencies.

Example: **Southwest Fridley Area Sites Groundwater Evaluation**

Fridley Minnesota

Since 2008, Antea Group has provided technical support to the MPCA Superfund program for multiple chlorinated volatile organic compound (VOC) sites located in southwest Fridley, including NPL and PLP listed and RCRA sites. Technical support at these sites has included review of RP generated work plans, reports, memorandums, historical data, decision documents and other documents related to these sites. While performing work in support of MPCA at the various southwest Fridley sites, Antea Group recognized the need for a comprehensive evaluation of all area sites to better provide technical support to the MPCA.

Beginning in 2009 Antea Group has provided technical support to the MPCA for evaluation of groundwater quality and flow characteristics utilizing data collected at the individual Southwest Fridley Area (SWFA) sites. Antea Group routinely evaluates data collected by the individual sites and compiles the data to better understand the contaminant distribution throughout the southwest Fridley area. As part of the SWFA groundwater evaluation Antea Group developed criteria and provided technical assistance for the MPCA to arrange for all monitoring wells at the individual SWFA sites to be surveyed into a common datum for groundwater flow evaluation. Following the completion of the SWFA survey Antea Group was able to develop groundwater elevation figures utilizing ArcGIS™ to assist in the interpretation of groundwater flow and approximate contaminant distribution for different geologic horizons across the entire southwest Fridley area. The completed survey has provided the MPCA and stakeholders within this area with a better understanding of groundwater flow and contaminant distribution throughout the area of southwest Fridley. Compilation and comparison of groundwater chemistry data and multiple flow horizons across the SWFA sites had not previously been completed due to administrative constraints posed by sites under different regulatory programs. As part of the SWFA groundwater evaluation Antea Group has on multiple occasions presented the evaluation of compiled data to various regulators and stakeholders affected by groundwater conditions in the southwest Fridley area.

Antea Group has also supported the MPCA to consolidate groundwater quality data from multiple responsible parties (RPs) in the south west Fridley area. Antea Group has worked with the RPs to obtain data in electronic format and process it into our EQuIS database. Antea Group worked with the MPCA and the RPs to address significant RP data quality and format issues and provided the MPCA with a normalized data set for transfer into their version of the EQuIS database system.

3.47 Oversight of responsible party and voluntary party contractors during site investigations or response actions

Antea Group provides oversight of RP and VP contractors as a standard service during all phases of site investigation and response action. Contractor oversight is a key service provided by Antea Group which ensures that the contractors work is completed to meet the bid specifications, design parameters, goals of the investigation and/or response action and is conducted in a safe and efficient manner.

Antea Group maintains through and continuously updates a database of qualified and pre-approved contractors through Avetta. The Avetta program assures that contractors utilized by Antea Group meet our clients' stringent contract, insurance and health and safety requirements. Poor performance or failure to meet these guidelines often results in a contractor being removed from the database of active contractors until the shortcoming has been resolved to the satisfaction of Antea Group and our clients.

Antea Group normally hires contractors through competitive bidding processes in order to ensure competitive pricing. Antea Group utilized contractors for drilling and probing investigations, geophysical investigations, excavation and earth moving, soil and waste transport, waste disposal, specialized in-situ remediation technologies and other various hazardous waste related activities.

Antea Group also provides third party oversight on behalf of client stakeholders during RP and VP investigations and response actions. Antea Group has experience collecting split samples for third party stakeholder data analysis and samples for independent verification of remedial actions.

Example: **Litigation Support**
Ashland, WI

As part of a litigation support effort, Antea Group provided third party observation of a RP remedial action at a former manufactured gas plant (MGP) along the shore of Lake Superior. Antea Group provided independent observation of RP remedial actions which included: Installation of slurry walls, excavation of unconsolidated wood waste impacted with MGP waste; excavation of a former MGP facility, and; excavation of a filled ravine which served as a discharge conduit for MGP waste. Excavated material was treated on site using thermal desorption. Antea Group also provided oversight of RP dewatering and primary treatment activities on behalf of our client and provided recommendations regarding discharge to sanitary facilities.

Antea Group provided continuous on-site staff with knowledge of the RP remedial action plan and historic operations at the facility to ensure that representative, independent samples were collected. The independent samples were analyzed to distinguish waste sources and discharge configurations used during various MGP operational periods. Analysis included polyaromatic hydrocarbon (PAH) analysis by EPA 8270 and forensic fingerprinting analysis and evaluation to determine the source material. Based on operational and remedial action knowledge of our on-site personnel; Antea Group was able to collect samples representative of the waste source and determine that former MGP operations were the sole contributor for environmental impacts at the site. This determination was upheld by the court and resulted in a zero-liability determination for our client.

3.48 Oversee or conduct bench scale lab treatability studies, pilot testing, and field demos

Antea Group regularly oversees the planning and execution of bench-scale treatability studies and pilot tests. Emphasis is always placed on laboratory selection, practicality of the testing, and use of state-of-the-art methods. Antea Group maintains a list of approved treatability laboratories from coast to coast. Several of the laboratories are specialists in bioremediation, chemical oxidation or reduction, or heating technologies. For bench tests, we strive to develop methods that use a soil to water ratio as close to reality as possible.

Bench scale treatability and pilot tests provide vital information to the design process and optimization of a specific technology, but even more important is their ability to uncover issues that might arise on a larger scale. These issues might preclude the use of the technology all together or might require a strategic change in direction or alteration to a technology.

Typical bench and pilot tests that we oversee will begin with a plan that clearly defines the objective for the test. The number of test conditions is determined and the sample collection size and test vessel size is determined. Methods of analysis are indicated and proper controls are setup along with the various treatment conditions. The duration of testing is established. Bench tests may compare different technologies or multiple conditions within a

given technology; field tests most often focus on a single approach or a combination of technologies working in concert.

At the completion of bench or field pilot tests, a report is prepared documenting sample collection, test setup, procedures used, parameters measured, and conclusions/recommendations from the test. Longer term bench tests or field pilot tests may have interim reports that document specific periods of time or sampling events and generally contain similar information has a final report.

At Antea Group >80% of our projects have bench and/or field pilot testing depending on information needed for design, site characteristics, and regulatory/client familiarity and comfort with a technology. When there is high certainty with a technology, our preference is to field pilot test so information can be gathered while a level of treatment occurs.

Example: Former BP Service Station (Milpitas, CA)
2011 -2012

Antea Group contracted with a specialized in situ chemical oxidation lab (JAG/PTS Laboratories) to address a complex buffering issue in high organic content soils at an off-site property where plume migration of gasoline has remained an issue. The site has significant access issues and considerable landscaping that had to be worked around. Initially, a traditional alkaline activated persulfate approach was taken at this off-site property with multiple injections made via direct push. Maintaining a high pH proved to be impossible, even with high doses of sodium hydroxide.

Antea Group oversaw the development of the test method and discussed field observations and objectives for the test. Antea Group performed QA/QC on the data generated from the testing as well as all associate analysis from an analytical lab supporting the project. Antea Group led all technical discussions on the testing program.

This test evaluated the total oxidant demand (TOD) and the oxidant persistence during chemical oxidation treatment using stabilized hydrogen peroxide activated sodium persulfate, an approach that does not require high pH. Antea Group discussed results and subsequent report content with the lab that showed the stabilized hydrogen peroxide activated persulfate could not maintain an acidic pH and did not perform well on the TPH-gasoline present. A high oxidant demand was determined and additional groundwater tests showed high iron and alkalinity much greater than had been observed at the site before. This testing led to a discussion of new alternatives for the site and possibly could support a determination of technical impracticability.

3.49 Assist and provide training as requested by the MPCA or MDA. Training must be related to the scope of this contract.

A key strength of the Antea Group staff located in the St. Paul office is providing a variety of training for various subject matters. Our stringent corporate health and safety internal requirements have necessitated the certification of trained staff and development of health and safety training modules that may be provided to our employees or as a service offering to our clients including but not limited to the following:

- Accident prevention;

- Contractor safety;
- Emergency response;
- Excavation;
- Hazard communication;
- HAZWOPER 8-hr refresher;
- Incident reporting;
- Personal protective equipment; and
- Site control and work zones.

Our diverse client base has also necessitated the certification of technical trained staff in our St. Paul office to provide the following to our employees or as a service offering:

- RCRA Hazardous Waste Management for LQG and SQG;
- RCRA Hazardous Waste Management for CESQG;
- Universal Waste Management;
- Spill Prevention Control and Countermeasure Plans;
- Chemical Management;
- Spill Response;
- Storm Water Management;
- Storm Water Pollution Prevention Plans;
- Wastewater Management;
- Air Emissions Management, and
- DOT HazMat Awareness Training.

Antea Group has a long history of working with clients in the development and delivery of a wide range of training topics from environmental, health and safety regulatory compliance to train the trainer and development and implementation of on-line Storage Tank Operator Training. Antea Group has multiple expert level training delivery specialists ready to assist the MPCA or MDA in the preparation of training materials which can be effectively used to present the designed materials to any target audience. Antea Group has worked with clients representing industries ranging from electronics manufacturing, to pulp and paper, to heavy manufacturing. Antea Group works with these clients to develop materials customized to their needs and specific to their application, thus helping to assure effective communication of the chosen training topic.

Our staff has also designed and delivered workshops on various environmental technologies at statewide regulatory staff meetings, including coursework provided instruction on concepts of remedial technology, design criteria and engineered alternatives. In addition, we have given several presentations at the EPA-sponsored and 50-states attended National UST/LUST Conference.

3.50 Follow MPCA green practices/procedures for remediation projects

To reduce environmental and economic impacts of remediation projects, Antea Group utilizes green and sustainable remediation (GSR) initiatives when feasible. Opportunities for employing GSR concepts are considered in development of the overall remediation approach and corrective action goals. GSR technology alternatives that enhance natural conditions, reduce carbon footprints and provide economic value compared to conventional remediation techniques are utilized by Antea Group to provide innovative and socially responsible approaches.

Since 2009, Antea Group has been implementing and documenting use of green practices on all MPCA fund-financed site remediation projects in accordance with the *Recovery Act LUST Requirements* and have incorporated the *Recovery Act LUST Green Practices Appendix A* spreadsheet into all submitted Work Plan/Cost Proposals (for PRP, Superfund, VIC and Closed Landfill Programs' sites). The Green Practices implemented subsequent to completion and final close out of an MPCA fund-financed project work order are documented in the Green Practices Metrics Table provided in a Work Order Summary Report.

Antea Group provided a design specification for a leaking UST carbon footprint calculator under contract through EPA Region 9. This calculator is now online and available to regulatory program managers and stakeholders for their use in calculating the carbon footprints of LUST remediation sites. The calculator evaluates five remedial approaches including excavation, pump-and-treat, soil vapor extraction, multi-phase extraction and MNA.

Below is a project example in which Antea Group utilized GSR practices in remediation system design and installation.

Example: Isanti Schumacher Superfund Site
West Point, Minnesota

The Isanti Schumacher site was once the location of an unauthorized burial pit for drums of industrial waste. These drums contained a variety of compounds including: halogenated and non-halogenated solvents, paint residues and sludges, varnish resins, metals, polychlorinated biphenyls (PCB), and volatile organic chemicals (VOC). In 1982 a contractor working for the EPA excavated, packaged and transported 843 drums to out of state disposal sites. Borings were conducted through the floor of the pit to determine the depth of contamination. The floor of the pit was then capped using a PVC liner and the excavated pit was backfilled with clean fill, however VOC impacts remained in the adjacent soils.

In the years since removal of the drums, assessment activities indicated a VOC groundwater plume migrating in the direction of the Rum River. The MPCA subsequently requested Antea Group to design a temporary SVE system to address residual VOC impacts in the former drum burial area.

GCR practices utilized in system design and installation:

- The remediation system building and several key system components were recycled from two separate existing MPCA remedial projects located in Brooklyn Center. Antea Group and MPCA personnel inspected the two systems configurations and site decisions were made in cooperation with the MPCA for those portions of the existing systems to be incorporated into the component design of the temporary SVE system.
- Soil generated during SVE well installation was thin spread in the immediate vicinity of the wells and native soil was utilized to backfill system trenching. Therefore, no waste requiring off-site disposal was generated during installation of the SVE wells or system installation.
- A wireless telemetry system was linked to the SVE system control panel. The telemetry utilizes a cellular network connection to send out fault or alarm notifications via electronic mail. This decreased the vehicle

miles traveled to conduct system checks and allows for sufficient identification of alarms prior to mobilization to the site.

In addition to the benefits of utilizing the above GSR practices, the above approach saved the MPCA significant costs compared to a new system and accelerated the installation timeframe.

3.51 Oversee hydrogeologic investigations including fate & transport modeling, capture zone analysis and pump tests

Antea Group has designed, prepared and implemented hundreds of site and remedial investigation Work Plans at a variety of sites that have involved hydrogeologic investigations. These sites have included: petroleum retail, terminals and refineries; chemical processing, manufacturing; landfills; brownfield redevelopment, and Ag-Chem sites with COCs consisting of: VOCs, SVOCs, PAHs, PCBs, PFCs, heavy metals, fertilizers and pesticides. The primary objective of these investigations is to characterize the subsurface hydrogeology to the extent necessary to assess potential contaminant migration pathways and to delineate the extent of subsurface impacts in both the unsaturated and saturated horizons for purposes of evaluating remedial alternatives. Our hydrogeologists are familiar with the current MPCA risk-based site evaluation process (RBSE) guidance documents, and understand the iterative approach often required to compile sufficient regional and site specific hydrogeologic information to perform fate and transport modeling. Antea Group utilizes a variety of literature and technical resources (i.e., DNR, MDH, MGS, and USGS) in addition to conducting site specific hydrogeologic investigations, as necessary, to support our development of reasonable conceptual site models (CSM) which is a critical initial step in any model development effort.

Site-specific hydrogeologic investigations often include the collection of undisturbed unsaturated and saturated soil or core samples of unique geologic units encompassing the extent of delineated COCs to assess soil and or fracture properties that are useful in evaluating contaminant migration such as: porosity, grain size distribution, fractional organic carbon, pore saturation if NAPL is present, total organic carbon, bulk density, vertical permeability and fracture density. Depending on the fate and transport questions to be answered, the characteristics of the COCs and the site complexity, 1-D or 2-D transport models such as BIOSCREEN, BIOCHLOR-AT, or VS2DTI that incorporate dispersion, adsorption and biotransformation may be sufficient in addressing the fate and transport of dissolved phase COCs under relatively simple groundwater flow conditions. Antea Group often applies these types of models to sites where monitored natural attenuation (MNA) is being evaluated.

For more complex sites, Antea Group can utilize a variety of field tests to assess the site-specific spatial variability of the saturated units or formations hydraulic characteristics including: slug tests, tracer studies, specific capacity tests and if warranted, aquifer pumping tests. Data obtained from these tests is typically analyzed using aquifer testing analysis software (i.e., AQTESOLV) or analytical calculations to obtain estimates of the aquifer's hydraulic conductivity (K), transmissivity (T), and specific storage (S) for use in development of a more rigorous 3-D groundwater flow model using MODFLOW.

Once a MODFLOW flow model is developed and calibrated, it can be coupled with MT3D to evaluate contaminant fate and transport. Model defined source cells are setup to reproduce the source types as defined by the conceptual site model (CSM) in the appropriate model layers and the modeled layers are assigned representative transport properties including storativity, porosity, and dispersivity values. COC reaction or decay rates are also incorporated into the model to assess contaminant attenuation. Calibration to existing monitoring well concentrations is an iterative approach using historical analytical trend data. In addition, sensitivity and uncertainty analyses are performed using the calibrated MODFLOW/MT3D model prior to using the model to predict future fate and transport scenarios.

Example: Fate and Transport
Regional Model

Using the transient version of the MODFLOW model discussed in the groundwater flow modeling example (Conduct surface water and groundwater modeling), Antea Group incorporated the use of MT3D to evaluate the fate and transport of non-reactive COCs released from former municipal and industrial landfills within the study area. The model was developed to assess the long-term impacts to the existing and future municipal wells and the potential need for secondary treatment prior to groundwater use.

3.52 Prepare and determine if the stormwater pollution prevention plan (SWPPP) is being followed and make recommendations if revisions ar needed during the life of the construction project

Antea Group has prepared Storm Water Pollution Prevention Plans (SWPPP) for multiple industrial facilities throughout the United States including Minnesota. Industries represented by the SWPP Plans developed by Antea Group include pulp and paper facilities, heavy manufacturing facilities, and transportation related railroad properties. Each Plan details how facilities control and monitor storm water runoff to minimize storm water impact. These plans address significant industrial materials stored on-site and industrial activities having the potential for storm water exposure. In addition, the plans describe facility best management practices, material transfer procedures, inventory control, inspection procedures and frequency, secondary containment, identification of non-storm water discharges, and spill response procedures and training.

Antea Group has extensive experience completing Erosion Control Plans, particularly as a component of storm water management projects. Storm water permits issued and managed by the MPCA require that facilities have sediment and erosion control measures in place to prevent the presence of solids in storm water runoff from facilities to waters of the state. Sediment and erosion control measures often include, but are not limited to: paved and swept surfaces, vegetation, rip rap, retention ponds, coir logs, straw wattles, silt fencing, and other filter media.

Examples of projects where Antea Group has prepared Storm Water Pollution Prevention Plans (SWPPPs) and implemented erosion control measures includes numerous railroad yards, food production facilities, and a large remedial excavation project. Implementation activities have included installation of erosion controls (e.g., coir logs,

rip rap), preparation of erosion control maintenance documentation, site control after storm events, repairs of erosion controls, and decommissioning of erosion controls during shutdown of a temporary Site.

Erosion control measures are periodically reviewed and evaluated for each Site to determine if changes must be made to further prevent erosion at the Site. If construction occurs at a Site, erosion controls are evaluated and changed as needed to maintain effective erosion control throughout the Site. Additionally, as part of the MPCA industrial storm water permit, Antea Group has advised clients in evaluating sediment and erosion controls after storm water sample Total Suspended Solids (TSS) exceedances, including oversight of installation and maintenance of erosion control Best Management Practices (BMPs).

Example: **Oil Spill Site**
Tioga, North Dakota

Antea Group oversees and implements erosion control practices at the Tioga, North Dakota remediation project site. During initial remediation and excavation phases of the project, Antea Group developed an action plan to reduce storm water runoff from the project site in coordination with the State of North Dakota. This action plan utilizes sediment basins within the project site and coir logs around the perimeter of the site, preventing suspended solid migration and water runoff. Fiber coir logs are placed along parts of the property boundary of the project area to provide the same sediment-control capability as a sediment basin.
The coir log placement is chosen based on the surface drainage direction. The coir logs are inspected and maintained at least once every 14 days and within 24 hours of any rainfall event greater than 0.5 inches. The logs are cleaned out when sediment reaches 1/3 to ½ the height of the BMP or fabric logs. Previously, silt fencing was used for erosion control at the site; however, due to frequent destruction from strong winds, fiber coir logs have been installed as the preferred BMP.

Once inspection occurs and inadequacies are discovered, the revised SWPPP must implement these changes within 7 calendar days. Inspection reports summarize the scope of the inspections, names, and qualification of the inspector. In addition, they include inspection dates, major observations, and remedial actions taken. These records are retained as part of the SWPPP for at least 3 years after the date of inspection. Record keeping of precipitation events is also included in the project documentation logs.

4.0 PROJECT DESCRIPTIONS

Example Project 1

Project Name: Ag Chem Lease Property
Client: Union Pacific Railroad
Client Contact: Mr. Kevin Peterburs

Site Description:

Project Name & Location:	Ag Chem Lease Property Auburn, Nebraska

Client Contact:	Kevin Peterburs Contact: 414-267-4164
Brief Site Description:	The site is located on the floodplain of the Little Nemaha River, which is located approximately 0.4 miles to the northeast. The surrounding area is comprised of agricultural cropland to the north and east, the city's wastewater treatment plant to the southeast, and a commercial area to the west and southwest. The topography in the area generally slopes gradually down toward the east. The site is slightly elevated in comparison to the surrounding farm fields. Soils encountered at the site generally consist of variable layers of silty clay, clayey silt, silt, and clay to depths of 12 to 15 feet below grade surface (bgs). Fine- to medium-grained sand was encountered beneath the silty or clayey sand, starting at depths of approximately 15 to 19 feet bgs. Bedrock (Pennsylvanian shale) was encountered in one boring at a depth of 30 feet bgs. The depth to groundwater varies from approximately 5 to 10 feet bgs. Mapping of historical and current groundwater elevation data has reflected a northerly to easterly flow direction. The lease site was operated as a fertilizer facility from approximately 1962 through early 2015. Operations have included the storage and handling of bulk amounts of dry and liquid anhydrous ammonia. Historically, fertilizer facility buildings were located on the property. The site has been unused since early 2015. During the course of a Limited Phase II Site Assessment of the property in September 2008 commissioned by the lessee, environmental impacts to soil and groundwater were identified at the site. Subsequent subsurface investigations confirmed the presence of soil and groundwater impacts at the property. The primary chemical of concern (COC) at the site is nitrogen as nitrate plus nitrite and ammonia (NNA). Groundwater impacts were found to have migrated off-site to the northeast. The site was entered into NDEQ's Voluntary Cleanup Program (VCP) in April 2011. An interim remedial action work plan (IRAWP) was submitted to the NDEQ in February 2015. The NDEQ approved the IRAWP in April 2015. Interim remedial actions conducted in 2015 included excavation of impacted soils, installation of the phytoremediation system, operation and maintenance (O&M) of the phytoremediation system, and quarterly groundwater monitoring. As per the NDEQ approval letter, a final Remedial Action Plan will be submitted following the evaluation of the effectiveness of the interim remedial actions via long-term groundwater monitoring.

	The soil excavation in 2015 removed impacted soil from areas exhibiting the highest NNA concentrations, and the phytoremediation will ultimately reduce NNA concentrations present in the soil and groundwater. The effectiveness of the remedial actions is being monitored under the long-term monitoring program presented in the IRAWP. Interim remedial actions conducted at the site in 2017 included operation and maintenance of the irrigation system in the phytoremediation area, mowing in the phytoremediation area, mowing of the restored prairies, and annual groundwater monitoring. Annual groundwater monitoring will continue in 2018, with the wells being sampled for nitrogen as ammonia and nitrogen as nitrate plus nitrite. Review of groundwater laboratory data dating back to June 2011 has not identified any obvious seasonal trends. The irrigation system in the phytoremediation area has continued to remove a significant amount of nitrogen from groundwater. The system will be restarted in late Spring 2018. Irrigation system startup will require replacement of the header manifold, turning on the solar powered pump, reprogramming the valve controller and inspecting/repairing the distribution system as needed. Mowing in the phytoremediation area will not be completed in the future since the tree canopy will reduce weed growth. Annual Interim Remedial Action Reports will be prepared following 2018 activities to summarize interim remedial actions conducted for the year and will be submitted to the NDEQ.
Tasks that were subcontracted out	Subcontract tasks included drilling services (installation of monitoring wells, soil borings); soil excavation, transport and disposal; soil, soil vapor and groundwater sample laboratory analysis; and tree planting and mowing and weed abatement around the phytoremediation area.
Outcome achieved	Based on the results of future interim remedial actions, a Final Remedial Action Plan will be prepared and will include a Site Risk Assessment. The Final Remedial Action Plan will take into consideration the reduction in mass of site COCs from the interim remedial actions. The Final Remedial Action Plan will be prepared when groundwater NNA concentrations begin showing a measurable decreasing trend. It is unknown when this will occur since establishment of the phytoremediation may take several years. It is estimated that a Final Remedial Action Plan will be submitted in 3 to 7 years.

Tasks accomplished personnel who performed each task	▪ Project management: Jared Otto ▪ Field activities: Paul Meier, Molly Partridge ▪ Data evaluation and report preparation: Nancy Rodning, Jared Otto, Corey Mecham

Example Project 2

Project Name: Harcros Chemicals Inc.
Client: Harcros Chemicals Inc.
Client Contact: Mr. Jack Cleary

Project Name & Location:	Harcros Chemicals, Inc. 584 Fairview Avenue North St. Paul, MN 55104 *MPCA #SR0000248*
Client Contact:	Jack Cleary, P.E. VP Risk Management & Regulatory Affairs Harcros Chemicals, Inc. 5200 Speaker Road Kansas City, Kansas 66106 Phone: 913-621-7891 Email: jack.cleary@harcros.com
Brief Site Description:	Commercial/Warehouse, approximately 40, 000 sq. ft. in area Evidence of a release was first identified at the Harcros property in 1994 followed by several iterations of on- and off-site subsurface soil and groundwater investigation. An area search of other chlorinated volatile organic compound (CVOC) sources and groundwater receptors conducted in the late 1990's indicated no groundwater receptors but several nearby known CVOC groundwater occurrences were identified, including down-gradient of the Harcros site. Based on these results, MPCA agreed in a meeting on July 13, 1999 that Harcros would further delineate the CVOC plume through the western right of way of Prior Avenue. Response action alternatives were analyzed in the *1998 Focused Feasibility Study*. In January 2000, a soil vapor extraction (SVE) pilot study was conducted to evaluate the removal of chlorinated hydrocarbons from the unsaturated zone on-site. Following positive results from the pilot study, a full-scale SVE system consisting of four shallow and four deep

	SVE points was started in February 2001. The SVE system operated until May 2002 when system discharge indicated asymptotic results. Operation of the SVE removed the targeted chlorinated and petroleum compounds from the former operational areas. On-site and off-site groundwater investigation and monitoring was conducted periodically through November 2006. Based on the receptor survey and risk evaluation that did not identify any receptors at risk, delineation of the plume east of Prior Avenue and stable to decreasing trends in groundwater contaminant concentrations, closure was requested in the 2006 Annual Monitoring Report. MPCA responded requesting completion of a soil gas survey at the site consisting of at least four soil gas samples. Due to alternative approaches to address the soil vapor pathway and personnel changes at both the MPCA and Harcros, the soil vapor assessment was implemented in a series of workplans starting with one MPCA approved in June 2013. After access agreements were renewed, all 15 of the existing monitoring wells were gauged and sampled. Six soil vapor probes constructed to allow future sampling were installed, as well as 6 additional probes to collect one time soil vapor samples. Vapor probes were positioned to collect current data throughout the central part of the groundwater plume area and nearby potential vapor receptors. Laboratory results indicated that the groundwater quality continued to be stable or improving. Soil vapor results from the initial round of sampling in May 2014 indicated that contaminant concentrations in soil vapor exceeding 10X Intrusion Screening Values (ISVs) were only detected in the two samples collected from former probable source locations on the Harcros property. Results from the 2nd round of sampling in August 2014 showed concentrations of TCE in soil vapor greater than 100x the industrial ISV on the Harcros property and PCE greater than 100x the residential ISV on the adjacent Griggs Midway property that is currently used by the YMCA Daycare. Based on these 2nd round results; a 3rd round of sampling was conducted in October 2014. This round confirmed elevated TCE and PCE vapors in the soil on the Harcros and Daycare properties respectively, and also confirmed no detections of soil vapors greater than residential ISVs in the 3 permanent probe locations along the off-site groundwater plume. In January 2015, a broader based assessment was conducted around and between the Harcros and YMCA Daycare buildings to try to identify a source area for these vapors that may be amenable to remediation and to further delineate their extent. Downhole sensing methods including hydraulic profiling tool (HPT) and electrical conductivity (EC) methods were used. Soil and groundwater were also collected in offset locations from the HPT/EC probes. Finally, direct push methods were used to install 17 permanent soil vapor

	collection points, some nested at shallow intermediate and deep intervals, offset in these same locations. Results from this assessment did not identify a source area. Elevated TCE and PCE concentrations (greater than 33x the appropriate ISVs) were detected in the intermediate and deep locations between the buildings; elevated TCE was detected in 2 of 6 locations around the Harcros building and elevated PCE was detected in 1 of the 5 shallow sample locations around the YMCA Daycare building. Based on these results, the VI Area of Concern (AOC) was generally defined to be the Harcros and Daycare properties as well as portions of the Griggs Midway building parking lot between the buildings. In March 2015, subslab soil gas sampling was conducted at the Harcros building and subslab soil gas and indoor air sampling were conducted at the YMCA Daycare building. Results indicated concentrations of TCE significantly greater than 33x the industrial ISV in 3 of 5 sample locations in the Harcros building and concentrations of PCE greater than 33x the residential ISV in 4 of 6 sample locations in the Daycare building. There were no detections of PCE or TCE in the indoor air samples. In May second sampling events for subslab soil gas and indoor air sampling were conducted at both the Harcros and Daycare buildings. Subslab results confirmed the concentrations of TCE greater than 33x the industrial ISV beneath the Harcros building, and concentrations of PCE greater than 33x the residential ISV beneath the Daycare building. There were no detections of PCE or TCE greater than the ISVs in the indoor air samples. In August 2015, a Passive Soil Gas Source Area Assessment was conducted on the Harcros property and up-gradient of the Daycare building. Results indicated elevated TCE concentrations beneath the central southeastern third of the Harcros building with PCE at lower concentrations and in a much smaller portion of that same area. There were no significant findings of TCE or PCE in sampling locations outside of this area. This data added more support that the VI AOC was reasonably defined and did not extend to the east of the Harcros or Daycare properties. Based on the accumulated data, a subsurface investigation was conducted in November and December of 2015 using direct push membrane interface probe (MIP) and electrical conductivity (EC) sensing technology in areas where the highest TCE and PCE concentration were identified in the PSG Source Assessment. Fourteen (14) MIP/EC probes were advanced followed by 15 direct push probes to collect either soil and/or groundwater samples. Results indicated no clear source area for the soil vapors. Heating season sampling events for subslab soil gas and indoor air were conducted at the Harcros and Daycare buildings in January 2016. Results at the Harcros building again

	indicated concentrations of TCE significantly greater than 33x the industrial ISV in 3 of 4 subslab samples and detection of TCE greater than the industrial ISV in 4 of 5 indoor air samples. Results at the Daycare building again indicated concentrations of PCE greater than 33x the residential ISV in 3 of 6 sample locations. There were no detections of TCE in any of the indoor air samples; however, there was a detection in 1 of the 3 indoor air samples of 1.2 µg/m^3 of PCE which was less than the 2 µg/m^3 ISV. Based on these results, the vapor mitigation decisions were made to proceed with subslab depressurization systems for both buildings. In March 2016, initial diagnostics were performed at the Harcros building followed up in May with a more robust pilot test using a larger blower and more pressure field extension (PFE) monitoring points to aid in the sizing of system components and design of a SSD system. Installation of the SSD system began in August. Initially the SSD system included 3 suction pits; however, during the initial phase of installation, testing of the PFE indicated the system would function more effectively with an additional suction pit. The system was started up initially with 3 suction pits at the end of August and was fully operational with 4 suction pits on December 1, 2016. Confirmation PFE monitoring and sub-slab and indoor air sampling were conducted at the Harcros building in September 2016. Results indicated pressure differential in all 11 monitoring locations with greater than 5 pascals of vacuum beneath the slab and only 1 of 6 sub slab soil vapor samples with a TCE concentration greater than 33x the industrial ISV. Results from 5 Indoor air samples detected TCE in only 1 sample, with a concentration less than the residential ISV of 2 µg/m^3. A second heating season confirmation monitoring and sampling event was conducted in January 2017 with similar results. A Project Summary Report (PSR) was prepared and submitted to MPCA. The PSR included an O&M Manual which was reviewed with the facility operations manager in April 2017. Quarterly O&M events have been conducted since startup of this SSD system. A pilot test was conducted at the YMCA Daycare Building using two fans and a blower to aid in the sizing of system components and design of a SSD system. Installation of a SSD system in the YMCA Daycare building began in November 2016 in conjunction with a remodeling of the northwestern quarter of the building. 3 suction pits, each powered with its own fan. This SSD system was started up initially on December 20th. Confirmation PFE monitoring was conducted at the YMCA Daycare building in early January and sub-slab and indoor air verification sampling were conducted later in the 3rd week of the month. The laboratory results of this winter season subslab and indoor air sampling confirmed significant reduction of subslab contaminant concentrations and no concentration of PCE greater than 33x the residential ISV and no detections of PCE in the

	building indoor air. PFE monitoring also confirmed adequate negative pressure in the subslab environment to maintain mitigation. A Project Summary Report (PSR) was prepared and submitted to MPCA. The PSR included an O&M Manual which was reviewed in July 2017 with the Griggs Midway Property Manager responsible for the YMCA Daycare building. Quarterly O&M events have been conducted since startup of this SSD system. In September 2017, Ramsey County property records were checked for property use in the VI Area of Concern. Using the available online County information, subsection site maps of the area and a table of the parcels and their use were prepared. A field survey of the area was conducted to confirm use, particularly for unidentified use by sensitive populations. No other properties were observed to be used by sensitive populations other than as shown in County records.
Tasks that were subcontracted out	▪ direct push probes for soil, groundwater and soil vapor sampling ▪ monitoring well installation ▪ soil vapor extraction system installation ▪ soil, groundwater, soil vapor, subslab vapor and indoor air laboratory analyses ▪ passive soil gas samplers, analysis and modeling ▪ some phases of subslab depressurization system diagnostics (Antea Group also completed more robust diagnostics) ▪ installation of subslab depressurization systems ▪ soil waste disposal
Outcome achieved	Soil Vapor intrusion risks were assessed and mitigation of those risks to a large industrial building as well as a medium size Daycare building were completed. Antea Group provided a report to MPCA in Mid-February 2018 that summarized the soil vapor intrusion assessment and mitigation as well as an assessment of the definition of the groundwater plume and other chlorinated VOC sources in the area. The report, which positions the site for closure, is currently under review by the MPCA.
Tasks accomplished personnel who performed each task	▪ Project management: Gary Turgeon ▪ Sr. Hydrogeologist: Wayne Hutchinson ▪ Hydrogeologist: Jacob Knapp, Nancy Rodning ▪ Field activities: Craig Johnson, Jarrod Cicha, Gary Turgeon, Layne Kortbein ▪ Data evaluation and report preparation: Wayne Hutchinson, Nancy Rodning, Gary Turgeon

Example Project 3

Project Name: Pleasant Hill Disposal Site
Client: John Deere and Companies
Client Contact: Mr. Robert Brod

Site Description:

Project Name & Location:	Pleasant Hill Disposal Site 1500 NW 56th Street Pleasant Hill, Iowa
Client Contact:	Robert Brod Contact: 608-821-2062
Brief Site Description:	The property was developed for commercial use in the 1970s. Part of the site was used at that time as a disposal area for construction and demolition (C&D) waste by the owner. The site was purchased in 2008 by Tyler Homes. During an excavation for a new building, C&D waste was discovered mixed with several corroded 55-gallon drums containing paint-related wastes. The paint-related wastes contain antimony, lead, arsenic and chromium as determined by field analyses using a portable x-ray fluorescence (XRF) instrument. Buried paint-related waste was identified during excavation activities conducted by the property owner in 2007 and further delineated by the Iowa Department of Natural Resources (IDNR) via an EM-31 electromagnetic geophysical survey as part of the October 2011 *Extended Site Screening Assessment*. Antea Group was retained in 2014 to continue the investigation and mitigate the site concerns. Nine (9) test pits in the area of concern at the site were excavated in June 2014. Two (2) drums of paint-related wastes were noted on the ground surface in previously disturbed areas. Seven (7) other drums of paint-related wastes were uncovered during the completion of the test pits. Several other crushed drums were encountered but did not contain paint-related wastes. Eleven (11) bundles of plastic wrapped paint-related wastes were encountered along with some loose paint-related wastes. Composite samples of the paint-related wastes and of the fill soils were collected for laboratory analyses. Abundant metal debris was encountered ranging from small metal pieces to car axles. Other debris encountered included, wood planks, carpet rolls, brick and concrete.

	Analytical results of the soil and paint-related wastes indicate the soil is not impacted by the paint-related wastes; however, the paint-related wastes are considered a Characteristic Hazardous Waste due to elevated Lead content (D008). Additionally, the paint wastes exceed the State of Iowa Statewide Standards for Cyanide. Antea Group then completed an excavation during October 2014 in the area of concern to remove the paint-related wastes for disposal. Generally, the excavation was completed in quarters divided north-south. Within each quarter, the excavation progressed from west to east. Paint-related wastes were segregated from the debris and soil and placed into hazardous waste roll-off boxes to be staged for disposal. Paint-related wastes were present in drums, in plastic wrapped bundles and loose within the fill area. The excavation was completed in approximately one week. The excavation extended to an approximate depth of 8-feet to 12-feet based on the results of the previous investigations and the test pits. Near the east-central area of the excavation a pocket of eight (8) 55-gallon drums of paint wastes were encountered. A total of four (4) hazardous waste roll-off boxes containing paint related wastes were sent off-site for disposal totaling 50 tons (~39 cubic yards) of paint related wastes. Wastes were disposed of at the Clean Harbors facility at Lone Mountain Oklahoma under a one-time disposal EPA ID number (IAR000519538). Following the completion of excavation and segregation of the paint-related wastes, the site was restored by grading and seeding the disturbed area.
Tasks that were subcontracted out	Subcontract tasks included; soil excavation, transport and disposal; and soil sample laboratory analysis.
Outcome achieved	Following the completion of excavation and segregation of the paint-related wastes, the site was restored by grading and seeding the disturbed area. IDNR issued a no further action letter on June 23, 2015.
Tasks accomplished personnel who performed each task	▪ Project management: Kirby Smail ▪ Field activities: Molly Partridge ▪ Data evaluation and report preparation: Molly Partridge, Kirby Smail, Don Reeder

5.0 PROJECT SCENARIOS

Scenario A: Remedial Investigation (RI):

Please see Attachment A: Example Workplan

Please see Attachment B: Example Scenario Project Spreadsheet

Scenario A: Remedial Design / Remedial Action (RD/RA):

Please see Attachment A: Example Workplan

Please see Attachment B: Example Scenario Project Spreadsheet

Table 1

Staff Matrix

Table 1
MPCA Staff Matrix - 2018

Antea Group Team Member	Classification	OSHA Certifications	Years of Antea Group Service	Education	Total Years of Experience	Licenses/ Certifications	Location
Joy Rooney	- Field Technician - Scientist 1 - Scientist 2 - Engineer 1 - Engineer 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	6	▪ BS – Biosystems and Bi-products	12	▪ Engineer In-Training: Minnesota - License #140168	Regional
Tara Duffy	- Field Technician - Scientist 1 - Scientist 2	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ OSHA 30-Hr	10	▪ BS – Geology	11	▪ Accredited Office Ergonomics Evaluator (AOEE) – June 2014 ▪ Professional Member, American Society of Safety Engineers	Local
Paul Durkee	- Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	28	▪ BA – Biology, Gustavus Adolphus College – St. Peter, Minnesota ▪ MA – Aquatic Biology, Bemidji State University – Bemidji, Minnesota	30	▪ --	Local
John Estes	- Scientist 1 - Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ HAZWOPER Supervisor Course ▪ Annual 8-Hr Refreshers	19	▪ BS – Geology	22	▪ Certified Petroleum Release Remediator: South Dakota	Local
Jessica Highfill	- Field Technician - GIS/CADD Specialist - Scientist 1 - Scientist 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	14	▪ BS – Environmental Biology, University of Dayton – Dayton, Ohio	18	▪ --	Regional

Table 1
MPCA Staff Matrix - 2018

Antea Group Team Member	Classification	OSHA Certifications	Years of Antea Group Service	Education	Total Years of Experience	Licenses/ Certifications	Location
Wayne Hutchinson	- Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	13	▪ MS – Geology ▪ BA – Geology	45	▪ Professional Geologist: Wisconsin – License #201-13 ▪ Professional Geologist: Illinois – License #196.000842 ▪ Professional Hydrologist: Wisconsin – License #106-111	Regional
Bob Karls	- Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	31	▪ MS – Hydrology ▪ BS – Earth Science/ Geology	38	▪ Professional Geologist: Minnesota – License #30067 ▪ Professional Geologist: Wisconsin – License #632 ▪ American Institute of Professional Geologists, CPG #7348	Local
Keith Knoke	- Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	21	▪ MS – Geology ▪ BA – Geology ▪ BA – History	25	▪ Professional Geologist: Minnesota – License #30277 ▪ Professional Geologist: Wisconsin – License #1141-013 ▪ Professional Geologist: Illinois – License #196-000386	Local
Jacob Knapp	- Field Technician - Scientist 1 - Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	11	▪ BA – Environmental Studies-Environmental Sciences Concentration	14	▪ Certified Radon Mitigation and Measurement Provider (ARST/NRPP)	Local
Dean Krebs	- Scientist 1 - Scientist 2 - Engineer 1 - Engineer 2 - Engineer 3 - Engineer 4 - Project Manager	▪ 40-Hour HAZWOPER ▪ HAZWOPER Supervisor Course ▪ Annual 8-Hr Refreshers	24	▪ BS – Geological Engineering	24	▪ Professional Engineer: Minnesota – License #26540 ▪ Professional Engineer: Texas – License #89822 ▪ Professional Engineer: Illinois – License #062.059808 ▪ Professional Engineer: Iowa – License #18322	Local

Table 1
MPCA Staff Matrix - 2018

Antea Group Team Member	Classification	OSHA Certifications	Years of Antea Group Service	Education	Total Years of Experience	Licenses/ Certifications	Location
Aaron Lapine	- Scientist 2 - Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	19	▪ MS – Environmental Science ▪ BA – Botany and Political Science	22	▪ Environmental Professional: Connecticut – License #522	Regional
Corey Mecham	- CADD Specialist - Scientist 2 - Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	17	▪ BS – Meteorology	17	▪ Illinois GIS Association	Regional
Cindy Meldrum	- Field Technician - Scientist 1 - Scientist 2	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	24	▪ AAS – Business, Scott Community College – Bettendorf, Iowa	24	▪ --	Regional
Mark Nelson	- Scientist 1 - Scientist 2 - Engineer 1 - Engineer 2 - Engineer 3 - Engineer 4 - Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	23	▪ BS – Civil Engineering	24	▪ Professional Engineer, Minnesota – License #25828 ▪ Professional Engineer: Illinois – License #062-055081 ▪ Professional Engineer: Florida – License #65189 ▪ Professional Engineer: California – License #6359 ▪ Professional Engineer: Louisiana – License #35631	Local
Jared Otto	- Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER	14	▪ BS – Geology	24	▪ Professional Geologist: Minnesota	Local

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Jon Pesicka	- Scientist 2 - Engineer 2 - Engineer 3 - Engineer 4 - On-Site Inspector - Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	27	▪ BS – Civil Engineering	31	▪ Professional Engineer: California – License #46093 ▪ Professional Engineer: Wyoming – License #8380 ▪ Professional Engineer: Washington – License #35514 ▪ Professional Engineer: Arizona – License #32539 ▪ Professional Engineer: South Dakota – License #6666 ▪ Professional Engineer: Colorado – License #32708 ▪ Professional Engineer: Michigan – License #6201046313 ▪ Professional Engineer: Utah – License #4814077-2202 ▪ Professional Engineer: Idaho – License #9908 ▪ Professional Engineer: Ohio – License #64415	Local
Brent Puck	- Scientist 2 - Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	14	▪ MS – Physics ▪ BA – Physics	21	▪ Certified Groundwater Professional: Iowa	Regional
Don Reeder	- CADD Specialist	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refreshers	15	▪ BS – Horticulture, University of Minnesota – Minneapolis, Minnesota	20	▪ --	Local

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Nancy Rodning	- Field Technician - Scientist 1 - Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ HAZWOPER Supervisor	15	▪ BS – Geology, University of Wisconsin	20	▪ --	Local
Tony Rossano	- Scientist 2 - QA/QC Officer	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ DOT Hazardous Materials Certification	16	▪ BS – Chemistry, Columbus State University – Columbus, Georgia	35	▪ DOT Hazardous Materials (HazMat Employee) Certification ▪ Lead Inspector (Target Housing and Child-Occupied Facilities) ▪ On-Scene Incident Commander (Hazardous Waste Operations and Emergency Response) ▪ Hazardous Materials Technician (Hazardous Waste Operations and Emergency Response) ▪ Asbestos Operational and Maintenance Worker ▪ Asbestos Emergency Response Act (AHERA) Building Inspector ▪ American Chemical Society Member (30+ years) ▪ Air and Waste Management Association Member	Regional
Pete Schwalbach	- Scientist 2 - Project Manager	▪ 40-Hour HAZWOPER ▪ HAZWOPER Supervisor Course ▪ Annual 8-Hr Refreshers	24	▪ BS – Civil & Environmental Engineering, University of Wisconsin – Madison, Wisconsin	26	▪ --	Regional

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Jack Sheldon	- Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	8	▪ MS – Environmental Microbiology ▪ BS – Bacteriology and Public Health	35	▪ American Society for Microbiology ▪ National Groundwater Association	Regional
Darius Szewczak	- Scientist 1 - Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	15	▪ Master of Environmental Management ▪ BS – Environmental Sciences and Resource Management	24	▪ Certified Hazardous Materials Manager (CHMM) Master Level #12563 ▪ Advanced Safety Certificate; National Safety Council, 2003	Local
Karen Thole	- Scientist 1 - Scientist 2 - Project Manager	▪ 40-Hour HAZWOPER ▪ HAZWOPER Supervisor Course ▪ Annual 8-Hr Refreshers	22	▪ MS – Geology ▪ BS - Geology	25	▪ Professional Geologist: Wisconsin, License #711-013	Local
Gary Turgeon	- Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	15	▪ BA – Speech Communications, University of Minnesota	30	▪ Minnesota Groundwater Association Member ▪ Minnesota Petroleum Marketers Association Member ▪ League of Minnesota Cities Member ▪ Minnesota Petroleum Tank Release Compensation Fund Rule Advisory Committees	Local
Jonathan Zimdars	- Scientist 1 - Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	20	▪ BS – Geology	27	▪ Professional Geologist: Pennsylvania, License #2166	Local

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Antea Group Team Member	Classification	OSHA Certifications	Years of Antea Group Service	Education	Total Years of Experience	Licenses/ Certifications	Location
Sara Austin	- GIS/CADD Specialist - Scientist 1	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	3	▪ MGIS – Geographic Information Science University of Minnesota – Minneapolis, Minnesota ▪ BLA – Landscape Architecture Ball State University – Muncie, Indiana	5	▪ --	Local
Dacre Busch	- Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher		▪ Graduate Courses in Hydrogeology, Engineering, Geology, and theoretical Geophysics ▪ BS – Geology, California State University - Northridge, California ▪ BA – Earth Science/ Geography, California State University - Northridge, California	25	▪ --	Regional
Jarrod Cicha	- Field Technician - Scientist 1 - Scientist 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	2	▪ MS – Earth and Climate Science (Hydrogeology focus), University of Maine - Orono, Maine ▪ BA – Geology ▪ BA – Environmental Science, University of Minnesota - Morris, Minnesota	4	▪ --	Local
Jacy Christenson	- Field Technician - Scientist 1 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	4	▪ BS – Natural Resources, University of Minnesota	4	▪ --	Local

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Eric Feenstra	- Field Technician - Scientist 1 - Scientist 2 - Engineer 1 - Engineer 2	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	3	▪ BS – Geological Engineering, Michigan Technological University	5	▪ Engineer In-Training – Michigan	Regional
Stan Freedman	- GIS Technician - Field Technician - Scientist 1	▪	4	▪ BS – Geology, University of Puget Sound – Tacoma, Washington	4	▪ Post-Graduate Certificate – Geographic Information Systems, Portland Community College – Portland, Oregon ▪ Geological Society of America	
Cathy Grams	- GIS/CADD Specialist - Scientist 1 - Scientist 2	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	10	▪ BS – Geology, minor Computer Science, University of Minnesota – Duluth, Duluth, Minnesota	15	▪ --	Local
Craig Johnson	- Scientist 1 - Scientist 2 - On-Site Inspector - Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	15	▪ A.S. – HVAC Systems Installation, Service and Operation, Dunwoody College of Technology, Minnesota ▪ A.S. – Environmental Design Technology, Dunwoody College of Technology, Minnesota	30	▪ --	Local
David Koppel	- Field Technician - Scientist 1 - Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ First Aid/ CRP/AED	2	▪ BA – Geology, Gustavus Adolphus College ▪ MS – Geology (Surface Processes), Ohio University	7	▪ AARST – NRPP Residential Measurement and Mitigation Provider	Local

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Layne Kortbein	- Field Technician - Scientist 1 - Engineer 1	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ First Aid/ CRP/AED	1	▪ BA – Bioproducts and Biosystems Engineering; Sustainability Studies University of Minnesota	1	▪ Engineer in Training (EIT): Minnesota, License #152343	Local
Todd Kremmin	- Field Technician - GIS/CADD Specialist - Scientist 1 - Scientist 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ First Aid/ CRP/AED	2	▪ MS – Earth and Environmental Studies, University of Minnesota – Duluth, Minnesota ▪ BA – Geology Gustavus Adolphus College	6	▪ Geologist In-Training (GIT): Minnesota, License #150242	Local
Laura Maki	- Field Technician - Scientist 1 - Scientist 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ First Aid/ CRP/AED	4	▪ BS – Physics and Math, Winona State University	5	▪ --	Local
Becky Matich	- Field Technician - GIS/CADD Specialist - Scientist 1 - Scientist 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ First Aid/ CRP/AED	4	▪ BS – Environmental Studies, Bemidji State University	5	▪ Accredited Office Ergonomics Evaluator (AOEE) – June 2014 ▪ AIHA – Fundamentals of Industrial Hygiene	Local
Molly Partridge	- Field Technician - GIS/CADD Specialist - Scientist 1 - Scientist 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ First Aid/ CRP/AED	3	▪ MS – Geological Science, Central Washington University ▪ BS – Geological Science, Winona State University	3	▪ --	Local

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Antea Group Team Member	Classification	OSHA Certifications	Years of Antea Group Service	Education	Total Years of Experience	Licenses/ Certifications	Location
Christine Tufts	- Scientist 1 - Scientist 2 - Project Manager - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher ▪ First Aid/CPR/ AED	10	▪ MS – Water Resources Science, University of Minnesota ▪ BS – Geology, Michigan Technology University	12	▪ Professional Geologist: Minnesota, License #48960 ▪ Member, Minnesota Groundwater Association ▪ Member, American Institute of Professional Geologists	Local
Paul Meier	- Field Technician - Scientist 1 - Scientist 2 - On-Site Inspector	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	13	▪ BS – Geology, Winona State University – Winona, Minnesota	30	▪ Professional Geologist: Wisconsin	Regional
Cortney Malloy	- Field Technician - Scientist 1	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	1	▪ BS – Geology, Northwest Missouri State University	1	▪ --	Regional
Beth Firkins	- Field Technician - Scientist 1	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	4	▪ BS – HTRM, University of Wisconsin-Stout – Menomonie, Wisconsin	4	▪ --	Local
Lawanda Olin	- GIS/CADD Specialist	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher	12	▪ MA – English Literature ▪ AAS – Civil Engineering Technology	12	▪ --	Regional
Chris Vandegrift	- Scientist 2 - Engineer 2 - Engineer 3 - Engineer 4 - On-Site Inspector - Project Manager	▪ 40-Hour HAZWOPER ▪ Annual 8-Hr Refresher		▪ BS – Civil Engineering, University of Pittsburgh – Johnstown, Pennsylvania	25	▪ Professional Engineer: Pennsylvania, West Virginia, Ohio, Delaware, Maryland, and Georgia ▪ Remediation Specialist: West Virginia ▪ Member, National Society of Professional Engineers ▪ Member, National Council of Examiners for Engineering and Surveying	

Appendix A

Staff Resumes

Curriculum Vitae

Sara Austin

Title
Project Professional

Education
MGIS- Geographic Information Science
University of Minnesota, Minneapolis, MN

BLA- Landscape Architecture
Ball State University, Muncie, IN

Language
English

Experience Summary

Sara Austin, Project Professional, has been with Antea Group for 2 years as a part of the CAVe program. She is the Drafting Coordinator. Her background includes GIS, data management, AutoCAD, and modeling site conditions. Prior to joining Antea Group, she has approximately five years of experience working in a variety of fields managing teams of contractors for maintenance and design implementation for property management and landscape design as well as managing spatial databases.

Related Projects

- Wrote and executed a program for watershed delineation and determination of stream locations using digital elevation models.
- Designed and implemented templates for Source Vulnerability Assessment figures for international projects.
- Created web application to interactively illustrate historical site features and potential contaminate sources.
- Managed and created maps for a variety of Antea Group projects, both static and mobile.
- Prepared and created diagrammatic and map based figures for presentations.
- Created 3 Dimensional and time lapsed models of underground chemical plumes.
- Designed and oversaw implementation of residential landscape projects as the principle designer, emphasizing native plants and ecologically friendly designs.
- Designed and created a database and analyzed data for a non profit helping alleviate food insecurity in Kossoye, Ethiopia.
- Created GIS maps to illustrate noise levels around the Memphis International Airport for use in illustrating areas of concern for noise pollution to be presented to the FAA and United States Congress.
- Undergraduate thesis- designed a comprehensive campus master plan for the University of Hyderabad in Hyderabad, India, using a variety of geological visualization techniques and emphasizing ecological conservation and preservation, water management, and intelligent growth.

Curriculum Vitae

Dacre Bush

Title
Senior Project Manager and Remediation Specialist

Education
Graduate Courses in Hydrogeology, Engineering, Geology, and Theoretical Geophysics

BS – Geology, California State University, Northridge, CA

BA – Earth Science/Geography, California State University, Northridge, CA

Languages
English

Experience Summary
Dacre Bush has more than 30 years in business management and technical oversight for environmental-related projects. He has been involved with investigation and remediation of over 800 contaminated sites; has experience in CERCLA and RCRA sites involving solvents and metals; and is experienced with UST sites that were impacted with petroleum hydrocarbons. He has been involved in the design and management of thermal remediation (steam and electrical resistive heating) for the last seven years.

Dacre is currently a Project Manager and the Technical Lead of the Remediation Evaluation and Engineering Term for a "guaranteed" remediation contract for over 200 retail petroleum sites in the western United States.

Experience on Superfund Sites with Chlorinated Chemicals
- ***Montrose Superfund Site, Latham & Watkins, Torrance, CA:*** Thermal Remediation Specialist: Assisting with the feasibility and costing of thermal remedies (steam injection and ERH) for the Montrose Superfund site in Torrance, California. Also a participant in meetings with EPA and the Montrose team, which discusses and negotiates the remedial objectives and approach for the project. The Montrose site is impacted with a DNAPL mixture that is comprised of DDT and chlorobenzene. The California DTSC is a stakeholder with this project, and reviews the remediation strategies for groundwater and soil remediation for this site.
- ***Pemaco Superfund Site / Project Manager***: This was the first CERCLA site in California to utilize Electrical Resistance Heating (ERH). Note that 1-4 dioxane, as well as TCE, PCE, and other chlorinated compounds were successfully remediated in the Electrical Resistance Heating target area (18,000 SF to a depth of 95ft). Responsible for all major aspects of the project including:
    - Client communications and reporting
    - Coordination of agenda and meeting materials for Public Meetings
    - Budget, schedule and staffing
    - Writing and/or QA/QC of all submittals (Management and Operations and Maintenance Plan, Waste Management Plan, Environmental Protection Plan, Health and Safety Plan, Sampling and Analysis Plan, Hazardous Response Plan, Data Management Plan, and HazOp Analysis

- Data review and oversight of heating and vapor/liquid treatment systems
- Development of project web site
- Development of post-thermal remediation strategy.

Mr. Bush was a co-author of the 5-Year Review, and has worked with the Army Corps of Engineers in the project sustainability and path to closure strategy.

Indian Bend Superfund Site. Phoenix. Arizona

Mr. Bush provided technical direction for a Superfund site in Phoenix, Arizona. EPA identified the site, an operating dry cleaner/laundry facility, as a responsible party (RP) for the South Indian Bend Superfund Area. Fluor Daniel GTI reviewed EPA's data and submitted a work plan for remedial investigation (RI) consisting of a soil gas survey, soil gas monitoring wells and monitoring wells.

Well installations were done by percussion hammer rig due to cobbles from 40 to 100 feet below grade. Groundwater sampling and aquifer tests were performed after the well installations for determining groundwater quality and hydro geologic parameters. All the above activities followed strict EPA protocol per a Consent Order. The National Contingency Plan (NCP) will require a risk assessment, although a pre-approved Record of Decision (ROD) for source reduction via vapor extraction has been negotiated.

Chevron Bulk Terminal in Superfund Area in Albuquerque. NM

Mr. Bush authored the Remediation Proposal for the Chevron Bulk Terminal in Albuquerque, which is under EPA jurisdiction by means of a Non-Interference Work Plan (NIWP). The NIWP was developed as a response to an EPA First Amended Unilateral Administrative Order. This remedial proposal provided a description of current site conditions; list of remediation standards (ARARs); justification of preferred remedial alternative; and a post- closure monitoring schedule.

Motorola 52nd Ave Superfund Site, Phoenix AZ

Mr. Bush became involved in the Motorola 52nd Street Superfund site during the Feasibility Study. The initial remediation involved a system of containment wells with the purpose of mitigating plume migration. The 52nd Street groundwater plume is primarily the results of TCE releases over a 30-year period, and is several miles long. Mr. Bush's involvement was evaluation of the logistics and locations of the treatment system and the cost projections for operation.

19th Avenue Landfill Superfund Site, Phoenix AZ

Mr. Bush assisted with the development of the final closure assessment for the 19th Avenue Landfill. The assessment consisted of a large array of ambient vapor collection from above the landfill cap, surrounding areas, and assessment of the natural attenuation of the groundwater plume. The results of the studies were there were no identifiable impacts from the landfill and closure was granted by EPA.

In Situ Thermal Remediation for Solvents Recovery Service of New England, Inc. Site (SRSNE) Southington, CT
Mr. Bush assisted the responsible party with review of the final design, evaluation of the contractors HazOp, participated in conference calls with the stakeholders, and reviewed of the progress of the thermal remediation.

Honeywell-Bull Superfund Site, Peoria, AZ
Mr. Bush assisted with the implementation of the first vapor extraction system for TCE at a Superfund site. The vapor extraction system was constructed in 1987 and operated for 2 years. Subsequent remediation activities (permanent pump and treat system, excavation of heavy metals, capping of metal-impacted soil, and removal of manufacturing equipment) was performed over a 6-year period. This facility was then nominated as a Brownfield site by EPA. In 1996-7 Mr. Bush aided Honeywell and Lowe's in development of risk-assessment procedures and evaluation for industrial development. The Lowe's store opened in 1998, and was the first Brownfield development in the state of Arizona.

Solvents Recovery Service of New England, Inc. Site (SRSNE) Southington, CT
Mr. Bush assisted the Responsibility Party (RP) group of 23 companies with review of the final design for DNAPL remediation, evaluation of the contractors HazOp, participating in conference calls with the stakeholders, and review the progress of the in-situ thermal remediation after it begins in late 2013.

Additional Experience

- ***McMillan-McGee Corporation, Various Locations / Program Manager:*** Served as Principal in charge for U.S. business development and project manager for major U.S.-based projects. Had design and project management roles for ten ElectroThermal-Dynamic Stripping Process (ET-DSP) projects noted below:
    - Emerson Electronics, St. Louis, Missouri
    - Flex-Fab, Racine, Wisconsin
    - Ato-Fina Petroleum, Greensboro, North Carolina
    - Total Petroleum, Greensboro, North Carolina
    - Cape Fear Superfund, Cape Fear, North Carolina
    - Westwater, Tampa, Florida
    - Rayloc Industries, Atlanta, Georgia
    - Site 298, Edwards AFB, California
    - Paducah Gas Diffusion Plant, Kentucky

- ***Area A of the Northeast Site at the Young-Rainey STAR Center, Largo, Florida*** In March of 2003, the United States Department of Energy (DOE) completed a full-scale non-aqueous-phase liquid (NAPL) remediation of Area A of the Northeast Site at the Young-Rainey STAR Center, Largo, FL. The site was remediated by SteamTech using a combination of steam-enhanced extraction and electrical resistance heating during operations lasting 4.5 months. This is the first full-scale demonstration of complete source removal at a DNAPL site. Since the post-operational sampling shows all concentrations to be below or close to groundwater MCLs, the thermal remedy may be satisfactory for site closure without a polishing phase.

- ***Area B of the Northeast Site at the Young-Rainey STAR Center, Largo, Florida*** DOE's prime contractor (Stoller) subcontracted a remediation team which consisted of three companies: WRS Infrastructure and Environment,

Inc. (WRS), McMillan-McGee Corporation (Mc2), and PPM Consultants (PPM). The approach for Area B (5x larger than Area A) was remediate the site was to heat the subsurface using Electro-Thermal Dynamic Stripping Process (ET-DSPTM) along with injection of ex situ generated steam, and then extract and treat the volatilized contaminants. Because of his experience with the Area A project, Mr. Bush was the Project Manager of the thermal elements of the project. A particularly challenging aspect of the project was to remove NAPLs from the area underneath a building, Building 1400, located adjacent to the remediation area. This building was continuously occupied by tenants during the remediation. All remediation goals and performance standards were met during the remediation. In addition, there were no accidents and no regulatory or environmental violations.

- ***SteamTech Environmental Services, Bakersfield CA / Senior Project Manager:*** Project Manager for Guadalupe Restoration Project Pilot Steam Injection Test and the DOE Young-Rainey STAR Center. Assisted with the design and implementation of three steam injection pilot tests at Lawry AFB, Edwards AFB, and Beale AFB.

- ***URS Corporation (formerly Dames & Moore) / Engineering/Geosciences Manager:*** Group Manager for the combined Geosciences and Civil/Mining practices in the Phoenix office, which had a staff of 60 engineers, geologists and environmental scientists. Mr. Bush performed design review, project management, and expert witness work for complex projects in Arizona.

- ***Fluor Daniel Australia LTD, Sydney / Managing Director, Australia:*** Responsible for five capital city offices and two satellite offices in Townsville and Hobart, Australia. Responsible for all environmental projects in the Pacific Rim area. Countries in which projects were performed included China, Thailand, New Zealand, Singapore, Indonesia, Korea, Japan, Malaysia, Papua New Guinea, and Vietnam. The list of services for offshore projects ranged from due diligence surveys for property acquisitions, wastewater treatment plant design and construction, contaminated site investigation and remediation, and ISO 14000 audits. Work in Japan and Korea was for the USAF, performing fueling system upgrades and construction management under an AFCEE contract.

- ***Fluor Daniel GTI (formerly Groundwater Technology, Inc.) / District Manager:*** Started the Phoenix office for Groundwater Technology, Inc. Later as District Manager for the Southwest, he was involved with development of the GTI Technology Review Team. The Southwest District had over 100 employees and offices in Tempe, San Diego, Albuquerque, Denver, and Salt Lake City. Oversaw large complex projects, which often involved co-mingled plumes, chlorinated solvent plumes, and multiple parties. He also was an expert witness for remediation and testified in court numerous times.

Remedial Investigation (RI) Experience

- As both Manager and Project Director, designed, supervised, and reviewed assessments for more than 1000 sites (mostly UST sites) in southern California, Arizona, New Mexico, Colorado, Utah, New Zealand, and Australia. Contaminants worked with include metals, hydrocarbons, acids, and solvents in soil and groundwater. Regulatory agencies have included EPA Region IX, EPA Region VI, New Mexico Environment Department, Arizona Department of Environmental Quality, Arizona Department of Water Resources, California Department of Health Services (presently Cal EPA), California Regional Water Quality Control Board (Region 7, 8 and 9), County Health Departments (San Diego, Orange, Los Angeles, Riverside, Imperial, Ventura, and San Luis Obispo), Utah Division of

Environmental Response and Remediation, Colorado Department of Health (UST and HMWM), and their Australian counterparts.

- Mr. Bush has extensive experience in the application of vapor extraction systems with thermal and/or carbon for off-gas controls). Evaluated and assisted in the implementation of pump and treatment systems utilizing air strippers and/or carbon for water treatment. Experienced with bioremediation of soil and groundwater by in-situ and ex-situ technologies. Worked on site requiring soil excavation with off-site disposal or on-site treatment. Utilized air sparging of dissolved organic compounds; implemented LNAPL fluid recovery technologies; and designed and managed in-situ enhanced oxidation for chlorinated compounds. Served as project manager for in-situ fixation of metals, thermal (steam and electrical) applications, and natural attenuation/risk assessments. Most of these remedial technology applications required permits or variances for the above agencies and/or air permits from the state or county air quality agencies.

Litigation and Negotiation Experience

- ***Various Clients and Locations:*** Assisted 30+ law firms and/or corporate legal staffs on a variety of issues. As an expert witness, testified in court, been deposed, written declarations, provided counsel, and attended mediation hearings. Most of the litigation and negotiation work involved determining allocation of damages, cost of remedial action, standard of care, and/or the source of impact(s).

Publications and Presentations

- “Electro-Thermal NAPL Remediation Under Building 1400 at the Northeast Site”, at the Fifth International Conference Remediation of Chlorinated and Recalcitrant Compounds, Battelle Conference, Monterey, California, May 2006
- “in-Situ Electro-Thermal Remediation of Chlorinated VOCs: Full Scale Evaluation” at the Fifth International Conference Remediation of Chlorinated and Recalcitrant Compounds, Battelle Conference, Monterey, California, May 2006
- "Evaluation of Remediation Technologies and Strategies for the Tucson Basin," presented at the Pima County Association of Governments, May 2000
- "Risk-Based Closures; How Evaluating Risk Applies to Closure Standards; Technological and Economic Implications," presented at New Mexico Water Law, The Fourth Annual Conference on Water Rights and Quality, August, 1996
- Addressed and Panel Member at State of New Mexico Environment Department Underground Storage Tank Conference and Trade Show, "Sparge and Vent Technology Roundtable," 1995
- Addressed Chevron USA Products Law Seminar on Petroleum Hydrocarbon Contamination of Soil and Groundwater, Legal and Technical Overview, "Technical Support in Evaluating Claims, Determining the Cost of Cleanup V s Cost of Litigation V s Probability of Winning," April 1994
- Addressed Arizona State University center for Environmental Studies and The Arizona Department of Environmental Quality, "Site Assessments, Remedial Requirements, and Cleanup Case Histories," October 1991 "Soil Vapor Extraction: A Short Term Cost Effective or the Next Pump and Treat?" Bush, D., R. Brown, and P. Kroopnick, New England Environmental Expo, Boston, MA, May 21-23, 1991

Curriculum Vitae

Jacy Christenson

Title
Staff Professional

Education
Bachelors of Science – Natural Resources, University of Minnesota

Language
English

Experience Summary
Jacy Christenson has worked in the field of environmental consulting since graduating from the University of Minnesota, Crookston in 2014. She also served as an intern prior to that during her 2011 academic year. She has been instrumental in many internal and client-facing projects, such as data input, design work, website development, social media, and presentation design. As a Staff Professional, Jacy conducts field work at client sites, completes reports, and conducts research to fulfill project needs. Jacy has performed numerous environmental services including SPCC plans, facility response plans, pollution prevention planning, standards and regulatory assessments, benchmarking studies, and soil, groundwater, and vapor sampling. Jacy's great work ethic and timeliness brings efficiency and high quality work products to the work she performs.

Related Projects
- Assisted in various projects in Minnesota, North Dakota, Wisconsin, and Iowa.
- Limited Site Investigation (LSI) for a retail petroleum company in Minnesota. Conducted site assessments and soil boring field work which included soil, groundwater, and vapor intrusion sampling.
- Phase I Environmental Site Assessment (ESA) for numerous clients in Minnesota and Iowa. Conducted a full site assessment and soil boring field work which included soil and groundwater sampling.
- Involved with a large scale, pipeline-release excavation site in North Dakota beginning in May 2017. Duties include excavation oversight and guidance, soil and groundwater sampling, ensuring compliance, and communicating with the project team, client, and state officials.
- Co-lead a major Sustainable Agriculture project for 23 of the leading global beverage companies as part of the Beverage Industry Environmental Roundtable. Duties included member interviews, research, analysis of data, and final report creation.
- Spill Prevention, Control, and Countermeasure (SPCC) plans. Project team works to audit, update, and complete plans at facilities storing 1,320 gallons or more of oil to be in compliance with federal regulations. Communicated with facility managers, and completed plans to maintain compliance for clients.
- Facility Response Plans (FRP) for oil handling facilities across the western United States. Completed calculations and the final deliverable FRP to determine the worst case oil discharge scenario and how to respond to the situation.

- Provided assistance to Project Managers locally and at other Antea Group offices in the delivery of various reports and plans, including Phase I Reports, Spill Prevention Control and Countermeasure Plans, and FRPs.
- Provide communications support for the Beverage Industry Environmental Roundtable. Includes press release, social media, and presentation assistance
- Designed numerous client facing presentations for senior management.

Curriculum Vitae

Jarrod Cicha

Title
Staff Professional

Education
MS – Earth and Climate Science (Hydrogeology focus), University of Maine, Orono, ME. (2013-2015)

BA – Geology
BA – Environmental Science, University of Minnesota Morris, Morris, MN. (2009 – 2013)

Training/Certifications
40hr HAZWOPER
First Aid/CPR/AED

Language
English

Experience Summary

Jarrod Cicha is a Staff Professional at the St. Paul office. He has worked in the field of environmental consulting since completing his MS in Earth and Climate Sciences at the University of Maine. He has thorough experience deploying and maintaining hydrologic monitoring equipment, analyzing and modeling hydrogeological data, and collection of soil, groundwater, and vapor samples. In addition to his technical abilities, Jarrod also has experience communicating scientific ideas to groups of people with varying scientific backgrounds. As a staff professional, Jarrod conducts field work at client sites, completes reports, and conducts research to fulfill project needs.

- Facility Response Plans (FRP) for oil handling facilities across the western Unites States. Completed calculations to determine the worst case oil discharge scenario and created reports regarding proper procedure for responding to a spill situation.
- Spill Prevention, Control, and Countermeasure (SPCC) plans. Project team works to audit, update, and complete plans at facilities storing 1,320 gallons or more of oil to be in compliance with federal regulations. Conducted site audits, communicated with facility managers, and completed plans to maintain compliance for clients.
- Multiple pre-purchase site audits. Due diligence reporting specified for client to incorporate aspects of Phase I ESAs and Phase II ESAs. Conducted contractor oversite of site assessments and soil boring field work. Completed historical and regulatory information reviews, regulatory file reviews at state agencies, and evaluating environmental conditions at subject properties for client's review before property transactions.
- Litigation support for expert witness testimony for a Manufactured Gas Plant (MGP) case. Project team worked to prepare expert witness testimony to deliver during the MPG litigation case. Prepared trial documents in an organized manner before presentation to the judges at trials.
- Construction Contingency Plan preparation. Created generic plans to have onsite during client's construction projects explaining the proper steps to take if impacted soil or groundwater is encountered during work.

- Worked with the Minnesota Pollution Control Agency on multiple projects. Communicated with regulators and property owners to find the best path for completion of field work such as monitoring well installation, groundwater sampling, and vapor sampling.
- Soil and Groundwater Screening Assessments (SGSA). Due diligence reporting specified for client to incorporate aspects Phase II ESAs. Conducted contractor oversight and collected soil and groundwater samples. Created reports for multiple sites.
- Completed a Master's Thesis project at the University of Maine (August 2013 – August 2015). Designed and completed experiments to assess the direction and magnitude of water flow within streambeds in northern Maine. Activities included literature reviews, writing project proposals, deploying temperature and pressure sensors, collecting large data sets, heat transport modeling with the computer language Python, manuscript preparation, and presentation of scientific findings in a group setting.
- Worked as a Research Assistant at the University of Maine from May 2014 to December 2014. Deployed and maintained hydrologic equipment in a bog setting. Collected, managed, and analyzed hydrological data.
- Worked as a Teaching Assistant at the University of Maine from August 2013 to May 2015. Led laboratory sections of Introduction to Geology and Geology of Maine.
- Worked as a Teaching Assistant at the University of Minnesota Morris from 2011 to 2013. Assisted the professor with lecture design, laboratory exercises, and grading for the following courses:
    - Mineralogy and Crystallography
    - Igneous and Metamorphic Petrology
    - GIS and Remote Sensing
- Participated in the University of Minnesota Hydrogeology field camp. Activities included conducting pumping tests, seepage meter analysis, slug tests, stream gauging, hydrogeologic modeling, and report preparation.

Curriculum Vitae

Tara Duffy

Title
Staff Professional

Education
BS – Geology, University of Wisconsin – River Falls
River Falls, WI

Training/Certifications
Accredited Office Ergonomics Evaluator (AOEE) – June 2014
First Aid/CPR/AED
OSHA 30 Hr

Professional Associations
Professional Member, American Society of Safety Engineers

Language
English

Experience Summary
Tara Duffy is a Project Professional with more than ten years of environmental experience and over 25 years of organizational experience. She has responsibilities for multiple steps of project lifecycles, including project management, project work plans, site health and safety plans, field work, report writing, data evaluation, database management, and cost modeling.

Related Projects
- Assists in development and management of EHS programs, written practices, training, and communications.
- Assisted in the development and maintains the internal Ergonomics program.
- Conducts monthly office audits and safety observations.
- Researches information regarding property records and other historical information required for the completion of Phase I Environmental Site Assessments (ESA).
- Assists in site walkovers, writing and completion of Phase I ESA reports.
- Provides full support for report writing including data entry support, proof reading, report assembly, uploading of reports to electronic file database, table development of laboratory analysis for inclusion in regulatory reports,
- Provides project management to client health and safety team, including responsibility for client document control database.
- Provides support to senior staff for marketing and business development projects.
- Provides assistance for completion and delivery of environmental proposals.
- Provides oversight in editing of site maps.
- Assists in writing, completion and delivery of standard operating procedures and spill prevention, control and countermeasure plans.
- Provided assistance to senior staff for BP's US Pipeline & Logistics (USPL) for nation-wide "Tank Operating Philosophy (TOP)" & "Tank Overfill Protection" programs.
- Processes Minnesota and North Dakota reimbursement applications for major petroleum companies. Tasks include gathering invoices, backup, and work orders; completing the Minnesota Department of Commerce and North Dakota Department of Insurance reimbursement application, change order forms; calculating reimbursement amount; and submitting applications to the Department of Commerce or Department of Insurance on behalf of the client.

- Performs fieldwork activities at a former bulk storage facility with multiple LNAPL plumes including groundwater sampling, LNAPL gauging and recovery, and treatment system monitoring and field data collection.
- Screens and logs soil/rock core samples during drilling activities; creates geologic logs and well construction diagrams for report presentation.
- Provides data analysis including chemical/hydrograph plots, groundwater impact trend evaluations and report summary text prep.
- Performs treatment system data review and processing including preparation of process flow and recovery graphs and discharge report summary tables.
- Provides cost modeling support to external and internal client needs in managing, financing and forecasting specific sites or portfolios.

Software Proficiency

- **Tr@ction** – Developed internal work flow procedures for companywide incident reporting for client's electronic incident reporting database. Responsible for all incident reporting, follow up and documentation control of client related incident reports**.**
- **Cost Modeling** –Provides Crystal Ball and @RISK cost modeling and decision analysis facilitation to support external and internal client needs in managing and financing specific sites or portfolios.
- **EQuIS** – Provides data entry and evaluation into petroleum company's data management database.
- **iEHS** – Developed internal process for document control of project and contractor records**.** Responsible for maintenance, training and updates.
- **Log Plot** – Provides support to end user. Developed new template for creation of geologic logs.

Curriculum Vitae

Paul A. Durkee

Title
Senior Consultant

Education
MA – Aquatic Biology, Bemidji State University, Bemidji, MN

BA – Biology, Gustavus Adolphus College, St. Peter, MN

Languages
English

Experience Summary
Paul Durkee, a Senior Consultant, also currently serves as the Inogen Environmental Alliance President and CEO. He previously served as Managing Director for Delta-Simons Environmental Consultants Limited in Lincoln, England for four years. Paul has spent more than 30 years working with clients regarding their environmental, health and safety needs. He has a wealth of knowledge and experience in evaluating and implementing EHS organizational and management systems and has assisted clients with strategic planning. His areas of expertise include delivery of international projects for multi-national clients, implementation of environmental management systems, environmental liability management, EHS audit programs, and providing strategic planning for EHS organizations.

Related Projects
- Managed environmental, health and safety compliance audits for specialty chemical and manufacturing clients throughout the world. Protocols were agreed with the client and the audits were typically implemented using iEHS®, to conduct the audit and produce the audit reports.
- Managed a health and safety organization diagnosis for a large agricultural cooperative. This project included conducting over 35 employee (C- suite to line managers) interviews across their various business units, evaluating and trending the responses and preparation of a recommendation report to enhance their H&S organization.
- Managed and coordinated projects in the Americas, Asia, and Europe. These projects ranged from due diligence assessments for mergers and acquisitions and compliance audits to remediation of contaminated sites.
- Managed the development and continued update of environmental, health, safety and security regulatory summaries for over 70 countries. These regulatory summaries provided the information our clients require to conduct their business in the countries where they operate. The registers were produced by in-country experts and updated on a monthly basis.

- Supported numerous clients with their merger and acquisition activities throughout the world and have served as their EHS expert during negotiations with the other parties.
- Introduced our clients to the use of environmental insurance products to facilitate transactions and to extinguish reserves for environmental liabilities. Projects have included the use of cost cap, blended finite risk and pollution legal liability insurance products. The projects have ranged from one site to over 120 locations across the globe and ranged in cost from $1.7 million to $7.1 million.
- Managed the implementation of an environmental management system for a large agricultural cooperative. This included working with the company stakeholders to design and implement the new management system which mirrored the elements of ISO 14001.
- Conducted compliance audits at manufacturing facilities throughout the UK and Europe. The audits were undertaken as part of pre-purchase purchase due diligence. The audits were designed to review the past and current waste handling, chemical use, health and safety procedures, discharge consents, air emissions and related permits.
- Provided project management for environmental assessments and audits at numerous sites in the UK and the United States. The assessments included evaluating contaminant liability relating to property transactions and property valuations.
- Provided senior consulting on Brownfield re-development projects in the United Kingdom and the USA. The projects ranged from office, industrial, retail and residential development all located on contaminated sites. By gaining the support of the various stakeholders (government, city, community groups, seller/buyer, architects, developer, etc) involved early in the process, the projects ran smoothly to completion. Creative remedial alternatives were selected to work with the new development. This in turn typically saved time and money during the development construction.

Curriculum Vitae

John R. Estes

Title
Geologist, Consultant

Education
BS – Geology, California State University-Long Beach, Long Beach, CA

Professional Registrations
Board of Technical Professions: South Dakota

Certified Petroleum Release Remediator

Languages
English

Experience Summary
John Estes has 20 years of experience in the environmental industry. He specializes in petroleum-related remedial investigations and environmental assessments, with technical field, project management, and portfolio management services.

- Field services have included operation of environmental drill rigs for installation of monitoring wells, recovery wells, and sparge and vent wells, as well as the operation of drill rigs for geothermal heat loop installation. Additional field services include the oversight of monitoring well installations, recovery well installations, and oversight of tank removals and subsequent over excavation, ground water and soil sampling, surveying well locations and pertinent data reduction.
- Project management services have included the overall coordination (scope, schedule, budget) of several individual projects from property transaction activities, underground storage tank removal to closure, initial investigations through to closure, and associated reimbursement fund requests.
- Portfolio management services (grouping of projects) have included the overall coordination (scope, schedule, budget) from a 10-year lifecycle perspective as well as developing, implementing and managing strategies, opportunities (and threats) to minimize the portfolio's total liability in terms of environmental costs.
- Manager in the firm's Decision Analysis & Cost Modeling services. Our Cost Modeling services support external and internal client needs to assess work scopes and to forecast costs for specific sites or portfolios. A significant aspect of these practice area targets asset transactions where a single site or a portfolio of sites require appropriate scopes of work to be created and defined for end-points of regulatory acceptance and business financial goals. Our Cost Modeling Practice utilizes various industry-accepted decision analysis/cost modeling simulation software, including @RISK, Crystal Ball, ModelRisk, and RACER. Our approaches to cost modeling have applications to the following business drivers.
    - Methods to estimate total environmental liability, both known and unknown.
    - Applicable models incorporating financial structures for liability transfer.
    - Additional technical and financial considerations in contracting, and insurance evaluation (markets and adoption).

  - Achieving an understanding of the forecasted certainty for the cost of the existing and future environmental liabilities.
  - Comprehensive management and business plan alignments of environmental liabilities during periodic work plan progress and peer reviews.
- Business process services have consisted of working independently as well as participation as a team member in areas including preparation and training of safety excellence models (Achieving Safety Excellence), operational models (Achieving Operational Excellence), project information database development, resource needs evaluation, as well as policy training and material preparation.

Related Projects

- Provided project management services to Minnesota State Superfund programs sites, including scope, schedule, budget management, community relation negotiations, and client correspondence.
- Provided project management services to Minnesota Brownfield programs sites, including scope, schedule, budget management, community relation negotiations, and client correspondence.
- Operated and assisted in operation of environmental drill rigs utilizing hollow stem augers, rock coring, and mud and air rotary equipment on several investigation sites in Minnesota, Iowa, Wisconsin, South Dakota, and North Dakota
- Provided field services in Minnesota, Wisconsin, Iowa, North Carolina, South Dakota, and North Dakota for several petroleum hydrocarbon spill investigations and remediation sites. Field activities included installation of soil borings and monitoring wells; collection of soil and ground water samples; excavation of tanks and contaminated soils; Resident on-site manager-inspector on an MPCA landfill excavation removing over 50 thousand cubic yards of municipal solid waste; and performance of slug tests, pumping tests, and packer tests. Conducted several Phase I and Phase II environmental assessments for property developers and lending institutions in Minnesota.
- Provided project management services to underground storage tank projects and terminal facilities to various retail petroleum companies in Minnesota, North Dakota, South Dakota, and Wisconsin.
- Provided portfolio management services for a major oil company. The portfolio consisted of retail operations (service stations, bulk storage facilities, and terminals in Minnesota, South Dakota, and North Dakota).
- Provided business process activities internally within the firm at various levels (unit, sector, company) while working independently as well as participating as a team member and trainer of a variety of projects.

Publications

- "Aerial spray cleaning of high voltage insulators". S. C. Tsai, J. Estes, et al. Powder Technology, 74 (1993) 13-21

Curriculum Vitae

Eric T. Feenstra

Title
Project Engineer

Contact
Email: portgerm@gmail.com
Phone: 616-443-7020

Education
B.S. – Geological Engineering,
Michigan Technological University,
Houghton, MI

Professional Registrations
Engineer in Training (EIT)

Language
English

Experience Summary
Eric Feenstra is an Engineer working in the environmental consulting and water treatment industries since 2013. Eric's education and experience combine to create a holistic understanding about geologic settings/conditions and their effect on remediation systems design and construction, as well as operations and maintenance.

Related Projects
Project Engineer

- Development of SPCC/PIPP plans for refined products terminal, refined petroleum pipeline release, and commercial sites.
- Preparation of air and NPDES permitting along with sampling plans for multiple soil vapor extraction and pump and treat systems.
- Development of remedy progress reports, site conceptual models, Right of Way Environmental Lease Agreements, and No Further Action report documents.
- Management, planning, and site installation of soil vapor extraction system on bulk fuel terminal.
- Supported the management and operations of a both a petroleum product recovery system and an air sparge system at a refined products pipeline release site.
- Support for consultant transfer of pump and treat system including design theory, geologic subsurface and the impact to system operations; field support including NPDES sampling and compliance, air stripper cleaning and maintenance, well field optimization, electrical and PLC troubleshooting, and pump cleaning.
- Field oversight of the demolition of residential structures at a client acquired property associated with a historical refined petroleum pipeline release site, which included asbestos survey/sampling, demolition permitting, and abatement.

Curriculum Vitae

Eric Feenstra

Petroleum Treatment – Soil and Groundwater Remediation

- Installation of air sparge/soil vapor extraction remediation systems including oversight, procurement, and testing at a refined products terminal site.
- Operations and maintenance of multiple pump and treat, air sparge, soil vapor extraction, and multiphase extraction systems on multiple refined product pipeline and terminal sites, commercial, and specialty chemical sites.
- Supported the design of large pump and treat system including process and identification diagrams, equipment specification, and process flow calculations for specialty chemical company site.

Heavy Metal Water Treatment – Metal Plating Industry

- Design of heavy metal treatment systems for the metal plating industry including mass flow calculations, sludge settling rates, heavy metal hydroxide sludge removal and handling, pH control, etc.
- System build including metal work, catwalk erection, pump and pipe placement, electrical control wiring.
- Management of project goals, parts inventory, and build of water treatment systems.
- Perform extensive in house system checkout including pumps, controls and piping to ensure complete system operation.
- Field check for system completeness with attention to placement of tanks, labels, safety, and ensure system controls work once water is introduced.

Curriculum Vitae

Beth Firkins

Title
Project Professional

Education
BS – HTRM
University of Wisconsin-Stout
Menomonie, WI

Language
English

Experience Summary

Beth Firkins, Project Professional, has over 4 years of experience in the environmental consulting industry and over 10 years of design, administrative, and data management experience in a variety of industries. Based in Antea Group's St. Paul office, Beth serves a variety of environment, health, safety and sustainability projects and clients. She has been instrumental in many internal and client-facing projects, such as writing press releases, creating systems for project management, conducting safety audits, facilitating employee safety trainings, reviewing reports, data review and trend analysis, staffing management, and creating online databases. Beth's diverse background and attention to details lend perspective, insight, and unique problem-solving skills to the work she performs.

Beth is also a trusted practitioner who specializes in providing services to clients in the food and beverage and technology industries. In addition to her client-facing work, Beth also serves as the Innovation Coordinator on Antea Group's Innovation and Commercialization Team.

Related Experience

- Serves on the Communications Team of the Beverage Industry Environmental Roundtable (BIER), a technical coalition (facilitated by Antea Group) of leading global beverage companies that are working together to advance environmental sustainability within the beverage sector.
- Designs media campaigns for BIER's communications for work product releases and coordinates external blog series.
- Provides ongoing health and safety support and auditing for a global consumer electronics company, including support to their local retail stores, environment/health/safety (EHS) auditing, emergency response planning, and other EHS services.

Related Experience - Continued

- Performs daily review, validation, and follow-up on reported incidents from a global technology retailer. Analyzes trends and communicates best practices to incident reporters. Reports to the corporate HSE team.
- Assists in building, designing, reviewing, and revising internal and external presentations.
- Provided Active Threat Awareness trainings to hundreds of employees across nine stores as part of a global retailer's training initiative (Summer 2016).
- Coordinated internal innovation meetings and calls. Oversaw and facilitated the creation of a change in internal tracking systems for innovations in Antea Group's Innovation and Commercialization Program.
- Provided assistance to Project Managers locally and at other Antea Group offices in the delivery of various reports and plans, including Phase I Reports, Spill Prevention Control and Countermeasure Plans, and Facility Response Plans.
- Coordinated the organization, printing and delivery of monthly and quarterly sampling reports to home owners in support of the clean-up of a pipeline release for a major oil manufacturer.

Other Experience

- Created the strategy for a social media campaign for a local restaurant that increased Twitter followers by over sixty percent.
- Managed operations and online reservation database systems for a local restaurant, including the development of training materials, training of end users, and troubleshooting/adjustments to the system.
- Assisted in the development and facilitation of the transition to a paperless filing system for a major law firm.
- Provided administrative assistance to lawyers in a fast-paced, Wisconsin law firm. Duties included drafting, proof-reading, printing and transmittal of legal documents and formal correspondence
- Coordinated and planned large corporate sponsored events at various trade shows, including the design of booths, development of menus, and staff scheduling.

Curriculum Vitae

Stan Freedman

Title
Staff Professional

Education
BS– Geology, University of Puget Sound, Tacoma, WA

Post-Graduate Certificate – Geographic Information Systems, Portland Community College, Portland, OR

Professional Associations
Geological Society of America

Languages
English

Experience Summary
Staff Professional with over 3 of experience as a GIS Technician and a Field Technician / Geologist working out of the Loveland, CO office. Mr. Freedman provides routine soil and groundwater sampling activities at project sites, performing planning, coordination, and data evaluation in conjunction with his field assignments. Mr. Freedman's primary GIS responsibilities include: development and application of spatial analysis solutions to meet the specific needs of projects; management of data resources for a wide range of environmental site assessments and remediation projects involving soil management, storm water management, and groundwater monitoring; technical support of GPS and field data collection units; and, development of template geodatabases and mobile GIS projects for data collection events.
Prior to his current position at Antea Group, Mr. Freedman performed mudlogging activities associated with oil exploration of the Elk Hills petroleum reserve in California.

Related Projects
- Performs routine groundwater sampling events and provides maintenance and troubleshooting to remediation systems in Colorado and Wyoming.
- Performed multiple soil sampling activities, creating boring logs and overseeing drilling contractors using geoprobes, hollow stem augers, and sonic drilling methods.
- Manage GIS data resources for storm water management plans at rail yard sites. Coordinate GIS activities with project teams. Develop web maps on ArcGIS Online designed for data collection in the field. Extract and visualize data to produce high quality maps to support project teams and their site assessments. Supervise and oversee the integration of data into the organization's data management structure.
- Created an environmental sensitivity atlas for a pipeline spill response plan across Montana and North Dakota. Acquired geospatial data and utilized spatial analysis to identify environmentally sensitive areas within proximity to the pipeline. Manipulated and visualized data to produce maps meeting the client's specific needs.

- Perform routine groundwater monitoring at a diesel fueling site in Marshalltown, IA. Site visits include well gauging and remediation system operation and maintenance activities. Perform data compilation for technical reporting and providing spatial analysis for groundwater figures, including potentiometric and LNAPL thickness maps.
- Coordinated and conducted a series of soil and groundwater sampling events on a portfolio of railroad properties being leased to an agriculture company in Kansas. Provided oversight of utility locating and direct push (GeoProbe) contractors for soil and groundwater sampling activities. Soil and groundwater samples were collected and analyzed for VOCs, PAHs, metals, herbicides and pesticides.
- Conducted railroad tie sampling throughout northern California and Idaho to analyze ties for creosote, metals, and toxicity. Coordinated work plans and schedules with railroad personnel to effectively and safely complete scope of work in a timely manner. Responsible for sample collection, documentation, and reporting.

Curriculum Vitae

Cathy Grams

Title
Database Administrator

Education
BS – Geology, minor Computer Science,
University of Minnesota – Duluth,
Duluth, MN

Language
English

Experience Summary

Cathy Grams, Senior Project Manager, has over 20 years of professional experience in the computer industry working with hardware and software technical support, network administration, database management, and Geographic Information Systems.

She is well versed in environmental data management software and tools including EQuIS, Access, Excel, gINT, and Logplot. Her GIS experience includes programming, project work, and training utilizing ESRI's ArcGIS applications.

Related Projects

- Responsible for database administration, design, and customization, including stored procedures and functions, of companywide SQL database
- Administers, maintains, develops, and implements policies and procedures for ensuring the security and integrity of database
- Developed and implemented customize VB software solutions
- Implement data models and database designs, data access and table maintenance codes for database
- Tests database layout to ensure the system is meeting company needs
- Designed custom solutions for clients including database design and report creation.
- Provides technical support for end users
- Provides GIS technical support services to internal and external clients

As a Principal Consultant for a large multinational computer technology corporation, her responsibilities included:

- Implementing data model conversion process using company standard tools, documentation and defined methodology.
- Gathering customer and product requirements through customer workshops and workbook tools.
- Creating and updating technical and functional specifications from requirement gathering.
- Providing assistance during application rollout including troubleshooting and resolution of issues.
- Creating and performing test plans according to client requirements.

Curriculum Vitae

Cathy Grams

Working as a Division GIS Coordinator/UNIX System Administrator for a state government agency, Cathy:

- Formulated the Division's GIS plan
- Established a general framework and specific procedures for collection, storage and retrieval of GIS data
- Conducted analyses, pilot projects and prototype projects
- Ensured database was designed consistent with governmental GIS standards
- Provided UNIX technical support for UNIX-based GIS systems and related network infrastructures for the division

Curriculum Vitae

Jessica Highfill

Title
Staff Scientist

Education
BS – Environmental Biology,
University of Dayton, Dayton, OH

Languages
English

Experience Summary

Jessica Highfill is a Staff Scientist with thirteen years of environmental experience. She is knowledgeable in environmental and ecological assessments in the petroleum remediation, transportation and construction fields within multiple states regulations. She is very knowledgeable in various computer software modeling protocols including Rockworks, LogPlot, AutoCAD, MicroStation and ArcGIS. She is confident in her ability to obtain, create, and work within large databases using ArcGIS, Microsoft Access, Rockworks software or internet databases, such as iEHS.

Related Projects

- (ArcGIS and Database Management)
- Served as a graphics specialist, as well as ecologist for large scale environmental assessments in the Midwest region. Including:
    - using ArcInfo and ArcView, digitized land parcels within the project boundary. These parcels were then joined to landowner databases and used in ArcView to assess the land use and impact of highway development to property owners within the area. Using ArcInfo and ArcView, assessed economic impacts within the area by identifying and digitizing businesses within the commercial areas of the proposed development
    - using ArcView software, analyzed historic and current land use using aerial photography and digitally mapped areas within the project boundaries of approximately 80 river miles.
    - using Trimble GPS and ArcView software, identified natural areas
    - using internet based files provided by state resources, digitally portrayed the ecological receptors within the project boundaries.
    - using Trimble GPS and ArcView, performed wetland delineations
    - performing mapping, graphics and writing for the final report

- (Aquatic Biology) Served as aquatic biologist for the monthly monitoring of zebra mussel populations in and around the intake/outtake piping of multiple nuclear power plants in the Midwest region. This work included both field and laboratory analysis as well as monthly and annual reporting.
- (Wetland Delineation) Served as wetland scientist, as well as graphics specialist, for multiple environmental assessments in the Midwest region. Projects varied from specific wetland delineations using Trimble GPS and ArcGIS to accurately map the wetlands and assess accuracy to state and federal databases; to simple delineations for use in permitting. In addition to these assessments, assisted in the mitigation and monitoring of numerous wetlands associated with the delineations and for use in future wetland mitigation banks.
- (AutoCAD and RBCA Reporting) - Assisted in preparing state-regulated RBCA assessments and groundwater monitoring reports for multiple states throughout the United States. Duties included data entry, the creation of tables and figures, and the creation and assistance of reports.
- (Phase 1 ESA Reporting) Served as environmental scientist for Phase 1 Environmental Site Assessments and the creation of technical reports.
- (ENFOS) - Served as a software specialist in a pilot study of an internet-based technical database. This database used Enfos to store project information from multiple contactors and clients that could be used to generate tables, figures, reports that could be state and/or client specific using a variety of software applications. In addition, it could be used to plan and organize proposed field work and deliverables.
- (Rockworks and AutoCAD) - Served as a project lead in the creation of subsurface modeling of petroleum remediation terminal and retail sites within Missouri, Illinois, Iowa and California. This modeling including cross sections and fences of both area lithology and areas of contamination.
- (LogPlot) - Assisted in preparing well construction and soil boring logs for many sites using numerous state regulations. Within select sites, used these LogPlot files in Rockworks to portray subsurface features.

Curriculum Vitae

Wayne Hutchinson, PG, PH

Title
Senior Professional - Hydrogeology

Education
MS – Geology, Rutgers University, New Brunswick, NJ

BA – Geology, Southampton College of Long Island University, Southampton, NY

Professional Registrations
Professional Geologist: Wisconsin

Professional Geologist: Illinois

Professional Hydrologist: Wisconsin

Professional Associations
International Society for Environmental Forensics

National Ground Water Association

Languages
English, Spanish, Arabic

Experience Summary
Wayne Hutchinson has over 40 years of experience as a hydrogeologist, geophysicist, engineering geologist and project manager. Wayne develops and implements environmental strategies, manages hydrogeological investigations, applies models to evaluate ground-water flow and contaminant transport, and coordinates remediation projects for soil and groundwater.

Related Projects
- Designed and managed investigation and remediation of both hazardous and non-hazardous soil and installation of ground-water recovery trench/sump to treat and discharge ground water contaminated with co-mingled plumes of benzene, toluene, and chlorinated solvents.
- Assessed leakage and impact from underground propane storage cavern, redefined hydrogeological conceptual site model, and implemented expansion of water curtain to prevent further leakage.
- Designed and successfully operated a ground-water recovery and treatment system to reduce carbon tetrachloride and chloroform concentrations. Site obtained closure in Wisconsin.
- Completed enhanced bioremediation of a petroleum contaminated site using oxygen release compound (ORC). Significantly reduced concentrations of petroleum compounds and vinyl chloride at two sites using ORC.
- Conducted and supervised soil-gas investigations at release sites and under buildings including petroleum and chlorinated solvents.
- Developed Conceptual Site Models and conducted petroleum remedial investigations and remediation in porous media, fractured rock, and solution-channeled limestone at active and closed service stations, bulk terminals, industrial sites, pipelines, and government maintenance facilities in Wisconsin, Illinois, Minnesota, Missouri, New Jersey, and New York.
- Supervised or conducted Risk-Based Corrective Action (RBCA) evaluations, including use of an unsaturated-zone-transport model, to establish soil contaminant clean-up levels for petroleum compounds, pesticides and chlorinated organic compounds in Wisconsin and Illinois.
- Applied multi-phase flow modeling to estimate petroleum mobility and recoverability.

- Conducted soil and groundwater investigations for multi-media remediation of chlorinated solvents, lead, chromium, cadmium, mercury, and cyanide.
- Project hydrogeologist on a major inorganic and organic mercury contamination investigation involving soil, ground water, and estuary sediments.
- Applied geophysical techniques to detect buried tanks, piping, bedrock surfaces, solution channels, mine shafts, rock fractures, and contaminant plumes.
- Conducted geophysical investigations at hazardous waste landfills to confirm presence of underlying clay, hydrostratigraphy, depth to ground water and map contaminant plumes.
- Conducted an extensive field investigation, developed Wellhead Protection Area, and prepared water-supply contingency plan for a major food manufacturer located near a confirmed source of chlorinated solvents as well as other potential sources of organic chemicals.
- Used hydrogeologic mapping, geophysical techniques, and aquifer testing to evaluate glacial aquifers in northern New Jersey for supplemental water supply during a drought.
- Developed hydrogeological framework and ground-water computer model that demonstrated a carbonate/glacial aquifer in New Jersey could sustain 6,000 gallons per minute under a variety of climatic conditions to produce 200,000 pounds of trout per year.
- Expanded the ambient ground-water-monitoring network in northern New Jersey. The project received an award from the Project Management Institute.
- Used geophysical techniques to map water-filled audits in an abandoned iron mine which was subsequently used by a township in New Jersey as a new potable-water source.
- On-site Project Manager in Egypt for test borings and geophysical investigation for major dredging project to widen and deepen the Suez Canal.

Publications

- Hutchinson, W.R. Developing a Geophysical Program; in Proceedings of the Symposium on the Application of Geophysics to Engineering and Environmental Problems, Society of Engineering and Mineral Exploration Geophysicists, Golden, CO, p. 481, 13-16 March 1989.
- Canace, R. and W. R. Hutchinson. Bedrock Topography and Profiles of Valley-Fill Deposits in the Ramapo River Valley, New Jersey. Geologic Map Series 88-6, New Jersey Geological Survey, 1988.

Presentations

- Hutchinson, W. (2016) 3D Visualization for Conceptual Site Model Clarification: Wisconsin Ground Water Association Annual Meeting; Waukesha, WI; March 2016.
- Hutchinson, W. (2013) LNAPL Transmissivity and Oil-specific Volume as Key Components of the Conceptual Site Model: International Petroleum Environmental Conference (IPEC 2013); San Antonio, TX; November 2013.

- Girard, M.; W. Hutchinson and M. Martinson (2011) Innovative Remediation of LNAPL: Development of a CSM Leading to a Sustainable Remedial Design: Intersol 2011
- Nelson, M.; M. Umholtz; W. Hutchinson; D. Taggart and R. Stoelting, Delineation and Recovery of Free-Phase Hydrocarbon in a Fractured/Solution-Channeled Rock; National Ground Water Association Petroleum Hydrocarbons Conference; Atlanta, GA; November 2002.
- Hutchinson, W.R. Wellhead Protection - It's Not Just for Communities; Federation of Environmental Technologists Annual Meeting, Lake Geneva, WI, 7-8 March 1995.
- Navoy, A.S.; R. A. Zampella; R. E. Good and W. R. Hutchinson. Assessment of the Potential Impact of Groundwater Supply and Related Development of the Kirkwood-Cohansey Aquifer System, Southern New Jersey: A Proposal for a Comprehensive Research Program; New Jersey Academy of Sciences, Annual Meeting, April 1990.
- Mullikin, L.; W. R. Hutchinson; S. K. Sandberg and J. S. Waldner. Hydrostratigraphy of the Kirkwood Formation in Southeastern New Jersey; Abstracts with Programs; v. 21, #2; Annual Meeting of the Geological Society of America, Northeast Section, 23-25 March 1989, New Brunswick, New Jersey.

Curriculum Vitae

Craig Johnson

Title
Project Manager

Education
A.S. - HVAC Systems Installation, Service and Operation, Dunwoody College of Technology, MN

A.S. – Environmental Systems Design Technology, Dunwoody College of Technology, MN

Languages
English

Experience Summary

Craig Johnson is a Project Manager with 30 years of solid, varied experience in environmental consulting, construction management, and system operation and maintenance in the oil and gas, chemical and HVAC industries. During his career, Craig has worked closely with clients to meet their remediation and consulting needs.

Related Projects

- Designed, installed and operated an enhanced thermal steam injection system to remediate a 17 acre brown field site in a metropolitan setting for the Minneapolis Community Development Agency. Subsurface steam injection was utilized to heat the impacted ground water and vadose zone soils. The elevated temperatures resulted in lowering the oil viscosity to enhance mobilization to the respective recovery wells. A combination of total fluids pumping, dual phase extraction, pneumatic product skimming, and soil vapor extraction technologies were utilized for ground water and product recovery. A complex treatment process was employed for oil separation and removal and to treat the contaminated water and soil vapor to an acceptable level for discharge to the sanitary sewer and atmosphere respectively. Ultimately, the system remediated over 200,000 cubic yards of impacted soil, recovered approximately 60,000 gallons of diesel fuel, and achieved timely project closure.
- Instrumental in several soil and groundwater feasibility/alternative analysis studies for various Industrial and Energy clients. The goal of these studies was to provide screening of the best available remediation technologies as they applied to each specific site challenge. Several options were outlined and considered in each case. Some of the options were initially eliminated during these processes due to technology limitations, physical limitations, and disruptiveness, etc. The ultimate selection criteria was typically based upon effectiveness, duration, and overall cost to closure.

Curriculum Vitae

Craig Johnson

- Designed, installed and operated several soil and groundwater remediation systems throughout the USA primarily for the industrial, oil & gas, and chemical manufacturing industries. System technologies varied due to geological conditions, physical site conditions, and targeted contaminants. Targeted contaminants were typically DNAPLs, LNAPLs, and chlorinated hydrocarbons. System technologies include enhanced groundwater pump and treat, product skimming, air sparging, ozone sparging, soil vapor extraction, thermally enhanced treatment, ART technology, In Situ Chemical oxidation and reduction (ISCO, ISCR), and several combinations of these technologies. Many combinations of product separation, and water and air process treatment elements were incorporated with these technologies to achieve required discharge criteria.
- Managed a construction management group responsible for the implementation of various soil and groundwater remediation technologies throughout the continental USA.
- Acted as liaison between engineers and construction as to provide open communication and a more consistent and effective product in the field.
- Worked on development of several design, construction management, and cost estimating tools as to simplify tasks and minimize redundancy in effort.
- Developed building, fire, electrical, mechanical and OSHA design code summaries as they applied to our industry practices.
- Designed, built and operated various portable, self-contained, soil and groundwater treatment systems. These systems were utilized for emergency response, short- term remediation, and pre system design pilot study applications.
- Developed project cost estimates and prepared project bid proposals for environmentally related construction and system operation and maintenance projects as well as, create and manage overall project budgets.
- Identified and communicated potential project improvement and value engineering practices with the internal project team, client, and subcontractors on an ongoing basis.
- Ensured on site compliance to all current clients, governmental and in-house health and safety standards and regulations. Identify, secure and assist in procurement of project mandatory governmental licenses and permits. Created, prepared, initiated, and monitored required health and safety documentation including the HASP, JSA's, JHA's etc.

Curriculum Vitae

Robert Karls, PG

Title
International Environment Director
Senior Consultant

Education
MS – Hydrology, University of Arizona, Tucson, AZ

BS – Earth Science/Geology, St. Cloud State University, St. Cloud, MN

Professional Registrations
Registered Professional Geologist: Wisconsin (#632), Minnesota (#30067)

American Institute of Professional Geologists: CPG (#7348)

Professional Associations
American Institute of Professional Geologists

National Water Well Association – Association of Groundwater Scientists and Engineers

Languages
English

Experience Summary
Bob Karls, the International Environment Director and a Senior Consultant for Antea Group, has more than 34 years of environment, health and safety leadership experience. Bob specializes in the management of environmental liabilities and partners with clients to build liability reduction strategies through innovative risk transfer techniques including guaranteed fixed cost programs and cost cap insurance policies. He has a proven track record of success working with risk transfer stakeholders who often include property owners, business unit managers, environmental managers, procurement managers, attorneys, lenders and risk managers.

With extensive international experience, Bob has led projects across Europe, North America and Latin America and has provided consulting services to over 25 Fortune 500 companies including global beverage, pharmaceutical and integrated oil companies. A professional geologist with astute communication skills and an unflappable demeanor, Bob is a highly sought after expert witness. He has provided countless depositions and testimony at trial on topics including hydrogeology, remediation selection, contaminant migration and source characterization.

Related Projects
- Bob has been deposed more than 50 times and has been cross-examined at trial seven times. He is considered an expert in geology, hydrogeology, remediation selection, contaminant migration, and source characterization.
- Provided services to over 25 Fortune 1000 companies in establishing their environmental reserve estimates, updating balance sheet reserves for SEC reporting purposes, and provided consulting related to liability reduction strategies.
- Assisted more than 15 clients in eliminating or reducing balance sheet liabilities through risk transfer techniques, including finite risk and stop loss coverage. Environmental liabilities transferred or managed using these methods have exceeded $40 million and several opportunities have involved portfolios including numerous sites in several states.

- Served as lead investigator or a team member on more than 15 manufactured gas plant (MGP) sites in the United States and the United Kingdom. He is familiar with the construction, processes, and features of MGP sites and the nature of chemicals, byproducts, and residuals related to MGP sites. He has dealt with investigation, as well as remediation, of these sites and has had a key role in negotiations related to site closures. He has provided testimony in four litigation cases related to MGP facilities regarding source, fate, and transport issues.
- Directed the implementation of an environmental management program for international telecommunications company to allow international harmonization of the client's environmental policies. Developed the client's environmental management systems.
- Provided expert testimony in an action that involved the pesticide contamination of more than 20 residential wells. The testimony was used successfully to apportion responsibility for the contamination between several responsible parties.
- Provided expert testimony and technical direction of data collection and analysis for the defense of two pipeline companies in a case involving over 20 plaintiffs alleging health impacts, property damages, and punitive damages. Testimony included multiple depositions and trial testimony. Bob's assistance helped successfully exclude 18 of the plaintiffs from the action. The case was settled during trial.
- Led a project team tasked with maintaining a construction schedule for a multi-million dollar commercial building after groundwater containing high levels of chlorinated solvents was discovered to be migrating from an adjacent manufacturing facility toward the client's site due to construction dewatering activities. Alternate dewatering methods were designed allowing reduced migration of contaminants during construction. Served as an expert witness in two separate actions to defend the clients from accusations that they had materially worsened the contamination problem and had "associated" themselves with the release. He was an expert witness in a second action on behalf of the client to recover damages incurred due to increased construction costs and delays prior to the project team's involvement. Both actions were successful with recovery of all costs and no Superfund liability for the client.
- Led a project team in determining the extent of trichlorethylene contamination in the soil and groundwater. The client needed to determine if the contamination at their site was contaminating a nearby regional groundwater aquifer. The contaminated aquifer supplied drinking water to two metropolitan communities and several private residences, and the client had been named a responsible party. Conducted a remedial investigation, including soil borings, monitoring wells, groundwater sampling, pump test analysis, and analytical contaminant transport calculations. Also reviewed files from the state regulatory agency and worked with the responsible party technical group. Prepared litigation documents, including affidavits and exhibits, and gave expert depositions on the investigation results. The investigation concluded a major off site source contributed to the regional groundwater aquifer contamination. As a result of this testimony, the court dismissed the third party claims against the client and an out of court settlement was reached.
- Served as the lead technical expert for a consortium of insurers in a coverage case involving a wood treating facility with ongoing operational releases spanning 60 years. The complex hydrogeology and multiple wood treatment processes utilized at the facility required detailed analysis, modeling, and interpretation. A key element in this case

was the ability to forensically determine causation factors leading to the contamination of soil and groundwater over the period of operation and to develop the chronological indicators of contaminant movement over the 60-year period.

- Was lead technical investigator and testifying expert in Texas on a case of alleged migration of chlorinated solvents from a client's premises to a distant property. The plaintiff alleged a diminution in value due to the discovery of chlorinated solvents on the plaintiff's site during due diligence investigations related to property transfer.
- Served as the manager of remedial investigations conducted at a city in central Minnesota to determine potential sources of contamination affecting the entire water supply of the city. The contamination resulted in the shutdown of both city supply wells. Project included establishing contacts with two drilling subcontractors, designing and implementing a soil boring program to locate potential sources and waste disposal areas, and supervising the installation and sampling of multiple shallow and deep monitoring wells. Project resulted in the location of two potentially responsible parties each with multiple potential sources.
- Served as the project manager for an alternate water supply design and contaminant pumpout program. The project included the design and supervision of the installation of a water supply for more than 20 residential locations to replace the wells contaminated by organic chemicals from a leaching pit used for the disposal of hazardous wastes. Replacement well design utilized a complex construction with multiple casings. Contaminant pumpout and treatment were completed.
- Completed extensive diagnostic evaluations of several manufacturing and service companies as a portion of the development of their strategic environmental management program. The diagnostic evaluations included: extensive survey of all portions of the companies operations and management; detailed gap analysis; work shops; strategic planning; and follow-up planning and implementation activities.
- Conducted an environmental benchmarking project for a major U.S. food manufacturing company. The benchmarking was identified as a key element of the company's environmental management system and was necessary to allow measurement of performance of the company in conjunction with their progress toward achieving ISO 14000 certification.
- Served as the project manager or technical expert on more than 200 hazardous waste contamination and petroleum investigations and remediation projects.

Curriculum Vitae

Jacob Knapp

Title
Project Manager

Education
BA – Environmental Studies-Environmental Sciences Concentration, University of Minnesota-Duluth, Duluth, MN

Certifications
NRPP Residential Measurement and Mitigation Provider
NRPP Multi-Family Measurement and Mitigation Provider

Languages
English

Experience Summary
Jacob Knapp is a Project Professional with over 12 years of experience working in the environmental field. He has experience in project management and oversight of investigation and remediation at sites with a variety of environmental concerns using a variety of techniques. He has knowledge of regulations regarding, collection, transportation and disposal of various wastes including hazardous wastes. He also has experience testing and documenting construction practices and materials.

Jacob has experience developing site investigations and writing reports in accordance with applicable regulatory formats in multiple states. He has experience supporting various clients and projects including supporting expert witness reports for litigation projects. He has experience developing Five-Year review reports for superfund sites within Minnesota. He is based in our St. Paul, Minnesota office.

Related Projects
- Jacob has provided project management and investigative support for a pipeline release of 20,000 barrels of crude oil through all phases of spill cleanup. Support was provided from the emergency response phase, remediation and long term monitoring. Jacob has supported negotiations between the client, landowner and the regulator. Site investigation design has included advanced techniques supporting 3D visualization and analysis. Project management support also included maintaining data collection and management controls between multiple staff from multiple Antea Group offices.
- Jacob has provided project management of a drilling production water spill from a tank truck into a county ditch and threatening a wetland. The high chloride content of the production water required remedial excavation, dewatering and site restoration. Through continual communication with the contractor, land owners and regulators site restoration was achieved within weeks of the reported spill and regulatory closure shortly after.

- Jacob has provided litigation support for expert witness testimony for multiple cases; including manufactured gas plants and natural resource damages cases. Jacob's experience includes document review and summarization, field data collection, management and evaluation, staff management, and supporting expert report documentation and compilation.
- Jacob has managed multiple sites simultaneously within client portfolios, utilizing task appropriate staff to support specific client and project needs.
- Jacob collected, analyzed and evaluated data during emergency response and site investigation phases of a pipeline release of gasoline in suburban Milwaukee, Wisconsin. Data collection and evaluation supported response efforts, site conceptual model development, and remedial design. Data collection and evaluation included logging fractured bedrock cores during monitoring well installation and interpretation of results of LNAPL gauging, groundwater chemistry and groundwater elevation data collected from monitoring wells, residential supply wells and surface water sample locations.
- Jacob has performed site evaluation, investigation and remedial construction oversight at a former bulk terminal site located in St. Paul, Minnesota. Investigation and remedial construction at this site involved installation of air sparge and vapor extraction points into stratified layers of sandstone and shale utilizing sonic drilling techniques. During this project Jacob developed bid specifications and evaluated subcontractor bids for client specific requirements.
- Jacob has utilized multiple lines of evidence to evaluate historic groundwater chemistry data in order to gain regulatory approval for reductions to groundwater monitoring schedules at multiple sites, including petroleum terminal sites, retail petroleum sites and chlorinated solvent sites in Minnesota, Indiana, and Illinois. Jacob has evaluated historic site data utilizing concentration trend evaluation through graphical presentations, statistical analysis, spatial moment data and evaluation of groundwater elevation data. Jacob has experience utilizing the Monitoring and Remediation Optimization System (MAROS) program to perform statistical and spatial evaluation of historic site data.
- Jacob has conducted Five-Year Review Reports for ten superfund sites within Minnesota following procedures established by EPA guidance. Guidance procedures include file review, site visit, public notification, ROD/RAP review and review of remedial progress at the site. Five-Year Reviews involve review of historic and recent reports to evaluate current site conditions against remedial objectives and regulatory standards. As part of the Five-Year Review process Jacob has identified issues related to remedial progress and site protectiveness and presented recommendations to address issues identified. Jacob has provided technical support to the Minnesota Pollution Control Agency (MPCA) for multiple superfund sites.
- Jacob has evaluated technical reports and work plans submitted by site responsible parties and provided comments and recommendations to the MPCA in order to support site management decisions. Sites which Jacob has provided technical support include: Naval Industrial Ordinance Reserve Plant (NIROP), FMC Superfund Site (Fridley Plant), Kurt Manufacturing, Koppers Coke, MIBCO (State Superfund), and BAE RCRA site.
- Jacob has experience developing and implementing a regional groundwater elevation study and evaluation of regional groundwater chemistry data collected across multiple chlorinated solvent sites in southwest Fridley,

Minnesota. Work plan implementation required coordination with multiple site responsible parties in order to survey more than 250 monitoring wells at five sites within the region and coordination of groundwater gauging events for each site. Groundwater elevation data was then evaluated and mapped for multiple flow horizons to provide a better understanding of regional groundwater flow. Jacob also evaluated and mapped groundwater chemistry data to understand the extent and magnitude of regional groundwater impacts. This regional study has been used by the MPCA to develop their site management strategies for sites located within the study region.

- Jacob provided technical support for environmental compliance and waste handling practices for a large vessel and equipment decontamination site in Mississippi as part of the MC-252 gulf oil spill in 2010. Daily site operations were observed in order to document and resolve environmental issues with site operations leadership.
- Jacob has experience in third party access negotiations, organizing fieldwork, conducting field work, developing subcontractor bid plans and specifications which meet client required formats, subcontractor oversight, analyzing data collected and writing reports for multiple sites within our multi-site contract with the MPCA. Jacob has utilized data collected and historic site information to develop site conceptual models for multiple sites for this client, including petroleum release sites and chlorinated solvent release sites.
- Jacob has conducted contractor oversight of site investigation and remedial activities involving test pit excavation, direct push probes, hollow stem auger, sonic drilling techniques, excavation as corrective action and remediation system installation and demolition at multiple sites throughout the Midwest for public and private clients.
- Experience includes collection and characterization for transportation and disposal of various wastes including hazardous wastes from households and businesses in many locations throughout the Midwest.
- Team leader on disaster relief efforts in Louisiana after the 2005 hurricanes; here pharmaceutical waste from damaged hospitals and clinics was identified, collected, and packaged for transportation and disposal.
- Inspected and documented liner installation and construction of landfill cells and caps in Lower Michigan.
- Test and document construction materials and practices for best practices and specification requirements. Construction materials and practices tested include concrete, asphalt, nuclear density testing and laboratory testing of soil properties for compaction strength specifications.

Curriculum Vitae

Keith E. Knoke, PG

Title
Senior Consultant

Education
MS – Geology, Michigan State University, East Lansing, MI

BA – Geology, University of St. Thomas, St. Paul, MN

BA – History, University of St. Thomas, St. Paul, MN

DOL/OSHA 30 Hour General Industry Training Course

Professional Registrations
Registered Professional Geologist: Illinois (#196-000386), Minnesota (#30277), Wisconsin (#1141-013)

Languages
English

Experience Summary
Keith Knoke is a Senior Consultant with more than 20 years of experience in environmental, health and safety (EHS) consulting. His technical expertise is in, EHS program development and implementation, assisting clients in identifying, quantifying and mitigating corporate EHS risk, implementing EHS information management systems, performing global EHS due diligence and remedial environmental investigations. Keith's most recent responsibilities have included, global account leadership, corporate EHS program development, EHS management system design and implementation, EHS information management system implementation, corporate EHS audit management, merger and acquisition consulting and environmental reserve estimation.

Related Projects
- Served as project manager and team member on the development and implementation of EHS management systems for a number of clients whose industries include commercial printing, US Federal Agencies, specialty chemical, private utilities, paper production, and on and offshore oil gas services.
- Served as project manager and team member on an EHS Audit program development project for a global food and beverage company
- Served as project manager and team member for the scoping and implementation of EHS information management systems (iEHS®) for a number of clients whose industries include clothing manufacturing, industrial manufacturing, US Federal agencies, specialty chemical, consumer products, food and beverage, commercial printing, and oil and gas services.
- Created and implemented a 3rd party waste and recycling audit program for a natural gas and electric utility company
- Performed compliance audits at a number of agricultural chemical storage facilities, gasoline stations, manufacturing, and transportation facilities. The projects included the preparation of applicable regulations and rules list, site visits, and report preparation.
- Served as program manager for the development of 3rd party environmental audit protocols and risk ranking procedures. Facilities being audited included metal recyclers, plastic recyclers, and waste TSD sites.

- Performed environmental aspect impact analyses for heavy manufacturing and oil and gas support services companies.
- Served on several litigation support teams for the defense of cost recovery claims regarding the release of manufactured gas plant wastes to the soil and ground water.
- Served on litigation support teams for the defense of cost recovery claim regarding mitigation of aluminum dross reactions in Tennessee municipal waste landfill
- Served as project manager for a SPCC plan development and implementation program for an oil and gas production company located in Kentucky.
- Served as project manager for numerous plant closures in the printing, heavy manufacturing, light assembly and paper manufacturing industries. Tasks included, permit closure, environmental reporting, plant clean up and waste disposal management.
- Served as project manager on a merger acquisition project that involved the acquisition of seven offset and lithographic printing facilities located in the US and Puerto Rico. Conducted Phase I and Phase II environmental site assessments and compliance auditing that helped result in a successful acquisition.
- Served as project manager on a merger acquisition project that involved the acquisition of 15 manufacturing facilities located, Spain, US, China, Hungary, Finland, UK, Germany, France, Canada, Greece and Italy. Conducted Phase I Environmental assessment and liability estimations.
- Served as project manager on a merger acquisition project that involved the acquisition of 25 bulk storage facilities in the US and Canada. Conducted Phase II environmental site assessments, provided corrective action costs, assisted in reporting and compliance auditing tasks.
- Served as project manager on a merger acquisition project that involved the acquisition of eight chicken egg factories and lithographic printing facilities located in the US.
- Served as project manager on a merger acquisition of five railroad repair facilities located in the US and Canada.
- Served as project manager on a merger acquisition of six fine paper plants facilities located in the US and Germany.
- Served as project manager on a chlorinated compound release site. The site was an active battery manufacturing facility. In the late 1970s, the facility had a release of trichloroethene resulting in significant soil and ground water impacts. Project activities included assessment of the extent and magnitude of the release and an assessment of monitored natural attenuation as a remedy for the off-site portion of chlorinated compound plume. A soil vapor extraction system was installed to remediate the source area and closure was granted.
- Served as project manager on a chlorinated compound release site in Mississippi. The site was an active printing facility that had a release of trichloroethene resulting in significant soil and ground water impacts. Project activities included assessment of the extent and magnitude of the release and an assessment of remediation technologies. A combination of chemical oxidation and source area removal resulted in soil and ground water concentrations below cleanup standards and the closure request was granted.
- Served as a project manager on a two city-block Brownfield redevelopment project in St. Paul, Minnesota. The site had soil and ground water impacts from former manufacturing and agricultural activities and was enrolled in the state Superfund and agricultural voluntary cleanup programs. Remediation activities of lead and petroleum-impacted soils were successfully completed and letters of notice of No Further Action were obtained. The property was successfully currently developed for upscale condominiums and townhomes.

- Served as project manager on an indoor air quality project in Mandan, North Dakota. The site was a residential apartment complex that had persistent diesel fuel vapors. Provided the client with an air quality standard and decision process from which reasonable decisions concerning the health of the residents could be made, as well as a process to be followed in the event that the standard is or was exceeded.
- Served as a project manager on a combined Phase I/Phase II Environmental Assessment of a proposed multi-unit residential development in Hinsdale, Illinois. Primary duties included preparation of a risk-based site evaluation and corrective action design. Worked closely with the developer and Illinois Environmental Protection Agency staff, which ultimately led to a successful development of the property.
- Served as project manager on a Brownfield redevelopment project in St. Paul, Minnesota. The property, a former railroad yard, was impacted with metals, petroleum products, and creosote. Assisted the developer in investigating and remediating the property for an intended future use of townhomes.
- Served as project manager on a Phase II investigation of an active tire warehouse and printing facility in St. Paul, Minnesota. Results of the investigation indicated chlorinated compounds were present in the ground water beneath the site. As a result of the impacts, the site was entered into the Minnesota Pollution Control Agency (MPCA) Voluntary Investigation and Cleanup (VIC) program. Further investigation revealed the source of the impacts was on the adjacent property and an off-site determination was issued by the MPCA resulting in a timely and successful property transfer.
- Served as a project manager for a number of Minnesota Pollution Control Agency and United States Environmental Protection Agency funded Superfund projects. The projects generally involved Phase I environmental assessments and remedial investigations. The projects included investigations of a former shingle manufacturing facility, scrap/salvage yards, a plating facility, automobile repair shop, petroleum refinery, and dry cleaning facility.
- Served as a project manager on a Minnesota site with polychlorinated biphenyl (PCB)-contaminated soils. Primary duties included budget management, preparation of risk-based site evaluation report and response action plan, managing remedial actions, and working closely with the client and MPCA staff from the VIC program to facilitate a high profile property transaction. Following limited corrective actions, VIC issued a No Further Action letter.
- Served as a project manager on a combined Phase I/Phase II Environmental Assessment of a horseshoe foundry facility in Minnesota. Primary duties included budget management, oversight of field activities, and report preparation. Due to contamination found on site, the site entered the Minnesota VIC Program. Site closure was obtained in a timely fashion and assured a successful property transfer.
- Served as a project manager on a combined Phase I/Phase II Environmental Assessment of a proposed commercial development site in Minnesota. Worked closely with staff from the Minnesota Voluntary Petroleum Investigation and Cleanup Program (VPIC) to assess ground water contamination found on site. Conducted hydrogeologic investigation and determined ground water contamination was due to an off-site source.

Publications

- “Temporal trends in nitrogen isotope values of nitrate leaching from an agricultural soil.” Chemical Geology 146 (1998) 219-227.
- “Bull Run Discovered.” Military Images Volume XXV, No 5 (2004) 31-33
- “Evil Effects of Dancing – The Story of James Tanner”. North and South Vol 12 (2012) 50-65.

Curriculum Vitae

David Koppel

Title
Project Professional

Education
BA – Geology, Gustavus Adolphus College, St. Peter, MN

MS – Geology (Surface Processes), Ohio University, Athens, OH

Training/Certification
OSHA 40-Hour HAZWOPER
First Aid/CPR/AED
AARST-NRPP Residential Measurement and Mitigation Provider

Languages
English

Experience Summary
David Koppel is a Project Professional with approximately five years of experience working in the environmental consulting field. He has been involved in a number of projects, and has actively participated in all stages of the project lifecycle. He has a strong knowledge and understanding of state and federal environmental regulations

Related Projects
- Perform extensive soil, groundwater, and vapor sampling, soil excavation, monitoring well installation, and sub-slab depressurization system (SSDS) installation oversight for federal, MPCA, and commercial clients.
- Manage Petrofund sites from new leak number to site closure, including soil, groundwater, and soil gas sampling, soil excavation, permanent monitoring well installation, and associated reporting.
- Manage emergency response petroleum clean-ups, including soil excavations and associate reporting.
- Develop proposals, work plans and reports for MPCA, including vapor remediation, and soil and groundwater investigations.
- Write proposals, work plans, and reports for military munitions response program (MMRP) and unexploded ordnance (UXO) sites.
- Develop work plans and reports for closure of petroleum and pesticide sites in various states around the continental United States.
- Performed Phase I environmental site assessments. Work included site reconnaissance, state file reviews, review of historical documents, and report preparation.
- Provided field support for Phase II Site Assessment investigation projects, including:
    - Contractor oversight (excavations and monitoring well installations)
    - Soil, groundwater, and soil-gas sampling,
    - Monitoring well gauging and sampling,
    - Free product recovery,
- Interpretation of field data and laboratory results, summarizing site recommendations, and investigation report development.
- Obtained certification for oversight of sub-slab depressurization system (SSDS) installation in Dec. ‘12 (Res. Measurement and Mitigation Provider)

Curriculum Vitae

Layne Kortbein

Title
Staff Professional

Education
Bachelors - Bioproducts and Biosystems Engineering
Minor in Sustainability Studies
University of Minnesota, Minneapolis, MN

Certifications
Engineer in Training (EIT): State of Minnesota, #152343

Language
English

Experience Summary

Layne Kortbein, Staff Professional with Antea Group since August 2017, has experience collecting scientific data in the field, analyzing and interpreting data, composing technical reports, and communicating results to the scientific and non-scientific community.

Her technical experience includes maintenance and troubleshooting of active remedial systems, editing geologic maps with ArcGIS, creating boring logs under company and state standards, performing pre-purchase site assessments, and analyzing field data for site conceptual model creation.

Her analytical method experience includes gas chromatography-mass spectrometry, infrared spectroscopy, and high-performance liquid chromatography analysis. Her experience also includes laser-induced fluorescence/ultraviolet fluorescence result interpretation.

Ms. Kortbein has experience with free product removal, soil sampling, groundwater sampling, vapor sampling, vapor and groundwater well installation, well abandonments, data entry, technical report writing, Phase I and Phase II site assessment report writing, and litigation support.

Related Projects

- Assisted with various remedial system maintenance and operation management events.
- Experienced in collecting non-aqueous phase liquid, sampling groundwater, sampling soil, and collecting vapor samples to multiple state standards.
- Oversaw groundwater and vapor well installation events and well abandonments for sites in multiple states.
- Reimagined over 30 years of historical data, comprehensive geology, and hydrogeology information to complete a detailed site characterization report for a former petroleum shipping dock in Wisconsin.
- Supported a variety of field work and report writing deliverables in several Midwest states including Wisconsin, Minnesota, Iowa, Nebraska, North Dakota, and Missouri.
- Completed document reviews and prepared trial exhibits and case summaries for multiple environmental litigation cases.

Curriculum Vitae

Dean A. Krebs, P.E.

Title
Senior Engineer

Education
BS – Geological Engineering,
University of Minnesota,
Minneapolis, MN

Professional Registrations
[Professional Engineer: Minnesota (#26540), Iowa (#18322), Illinois (#062.059808)

Languages
English

Experience Summary

Dean Krebs, a Senior Environmental Engineer/Program Director, is a Registered Professional Engineer with more than 24 years of experience in remedial investigations, environmental assessments, soil and groundwater remediation, compliance services, and project/program management. He is the program director for a multimillion dollar multidisciplinary client and the leader of Antea Group's Railroad Segment. He has implemented programmatic work across multiple business groups for various clients. His responsibilities include all aspects of client /portfolio management, including business development, resourcing, budgeting and technical review. He has extensive experience managing complex portfolios of Spill Prevention, Control and Countermeasure (SPCC) and Storm Water Pollution Prevention plans. Dean works out of our St. Paul, MN office.

Related Projects

- Designed, implemented, and managed a program to complete preparation of a portfolio of 130+ SPCC plans for complex railroad facilities across the western United States. This project consisted of customizing the plan to each site while adhering to overall client procedures and compliance with SPCC rules and regulations. The program required coalescing a team of engineers throughout multiple business units and geographies to serve a broad geographical base of facilities. The facilities ranged from moderately complex to some the largest railroad yards in the US. The program expanded to include Facility Response Plans and other compliance related inspections and documents.
- Lead Antea Group's Railroad Segment from a concept to a fully funded segment with year over year growth. In his role as Segment Leader, he has developed the marketing plan, conducted a market analysis, generated and led multiple campaigns to promote Antea Group to the railroad industry.
- Led a solution development team to bring an automated application to SPCC field evaluations creating efficiency and reducing human touch points.
- Developed and managed a program to sample treated wood (railroad ties, bridge components, signal poles, etc.) across multiple states in a logistically challenging environment.

- Provided program management on a portfolio of SWPPP plans for a nationwide client that involved creating consistency across the facilities yet are tailored to meet the requirements of each state and locality. Managed the development and/or completed more than 160 SPCC, SWPPP or Facility Response plans.
- Provided client management on a portfolio of over 200 remediation, compliance and due diligence sites across the western U.S. that averages $3 million dollar annual spend. Successfully negotiated two 5-year contract extensions with this client without having to go through an expensive procurement process.
- Provided senior engineering and oversight of engineering for all aspects of the firm's projects. As a senior engineer, he is focused on managing the remediation aspects of a project and tracking progress against financial and time schedule requirements. He has written external documentation and reports to meet company, client, and regulatory requirements. Additionally, he has prepared proposals and bid documents, secured new work, arranged and provided contractor oversight, and reviewed proposals, work plans, designs, and the data evaluation of staff and project level engineers.
- Has supervised many engineers-in-training and other remediation specialists. He has led a team of engineers who have worked on many large-scale remediation projects and designed complex remedial systems in many parts of the United States. He has been consulted to provide senior engineering support and review on remediation projects undertaken by other divisions within the firm. His support consists of reviewing the site and remediation technology to determine compatibility, followed by reviewing the design to determine whether it is both technically and economically feasible. During the past ten years, some of the specific project tasks completed have included the following:
- Designed and managed multiple large-scale excavations, including; a multimillion dollar excavation that included soils contaminated with polychlorinated biphenyls (PCBs), chlorinated solvents, and petroleum hydrocarbons, a major excavation of DDT impacted soil at a former mushroom farm, a logistically complicated excavation of chlorinated solvent impacted soil at an active dry cleaning facility, and numerous excavations for petroleum impacted soils at service stations.
- Designed, installed, and operated numerous remediation systems including, a steam injection/ extraction system to recover No. 6 fuel oil at a manufacturing facility, a combination of bioventing (BV), soil vapor extraction (SVE), and air sparging (AS) featuring more than 170 points at a major oil company terminal, a BV/SVE/AS system at a major oil company terminal located within a complicated geological region, a successful bioslurping pilot test at a site featuring more than 30,000 gallons of free phase hydrocarbons located 45 feet below ground surface, six additional bioslurping pilot study/system designs, six dual phase extraction systems across the United States to remove free phase product while minimizing groundwater recovery, 21 AS/SVE systems for service stations, chemical manufacturing facilities, and other industrial clients, five thermal and catalytic oxidizers for treatment of air emissions
- Operated and evaluated the efficiency of a steam injection/dual phase extraction/SVE system on a 20-acre former railroad site impacted with more than 50,000 gallons of diesel fuel.
- Designed and installed a stream aeration system to remove dissolved petroleum hydrocarbons from a major pipeline leak in rural Illinois. Designed and installed a pump-and-treat system to reduce impacts to the stream. Designed and coordinated a free-product remediation plan utilizing dual-phase extraction.

Curriculum Vitae

Todd Kremmin

Title
Project Professional

Certifications
Geologist In-Training (GIT)
State of Minnesota, License 150242

Education
M.S. Earth and Environmental Sciences
University of Minnesota Duluth
Duluth, MN

B.A. Geology
Minors in Geography and
Environmental Studies
Gustavus Adolphus College
Saint Peter, MN

Languages
English
Spanish (semi-proficient)

Experience Summary
Todd Kremmin graduated from Gustavus Adolphus College with a Bachelor of Arts in Geology, along with minors in Geography and Environmental Studies. Todd joined the energy industry immediately following graduation and worked for 2 years in various roles at Anadarko Petroleum Corporation; Geology Intern, Senior and Staff Geosteering Technologist. Todd continued his quest to diversify his knowledge of geology, and more specifically geophysics while pursuing a Master of Science degree at the University of Minnesota Duluth. Todd gained invaluable experience during this time, assisting with seismic exploration surveys in the country of Colombia, performing geophysical surveys in and around Minnesota, mentoring teaching assistants, teaching laboratories, and further expanding his knowledge in hydrogeology, geographic information systems, geomorphology, sedimentology, stratigraphy, and environmental science. Todd is now working at Antea Group's St. Paul Office.

Related Projects
- May 2016 – Current: *Project Professional, Antea Group*
  Perform various statistical analyses using MAROS v. 3.0. Assist in research, reporting, and development of trial exhibits for litigation support. Provide GIS support in mapping and geospatial analysis. Write and review technical reports. Develop graphical illustrations of data, hydrographs, and groundwater contour maps. Review project specific engineering specifications and provide calculations. Support onsite field operations and maintenance at LNAPL remediation sites as well as brine spill sites. Gauge and bail LNAPL, and gauge groundwater. Assist in geoprobe drilling, monitoring well installation, vapor pin installation, and prepare boring logs from field notes. Collect soil samples, water samples, and air samples. Provide assistance with Phase I site investigations. Assist with underground storage tank removal, soil sampling, and analysis. Assist in field staff preparation and logistics.

- September 2014 – May 2016: *Lead Graduate/Graduate Teaching Assistant, University of Minnesota Duluth*
  Trained and mentored 6 graduate teaching assistants. Assessed and resolved teaching assistant and student concerns. Conducted weekly meetings to prepare lab materials, communicate, and educate on future labs. Organized and coordinated graduate teaching assistant lab schedules. Taught 2-3 lab sections of Geology and Earth Systems, and Principles of Geophysics per semester. Maintained regular office hours to meet with students in study and

review sessions. Evaluated student progress and provide consistent feedback during the academic semester. Assisted professors with lecture, laboratory, and field instruction including instructing students, proctoring exams, and grading assignments.

- July 2015: Seismic Exploration Research Assistant, Aquitania, Colombia
  Supported the Principal Investigator, Dr. Nigel Wattrus in conducting a detailed geophysical survey of Lago de Tota, a large tectonic lake in the Eastern Cordillera of the Colombian Andes. Project part of a NSF grant to map and interpret lake floor bathymetry, subsurface thicknesses of lacustrine sedimentary sequences, locations of depositional centers, transgressive-regressive lake level sequences, and long-term tropical paleoclimate records. Operated a high-resolution single-channel airgun seismic reflection system and a CHIRP sub-bottom profiler. Maintained compressors, air pressures, and data cables during surveys. Deployed and retrieved geophysical equipment from a hand built platform before and after surveys.

- January 2013- June 2014: *Senior/Staff Geosteering Technologist, Anadarko Petroleum Corporation*
  Provided 24/7 geotechnical operational support for multiple active drill rigs in the unconventional Eagleford and Wolfcamp Shale plays of Southern and Western Texas. Geotechnical support included 3-4 daily operational updates and geologic interpretations of real-time wellbore placement, quality control of data acquisition, management and relationship development of vendors, and post well statistics and summarization. Supported onsite field operations for significant data acquisition jobs which included services for mudlogging, wireline, open-hole imaging, and coring. Collected, analyzed, prepared, and interpreted mudlog samples. Monitored geophysical well log and image log assembly, acquisition, and disassembly. Supervised coring logistics, assembly, recovery, and take down. Assisted onsite core processing, transportation, and storage. Verified safety and calibration quality control standards were maintained during rig site data collection operations. Consulted with geologists, geophysicists, reservoir engineers, and drilling engineers in subsurface interpretation, drilling logistics and specifications, vendor costs estimates, exploratory projects, and aided in analysis of geochemical, core, geophysical, and geospatial data.

- June 2012- January 2013: *Geology Intern, Anadarko Petroleum Corporation*
  Collaborated with the Eagleford Shale asset team to understand the lateral and depositional distribution of the Upper Cretaceous Olmos Sandstone in order to determine reservoir qualities suitable for the company's interest. Interpreted vintage and new petrophysical well logs; gamma ray, resistivity, spontaneous potential, acoustic, density-neutron, sonic, and nuclear magnetic resonance. Integrated 2D and 3D geophysical data into the interpretation and generated geologic maps, cross sections, and figures. Used PETRA, Rockpilot, and Interactive Petrophysics software.

Publications

- Breckenridge, Kremmin, Dott, and Mossberger, (2016). Field Trip #9: Duluth Harbor Geologic History Boat Cruise: Quaternary to Anthropocene. Institute on Lake Superior Geology, Proceedings Volume 62 Part 2 Field Trip Guidebook, Duluth, Minnesota May 4-8, 2016, p. 160-187.

Presentations

- Near Surface Geophysics, NS41B-1944, American Geophysical Union (AGU) Poster Presentation, December 17, 2015. Title: Reconstructing the Geomorphic Evolution of a Freshwater Baymouth Bar in Response to Lake Level Change Using Three Dimensional (3D) Ground-Penetrating Radar (GPR) Data. Authors: Dr. Nigel Wattrus and Todd Kremmin.

Curriculum Vitae

Aaron Lapine, LEP

Title
Senior Consultant

Education
MS – Environmental Science, University of New Haven, West Haven, CT

BA – Botany and Political Science, Miami University, Oxford, OH

Professional Registrations
Licensed Environmental Professional: Connecticut (#522)

Professional Associations
Member, American Chemical Society
Member, National Groundwater Association

Languages
English

Experience Summary

Aaron Lapine, Senior Consultant, has more than 18 years of experience in the environmental field. His technical expertise includes: environmental site assessment; environmental exposure assessment; soil and groundwater remediation; regulatory compliance; environmental liability quantification and mitigation; environmental litigation support; and management of multiple site remediation portfolios in various states. He specializes in the quantification and management of environmental risk, whether transactional, operational, or legacy.

Related Projects

- Prepared and currently the executive sponsor for a guaranteed fixed-price to closure legacy liability mitigation option for approximately 90 active clean-up sites in Connecticut.
- Currently serving as Program Manager for a guaranteed fixed-price to closure portfolio of approximately 160 active cleanup sites across 17 states. Responsible for creating a program and building an executing team to effectively characterize, mitigate, and receive regulatory case closure for all of the active cleanup sites within a predetermined budget and timeframe.
- Provided expert testimony on behalf of an integrated energy company client in defense of a product liability class-action claim involving the additive MTBE. The testimony specifically involved the chemical fate and transport relating to the location of municipal well fields.
- Served as technical lead and the responsible manager for approximately 190 active cleanup sites in New Jersey, New York, Maryland, Delaware, District of Columbia, Mississippi, North Carolina, and South Carolina. Responsible for the formulation of contaminant characterization and innovative remedial strategies to address contamination and achieve case closure status with the appropriate regulatory agencies.
- Served as technical lead and responsible manager for approximately 185 active retail and non-retail petroleum cleanup sites in Southern California and Washington.
- Managed the remediation and provided technical expertise at a site where an active major oil storage facility terminal was located on a parcel of a former

refinery. A liquid phase hydrocarbon (LPH) plume with an original estimated volume of 17 million gallons was identified under the former refinery, two million gallons of which was originally estimated under the client's active terminal. A lawsuit and counter-lawsuit were filed between two major oil companies for breach of contract related to the remediation of the contaminant plume. Multiple LPH seep areas were identified into a nearby tributary. The most significant achievements in the project included the following: characterization of the extent and estimated volume of the LPH, the management of the operation and maintenance and the later design and the implementation of a complete overhaul of a dual-phase recovery remediation system that recovered over three million gallons of LPH; the successful face-to-face negotiation as the technical lead with an NGO resulting in the preparation of a formal letter rescinding potential claims and stating that the client's containment system and remedial efforts were appropriate; the successful negotiation as the technical lead resulting in a novel settlement in which the client received services and proceeds worth an estimated value that exceeded the client's original claim; and the successful face-to-face negotiation with the state agency as the technical expert resulting in the indefinite postponement of an administrative executive order.

- Served as one of 22 experts representing private industry, academia, and local, regional, state, and federal regulatory agencies invited to participate in the National Water Research Institute (NWRI) Nominal Group Technique two-day workshop to provide answers to the workshop question: "What improvements to subsurface monitoring are needed to properly evaluate the fate and transport of petroleum and fuel oxygenate contaminants?" for the protection of potable water sources. Participants included representatives from California Regional Water Quality Control Boards of Los Angeles and Santa Clara, the California State Water Resources Control Board, Santa Clara Valley Water District, Alameda County Department of Health, and the EPA. The purpose of the workshop was to improve monitoring strategies and provide insight into planning monitoring programs that will consider new technologies providing cost-effective means of protecting drinking-water resources.
- Designed and patented (provisional Patent Application No. 60/723,508) an automated bioaugmentation/ biostimulation system that delivers treatment solutions to the subsurface with limited site visits. The system can store and intermittently introduce terminal electron acceptors, macronutrients, micronutrients, and/or bacterial colonies.
- Experienced with various geophysical assessment techniques (CPT/LIF, Mise-a-la-Masse, seismic refraction, dual temperature/dual fluid resistivity, and acoustic televiewer borehole logging). Based on this knowledge, he was invited to present "3-sided Refraction Tomography Assessment Technology" at the 2003 15th Annual EPA OUST UST/LUST National Conference in support of the Site Investigation Methods Session.
- Designed, advocated, and implemented numerous novel chemical oxidation remedial applications at retail service station LUST sites. Created a safety protocol for field applications of various chemical oxidation techniques.
- Conducted numerous vapor intrusion to indoor air pathway evaluations and employed vapor intrusion mitigation technologies. Designed a thorough field sampling protocol to collect data for use in fate and transport models to evaluate human health risks associated with potential indoor air pathways.
- Developed and instituted a risk-based decision making process to prioritize portfolios and devise remedial strategies. The procedure utilizes analytical and numerical computer generated fate and transport models and field data collection to quantify potential exposure to human health and the environment.

Curriculum Vitae

Laura R. Maki

Title
Staff Professional

Education
In Progress: M.S. Civil Engineering from University of Minnesota, Minneapolis, MN
Expected Dec. 2014

B.S. Physics with additional major in Mathematics from Winona State University, Winona, MN

Awards and Recognition
Graduation with honors in physics and mathematics from Winona State in May, 2012

Received Eileen Fahey Memory Scholarship granted to outstanding woman in physics for 2011-2012 academic year

MAA Outstanding Presentation Award for Advanced Linear Algebra research at MAA Conference in August, 2010

Language
English, French (some)

Experience Summary
Laura's education and research projects emphasized leadership and teamwork. She also has experience with computer modeling, using Python, Java, Mathematica, and MatLab. Her high aptitude for applied mathematics and logical problem solving lend to her abilities to do computer modeling. She successfully modeled the square cavity problem using MatLab for her Computational Fluid Dynamics course and has also used MatLab to model flow of water around stationary circular obstacles in two dimensions. In a course on remediation technologies, she helped write a Feasibility Study as part of a final group project. Most recently, her master's thesis work has required organizational and analytical skill as well as the ability to think and act quickly to solve problems using available resources.

Related Research Projects
- September 2012-Present: Master's thesis research on debris flows, specifically the erosion and entrainment of particles. She conducted laboratory experiments, collected and analyzed data, and is now in the process of writing her thesis.
- September 2010-May 2012: Honor's thesis for mathematics department at Winona State on real applications of complex analysis and advanced linear algebra. She applied principles from both branches of mathematics to two systems, an electromagnetic ball suspension system and a simple electrical circuit, to reveal information about the system variables.
- Summer 2011 – Research at the University of Michigan in Astrophysics. Laura used star location and magnitude data from a sky survey, and wrote a program using Python to calibrate it to cataloged data. This research will aid the Dark Energy Survey (DES) in trying to better understand the nature of dark energy.
- Summer 2010 – Research at the University of Minnesota in Differential Geometry, using Mathematica to write code that utilizes distance histograms to define rigid shapes and objects.

Presentations
- 'Advanced Linear Algebra applied to an Electromagnetic Ball Suspension System', MAA Mathfest in Pittsburgh, PA, in August 2010

Curriculum Vitae
Cortney E. Malloy

Title
Staff Scientist/Geologist

Education
BS – Geology, Northwest Missouri State University

Languages
English
German

Experience Summary

Cortney Malloy has one year of experience as an environmental consultant providing Environmental Site Assessments (ESAs), soil and groundwater investigation and characterization, drilling oversight, installation of groundwater monitoring wells, data evaluation and development of visual graphics, report preparation, subcontractor coordination, and characterization of subsurface soil and geology. Cortney works in Antea Group's Bettendorf, Iowa office.

Related Projects

- Provided technical and project support for multiple petroleum contaminated sites throughout the Midwest. Tasks included evaluating the nature and extent of contamination and the development of remediation costs. Activities included supervision of data collection and analysis of affected media including soil, bedrock and groundwater; estimation of remediation costs; technical evaluation of corrective actions; supervision of field staff; report preparation; and engagement with regulatory agencies.
- Supervised the installation of soil boring and groundwater monitoring well networks including classifying and logging of subsurface soil and geology, and the collecting soil and groundwater samples for chemical analyses. Provided oversight of drilling contractors using Geoprobe methods.
- Performed as the primary author of multiple Phase I ESAs for major railroad client. Project tasks included: performance of site visits, interviewing, review of EDR report and historical maps, historical investigation and reporting.
- Performs data management assignments for major railroad and high-tech clients. Tasks includes: interpretation data, formatting and development of graphical representation of data.
- Performs data management and project support for major high-tech clients. Tasks includes: subcontractor management and tracking, compiling and presenting client monthly Environmental Health and Safety (EHS) matrices, review of EHS regulatory registries, evaluate applicability of regulations and assists with the development and maintenance of client compliance calendars.

Curriculum Vitae

Becky Matich

Title

Project Professional

Education

BS – Environmental Studies, Bemidji State University, Bemidji, MN

Training/Certifications

Accredited Office Ergonomics Evaluator (AOEE) – June 2014

OSHA 30-Hour for General Industry

First Aid/CPR/AED

AIHA – Fundamentals of Industrial Hygiene

Languages

English

Experience Summary

Becky Matich is a Project Professional with seven years of experience working in the environmental consulting and chemical manufacturing fields. She has been involved in a number of related environmental and environmental, health and safety (EHS) projects and has actively participated in all stages of the project lifecycle. She has a very strong knowledge and understanding of EHS regulations.

Becky currently supports a wide variety of EHS projects, including incident management, industrial hygiene, emergency response plan (ERP) development, safety committees, and environmental regulatory compliance projects. She currently serves as the Health, Safety, Security, and Environmental (HSSE) Regional Advisor for Antea Group's Upper Midwest region.

Related Project Experience

- As an HSSE Regional Advisor, provides HSSE support and guidance to operations teams in the region and supports company-wide HSSE initiatives.
- Provides incident management support for a leading tech company by validating No Treatment and First Aid incidents within their Incident Management System. For certain incidents, completes follow up with store management to check on the employee's well-being, if they sought medical treatment, and/or to provide guidance on safe work practices and injury prevention.
- Conducts industrial hygiene monitoring, specifically for noise and Indoor Air Quality (IAQ) projects within the technical industry.
- Provides ongoing health and safety support for technical companies, including facilitating safety committee meetings, EHS auditing, emergency response planning, workstation ergonomic assessments, and other on-demand services.
- Prepares Spill, Prevention, Control & Countermeasure (SPCC) plans and Stormwater Pollution Prevention Plans (SWPPP) for numerous sites in various industries.
- Performs office ergonomic evaluations and provides recommendations to improve employee's comfort and prevent future discomfort or injury.

- Provided Active Threat Awareness trainings to hundreds of employees across nine stores as part of a global retailer's training initiative (Summer 2016).
- Has performed several EHS audits in the retail, industrial and medical sectors.

As an EHS Specialist at a leading ethanol company, Ms. Matich supported the management team in all facets of EHS regulatory compliance and safe work practices, including:

- Observed employees performing their job duties to ensure safe work practices were effective in controlling health and safety hazards.
- Completed annual reviews and updates to health and safety programs to ensure compliance, including hazard communication, blood borne pathogens, hearing conservation, lockout/tag out, and respiratory protection.
- Lead and assisted in the investigation of health and safety incidents.
- Coordinated and directed inspections for fire suppression systems, Process Safety Management (PSM) mechanical integrity requirements and pollution control equipment.
- Administered safety programs, including the instruction of hazard communication, lockout/tag out, Process Safety Management (PSM), permit-required confined space, and fall protection for approximately 42 employees at the facility.

Throughout the course of her career, Becky has also:

- Become proficient in Microsoft and iOS applications and has worked in SharePoint and Egnyte platforms for document management and storage.
- Performed Phase I environmental site assessments, where work included site reconnaissance, state file reviews, review of historical documents, and report preparation.
- Interpretated field data and laboratory analytical results, summarized site recommendations, and prepared investigation reports.
- Supported work on litigation cases by reviewing deposition transcripts, analytical data, environmental permits, and correspondence.

Curriculum Vitae

Corey C. Mecham

Title
Project Manager

Education
BS – Meteorology, Northern Illinois University, DeKalb, Illinois

Post-Graduate Certificate in Geographic Information Analysis, Northern Illinois University, DeKalb, Illinois

Professional Associations
Illinois GIS Association

Languages
English

Experience Summary
Corey Mecham, project manager with Antea Group, has 12 years of professional experience in the consulting, research, industrial and laboratory fields. His background includes project management, GIS, EMIS, LNAPL modeling and evaluation, remediation system operation and maintenance, air pollution testing, sample recovery and analysis, sampling of soil and ground water contamination and health and safety enforcement. He provides management as well as technical support for site investigation and remediation projects at a variety of active and abandoned sites in the Midwestern United States. He directs and coordinates the preparation of work plans, site health and safety plans, investigation reports, remediation reports, conceptual site models, corrective action plans and remedial designs from Antea Group's Bettendorf, Iowa, office.

Related Projects
- Provides GIS and EMIS data management services for multiple North American projects, including management of large volumes of diverse spatial, geotechnical and chemical data. Utilizes ESRI Arc View 10 for creation of raster, vector and surface layers; performs spatial and three-dimensional analysis and creates visualizations for project sites. Provides data and analysis for use in decision making for investigation, risk assessment, property assessment, and environmental litigation and remediation projects.
- Guided an LNAPL assessment and remediation at a former impoundment pond in Iowa. Directed the LNAPL mass, mobility, and recoverability assessment and developed the Conceptual Site Model. Based upon the results of the LNAPL assessment, successfully proposed alternate remedial endpoints that substantially reduced remediation costs. Following successful remediation, the site obtained closure from the regulatory agency.
- Provided project management at a railroad yard in Kansas. Conducted and directed site assessment in association with an inactive fueling facility. Coordinated and directed a technical education session for the regulatory agency, on behalf of the client. Managed and coordinated field, laboratory

and engineering activities associated with a site-wide LNAPL mass, mobility and recoverability evaluation. Performed assessment activities including determination of groundwater and soil source concentrations of VOCs, BNAs, and TPH constituents, groundwater flow direction, inferred area of soil and groundwater impact, and migration mechanisms.

- Provided field services associated with leaking underground storage tanks at a Brownfield assessment and remediation site in Iowa. Conducted soil and groundwater sampling at an abandoned railroad yard. Performed field activities that included free product measurement and removal, soil boring sampling and survey work. Completed monthly operation, maintenance and sampling of dual phase extraction system and associated monthly compliance reporting.
- Performed third-party testing at a manufacturing plant to provide information on NOx and CO emission levels that were guaranteed objectives by the manufacturer. Simultaneously performed relative accuracy testing for calibration of plant instrumentation. Assisted in logistics and scheduling of personnel and equipment, which included shipping of hazardous materials.
- Directed field activities for testing of particulate, metals/mercury, and PCDD/PCDF, HCL, O2/CO2, NOX/NO2, SO2 and CO emissions at various municipal waste incineration facilities in Florida. Testing was needed for state and federal EPA compliance for Title V, Municipal Waste Incinerator emission compliance, and relative accuracy testing of plant instrumentation. Activities included wet method and monitor testing, laboratory sample recovery and field analysis, packaging and shipping hazardous materials for additional laboratory analysis. Also directed personnel and equipment logistics and scheduling.

Curriculum Vitae
Paul M. Meier, PG

Title
Staff Scientist/Geologist

Education
BS – Geology, Winona State University, Winona, Minnesota

Professional Registrations
Professional Geologist: Wisconsin

Professional Associations
Minnesota Groundwater Association

Languages
English

Experience Summary

Paul Meier has 30 years of experience as an environmental consultant providing services to public and private sector clients. His specialties include management of emergency response cleanups; remedial actions design and implementation; construction and excavation oversight; drilling oversight; installation of groundwater monitoring wells; soil and groundwater sample collection for analytical testing; report preparation; subcontractor coordination, and characterization of subsurface soil and geology. Paul works in Antea Group's Bettendorf, Iowa, office.

Related Projects

- Participated in several Stormwater Pollution Prevention Plan (SWPPP) site surveys for an industrial client in Iowa. Project tasks included reviewing project site background information, conducting on-site inspections of the site facilities and activities and identifying stormwater flow paths and discharge points.
- Participated in a large-scale crude oil pipeline spill remediation project for a petroleum client in northwest North Dakota. Project tasks included assisting with the excavation of the impacted soils which totaled into the several hundred thousand tons, directing the drilling of direct-push soil probes to further define the crude oil plume, classification of soils and geology, and collecting soil and groundwater samples. Additional project tasks included coordinating the pumping and discharge of storm and snowmelt water from the excavation during several events and the collection of discharge samples to ensure compliance with the NDPES permit.
- Participated in a site investigation project for an industrial client in Des Moines, Iowa. Project tasks included directing the drilling of direct-push probes to further define a petroleum TCE/PCE plume, classification of soils and geology, collection of soil and groundwater samples including the use of passive diffusion samplers, and contractor coordination and oversight.
- Participated in a large sludge pond remediation project for an industrial client in Council Bluffs, Iowa. The project included characterization of soil and

geology, on-site remediation via excavation and disposal of petroleum- and solvent-contaminated sludge. Project tasks included air monitoring, soil sampling, groundwater sampling, contractor coordination, and data analysis.

- Participated in a site investigation project for a commercial client in Black River Falls, Wisconsin. Project tasks included oversight of drilling groundwater monitoring wells into bedrock using a rotasonic drill rig to further define a TCE/daughter products plume, classification of soils and geology, collection of soil for laboratory analysis, collection of groundwater utilizing low-flow sampling methodology, collection of natural attenuation parameters, and contractor coordination and oversight.
- Participated in groundwater sampling projects for an industrial client at sites in Nebraska. The project included the collection of groundwater samples for chlorinated solvents using passive diffusion samplers, and recording groundwater natural attenuation parameters.
- Participated in a multi-facetted site remediation project for an industrial client in Chadron, Nebraska. Tasks includes reviewing historical information regarding site use and process; completing an on-site investigation to identify soil and groundwater impacts at the site; classification of soil and geology; and the completion of a subsurface investigation to further delineate environmental impacts at the site. The remediation phase included documenting and coordinating with contractors to remove product, sludge and contaminated water from several storage vessels; documenting the cleaning of the vessels; coordinating the disposal of the waste products; and documenting the decommissioning of the storage vessels. The storage vessel cleaning activities were conducted under permitted confined space entry. Additional work included data analysis and completion of the decommissioning report.
- Participated in a gasoline pipe line spill remediation project for a petroleum client in northwest Indiana. The project site was located in a residential neighborhood with multiple overhead and underground utilities and under high public scrutiny. Tasks included assisting with coordination and oversight of the excavation and disposal of the impacted soil, soil screening and sampling, soil segregation, soil and geology classification, and soil boring and monitoring well installation oversight.
- Participated in a crude oil pipe line spill remediation project for a petroleum client in northeast Illinois. The project site was located in a wetland adjacent to a railroad and highway corridor. Project tasks included performing sediment sampling and water quality monitoring at multiple locations within the wetland; and oversight of the installation of several groundwater monitoring wells installed into the bedrock.
- Managed many underground storage tank remedial investigations and actions. The investigations included subcontractor coordination, collection of soil and groundwater for laboratory analysis, and contractor and stakeholder coordination. Remedial action activities included the design and implementation of remediation systems including: soil venting, groundwater treatment using in-situ air sparging, carbon absorption, and liquid-phase product separation. Worked with the client and regulatory agency to provide cost-effective project solutions.
- Provided technical and project support for multiple petroleum contaminated sites throughout the Midwest. Tasks included evaluating the nature and extent of contamination and the development of remediation costs. Activities included supervision of data collection and analysis of affected media including soil, bedrock and groundwater;

estimation of remediation costs; technical evaluation of corrective actions; supervision of field staff; report preparation; and engagement with regulatory agencies.

- Performed water use audits for the United States Post Office. The audits included conducting a walk-thru of two Post Office facilities and documenting water usage. Follow-up work included providing recommendations for water-saving fixtures and a cost benefit analysis.
- Supervised the installation of soil boring and groundwater monitoring well networks including classifying and logging of subsurface soil and geology, and the collecting soil and groundwater samples for chemical analyses. Provided oversight of drilling contractors using Geoprobe®, hollow stem auger, rotasonic, mud rotary, air rotary, and rock coring drilling methods.

Curriculum Vitae

Cindy Meldrum

Title
Technical Scientist
Project Manager Assistant

Education
AAS – Business, Scott Community College, Bettendorf, Iowa

Professional Registrations
Iowa Public Notary

Language
English

Experience Summary
Cindy Meldrum has an extensive background as an office manager, field technician and drafter, having provided environmental project support for more than 19 years. Her responsibilities include preparation of maps and well diagrams by utilizing AutoCAD, as well as reimbursement packets, data entry, laboratory and sample tracking, project and budget tracking, groundwater sampling, free product recovery, water level data collection, site surveys, well searches and drafting reports and Health and Safety Plans (HASP). She is currently responsible for creating over 80 HASPs for a major transportation client across the country and keeping them updated on an annual basis.

Related Projects
- Conducted quarterly water level data collection from 38 monitoring wells, along with low-flow groundwater sample collection from a network of 15 monitoring wells at a chemical manufacturing facility in Iowa.
- Assisted project team with performing monthly water level gauging and free product recovery, in addition to quarterly groundwater sample collection at numerous underground storage tank sites across Iowa and Illinois.
- Conducted monthly water level and free product recovery and semi-annual groundwater sampling for a national transportation client.
- Served as a project assistant responsible for performing annual water level gauging and groundwater sampling at multiple LUST sites throughout Iowa.
- Responsible for invoicing and uploading information to a major transportation corporation on a monthly basis using their systems.

Curriculum Vitae

Mark D. Nelson, PE

Title
Consultant

Education
BS – Civil Engineering, University of Minnesota, Minneapolis, MN

Professional Registrations
Professional Engineer: Minnesota (25828), Illinois (062-055091), Florida (65189), California (CH 6359), Louisiana (35631), Mississippi (26532)

Professional Associations
American Chemical Society

Languages
English

Experience Summary

Mark Nelson, a consultant for Antea Group, has more than 24 years of experience. He specializes in evaluating environmental risks, developing creative strategies and cost effective solution implementation. He has broad experience in the design and implementation of a creative site remedies encompassing traditional and experimental technologies including mechanical systems, bioremediation, chemical oxidation and steam injection. Mark has completed remediation projects in over 30 states and several locations abroad. In addition, Mark has substantial experience managing facility closures, safely removing site assets.

Related Projects

- **Engineering Quality Assurance.** Mark provides technical support and quality assurance for remediation system design and optimization across the company.
- **ELT Portfolio.** Mark has led several environmental liability transfer portfolios. In this role he focused on managing several project teams dedicated to extinguishing environmental liability on a portfolio of retail petroleum release sites. Antea Group entered into a contract to close all of the sites for a fixed price. Mark acted as the responsible party, managing strategies to close sites and eliminate liability at the lowest cost.
- **Account Leader.** Developed and led a multi-office team serving a National, mid-stream petroleum storage and distribution client. Services provided to this client included site remediation, emergency response, site compliance, and operations manual development. Account has consistently met revenue and profitability targets.
- **Pipeline Release, Tioga, ND**. Mark led the remedy strategy development for a large crude oil release in north western North Dakota. Mark developed the strategy for crude oil recovery as part of the emergency response and is developing the strategies for the final remedy to return the impacted area back to productive farm land.
- **Vapor Intrusion**. Mark has provided engineering design for sub-slab depressurization systems to protect building occupants from vapor intrusion. He has developed systems for residential and manufacturing facilities.

- **Manufacturing Plant, Sanmina, Canada – Site Investigation/Pump & Treat Optimization** - Senior Project Scientist providing developing strategy and oversight of work scopes prepared by our local Inogen partner. Developed strategy to completed additional investigation and source area reduction to allow shut down of the current pump and treat system. Strategy was accepted by the Ontario Ministry of the Environment and will lead to earlier site closure and significant life cycle cost savings.
- **Pipeline Release, Jackson, WI.** Mark was the lead consultant developing the remedial strategy in response to a pipeline release of approximately 50,000 gallons of gasoline. Mark developed a creative remediation strategy tailored to unique site conditions to recover gasoline from a layered bedrock with gasoline impacts located a depths of 25 feet below grade and 150 feet below grade. The system consists of 53 shallow extraction wells and five deeper recovery wells.
- **Litigation Support, Green Bay, WI.** Provided Expert Witness support for a case regarding sources, transport and remediation of an LNAPL plume affecting a basement. The support required review of historical reports, forming opinions regarding the sources and transport of an LNAPL plume, writing expert reports and responding to plaintiff's expert reports. Efforts lead to a favorable settlement with the plaintiff saving the client over $4 MM.
- **Petroleum Refinery, Petite-Carounne, France.** Mark was the lead design engineer for development of the design and implementation strategy for remediation of an LNAPL plume located under a refinery and the surrounding township that was responsible for significant vapor intrusion into a nearby residential area. Mark lead the design effort for a remedial system that will recover LNAPL and mitigate vapor intrusion from a 35 acre plume consisting of 175 multi-phase extraction points, 180 soil vapor extraction points complete with water and air treatment systems.
- **Pipeline Release, Livingston, IL**. Senior engineering oversight in response to a pipeline release of gasoline in a rural west, central Illinois. Mark designed an extensive laser induced fluorescence investigation of the release area once emergency response activities were complete. Mark interpreted the results of the investigation and is directing the remedial strategy to restore the affected properties.
- **Pipeline Release, Lockport, IL**. Mark provides senior oversight, directing the remedial response to a pipeline release of crude oil. The release affected a commuter rail line, wetlands and affected the habitat of an endangered Hines Emerald dragonfly. Mark directed remedial efforts to recover crude oil at the conclusion of the emergency response effort. These efforts included design of a system to recovery crude oil from utility corridors and design work to protect the wetlands from seeps from the remaining residual oil.
- **Closed Bulk Petroleum Storage Facility, Superior, WI**. Mark provided oversight developing the strategy for investigation and remediation of a closed bulk facility located in Superior, WI. Hydrocarbon releases over its 100 year operating history resulted in two multi-acre LNAPL plumes. Developed and implemented a source removal plan where existing underground facilities were removed. The removed facilities included over 26,457 feet of pipe recovering 16,000 gallons of product and 1300 tons of product saturated soil. Directed the design and implementation of a phased multi-phase extraction system to address one of the LNAPL plumes and directed the design and implementation of both fixed and mobile LNAPL skimming system(s) for the second plume.
- **Former Bulk Storage Facility, Peoria, IL**. Mark provided senior engineering oversight for operation of a large scale pump and treat system and strategic planning to move the site to regulatory closure. Designed and implemented sub grade facility removal removing 27,350 feet of piping. Used vacuum pigging techniques to recovery more than 9,000 gallons of product from the piping prior to removal. Discovered and removed 7 assorted process flow tanks.

- **Former Bulk Storage Facility, Jefferson, Missouri**. Mark provided strategic engineering support in decommissioning a closed bulk storage facility. Removed sub grade piping between the facility and the barge dock located on the Missouri river. Removed product from piping prior to piping removal. Removed the barge dock facility utilizing barge mounted cranes and equipment to remove the dock, control room and other riverside facilities.
- **Bulk Petroleum Storage Facility, Spring Valley, MN.** Mark led the team to develop the strategy for investigation and remediation of a LNAPL plume at an operating bulk storage facility. Directed design, installation and operation of a dual phase extraction system to recovery LNAPL from karst. This system has successfully recovered LNAPL, reaching regulatory criteria for system shut down within 4 years of operation.
- **Historic Railroad Depot and Rail Yard, Minneapolis, MN:** Mark designed and performed a combination soil vapor extraction, total fluids recovery and steam injection pilot test. Used the data developed from this test to design and implement a full-scale steam injection system to treat four acres of diesel fuel impacted soils surrounding and underneath a historic railroad depot located in the downtown area of Minneapolis, MN. Operation of the steam injections system recovered over 30,000 gallons of diesel fuel and successful regulatory closure and subsequent site redevelopment.
- **Daimler-Chrysler, Huntsville, AL.** Mark designed a large-scale combination multi-phase and soil vapor extraction system for a DaimlerChrysler site located in Huntsville, Alabama. The extraction system consisted of 29 nested wells for a total of 58 separate extraction points. The system was designed to allow simultaneous SVE and MPE to operation on separate wells using the same manifold system. In this way, high volume air extraction is occurring subsequent to the well being dewatered by the multiphase extraction.

Presentations

- "Microbial Ecology as an Indicator of Effectiveness of Sequential Chemical Oxidation-Bioremediation", 25th Annual International Conference on Soils, Sediments, Water and Energy, Amherst, MA.
- "LNAPL Recovery from Karst", Atlantic Richfield Remediation Engineering and Technology Exchange Meeting, Houston, Texas, April, 2006
- "Underground Piping Removal: Lessons Learned From Three Terminal Sites", The 17th Annual Conference of Remediation Management Global Soil and Groundwater Network, Calgary, Alberta, October 3, 2005.
- "Ethanol; Environmental Guidance", BP Environmental Conference, Chicago, Illinois, January 14, 2003.
- "Ethanol Release: A Case Study", BP California Ethanol Conference, La Palma, California, September 26, 2002.
- "Delineation and Recovery of Free-Phase Hydrocarbon in a Fractured/Solution-channeled Dolostone", 2002 National Ground Water Association, Petroleum Hydrocarbons and Organic Chemicals in Ground Water: Prevention, Detection and Remediation.
- "Milwaukee Road Depot: Application of Steam Injection", BP Hydrocarbon Environmental Management Meeting, Chicago, Illinois, 2001.
- "In-Situ Remediation of Ethanol, Ammonia and Petroleum Hydrocarbons Via Aerobic Biodegradation", The 6th International In Situ and On Site Bioremediation Symposium, San Diego, California, 2001.
- "Designing Piping Networks for Multi-Phase Extraction Systems", The 5th International In Situ and On Site Biodegradation Symposium, San Diego, California, 2000.

Curriculum Vitae

Lawanda Olin

Title

Staff Professional/Local Contact

Education

MA - English Literature

A.A.S - Civil Engineering Technology

Languages

English

Hindi

Summary

Lawanda Olin has more than 12 years of experience in environmental consulting, providing support services including AutoCAD work, document review, quality control, and professional report writing. She specializes in working with Antea Group's Mergers & Acquisition practice area, and assists with Antea Group's due diligence work and work products. Lawanda is also a member of Antea Group's Executive Support team, supporting five senior executives within the company with day to day tasks.

Experience and Skills

- Produce maps for clients under specific guidelines, including regulatory electronic GIS deliverables such as NJDEP Remedial Investigation Report maps. Work includes reports for clients such as BP, Kinder Morgan, Getty, Buckeye Terminals, Alliance Energy, Ashland and state agencies.
- Create and perform calculations for client specific Environmental, Health and Safety reports, OSHA logs, Excel graphs, charts, and timelines.
- Set up Excel macro to automate processes, saving time and effort.
- Initiate and follow-up FOIA requests, online, on the phone and in person.
- Prepare summaries of EDR reports for client sites.
- Enter information and generate forms and audit protocol reports in iEHS, Antea Group's web-based platform.
- Support internal and client-facing presentations, website blogs, case studies and press releases.
- Review proposals and reports for correct grammar usage, spelling, and sense.
- Use Word and Acrobat in an advanced capacity for preparing reports, letters, and correspondence.
- Prepare invoice and backup documentation.
- Post-ghost computers and assist with minor IT issues.
- Arrange meeting venues and all details from internet access, audiovisuals, and meeting handouts to refreshments.
- Support confidential aspects of projects such as client and vendor communications.

Curriculum Vitae

Jared Otto

Title
Senior Project Manager

Education
BA – Geology, University of Minnesota, Morris

Professional Registrations
Professional Geologist: Minnesota

Professional Associations
Minnesota Ground Water Association (MGWA)

Languages
English

Experience Summary

Jared Otto is a Senior Project Manager with Antea Group based in Shoreview, Minnesota. He has more than 23 years of experience in environmental consulting. He specializes in project management, environmental investigations, and remedial corrective actions. His technical specialties include geology, hydrogeology, soil and water contamination source identification, contaminant fate and transport, groundwater monitoring program design, groundwater quality data analysis and evaluation, and corrective action design and implementation.

Related Projects

- Currently serves as Senior Project Manager for petroleum and railroad clients. Responsibilities include communication with clients, regulators, and contractors; preparation of work plans; budget preparation and tracking; work oversight and delegation; and project database tracking.
- Served as Project Manager / Hydrogeologist for numerous site investigations of soil and groundwater contamination in the states of Minnesota, Wisconsin, South Dakota, North Dakota, Iowa, Kansas, Montana, Missouri, Illinois, Indiana, Arizona, Michigan, Tennessee, Ohio, Nebraska, California, Wyoming, and Georgia.
- Hydrogeology field experience has included supervision of underground and above ground storage tank system removals, soil excavation, drilling supervision (push probe, hollow stem auger, air rotary, mud rotary, rotosonic, cable tool, CPT, LIF ROST, MIP), chem-ox injections, utility receptor surveys, well receptor surveys, soil and groundwater sampling, enhanced fluid recovery technology (EFRt), slug tests, pump tests, soil gas surveys, indoor air sampling, system pilot tests, remediation system installations, and system operation and maintenance.
- Hydrogeology technical activities have included groundwater flow analysis, slug and pump test analysis, groundwater modeling, groundwater data analysis, trend analysis, soil gas evaluations, monitoring well network design, and report preparation.
- Corrective action activities have included working with soil vapor extraction, air sparge, pump and treat, product skimmers, and multi-phase recovery systems. Also performed bench scale testing, pilot testing, and full implementation of in-situ chemical oxidation.

- Completed activities in accordance with varying and state specific regulations and guidelines. Activities included the preparation and/or review of reimbursement program applications.
- Performed technical reviews of approximately 100 leak sites to determine potential costs to closure for an environmental risk transfer project. Provided site recommendations to drive project to regulatory closure in the states of New York, New Jersey, Connecticut, Rhode Island, and Massachusetts for a large petroleum company.
- Participated in the environmental risk transfer of approximately 80 projects in Minnesota, Wisconsin, Iowa, North Dakota, and South Dakota. Activities included preparing site reviews, preparing cost to regulatory closure, and negotiating with insurance and state agencies.
- Prepared winning cost to closure bid for a liability risk transfer project in Wisconsin. The site is a former terminal with multiple LNAPL plumes and sensitive receptors nearby.
- Served as senior project manager for a terminal project involving a petroleum plume that extends over one-mile from the source area in karst topography that migrated toward sensitive receptors including a trout stream and private wells. Activities included defining and monitoring the plume, performing remediation, and communicating with neighboring stakeholders and government agencies. Site received NFA status in 2014.
- Currently serving as senior project manager for a terminal project in Wisconsin that has a LNAPL plume extending off-site onto a third party property. A multi-phase recovery system has been installed in the basement of the third party building. Indoor air monitoring and product mobility have been two areas of focus for the project.
- Serving as senior project manager for a Class 1 railroad company overseeing a program to assess environmental conditions on properties leased to non-railroad entities. Tasks include lease site file reviews, site inspections, and limited soil and groundwater site assessments on leased properties.
- Serving as senior project manager for a large railroad company overseeing a project that has nitrate, nitrite, and ammonium impacts to soil and groundwater in the state of Nebraska. A large scale excavation was completed to remove a bulk of the mass and then phytoremediation was implemented wich included planting over 1,500 hybrid poplar trees. Even though the site is in a wellhead protection zone, phytorediation was approved by the state agency as the corrective action. Long term groundwater monitoring will occur until site specific cleanup standards have been satisfied.

Curriculum Vitae

Molly Partridge

Title
Project Professional

Education
MS – Geological Science
Central Washington University, Washington

BS –Geological Science
Winona State University, Minnesota

Languages
English

Experience Summary
Molly Partridge, Project Professional, started with Antea Group in March 2015. She has abundant experience collecting scientific data in the field, analyzing and interpreting data, composing technical reports, and communicating results to the scientific and non-scientific communities.

Her technical expertise includes obtaining groundwater field data; collecting GPS data; surveying site features; collecting rock samples for petrographic analysis, geochemical analysis, and geochronologic analysis; using GPS data and sample data to create geologic maps; editing geologic maps with ArcGIS and Adobe Illustrator; interpreting geologic maps and data to create corresponding cross sections.

Ms. Partridge has experience with excavation of contaminated soil, monitoring and vapor well installation, in-situ chemical oxidation (ISCO) injection, high vacuum extraction, free product removal, groundwater sampling, soil sampling, vapor sampling, ambient air monitoring, data input, hydrograph and contaminant graph creation, technical report writing, and support on litigation projects.

Related Projects
- Oversaw in-situ chemical oxidation (ISCO) events at numerous petroleum contaminated sites
- Oversaw High Vacuum Extraction (HVE) events for soil vapor extraction (SVE) and free phase product abatement
- Oversaw MIHPT drilling, a combination of a Membrane Interface Probe (MIP), Electrical Conductivity (EC) probe, and a Hydraulic Profiling Tool (HPT) to detail subsurface water table and contaminant conditions
- Assisted with various investigations including: installation and abandonment of monitoring wells, completion of soil borings, and installation of vapor monitoring points
- Conducted multiple Phase I Environmental Site Assessments and Pre-Purchase Audit Reports, including site visits, interviews, and report writing

- Directed the removal of multiple types of hazardous waste from sites, including lead impacted soil and hydrochloric acid impacted water
- Experienced in collecting free phase product, sampling groundwater and soils, and collecting vapor samples
- Coordinated with subcontractors for site work for the removal of non-hazardous materials and equipment from an active petroleum terminal
- Compiled historical site data to aid in site understanding and project plan development
- Worked as field lead for various projects including contaminated soil excavation, groundwater/soil sampling, well installation/abandonment, free product recovery, and ISCO injection
- Conducted groundwater sampling and report writing for an EPA oversight project
- Communicated with regulators and clients on-site to explain site activities and plans
- Assisted with management and logistics of projects including: scheduling subcontractors, communicating project information to the project manager and staff, along with communicating with stakeholders to secure access agreements with affected third parties
- Supported a wide variety of project reports and deliverables in several Midwest states

Curriculum Vitae

Jon P. Pesicka, PE

Title
Senior Consultant

Education
BS – Civil Engineering, South Dakota School of Mines and Technology, Rapid City, SD

Professional Registrations
Professional Engineer: California, Wyoming, South Dakota, Colorado,

Professional Associations
Member, American Society of Civil Engineers; Association for Environmental Health and Sciences; National Groundwater Association;

Languages
English

Experience Summary

Through 27 years of engineering and consulting experience, Jon delivers strategic environmental liability management and business-minded remediation solutions to oil and gas industry clients. Jon provides expertise in the areas of decommissioning strategy, hydrocarbon investigation and remediation, regulatory compliance, UST system design, installation and removal, international project management and safety training. Jon also assists attorneys as an expert technical advisor during environmental case depositions and legal proceedings as well as supports counsel with strategy development and information discovery. Jon has provided portfolio management oversight for over 1,000 petroleum-impacted properties across the United States. Clients value Jon's technical focus, attention to detail and ability to seamlessly coalesce cross-functional teams to ensure compliance of common policy and procedure throughout an organization.

Related Projects

- Served as project manager for a large scale port based petroleum terminal demolition in South Africa. The recently idled terminal assets included 18 above ground storage tanks, six underground storage tanks, three two story concrete block buildings, one large warehouse and one six-story steel industrial building. The terminal was located immediately adjacent to shipping docks on one side, railroad on the other side and large volume fuel storage tanks on the remaining sides. Accountabilities included management of resources and logistics of personnel groups on site, site audits and safety assurance coordination, summary report completion and validation of site waste and transport data. The entire demolition was completed in 5 months and the site was restored to a bare lot.
- Assisted design engineer with patent application for innovative zero emissions soil vapor extraction system. Provided senior oversight of the first site operations. Assisted project team with operation and monitoring plan, schedule and implementation. The system operations resulted in groundwater concentrations decreasing to near non detectable in less than 4 months of operation. Developed marketing materials and presentations for other clients, consultants and conferences to showcase the innovative design that required no air quality permit and discharged no emissions to the atmosphere.

- Key member of company's engineering remediation practice team. The team develops key processes for operations teams to utilize when engineering or site remedies are needed. This system is available to all personnel who made need a specific technical expertise as well as maintain compliance with state registration compliance requirements. The team developed design standards, bidding specifications, construction oversight practice and an assurance process to allow project managers the opportunity to utilize expertise across the company while still managing risk for the company and documenting these actions.
- As a maintenance engineer for a global oil company responsibilities included a large scale underground storage tank replacement project in Southern California. The new UST systems included some of the first double wall tank and piping installations at retail sites. Accountabilities included complete specification packages for permitting and bidding, extensive field inspections to ensure compliance with company and vendor protocols and warranties. Various types of tanks and piping were used including Owens-Corning, Xerxes, Joor, A.O. Smith, Fiber Trench and telescoping double wall piping.
- Designed fueling systems for United States Postal service facilities. Following a site specific facility review to determine site capacities and needs, a proposed fueling system concept plan was developed for site facility managers to review. Custom fueling centers were needed due to the highly variable site constraints, volumes of fuel needed and permit requirements. Above or below ground tanks were utilized depending on site dimensions and permit requirements. Construction schedules were detailed in the bid specifications to allow for 24 hour site activity at the USPS facilities.
- Served as Senior Project Manager for Antea Group's field response to the Gulf of Mexico oil spill. Coordinated the training and logistics of over 40 personnel on the ground in the Gulf region that support client with safety oversight for cleanup operations, waste management inspections and audits and sampling. Direct resources to the region often with immediate needs and logistics of travel, field equipment, and site location support. Multiple personnel in several states were simultaneously working, with varying work locations daily, severe weather often threatening their work location and potential for unknown safety concerns.
- Served as a National Account Manager for two major oil company clients. Responsibilities included coordination of internal teams to provide seamless product delivery to national clients, assure compliance of client policies and procedures, and negotiated acceptable contract language and pricing. Created a team of resources to meet needs of clients and determine and continually calibrate team for appropriate staff mix.
- Provided technical support for litigation project at a Superfund project involving multiple parties with source determination and allocation disputes. Assisted legal counsel and expert witness with technical review of historical data, source determination, allocation of responsibility and engineering review of demolition, assessment and dredging plans.
- Provided technical assistance for a major oil company's defense against the State Attorney General's office claim. The AG was attempting to impose compliance penalties regarding underground storage tank compliance, particularly the 1998 EPA upgrade standards. Several test sites were selected and extensive reviews of site assessments, remediation plans and operations, regulatory agency records research, corrosion evaluations, permit reviews and maintenance records were conducted. A detailed evaluation of the environmental risks that may have been the result of the non-compliant components was performed as well as in-depth evaluation of alternative

methods of releases other than the non-compliant components. Several negotiation sessions were held, including in-depth review of particular sites and specific circumstances. The proposed fine was significantly reduced, without being tried in court.

- Supervised and directed teams managing over a thousand petroleum impacted site investigations at leaking underground tank sites as a major oil company representative and as an environmental consultant. Investigations incorporated work plan development, permit acquisition, subcontractor negotiations, status reporting for client, waste disposal coordination and soil boring and well placement. Investigations also included soil and water sampling, boring log preparation, assessment report preparation, data evaluation, site closure, and budget responsibility. Primary contaminants involved in the majority of the corrective actions were petroleum fuel constituents such as benzene, toluene, methylbenzene, and xylene and oxygenates such as MTBE and TBA.
- Coordinated and managed the permitting, design, construction, operation, and maintenance of several soil venting systems used for hydrocarbon site remediation. Implemented new technology remedial techniques: sparge and vent groundwater and soil remediation, in-situ bioventing. Evaluated and utilized various types of exhaust treatment systems, such as thermal oxidizers, catalytic oxidizers and granulated carbon absorption for use in conjunction with soil vapor extraction. Construction oversight was also performed for many of the designs to assure compliance with designs and permit conditions as well as providing safety oversight for all workers and stakeholders.
- Supported client with negotiations involving allocation of responsibility for sites with impacts from different operators at different times. Technical review of the sites included a detailed review of historical site owners and operators as well as what type of site operations were conducted. A historical review of regulatory compliance was performed to determine if permit compliance was maintained, potential inventory control mechanisms, and release reporting compliance. Additionally geochemistry data was analyzed to attempt to date impacts and differentiate product formulas to determine responsibility. Forecasting future cleanup costs was provided to prepare for negotiations with other responsible parties. Often the negotiations were presented to a mediator who would provide a final determination on allocation of accountability. The development of the technical arguments and the presentation of the arguments were critical to achieving a fair outcome.

Presentations

- Pesicka, Jon, Gilchrist, Phil, Poster Presentation, Zero Emissions - ECO SVE: Enhanced Concentrating Soil Vapor Extraction System, 27th Annual International Conference on Soils, Sediments, Water, and Energy. San Diego, CA, March 2012.
- Pesicka, Jon, Gilchrist, Phil, Platform Presentation, Zero Emissions - ECO SVE: Enhanced Concentrating Soil Vapor Extraction System, 28th Annual International Conference on Soils, Sediments, Water, and Energy. Amherst, MA. October 2012.

Publications

- Pesicka, Jon. Tank Decommissioning – Down But Not Out. Tank Storage Magazine, Volume No. 8, Issue No. 4, September 2012, pp. 82-83.

Curriculum Vitae

Brent D. Puck

Title
Senior Project Manager

Education
MS – Physics, Ball State University, Muncie, IN

BA – Physics, Taylor University, Upland, IN

Professional Registrations
Certified Groundwater Professional, Iowa

Languages
English

Experience Summary
Brent Puck is a senior project manager with more than 18 years of professional experience in remedial investigations, environmental site assessments (ESAs), soil and groundwater remediation and project/program management. He is the operations manager located in the Bettendorf, Iowa, office, where he is responsible for the day-to-day operations of a nine-member team. Brent focuses his efforts on providing portfolio management and oversight for all aspects of project work. As a senior project manager, he is responsible for all facets of the project's activities, including strategy development, client communications, proposal preparation, staffing assignments, data evaluation, document review, contractor oversight, and health and safety compliance. Brent monitors progress against financial and time schedule requirements, and is responsible for meeting client budgetary and project goals.

Related Projects
- Current client contact for the Midwest portfolio of a major railroad client, responsible for management of all projects within Iowa, Kansas, Missouri and Nebraska. He is responsible for assembling the 15-year environmental liability estimates for the company's entire portfolio of client sites. Also served as the senior project manager for the Midwest portfolio of a nationwide groundwater sampling program.
- Project management for the ESA and Remedial Action Plan development at a railroad yard in Iowa. Conducted and directed site assessment in association with an inactive surface impoundment pond. Performed assessment activities including determination of groundwater and soil source concentrations of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) and metals constituents; hydrogeology characterization; analysis of inferred area of soil and groundwater impact; and identification and evaluation of migration mechanisms. He also proposed and implemented innovative remediation of VOC-impacted soils and sludges, reducing disposal costs by judicious selection of soil amendments. Directed soil excavation and disposal permitting for VOC-, SVOC-, and metals-impacted soils and free product.

- Primary lead in development of a Soil Management Program for a Class I railroad client. The program was developed as a means to reduce liability exposure resulting from export of surplus soils during construction projects. Worked collaboratively with the client's environmental and engineering departments to develop a uniform procedure for management of soils, including sampling frequency, sample location selection, analytical requirements, data evaluation, and deliverables.
- Senior Project Manager providing direction and oversight of emergency response actions associated with the release of petroleum to a drainage ditch. Coordinated all response actions, including oil recovery, soil excavation, surface restoration, source identification and corrective action, and incident reporting. Identified process failures with on-site water treatment facility as source of release, and directed corrective actions to prevent future failures. Facilitated communication across the client's multiple business units, and served as client liaison to regulatory agency. Cost savings were realized by identifying solutions to logistical problems related to grubbing and excavation activities.
- Primary project manager for assessment, remediation, monitoring and closure of four separate project sites within a railroad yard in Iowa. Developed individual strategies for each leaking underground storage tank (LUST) site due to heterogeneity of soils and presence of shallow bedrock. Developed and implemented supplementary investigation and remediation for non-petroleum impacts at the 30-acre site. Provided environmental support during property sale negotiations. Proposed innovative closure mechanism allowing for classification to No Further Action while exceeding regulatory free product threshold. Served as the point of contact between the new property owner and responsible party during a highway construction project through the former railroad yard.
- Lead resource for development of client-specific Ground Disturbance safety practice. Selected by client to lead practice development, which included fostering open communication and coordination with health and safety professionals from five other consulting firms providing services for the client. Accumulated input from the client's environmental, engineering, and operations departments, incorporating pertinent information to create a document that presents the ground disturbance practice in a thorough and unified manner.
- Provided management and field support for cleanup activities at an active railroad switching yard that experienced major flooding. Identified potentially hazardous materials and conditions, and coordinated cleanup efforts with emergency response personnel, railroad managers, and municipal officials. Directed removal and disposal of hazardous and non-hazardous materials, including petroleum products, solvents, propane tanks, bagged asbestos waste, paints, and general flood debris.
- Project manager directing assessment and remediation activities in association with a crop duster crash in a residential setting. The crash involved the release of fully-loaded tanks of fungicide and aviation gas. Assessment of soil, groundwater, and the residential septic system were conducted. Oversaw excavation of fungicide-impacted soils as primary remedial action, and subsequently obtained regulatory closure upon completion of assessment and remediation activities. Served as liaison between homeowner, insurance company, and regulatory agencies.

Presentations

- "Remediation of VOC Impact at a Former Surface Impoundment Pond," J. McDermott, B. Puck, K. Miller, presented at the Railroad Environmental Conference, Champaign, Illinois, October 2006.

Curriculum Vitae

Donald Reeder

Title
Staff Professional

Education
BS – Horticulture, University of Minnesota, Minneapolis, MN

AutoCAD 2013

Language
English

Experience Summary
Don Reeder is a drafter with more than 15 years of experience. He specializes in AutoCAD civil and environmental drafting. Don's site maps are used in the entire lifecycle of work on a project. His drafting work is the basis for all samples, analysis and studies of groundwater and soil.

Related Projects
- Worked on several large scale projects, including civil and environmental drafting work on a large Conoco Terminal in Wrenshall, Minnesota large rail yard for Union Pacific in Clinton, Iowa.
- Served as Health and Safety Manager (Dahl and Associates) for the north central regional office.
- Assisted project management staff in Phase I Environmental Site Assessments and remedial investigation corrective action designs.
- Served as assistant in Information Services Departments (Dahl and Associates and Epoch Environmental). Created and maintained company web sites.
- Served as Field Technician. Extensive field experience included agricultural chemical site inspections; data collection; soil, water and air sampling; remediation system repair; and pilot studies in a wide range of situations. Also served as Technical Services Coordinator. Involved in scheduling and coordinating field work, field equipment maintenance and repair and supply purchases. Also experienced in directing underground storage tank removals, excavations and drilling.
- Provided civil drafting work for location of streets, roads and utilities for general analysis. The maps were used for site analysis and surveying service stations, large terminals and neighboring surroundings.
- Provided environmental drafting work related to underground storage tanks and wells used by geologists to locate groundwater flow, soil contamination and chemical analysis. Also provided Geologic Cross Sections of sites to show the underground geology of the soil and water. They are also are used for drilling, Geoprobe and excavating activities at project sites.

Curriculum Vitae

Nancy Rodning

Title
Project Geologist

Education
BS – Geology, University of Wisconsin

Languages
English

Experience Summary

Nancy Rodning is a Project Geologist with 15 years of experience in the environmental industry. She specializes in Phase I and II environmental assessments and related due diligence projects and remedial investigations. She contributes the following consulting experience and services:

- Field services at petroleum and non-petroleum sites under State Leaking Underground Storage Tank and State Voluntary Investigation and Cleanup Program direction include oversight of excavations for soil remediation; oversight of soil boring and monitoring well installations, and tank removals; soil, soil vapor, ground water, surface water, air and asbestos sampling; and, surveying.
- Technical services include interpretation and preparation of geological cross sections; writing of investigation, assessment and monitoring reports for sites with petroleum, chlorinated solvent, and metals impacts; writing of property transaction Phase Is and Phase IIs in accordance with ASTM, Minnesota VIC, Fannie Mae, and HUD guidelines; preparing Spill Prevention, Control and Countermeasure Plans; and, waste compliance oversight.
- Project management services include preparation and tracking of work scopes, budgets and job schedules; and, written and verbal correspondence with clients, contractors, off-site property owners, and local and State regulators.

Related Projects

- Multiple clients, across the US – Provides field and project management services in Minnesota, Wisconsin, Iowa, South Dakota, North Dakota, Missouri, Nebraska, Louisiana, Idaho and Texas for brownfield sites, petroleum, and non-petroleum spill investigation and remediation sites. Field activities include installation of soil borings and monitoring wells, collection of soil, soil vapor and ground water samples, excavation of contaminated soils, and Phase I and Phase II environmental assessments for property developers and lending institutions.

- Westgate V/Archer-Daniels-Midland/Highway 280 Superfund Site, St. Paul, MN – Researched and prepared Phase I ESA for Superfund site; conducted soil and groundwater sampling via soil borings and monitoring wells for non-petroleum contaminants as part of redevelopment assessment; assisted with Development Response Action Plan detailing soil excavation plan for varying depth intervals; performed excavation oversight and sampling for suspect ACMs in the area of excavation.
- Union Pacific Railroad Roundhouse, Huron, SD – Conducted excavation oversight of petroleum-impacted soils in and around holding ponds and adjacent creek. Excavation oversight included field monitoring of soil samples and directing the separation of impacted soil for off-site disposal from soils acceptable for on-site re-use. A total of 47,000 cubic yards of soil was excavated over a one-year period. Prepared weekly activity reports for submittal to UPRR, South Dakota Department of Environmental Resources, and Environmental Protection Agency.
- Milwaukee Road Depot MN VIC Site, Minneapolis, MN – Researched and prepared Phase I ESA for former railroad depot; conducted soil and groundwater sampling as part of redevelopment assessment; provided excavation oversight of petroleum and non-petroleum impacted soils from former railroad depot, including soil sampling, directing the separation of impacted soil for off-site disposal.
- City of Chaska Block 5 and Klein Brick Yard Redevelopment MN VIC and VPIC Sites, Chaska, MN – Researched and conducted Phase I ESAs on two blocks slated for City redevelopment; prepared Phase II and Development Response Action Plans for redevelopment of sites for retail and multi-family residential uses; implemented DRAP at both sites, including soil and groundwater sampling for petroleum and non-petroleum impacts, excavation of impacted soil for off-site disposal, and managing waste water discharge; obtained No Further Action determination from MPCA, allowing for site redevelopment; prepared DTED grant application for project funding for the City of Chaska.
- British Petroleum(BP) MC252 Spill Site, Mississippi – Provided waste management compliance oversight at a spill response equipment decontamination facility associated with the MC252 spill site on the Gulf Coast.
- Library Square Residential Development, Mandan, ND – Researched and prepared Phase I ESA for several lots slated for residential development located over railroad petroleum plume in downtown Mandan; prepared and implemented Phase II and Development Response Action Plan for redevelopment of properties with off-site source impacts; coordinated with City and State regulatory authorities and Fannie Mae to satisfy varying environmental standards and requirements.
- Unisource MN VIC Site, St. Paul, MN – Researched and prepared Phase I ESA for commercial property located adjacent to Valentine Clark Superfund site; prepared and implemented Phase II soil and groundwater sampling for redevelopment of property with off-site source impacts.
- AlliantTech Systems, St. Paul, MN – Researched and prepared Phase I ESA for ammunitions maker and large quantity hazardous waste generator. Reviewed historical and current hazardous waste management plans and prepared and implemented Phase II soil and groundwater sampling for site-specific chemicals of concern.
- ConocoPhillips – Circle K Retail Store Site Assessments, MN, TX, LA, GA – Conducted subsurface assessments at retail gas stations as part of a large scale property transfer, including project scheduling and coordination; soil boring oversight, including soil and groundwater sampling; conductance of scope of work in accordance with State-specific regulations; release reporting to State; and, preparation of site assessment reports and release reports as required by State agencies.

Curriculum Vitae

Joy Rooney, EIT

Experience Summary

Joy Rooney, a project professional for Antea Group, has more than 6 years of experience exploring a host of groundwater and surface water related issues. Her experience includes operation and maintenance of soil vapor extraction, air sparge, and pump and treat remediation system. Joy also has extensive experience in surveying, hydrological modeling, instrumentation, and water, air, and soil sampling. She has written external reports to meet company, client, and regulatory requirements.

Joy pairs her field engineering experience with a deep understanding of data management. Her experience includes a vast background working with EQuIS, ArcGIS, and Visual Basic. Joy uses her knowledge of field data collection to enhance the quality and integrity of data management, programming, and visualization practices.

Related Projects

- *Remediation System Operation and Maintenance:*
  - *Pipeline Spill, Jackson, WI:* Oversaw the daily engineering operation of two soil vapor extraction units and one pump and treat system. Performed all necessary scheduled and unscheduled maintenance to optimize the performance of all systems. Reconfigured enhanced fluid recovery technology on a daily basis to maximize product recovery. Completed all daily field and system readings, sampling, and reporting.
  - *Bulk Oil Storage, St. Paul, MN:* Currently the primary engineer for the operation and maintenance of a soil vapor extraction and air sparge remediation system. Performs all system readings, sampling, and reporting. Monitors system daily via telemetry.
  - *Drum Disposal Facility, Isanti, MN:* Currently the primary engineer for the operation and maintenance of a soil vapor extraction unit in Isanti, MN. Performs all system readings, sampling, and reporting.
- *EQuIS Data Management and Reporting:*
  - Pioneering team member in company-wide initiative to enhance data management technology and visualization tools

Title
Staff Engineer
Data Manager

Education
BS – Biosystems and Bioproducts Engineering, University of Minnesota, Minneapolis, MN

Professional Registrations
Engineer in Training: Minnesota (140168)

Languages
English

  - Completed EarthSoft Power User training in Seattle, WA
  - Currently providing EQuIS support and training to multiple Antea Group teams, including: loading data, reporting, troubleshooting loading and reporting errors, and data verification
  - Communicating with laboratories to increase the integrity and consistency of data packages
  - Designing tools in Visual Basic to transform historical data into formats accepted my EQuIS

- *ArcGIS – Mapping and Visualization:*
  - *Jackson, WI:* Using historical well records within a 2 mile radius of the site, calculated and mapped the hydraulic conductivity, transmissivity, and specific capacity index
  - *Nebraska:* Created visualizations in ArcGIS to delineate the extent of nitrate, nitrite, and ammonia in groundwater and varying depths in soil
  - *Kansas City, MO:* Created sensitivity maps for FRP Plan. Used LIDAR data to create cross-sections and slopes to determine flow rate and distance of a worst case scenario oil spill
  - *Superior National Forest, MN:* Implemented time saving process for identifying potential crossing locations using ArcGIS to pinpoint locations where streams cross roads and trails

- *Visual Basic Data Collection Streamlining, St. Paul, MN*: Previous data collection using a PDA system presented several problems: slowness of use, inability to check data, and limited access to data within office. Created new field forms using Visual Basic to overcome existing problems and fully integrate into the existing database at no additional cost.

- *Illicit Discharge Identification and Elimination, St. Paul, MN:* A persistent illicit discharge into the Mississippi River was both an eyesore and could potentially present a host of ecological issues. The stormwater interceptor, located 150 ft. underground, is inaccessible to traditional sampling and monitoring. Used 90,000 points of instantaneous flow data and associated laboratory data from the outfall to construct flow and load duration curves. Load duration curves are used to identify potential constituents and flow regimes associated with an illicit discharge. Identified *E. coli* and suspended solids as primary constituents associated with the illicit discharge during low to moderate flow conditions. The City of St. Paul has since relined portions of the stormwater interceptor and eliminated the illicit discharge.

- *Stormwater Monitoring and Reporting, St. Paul, MN:* Fifteen ISCO 6712 full water quality stations and 18 level loggers are located throughout the Capitol Region Watershed District. These stations are monitored to quantify the effects of stormwater improvement projects and water quality changes within the district.
  - Installed, maintained, and collected data and water samples from water quality stations and data loggers.
  - Calculated annual TP and TSS loading from each monitoring location using 10-minute instantaneous level and velocity data collected throughout monitoring year.

- *BMP Inspection and Maintenance, St. Paul, MN:* Inspected district owned BMPs for functionality and damage including; tree trenches, raingardens, infiltration trenches, catch basins, wetland systems, stormwater ponds, and an underground stormwater infiltration facility.

- *Culvert Replacement Prioritizing in the Superior National Forest, Duluth, MN:* The Superior National Forest consists of over 3 million acres in northeast Minnesota with over 1,300 miles of cold water streams and 950

miles of major warm water streams supporting fisheries. Many of these streams are segmented and impassible to fish and macroinvertibrates due to improper culvert sizing and alignment.
  - Located and surveyed over 500 crossing locations throughout the Superior National Forest
  - Ranked and prioritized crossings for replacement using quantitative and qualitative field data.

- *Background Parameter Collection of Crude Oil Spill, Bemidji, MN:* In 1979 a crude oil pipeline burst just outside of Bemidji, MN. Approximately 110,000 gallons remain in the subsurface after remediation efforts. Collected background parameter data (DO, pH, temperature, and conductivity) data using an YSI meter from over 100 sampling points throughout the affected area. This data is collected annually to monitor long-term changes outside the plume.
- *Investigating the Fate of Veterinary Pharmaceuticals in Groundwater, Bethel, MN:* Antibiotics, hormones, and other pharmaceuticals persist in the environment, present reproductive problems to fish, and often pass intact through traditional wastewater treatment facilities. A three-year field study at Cedar Creek Ecological History Reserve was conducted to investigate the fate of four antibiotics and an estrogen compound applied to different cover crops (corn, CRP, prairie, and bare ground) to groundwater.
  - Initialized project by collecting background data, determining pharmaceutical list, creating seeding plan, constructing and calibrating monitoring equipment, and installing 35 water sampling points.
  - Constructed, installed, collected and maintained data from four Campbell Scientific data loggers recording soil temperature, soil moisture, and osmotic potential at varied depths under each cover crop type.
  - Supervised five to seven interns and work studies in conducting field operations such as: USGS protocols for water and soil sampling, above and below ground biomass harvesting, ELISA kit testing, equipment calibration, and sample preparation.

Curriculum Vitae

Anthony (Tony) Rossano

Title
Senior Project Manager

Education
BS – Chemistry, Columbus College (Columbus State University), Columbus, GA

Credentials
- DOT Hazardous Materials (HazMat Employee) certification
- Lead Inspector (Target Housing and Child-Occupied Facilities)
- On-Scene Incident Commander (Hazardous Waste Operations and Emergency Response)
- Hazardous Materials Technician (Hazardous Waste Operations and Emergency Response)
- Asbestos Operational and Maintenance Worker
- Asbestos Emergency Response Act (AHERA) Building Inspector
- American Chemical Society – Member (30+ yrs)
- Air and Waste Management Association - Member

Languages
English

Experience Summary
Anthony (Tony) Rossano is a senior project manager for Antea Group with more than 30 years of environmental, health and safety experience. He is extremely knowledgeable in state and federal regulations applicable to Clean Air Act permitting, reporting, and compliance, industrial hygiene, Health, Safety & Environmental program auditing, laboratory operations, due diligence auditing, environmental site assessments, OSHA compliance, chemical products evaluations, TSCA, and EPCRA compliance. He has strong project management, planning and problem resolution skills and is an effective liaison with management, employees, contractors, and regulatory agencies.

Related Projects
- Completed Synthetic Minor Air Permit modifications for major containerboard manufacturer. Responsibilities included regulatory review, air pollutant emissions development, permitting, and interaction with State and Local permitting agencies.
- Completed environmental, due diligence, and Phase I Environmental Site Assessments (ASTM) audits for a national containerboard manufacturer. Responsibilities included reviewing environmental compliance, assessing environmental risk to property, and evaluating the current permitting / environmental reporting status (air quality, hazardous waste, storm water, wastewater, EPCRA, etc.).
- Completed numerous Qualified Facility and non-Qualified Facility Spill Prevention Control and Countermeasure (SPCC) Plans, and Storm Water Pollution Prevention (SWPP) Plans for national containerboard manufacturer and rental car company.
- Completed Title V Air Permit revisions for major automotive parts manufacturer. Responsibilities included regulatory review, air pollutant emissions development, air dispersion modeling, liaison with regulatory agency, and Title V application completion.
- Corporate Laboratory Manager for national bed and bath textile company - Supervised and managed laboratory technicians in R&D, Environmental, Analytical (Technical Services), Cotton Dust, and Water / Wastewater laboratories; Instituted and maintained quality control procedures / data and OSHA compliance for all labs.

- Completed Title V (PSD) permitting for major international glass manufacturer. Responsibilities included air dispersion modeling, emission factor development, emission reduction offsets determination, and Title V modification application.
- Completed Synthetic Minor Permit revisions for major turbine manufacturer. Responsibilities included regulatory review, air pollutant emissions development, and interaction with State and Local permitting agencies.
- Developed air emission factors for wood preservative operations for major wood preservative manufacturer. Responsibilities included protocol development for air emissions factors, development of air emissions calculations, and air permitting regulatory review for several eastern and western U.S. states.
- Completed numerous major Title V and New Source Review revisions for an international pulp, paper, and containerboard company. Responsibilities included air dispersion modeling, Title V modification application preparation, and liaison with state permitting agency.
- Completed compliance plans for import/export of chemicals under TSCA Section 12(b) and 13. Responsibilities included developing and implementing protocols for laboratory import of chemicals in major textile laboratory and development of TSCA compliance plan for a major printing company.
- Assisted major wood preservative manufacturing company with TSCA reporting and required notifications under Section 8(c).
- Developed 112(r) Chemical Risk Management Programs for numerous facilities. Programs included evaluation of chemical releases, assessment of risk, and emergency response.
- Completed major Title V and New Source Review revisions for an international packaging printing company. Responsibilities included writing draft permit and interaction with state permitting agency.
- Served as corporate environmental, health and safety coordinator for a national manufacturer of bedding and bath products. Duties included:
  - Advised facility managers and corporate management on regulatory compliance of state and federal regulations
  - Developed model General Duty Plan, Clean Air Act (CAA) amendments – Section 112 (r), for company-wide compliance
  - Prepared and submitted Conditional Major / Synthetic Minor air permit applications (Title V) and assisted facilities in implementing record keeping requirements for issued permits
  - Directed compliance with Community Right-to-Know (SARA Title III) reporting for over 50 facilities in 38 states
  - Coordinated company-wide disposal of RCRA-regulated hazardous waste, as well as universal waste
  - Implemented sampling strategy for lead paint compliance
  - Developed and implemented radiation safety program for the operation and licensing of x-ray fluorescent lead analyzer
  - Assisted corporate safety director with development of various safety programs
- Developed an asbestos management plan for a large industrial company. Plan included coordination of sampling and abatement activities, coordination of AHERA Inspector Training and researching/approving licensed asbestos abatement companies for working in company facilities.
- Developed Medical Waste disposal procedures for occupational clinics for a large industrial company for multiple state facilities including state licenses and facility medical waste management programs.
- Served as chemist and laboratory supervisor for textile manufacturer. Duties included:

  - Supervised and managed laboratory technicians in R&D, Environmental, Analytical (Technical Services), Cotton Dust, and Water/Wastewater laboratories; coordinated and scheduled analyses of test samples received, developed and implemented laboratory standard operating procedures, and Quality Assurance program.
  - Maintained proficiency of Environmental Measurements Lab as an American Industrial Hygiene Association accredited laboratory with participation in the NIOSH Proficiency Analytical Testing Program
  - Instituted and maintained quality control procedures and OSHA compliance for all labs.
    - Assisted in evaluation of health hazards in the workplace using industrial hygiene sampling protocols.
- Developed a lead-based paint management program for a large textile manufacturer. Responsibilities included evaluating sampling strategies, potential for lead exposure, and developing cost effective removal or encapsulation strategies to minimize employee exposure to airborne lead dust.
- Prepared numerous air emission inventory reports for major Title V, Synthetic Minor, and Minor facilities. Responsibilities included overall project management, development of emission factors, emissions determinations using EPA TANKS program and vapor pressures based on Raoult's Law, report preparation and interaction with state agencies.
- Performed environmental, health & safety audits for a U. S. petroleum pipeline distributor and petroleum products manufacturer. Responsibilities included identifying non-compliance issues and providing recommendations for issue resolution. Audits included evaluation of Federal (RCRA, EPCRA, TSCA, CAA, CWA, & OSHA) as well as state compliance programs.
- Performed an environmental, health & safety audit for a U. S. API pharmaceutical company. Responsibilities included identifying non-compliance issues and providing recommendations for issue resolution. Audits included evaluation of Federal (RCRA, EPCRA, TSCA, CAA, CWA, FDA (limited) & OSHA) as well as state compliance programs.
- Completed environmental, health & safety due diligence audits for a major global medical device manufacturer. Responsibilities included reviewing environmental compliance, assessing environmental risk to property, and evaluating the current permitting / environmental reporting status (air quality, hazardous waste, storm water, wastewater, EPCRA, etc.).
- Managed multisite International EHS audit programs for numerous international and U.S. manufacturers. Responsibilities included auditor management, scheduling, protocol management/development, report preparation, and auditor training.
- Conducted numerous Phase I Environmental Site Assessments (ASTM) for several international manufacturers. Typical properties included active and closed manufacturing sites in preparation for sell by owner/operator or purchase by prospective buyer. Responsibilities included assessing recognized and de minimis environmental conditions.
- Performed environmental, health & safety audits for a major worldwide beverage manufacturer. Responsibilities included identifying non-compliance issues and providing recommendations for issue resolution. Audits included evaluation of Federal (RCRA, EPCRA, TSCA, CAA, CWA, & OSHA) as well as state compliance programs.
- Developed Integrated Contingency Plans (ICP) for several facilities to include spill control (oil), stormwater, hazardous waste (LQG), chemical storage, and bulk chemical storage tanks for a national printing and publishing company. Responsibilities included site review/observations, SOP review, site drawings, and development of comprehensive ICP.

Curriculum Vitae

Peter J. Schwalbach

Experience Summary

Pete Schwalbach, a Senior Project Manager, has more than 27 years of experience in the area of environmental regulatory compliance. Peter's technical specialties include environmental training, compliance auditing, air emissions permitting, hazardous waste management, environmental awareness training presentations, and stack emissions testing.

Title

Senior Project Manager

Education

BS – Civil and Environmental Engineering, University of Wisconsin Madison, Madison, Wisconsin.

Languages

English

Related Projects

- Project Manager and Lead Presenter for the preparation and delivery of training customized for the environmental coordinators of a major international manufacturing company. This included the development and use of practical exercises that reinforced the regulatory lessons taught during the lecture portions of the training. Environmental regulatory topics included air emissions (CAA) management, solid and hazardous waste (RCRA) management, community right to know reporting (EPCRA), and wastewater and storm water (CWA) management.
- Project Manager and Lead Presenter for the implementation of a company wide environmental awareness and compliance program for the corrugated box and converting division of a major paper company. The project was delivered to over 400 plant environmental coordinators for implementation within plant operations.
- Served as Content Development Manager and Lead Presenter for the preparation and delivery of a series of webinars for a globally recognized Pulp and Paper Company as they conducted internal EHS auditor training. Session topics included audit process, writing audit findings, audit activities, and auditing tools.
- Lead presenter for company-wide talent management initiative entitled “Crucial Conversations”. Crucial Conversations is a course that teaches skills for creating alignment and agreement by fostering open dialogue around high-stakes, emotional, or risky topics—at all levels of an organization. The course teaches attendees how to speak and be heard (and encouraging others to do the same) in an effort to surface the best ideas, make the highest-quality decisions, and create unity and commitment in all decisions.

- Project Manager and Lead Presenter for the preparation and delivery of training customized for the environmental coordinators of a major pulp and paper company. This included the development and use of practical exercises that reinforced the regulatory lessons taught during the lecture portions of the training.
- Developed and presented an annual environmental regulatory update to a leading international manufacturing company. The meeting was attended by the North American environmental managers for the company's operational divisions.
- Presented "Culture Assessments: Accelerating the Journey to Excellence" at a local NAEM meeting. The meeting was attended by the local members of the National Association of Environmental Managers from companies located in Minneapolis and St Paul, Minnesota. The presentation included a discussion of how company culture can enhance or inhibit regulatory performance.
- Worked with a Food and Textile Company's environmental corporate team to develop a company wide awareness-training program. Served as the Project Manager during the development of their materials and presented at their annual training seminar.
- Served as primary auditor for 40 multi-media environmental compliance audits at manufacturing and service facilities for an international manufacturer over a 3-year period. The facilities manufactured heavy construction equipment, auto parts, and door hardware.
- Assisted as a member of a multi-disciplinary audit team in the completion of over 70 environmental compliance audits at manufacturing and service operations across the United States.
- Served as primary auditor for multi-media environmental compliance audits at two 500,000 square-feet cereal manufacturing plants.
- Assisted in completing environmental compliance audits of eight TSDs and transporters of hazardous waste in eight different states. Operations included metal smelting, metal refining, and transportation, and disposal of hazardous wastes.
- Completed a storm water permit application for a national based manufacturing company for one of its facilities located in North Carolina. Reviewed storm water pollution prevention plan and best management practices for an electronics manufacturing facility located in Minnesota.
- Lead project engineer for the completion of a Part 70 air permit at a steel fabrication facility in Wisconsin.
- Conducted air emission inventory and air quality compliance review for a manufacturing facility in Wisconsin. Assisted in preparation for writing a Major Source Operating Permit application to meet Wisconsin Clean Air Act regulations.
- Completed a chemical inventory and determination of potential to emit calculation for Title V applicability for a flexographic print shop. The printer inventoried over 150 different inks and operated four flexo printers and four cold set presses.

Curriculum Vitae

Jack Sheldon

Title
Senior Professional

Education
MS – Environmental Microbiology, Wagner College, Staten Island, New York

BS – Bacteriology and Public Health, Wagner College, Staten Island, New York

Professional Associations
American Society for Microbiology

National Groundwater Association

Languages
English, German

Experience Summary

Jack Sheldon is a remediation subject matter expert located in West Des Moines, Iowa. He has over 35 years of experience as a project manager and program director. He has specialized in the field application of various types of bioremediation and chemical oxidation/reduction systems, with personal involvement in 23 first type remediation projects in their respective states/countries. He has completed remediation projects in all 50 states and several locations abroad.

Jack has provided global remediation, microbiology, and regulatory negotiation services for many government and commercial clients on concerns of soil, sediment, air, and groundwater. He has worked extensively on site investigation, prepared various environmental reports, and successfully managed numerous projects and technology programs. He works regularly with investigation tools including MIP, HPT, UVOST, ROST, FLUTe™, and SIFT™. His primary expertise has been in the identification/selection of remediation technologies for projects and the monitoring of those technologies. Jack has designed, implemented, and supervised hundreds of treatability/pilot studies comparing technologies. He is actively involved in the design, equipment selection, monitoring, supervision, and peer review of full-scale remediation projects using a broad array of technologies.

Jack has authored more than 50 technical papers/articles, two best-selling books on bioremediation, and delivered more than 100 major presentations/webinars. He has conducted seminars for many regulatory agencies and taught courses for the University of Minnesota, the University of Wisconsin, Rutgers - the State University, Drake University, and the MA/CT/NY Licensed Site Professionals program. He serves on the peer review teams for multiple clients.

Jack is the primary quality assurance resource for all in situ chemical oxidation projects implemented by the company. He is also a member of the corporate project audit team, the corporate Volunteerism group, and the Remediation Engineering Evaluation Team (REET).

Curriculum Vitae
Jack Sheldon

Selected Chlorinated Compound Remediation Projects

- **Oatland Island, Georgia, USA, Center for Disease Control, MNA/ In-situ Chemical Oxidation** - Senior Project Scientist on a Monitored Natural Attenuation evaluation for a former pesticide/herbicide disposal site impacted by DDT, pCBSA, Lindane, and Dieldrin. Designed pilot studies for potassium permanganate and Fenton's Reagent that were completed on two hot spot locations. Results showed that the latter technology was more effective at desorbing and treating the primary constituents beneath the landfill.
- **Salt Lake City ANG Base, Utah, USA, Air National Guard Bureau, In-situ Chemical Reduction/In situ Chem-Bio** - Senior Project Scientist providing FS support and evaluating specific technologies for three individual sites impacted by petroleum hydrocarbons and chlorinated solvents at an active base. Completed review of QAPP, SAP, PP, HASP, and ROD for the project. Chemical oxidation using alkaline catalyzed Klozur® persulfate (provided as a single product, Klozur® CR) for TPH and chemical reduction of TCE using the EHC™ technology were selected and injected in 2008-2009. This was a 3 year performance based contract (PBC).
- **ANGB/AC Thompson Field, Mississippi, USA, *In situ* Bioremediation (Anaerobic) –** Senior Project Scientist for an HRC® injection bioremediation project at an air base in Mississippi focused on TCE and daughter products. Responsible for design review and performance progress monitoring. Evaluated various carbon substrates at the start of the project.
- **Manufacturing Plant, New Jersey, USA HB Fuller, In-situ Chemical Reduction** - Senior Project Scientist for pilot test evaluation and full scale design for an in-situ chemical reduction in groundwater found in the overburden and fractured media impacted by CVOC's. Evaluated distribution of the amendment following direct placement and fracturing techniques. Reviewed progress reports and participated in client meetings. Providing full-scale design review and provide regular data interpretation using 3D visualization tools.
- **Manufacturing Plant, New York, USA, Grumman, Bioreactor** - Senior Project Scientist for pilot test evaluation of a fixed film bioreactor inoculated with a specialized culture for TCE degradation. Optimized system parameters and reviewed performance data.
- **Manufacturing Plant, Georgia, USA, Northrop Grumman, In-situ Chemical Oxidation** - Senior Project Scientist for third party review of a potassium permanganate injection approach designed by others for TCE remediation. Provided data review and a technical memorandum describing the findings of the evaluation.
- **Electronics Manufacturing Facility, North Carolina, USA, Confidential Client, MNA** - Senior technical support for data interpretation from MNA program. Provided oversight for use of the NAS model (USGS/Virginia Tech) to generate additional evidence in support of the remedy.
- **Tool Manufacturing Facility, North Carolina, USA, Confidential Client, In-situ Chemical Oxidation** - Senior technical support for two in-situ chemical oxidation pilot tests involving modified Fenton's reagent and alkaline activated persulfate on CVOC's in tight soil and fractured rock. Reviewed pilot study design and provided data interpretation.
- **Former Manufacturing Facility, Minnesota, USA, Chemart, Microbial Profiling/Remedy Selection** - Senior technical support to develop a microbial profiling program on a small CVOC site for the purpose of remedy selection. The site is administered by the MPCA. A new molecular biological tool, QuantArray Chlor™, was utilized

to understand active microbial populations and processes to better focus a remedy.

- **Beverage Formulation Facility, Massachusetts, USA, Coca Cola, Additional Investigation/Feasibility Study** - Senior technical support for development of a groundwater sampling strategy to delineate CVOCs in fractured bedrock. At the client's request, prepared feasibility document showing pros/cons of conventional and innovative approaches to source treatment and plume migration.
- **Canton Drycleaners, Michigan, USA, Colony Insurance, In-situ Chemical Reduction/Bioremediation –** Senior technical support for a combination in-situ chemical reduction/bioremediation amendment delivery into an artificial saturated condition impacted by CVOC.s. Developed injection procedure and monitoring program. Assisted in regulatory interaction.
- **Former Drycleaners, New Mexico, USA, AmeriPride, In-situ Chemical Reduction/Bioremediation –** Senior technical support for implementation of a combination in-situ chemical reduction/bioremediation approach at a site impacted by CVOC's and metals. Developed monitoring plan and provide regular data interpretation.
- **Former Pump Manufacturing Facility, Illinois, USA, ITT, In-situ Soil Mixing** - Senior Consultant on an in situ soil mixing project where TCA, DCA, and DCE were treated with quicklime and Klozur® persulfate to a depth of 16 feet. Designed pilot test for soil treatment that looked at mixing regimes and amendment ratios. Evaluated data and designed scale-up. Oversaw full-scale application for treatment of 7500 cubic yards of soil.
- **North RR Superfund Site, New Mexico, USA, New Mexico DEP/EPA Region VI, In situ Bioremediation (Anaerobic)** – Senior Project Scientist for the application of bioremediation strategies at the North Railroad Superfund site in Espanola, NM. Responsible for plan review and data interpretation as part of an extensive technology pilot program involving injection of various amendments to a large chlorinated solvent plume. This project was peer reviewed by John Wilson of EPA.
- **Keyser Yard, West Virginia, USA, CSXT, In-situ Bioremediation (Anaerobic)** - Senior Project Scientist providing data interpretation for a TCE site where unique canisters of carbon source and nutrients, provided by Geovations have been placed in wells in the distal plume. Developed an exit strategy for the site.
- **Farmers Grain Coop, Utah, USA, Scoular Companies, In-situ Chemical Reduction/Chemical Oxidation** - Senior Project Scientist for the development of a bench test evaluating oxidant demand for in situ chemical oxidation using potassium permanganate and Fenton's reagent. Also, evaluated the microbial and chemical capacity of the site to degrade TCE through ethane/ethane and to determine whether emulsified oil would be a good substrate to promote degradation of the chlorinated compounds present. Ultimately developed a pilot study involving a Klozur® sodium persulfate injection in the source area and a chemical reduction barrier at the property boundary.
- **Athens Production Facility, Alabama, USA, Steelcase Manufacturing, MNA/In-situ Bioremediation (Anaerobic)** - Senior Project Scientist providing data interpretation and sampling program support for an MNA remedy on a TCE plume at an active furniture manufacturing facility. Selected emulsified vegetable oil as a substrate for source area reduction and a pilot test was conducted.
- **HRC® Technology Development Program, Wisconsin/Iowa, USA, Regenesis, In-situ Bioremediation (Anaerobic)** - Program Manager for the first field demonstrations of Hydrogen Release Compound (HRC®), an innovative in situ enhancement for bioremediation of PCE/TCE. Used direct push injection and in-well treatment techniques to apply the product at the Cedarburg Drycleaning site in Cedarburg, WI and the Mark IV Industries automotive parts

manufacturing site in Eldora, IA. HRC® amendment application resulted in a >80% mass removal in 6 months in the source area of the drycleaning site. HRC® also was effective in reducing the total chlorinated VOC's by 90% at the Mark IV site over five years. This site has the longest period of HRC® application of any site in the US. The Iowa site was conducted as a demonstration project for the Iowa Department of Natural Resources.

- **Confidential Electronics Client, Mississippi, USA, In-situ Bioremediation (Anaerobic)** – Senior Project Scientist on one of the largest HRC® bioremediation applications at an abandoned manufacturing site. Provided conceptual design and data interpretation. Several biobarriers were installed onsite and offsite to prevent further migration of a TCE plume; some were even installed in the right of ways of residential properties. The HRC® barriers proved to be an economic alternative to an ineffective air sparging/SVE system previously installed at the site by others. The old air sparging/SVE system was relocated to another area of the site where it is being used to address a newly found source area.
- **Abandoned Zanesville Site, Ohio, USA, Lear Automotive Corp., In-situ Bioremediation (Anaerobic)** - Project Manager for an emulsified vegetable oil (SRS™) injection project for bioremediation of a chlorinated solvent groundwater plume at an abandoned automotive parts manufacturing facility. This application was more than $100,000 less expensive than other remedial options. Provided oversight for bench testing, developed the conceptual design, selected subcontractors, supervised field application, and provided data interpretation.
- **Unison, Kansas, USA, Dow/Union Carbide, In-situ Chemical Oxidation** - Project Manager for an in situ chemical oxidation pilot study of two modified Fenton's reagent solutions at a former transformer servicing company. Both on-site and off-site TCE plumes were addressed in the pilot study. The chemical oxidants were applied directly through direct-push rods saving the cost of expensive injection well installation. Results clearly demonstrated a citric acid/ferrous iron catalyst with 8% hydrogen peroxide formulation was most effective, and helped determine the injection layout for source treatment and downgradient application. Prior to the field work, coordinated a treatability study evaluating chemical oxidant formulations for the site.
- **Maine Electronics, Maine, USA, Rockwell Collins, In-situ Chemical Oxidation** – Senior Project Scientist on an in situ chemical oxidation project where TCE and arsenic are impacting groundwater in two separate plumes that ultimately co-mingle off-site. A bench-scale treatability study was designed and completed showing that greater than 99% of both contaminants could be reacted. During a pilot study, results showed there was significant heterogeneity in the subsurface. It was possible to treat the arsenic area with chemical oxidation, but the TCE area was not treated successfully. A biological approach is currently being designed for this area of the site.
- **Manufacturing Facility, North Carolina, USA, Honeywell, Phytoremediation** – Senior Project Scientist for the development of a cap for the source area and barrier for the toe of the plume using rows of hybrid poplar and willow trees to control TCE migration. Coordinated with subcontractor, Ecolotree, to review data, collect additional information, and prepare preliminary and final design reports along with an implementation schedule and plan.
- **Manufacturing Plant, Confidential Client, Wisconsin, USA, In-situ Chemical Oxidation** – Senior Project Scientist for a multi-depth ozone sparging application for a chlorinated solvent groundwater plume in southern Wisconsin. This application was estimated at half the cost of a previously recommended ZVI barrier and was more practical in dealing with the depth to groundwater (>50 ft.) at the site.

- **Brownfield Property, City of Louisville, Kentucky, USA, In-situ Chemical Reduction** - Senior Project Scientist for a Brownfield site slated for development into senior citizen housing. The site was impacted by PCE/TCE from a former drycleaning operation. Evaluated site investigation data and developed list of potential cleanup technologies. In-situ chemical reduction was selected for cost estimation and a conceptual design.
- **Chemical Manufacturing Facility, Iowa, USA, Hydrite Chemical, MNA** – Senior Project Scientist on a unique MNA project involving mixed chlorinated solvents at a RCRA site. Abiotic reduction of the groundwater constituents was found to be the primary removal mechanism more so than biodegradation. Carbon isotope analysis, groundwater modeling, MNA modeling using Biochlor, mineral tests, and molecular biological assays were used to develop attenuation evidence.
- **Ralston Landfill, Iowa, USA, Rockwell Collins, MNA** – Senior Project Scientist on a unique CVOC MNA project in fractured rock at a landfill formerly operated in Cedar Rapids, IA. After extensive negotiation with EPA Region 7 and its consultants, the approach saved the client over $1 million in treatment cost by gaining approval for this remedy over pump & treat.
- **Manufacturing Plant, Sanmina, Canada – Site Investigation/Pump & Treat Optimization/ In-situ Chemical Oxidation** - Senior Project Scientist providing oversight of work scopes prepared by Inogen partners, DCS and Franz Environmental. Project involves additional investigation of CVOC impacts through well installation and sampling program. Also, an existing Pump & Treat system was optimized to provide maximum capture prior to coupling with a source reduction approach. Currently, an ISCO program is underway using potassium permanganate injection in the source area. Providing process review and data interpretation support.
- **Asti Plant, Italy, United Technologies Corp., MNA** – Senior Project Scientist on one of the first MNA projects in the Asti region of Italy. The site was a former automotive parts manufacturing facility that used air sparging/SVE to treat chlorinated solvents in soil and groundwater. The project was transitioned into an MNA remedy for polishing.
- **Air Bag Manufacturing Plant, France, Herakles, Feasibility Study,** - Senior Project Scientist on the evaluation of biological and non-biological technologies for source area and plume control of a large perchlorate and CVOC plume. Provided expertise on conceptual model development and design study for a permeable reactive barrier and source treatment. Evaluated a unique phytoremediation amendment for source treatment.
- **Chemical Manufacturing Plant, France, Akzo Nobel/EKA Chimie, Feasibility Study,** - Senior Project Scientist on the completion of feasibility study of biological and non-biological technologies for source area and plume control of soil and groundwater impacted with sodium chlorate.
- **Manufacturing Plant, Grace, Brazil – In-situ Chemical Reduction** - Senior Project Scientist for technology selection, pilot test/full scale design and monitoring for an in-situ chemical reduction approach in a source area/distal plume impacted by CVOCs in tight media. Evaluated distribution of the amendment following direct push and hydraulic fracturing. Reviewed progress reports and also offered guidance on vapor intrusion studies performed at the site. Provide regular data interpretation. This effort was in support of Inogen partner, ANGEL.
- **Manufacturing Plant, HB Fuller, Brazil – In-situ Chemical Reduction** - Senior Project Scientist for technology selection, pilot test/full scale design and monitoring for an in-situ chemical reduction approach in both on- and off-site areas impacted by carbon tetrachloride and chloroform in tight media. Evaluated distribution of the

amendment following direct push, soil mixing and hydraulic fracturing. Reviewed progress reports and participated in client meetings. Completed full-scale design review and provide regular data interpretation using 3D visualization tools. This effort is in collaboration with our Inogen partner, ANGEL.

- **Public Landfill, Confidential Client, Taiwan, - Litigation Support –** Senior technical support conducting a literature search to document fate and transport for individual CVOCs and biodegradation mechanisms.
- **Parts Degreasing Plant, Confidential Client, Brazil – In-situ Bioremediation (Anaerobic)** - Senior Project Scientist for data review and injection optimization of an emulsified vegetable oil injection for TCE in groundwater. Evaluated distribution of the amendment and ability to create anaerobic conditions and increase organic carbon. Helped local office prepare report for regulators.

Curriculum Vitae

Darius S. Szewczak, CIH, CSP, CHMM

Title
HSSE Advisor- Senior Project Manager

Education
MEM, Environmental Policy and Management, Yale University, School of Forestry and Environmental Studies, New Haven, CT

BS, Environmental Sciences and Resource Management, Lehigh University, Bethlehem, PA

Professional Registrations
CIH, Certified Industrial Hygienist

CSP, Certified Safety Professional

CHMM, Certified Hazardous Materials Manager

Professional Associations
Professional Member, American Society of Safety Engineers

Certified Member, Alliance of Hazardous Materials Professionals

Full Member, American Industrial Hygiene Association

Languages
English

Experience Summary
Darius Szewczak is an HSSE (Health, Safety, Security and Environmental) Advisor and Senior Project Manager with the firm. He has over 20 years of professional experience in the environmental, health and safety fields, with the last 12 years focused on Antea Group's internal HSSE program.

Darius has worked in both the public and private sectors. His background includes health and safety compliance and management, hazard identification and risk assessment, Superfund project management, environmental investigation and remediation of contaminated properties, and environmental site assessments.

Related Projects
Antea Group HSSE Advisor

- Oversees and manages the operation of Antea Group's internal health, safety, security and environmental (HSSE) program within the United States. Develops and implements internal policies, procedures, and training tools to ensure that employees and field sites are in compliance with regulatory, company and client health and safety requirements.
- Oversees Antea Group's Contractor Management Program- 295 contractors currently in the system.
- Performs internal HSSE audits and manages company responses to third-party HSSE audits including ISNetworld, Avetta, PEC Premier, Browz and ComplyWorks.
- Performs incident investigations and root cause analyses, incident and near miss trend analysis, and HSSE metrics tracking.
- Performs HSSE hazard analysis and risk assessments of project sites and work activities.
- Assists project teams with site-specific health and safety implementation and trains project teams on company safety programs and OSHA regulations.
- Manages HSSE staff.

Incident Investigation and Root Cause Analysis

- Lead investigator for over 30 formal incident investigations of employee injuries, contractor injuries, property damage events, high potential near misses and equipment failures.
- Skilled in:
    - information collection and analysis
    - interviewing
    - root cause analysis
    - corrective action plan development and implementation
    - report writing and presentations to stakeholders

In Situ Chemical Oxidation (ISCO) Hazard Assessment

- Led a team of internal experts in the H&S assessment of Antea Group's implementation of ISCO remediation projects.
- Developed an interim project review and approval process to keep existing projects on track during the assessment. The ISCO team reviewed approximately 60 sites, without delaying a single project's completion.
- Performed site audits and hazard assessments of representative ISCO field projects.
- Reviewed Antea Group contractor work procedures and established a pool of approved ISCO contractors.
- Developed new minimum safety standards to improve the execution of ISCO related field work.
- Presented a summary of the assessment process, findings and corrective actions to a nationwide audience of Antea Group operations managers and staff.

Closed Landfill HSSE Risk Assessments

- Developed a HSSE hazard risk assessment tool to meet a client's need to perform in-house hazard analyses and risk assessments of a portfolio of over 100 closed landfill sites across the state of Minnesota. The risk assessment tool identifies hazards via energy source analysis, and allows the risk ranking of the hazards through a determination of the frequency, likelihood and severity of potential incidents.
- Created a site health and safety plan (HASP) template package for the client to customize for each specific site. The template package included a HASP, the risk assessment tool, job safety analyses (JSAs), a tailgate meeting checklist and other supporting documents.

Environmental Experience

- Leaking Underground Storage Tank (LUST) Sites, Minnesota – Managed site investigations and remedial actions for multiple LUST sites throughout Minnesota. Project management tasks included developing and overseeing soil and groundwater investigations, soil and groundwater remedial actions, vapor risk assessments and groundwater receptor surveys, and underground storage tank removal activities; assisting with state-funded reimbursement applications; and managing client and regulatory agency meetings.

- Phase I Environmental Site Assessments, Minnesota, New Jersey, and New York– Performed Phase I Environmental Site Assessments of various industrial and commercial properties throughout Minnesota, New Jersey and New York.

- Preliminary Exposure Pathway Assessments (PEPA), South Dakota, Michigan and Georgia – Performed preliminary exposure pathway assessments (PEPA) of petroleum bulk storage facilities, oil production sites, and former retail facilities in South Dakota, Michigan and Georgia. PEPAs are regional assessments designed to identify potential preferential contaminant pathways and receptors in the event of a release from a target property.

- US EPA CERCLA Sites, Pennsylvania – Managed the State of Pennsylvania's interests in Federal CERCLA sites within northeastern Pennsylvania. Served as liaison between EPA Remedial Project Manager and PADEP technical staff for US EPA CERCLA sites in eastern PA. Reviewed remedial action and design plans for compliance with Pennsylvania's applicable, relevant and appropriate requirements. Coordinated PADEP responses to EPA inquiries and requests.

- Pennsylvania Department of Environmental Protection (PADEP), Hazardous Sites Cleanup Program/Site Remediation; Chemical Company, Pennsylvania - Managed the remediation of an abandoned chemical company listed in the Pennsylvania State Superfund (Hazardous Sites Cleanup) program. Coordinated the efforts of State agency technical staff and environmental consultants. Oversaw daily on-site duties and project administration. Cleanup consisted of the characterization and disposal of 500+ drums and several bulk containers of unknown chemicals and chemical mixtures.

- Site Investigation and Remedial Action Evaluation, Land Development Project, New Jersey – Managed a site investigation and remedial action evaluation for a land developer to substantiate his claim filed against his environmental insurance policy. Performed a site investigation, reviewed client's remedial action and reviewed site investigation performed by insurance company's environmental consultant. Formalized findings in a Remedial Action Report submitted to the NJ Department of Environmental Protection.

- Ecological Resource Risk Assessment; Golf Course; New Haven, Connecticut – Performed an ecological resource risk assessment of the effects of pesticide application to a pond within a golf course. Identified golf course pesticide use and application rates. Evaluated pesticide toxicity to aquatic organisms and determined appropriate indicator species receptors. Estimated the concentration of pesticide reaching the lentic environment using an overland flow model from the Vermont Department of Environmental Conservation. Evaluated effect of estimated pesticide concentration on indicator species population.

Curriculum Vitae

Karen Thole

Title
Hydrogeologist

Education
MS – Geology, Washington State University, Pullman, WA

BS – Geology, Winona State University, Winona, MN

Professional Registrations
Professional Geologist: Wisconsin (711-013), Minnesota (30709)

Languages
English

Experience Summary
Karen Thole is a hydrogeologist with 20 years of experience. She specializes in Phase I and II environmental assessments and related due diligence projects, remedial investigations, PCB investigation and remediation, and air emissions permitting.

Related Projects
- Served as project manager and/or Environmental Professional in conducting Phase I and II Environmental Assessments at a variety of residential, commercial, industrial, and agricultural properties throughout the United States. Responsible for the coordination of staff and contractor activities and the determination and tracking of project budgets. Responsible for collection and interpretation of historical and field data and preparation of reports. Responsible for the design and implementation of subsurface contamination assessments that included the determination of contaminant source areas and evaluation of ground water chemistry.
- Served as project manager and/or hydrogeologist for numerous petroleum hydrocarbon, chlorinated VOC, and agricultural chemical spill investigations and remediations in Iowa, Michigan, Minnesota, Ohio, South Dakota, and Wisconsin. Management tasks involved communication with clients, regulators, and contractors; preparation of work plans, cost estimates, and reports; and design and implementation of investigations and remediation systems. Fieldwork included installation of soil borings and monitoring wells; collection of soil and ground water samples; excavation of tanks and contaminated soils; and performance of slug tests, pumping tests, and packer tests.
- Interpreted 10 years of hydrochemical data for the South Dakota Department of the Environment and Natural Resources. Assessed the impact of best management practices on these water quality parameters and assisted in report completion.
- Conducted PCB investigation and remediation at two industrial facilities with historical electrical transformer releases. Responsibilities included design and implementation of PCB investigations; coordination and

supervision of field staff and subcontractors; preparation of EPA notifications, applications, and certifications; and preparation of implementation reports, long-term management plans for engineered controls, and environmental covenants for residual PCBs.

- Completed annual air emission inventory reports and operating permit applications for industrial facilities in Illinois, Iowa, Minnesota, and Missouri.
- Developed a chemical inventory tracking system and completed determination of potential to emit calculations for NESHAP applicability for an industrial facility in Minnesota. The facility operated 10 paint spray booths and inventoried over 150 different paints and associated chemicals.
- Completed Form R reports for an industrial facility in Minnesota. Prepared a self-disclosure letter for violations related to late submittal of three years of Form R reports in accordance with the EPA's Audit Policy and received full penalty mitigation from the EPA.
- Completed Registration Permit and Part 70 Air Permit applications for an industrial facility in Minnesota. The facility operated two boilers, three shotblast booths, 10 paint spray booths, and a burnoff oven.

Curriculum Vitae

Christine R. Tufts, P.G.

Title
Project Manager

Education
MS – Water Resources Science, University of Minnesota, Minneapolis, MN

BS – Geology, Michigan Technological University, Houghton, MI

5-Day Basic Wetland Delineation Course, June 6-10, 2011

Professional Registrations
Professional Geologist: Minnesota, #48960

Professional Associations
Member, Minnesota Groundwater Association
Member, American Institute of Professional Geologists

Languages
English
Spanish (Limited)

Experience Summary
Ms. Tufts is a Project Manager/Geologist with over twelve years of environmental consulting experience, specializing in soil and ground water investigation and remediation. She has a broad background with the investigation and remediation of a wide variety of sites, including gas stations, dry cleaners, industrial facilities, pipeline releases, mining facilities, and manufactured gas plants. Ms. Tufts is based in Antea Group's St. Paul, Minnesota office.

Ms. Tufts supports work on litigation and mediation cases by providing detailed analysis of case documents and recommendations to the stake holders, particularly in the areas of contaminant fate and transport and timing of contamination. Ms. Tufts also manages the day-to-day tasks of coordinating personnel and data management on large cases. Types of cases have included landfills, refineries, industrial facilities, and manufactured gas plants, among other technically challenging sites. Contaminants of concern have included petroleum hydrocarbons, chlorinated solvents, metals, explosives, and poly- and per-fluoroalkyl substances (PFAS, aka PFCs).

Ms. Tufts provides project management services, including preparation of cost estimates, budgets, project work plans, site health and safety plans, and reports. She is the key point of contact, and communicates regularly with clients, regulators, and contractors.

Ms. Tufts' work is supported by her extensive field work experience, including sample collection (soil, soil vapor, sediment, surface water, and groundwater), and supervision of drilling operations, monitoring well installations, underground storage tank (UST) removals, and remedial excavations. This experience is backed by her graduate level education and training and registration as a Professional Geologist in Minnesota.

Curriculum Vitae
Christine R. Tufts, P.G.

Overview of Project Experience

- **Site Investigation:** Experience planning, managing, and performing delineation of the vertical and horizontal extent of contamination at multiple sites. Coordination and communication with client, regulators, and stakeholders.
- **Remediation:** Experience designing and implementing *in-situ* chemical oxidation (ISCO) for remediation of petroleum hydrocarbons in soil and groundwater. Experience designing and implementing targeted source area excavations for remediation of various COCs.
- **Litigation Support:** Provide technical expert support on litigation cases, including insurance cost-recovery projects. Review site historical and geological information to determine historical timeline of site structures and events. Establish timing of soil and groundwater contamination at the sites for use in litigation settlements. Analyze historical documents to determine placement and timing of releases. Review invoices and costs associated with environmental investigation and corrective action. Evaluate invoices for discrepancies and reasonableness of costs incurred for site remediation.
- **Feasibility Studies & Technology Assessments:** Analyzed site geological and hydrogeological data to establish the extent of free phase petroleum hydrocarbon contamination at several gas stations and railroad facilities, and chlorinated solvent contamination at several manufacturing facilities. Applied results to fully assess multiple alternatives to remediate the contamination. Evaluated each technology alternative for effectiveness, implementability, and cost to determine the most reasonable and cost-effective approach to address the contamination at the site.
- **Probabilistic Cost Modeling:** Created and updated site-specific probabilistic cost models for the purpose of predicting potential future environmental costs at sites with limited information.
- **Phase I and Phase II Environmental Site Assessments (ESAs):** Completed Phase I ESAs at multiple locations throughout the Midwest. Work included site reconnaissance, state file reviews, review of historical documents, and report preparation. Also completed Phase II ESAs at numerous properties. Responsibilities included the coordination and supervision of drilling operations and monitoring well installations, soil and groundwater sampling, and report preparation. Provided support for large-scale transaction projects, by reviewing data regarding current and historical environmental conditions at each site, and synthesis, summary, and compilation for a final report.

Example Projects

- **Active Remediation, Gasoline Service Station, Baxter, Minnesota:** Planned and managed a focused investigation utilizing laser-induced fluorescence (LIF) technology to determine the extent of non-aqueous phase liquids at the Site. Developed a corrective action design, and is leading the Site to active remediation through *in-situ* chemical oxidation (ISCO), including performance of an ISCO Pilot Test.
- **Active Remediation, Gasoline Service Station, Mounds View, Minnesota:** Developed a Remediation System Detailed Corrective Action Design Report (SDCAD) for ISCO implementation at the site to reduce the source area contaminant mass as the final remedy at the site.

- **Active Remediation, Former Gasoline Service Station, Alexandria, Minnesota:** Developed a Conceptual Corrective Action Design (CCAD) report to determine the path forward for remediation at the Site, recommending *in-situ* chemical oxidation to reduce the source area contaminant mass. Provided future cost estimates and path forward scenarios for use in cost forecasting.
- **Site Assessment, Gasoline Service Station, Alexandria, Minnesota:** Planned and managed a remedial investigation, including the installation of a deep well using Rotosonic drilling techniques. Coordinated quarterly groundwater and soil vapor monitoring events. Prepared a remedial investigation report.
- **Due Diligence Support, Underground Mine, Michigan:** Provided Phase I ESA and Baseline Environmental Assessment support, including document review, compilation and distillation of existing site data, and report writing. The Site consisted of a 100+ acre area with former underground mine workings, surface tailings, ponds, a smelter, and a power plant.
- **Due Diligence Support, Historical Copper Smelter, Michigan:** Provided Phase I ESA and Phase II ESA support, including document review, groundwater monitoring well sampling, report writing, and due care plan activities. The Site included the remains of a smelter operation dating to the late 1800's, with numerous buildings, equipment, and debris piles.
- **Site Assessment, Niles, Michigan (Client-MDEQ):** Performed semi-annual field work, including collection of groundwater samples for chlorinated VOCs and MNA parameters, with compilation and analysis of the results in an annual report for the 10-mile long groundwater plume. Researched and wrote a detailed site history report summarizing the site's 40-year history.
- **Monitoring and Maintenance, Acid Mine Drainage Site, Michigan (Client-MDEQ):** Performed quarterly field work at a former underground mine with a passive wetland system treating acid mine drainage. This included collection of surface water quality measurements and samples, and inspection and maintenance of the treatment system.
- **Phase I and Phase II Targeted Brownfields Assessment (TBA), Chatham, Michigan (Client-USEPA):** Provided site reconnaissance, review of historical documents, and Phase I report preparation for a former gasoline station with LNAPL present in shallow bedrock groundwater monitoring wells. Performed a Phase II investigation, including the coordination and supervision of drilling operations and soil vapor probe installations, soil and soil vapor sampling, potable well sampling and abandonment, and report preparation.
- **Potentially Responsible Party (PRP) Oversight, Lake Linden, Michigan (Client-USEPA):** Provided oversight and documentation of PRP activities at a mining-era power generation site. Initial response activities that were conducted included abatement of asbestos-containing building materials, support zone construction, and hauling of asbestos-containing soil from the site for disposal.
- **Lead Sampling, Historical Lighthouse, Pictured Rocks National Lakeshore, Michigan (Client-NPS):** Investigated lead contamination in surface soil adjacent to a lighthouse with a history of lead-based paint usage in order to determine recommendations for targeted soil excavation.
- **Site Closure Activities, Skanee, Michigan (Client-MDEQ):** Performed closure activities at a school bus garage, including abandonment of existing bedrock monitoring wells. Completed documentation of closure activities.
- **Site Closure Activities, Isle Royale National Park, Michigan (Client-NPS):** Performed closure activities at several petroleum release sites on remote islands in Lake Superior, including abandonment of a bioventing system and monitoring wells. Assisted with material delivery and logistics coordination. Documented closure activities.

- **Phase II TBA, Gladstone, Michigan (Client-USEPA):** Performed field work and reporting at a former lumber mill and tannery where arsenic was the primary contaminant of concern. Activities included collection of soil, groundwater, and sediment samples along Lake Michigan. Compiled and assessed results in a Phase II TBA Report.
- **Site Assessment and Removal Action, Manufactured Gas Plant (MGP), Ironwood, Michigan (Client-USEPA):** Performed field work at and near the former MGP, including collection of surface water, sediment, and groundwater samples, with compilation and analysis of the results in a Site Assessment Report. Provided technical assistance during excavation of impacted soils at the site under EPA oversight. Used VIPER, managed COC documentation, and assisted with preparation of POLREPs.
- **Site Assessment, Sandusky County, Ohio (Client-USEPA):** Provided technical support on a high-profile, time-sensitive assessment of 11 former dump sites. Activities included review of historical documents and aerial photographs to ascertain site histories and develop sampling locations, Field Sampling Plan preparation, collection of groundwater samples using low-flow techniques, collection of soil and vapor samples, sample management, data analysis and synthesis, and report preparation.
- **Pipeline Release, Lockport, Illinois:** Provided technical support on a crude oil pipeline release, including report preparation and data management. Releases to surface water, sediment, soil, and groundwater had occurred on the site. Work involved daily surface-water sampling in the affected wetland for the first 2.5 months following the releases. Used Equis database management software to manage multimedia sampling data for the site.
- **Remedial Excavation, Deer Creek, Minnesota (Client-MPCA):** Developed plans and specifications for a remedial excavation at a former gasoline service station in Minnesota. Provided oversight for asbestos abatement and subsequent building demolition. Oversaw and directed the remedial excavation, coordinated with various contractors, and provided daily updates to the client.
- **Chlorinated Solvent Groundwater Plume Investigation, Farmington, Minnesota (Client-MPCA):** Investigated the extent of a large chlorinated solvent plume, including low-flow groundwater sampling and installation of additional monitoring wells. Contacted and received drilling access from private property owners. Sampled potable water from GAC treatment systems located in residences.
- **Remedial Excavation, Stillwater, Minnesota:** Developed plans and specifications for a remedial excavation at a dry cleaner site in Minnesota. Oversaw and directed the removal of chlorinated solvent impacted soils, and coordinated with various contractors for sampling and disposal.
- **Raze and Rebuild Service Station Sites, Illinois:** Provided oversight and soil and groundwater sampling for numerous UST removals at gasoline service stations in Illinois. Coordinated with on-site contractors for necessary soil removal and disposal. Reported petroleum hydrocarbon releases to the State when required.
- **Wireless Sensor Network for Urban Water Quality Monitoring:** Worked with watershed districts, city personnel and consultants to plan and coordinate monitoring locations in two urban streams and a storm water pond in Brooklyn Center, Minnesota. Operated and maintained a wireless sensor network for continuous surface water quality data collection. Wrote a comprehensive user manual to guide future operation and maintenance of the wireless sensor network. Reviewed and analyzed water quality data, and calculated pollutant loadings in and out of a storm water pond.

Publications

- Henjum, Michael B., Hozalski, Raymond M., Wennen, Christine R., Novak, Paige J. and Arnold, William A. A comparison of total maximum daily load (TMDL) calculations in urban streams using near real-time and periodic sampling data, J. Environ. Monit., 2009, DOI: 10.1039/b912990a.

Presentations

- Wennen, Christine R.; Henjum, Michael B.; Hozalski, Raymond M.; Novak, Paige J.; Arnold, William A. Application of Wireless and Sensor Technologies: Pollutant Loading in Storm Water Ponds, Minnesota Water Resources Conference, St. Paul, MN, 2008.
- Kang, James M.; Shekhar, Shashi; Wennen, Christine; Novak, Paige. Discovering Flow Anomalies: A SWEET Approach, IEEE International Conference on Data Mining, 851-856, 2008.

Curriculum Vitae

Gary Turgeon

Title
Consultant

Education
BA – Speech Communications, University of Minnesota

Professional Associations
Member, Minnesota Groundwater Association

Member, Minnesota Petroleum Marketers Association

Member, League of Minnesota Cities

Appointed to the Minnesota Petroleum Tank Release Compensation Fund (Petrofund) Rule Advisory Committees

Languages
English

Experience Summary

Gary Turgeon has worked professionally in the field of environmental consulting and engineering for more than 29 years. He has managed projects in three of Antea Group's five Practice Areas: Transactional Support, Environmental Liability Management, and Operational Performance and Assurance. He has also worked on development teams for services in the other two practice areas – Information Knowledge Management and Sustainability Consulting. Gary has gained extensive experience in environmental due diligence, compliance, liability management, site assessment, subsurface investigation, vapor intrusion, remedial design and implementation of corrective action plans and systems. He has directed and completed corrective actions at residential, commercial, industrial and government properties and transportation corridors impacted with a range of petroleum hydrocarbons, metals, polynuclear aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs). Gary has also performed numerous other environmental services including estimates of environmental liability for financial reserves, compliance audits, training, SPCC plans, pollution prevention planning, incident response plans, litigation support, securing discharge permits, soil and waste characterization and treatment, and air emission permits.

As a Senior Project Manager, Gary manages complex projects and takes on special assignments. He has a high degree of client contact, evaluating environmental and other client issues, defining appropriate scopes of service and implementation plans, and assembling and leading teams to complete client work assignments.

Related Projects

- Phase II environmental due diligence for a 68-site portfolio of retail petroleum facilities controlled by a major integrated petroleum company in Northwest Oregon and the greater Portland area. Managed a team of approximately 50 staff members and six subcontractors on this project through all components of its implementation. This included refining site specific scopes, developing and implementing field, health and safety, data transfer and storage protocols, subcontracting, reporting and financial management.

Fieldwork was essentially completed within eight weeks of notice to proceed, and repots were completed four weeks afterward over a period from July to October 2007. Over 450 test borings were drilled totaling more than 9,300 vertical feet over 175 field days without a safety incident.

- Historic Chemical distribution center vapor intrusion (VI) assessment and mitigation. Although storage and distribution of chlorinated solvents was discontinued in 2000, previous historic releases of petroleum and chlorinated VOCs had impacted the soil and groundwater at the facility and resulted in a groundwater plume approximately 2000 feet long originating at the facility. Previous SVE remediation was successful in reducing contaminant mass and subsequent groundwater monitoring indicated that the groundwater plume was stable and declining; however regulatory requests to address the vapor pathway across the groundwater plume detected soil vapor concentrations at the facility and at the adjacent Daycare facility indicated concern for potential VI. Multiple soil vapor events were conducted including near building and subslab events at both facilities of concern. Indoor air sampling indicated TCE at concentrations greater that the health risk intrusion screening values (ISVs) at the facility but not at the Daycare. A Source Area Assessment was conducted in multiple phases to identify if there was a remaining contaminant mass that was amenable to remediation. First, 61 passive soil gas (PSG) samplers were used to more broadly identify potential source areas. Based on that information, direct push downhole sensing membrane interface probe (MIP) technology with PID/FID and XSD detectors and electrical conductivity (EC) sensors were employed in areas of elevated PSG response, Closely following the MIP assessment, actual soil and groundwater sampling was conducted in areas indicated by data from these previous lines of evidence. A significant contaminant mass was not identified, so subslab depressurization (SSD) of the industrial building floor slab was selected to mitigate the VI. While no exceedance of the ISVs were detected in subslab soil vapor samples at the Daycare, plans are to implement an SSD system there to pre-emptively mitigate the occurrence of VI in that building.
- Petroleum release from top of UST equipment that intersected a historic drain tile and impacted multiple receptors. Gasoline migrated through the historic drain tile and was released more significantly into the environment through a tile line failure near a wetland that flowed through a culvert into a recreational lake. Mr. Turgeon developed response actions, participated in and lead a team to address the release and break the receptor pathways. Actions included containing the release to the wetland and lake by deploying and maintaining booms and sorbent material in three locations; installation of a recovery well in the UST basin to recover LNAPL; excavation and disposal of petroleum impacted soil; vacuum truck removal of LNAPL in the UST basin and excavations in and near the wetland; replacement of the drain tile in the failed area; investigation of the extent and magnitude of the soil, groundwater and soil vapor impacts; exposing and reconfiguring the drain tile to break the connection to the source area while maintaining its drain function; conducting indoor air sampling of an adjacent residence and securing access and working with four property owners to conduct necessary work on their affected properties.
- State Highway/Main Street road reconstruction project of a 0.7 mile section of State Highway and Main Street through downtown Marshall, MN. Project team performed a Phase I and Phase II ESA for MnDOT, where findings indicated multiple areas of petroleum impact, solvent impact and commingled impacts to soil and groundwater, along with abandon steam heating piping insulated with ACM coating. Developed an overall Remedial Action Plan (RAP) under the MPCA Volunteer Investigation and Cleanup (VIC) program, a Health and Safety Plan, and training

and monitoring to include MnDOT inspectors and surveyors. In addition to worker and work zone monitoring, scope included developing and implementing a work zone perimeter air monitoring plan with contingencies for the excavation of solvent impacted soils from the right-of-way in the heart of downtown Marshall. The RAP was approved with minimal comments from MPCA VIC staff. Coordinated implementation oversight work with MnDOT and contractor staff, often responding on short notice to accommodate a high priority construction schedule and emergency situations (contractor fiber optic hit). He also supported MnDOT on several issues related to questionable work practices performed under the City's supervision on City utilities. Also managed multiple other transportation corridor Phase Is and Phase II Drilling Investigations for Mn/DOT.

- Portfolio environmental due diligence following ASTM 1527-05 all appropriate inquiry (AAI) standards and tank compliance reviews for a new entry into the US retail petroleum/C-store market. Scoped and managed delivery of Phase I and II ESAs and review of tank system compliance incorporating both record and field inspections. Work consisted of three separate portfolios totaling 50 facilities in OH, IL and PA. Work was completed over a four-month period from May to August of 2007. Other services included clarifying State Tank Release Insurance Fund issues and follow-through with tank compliance issues on the IL portfolio.
- Provided transaction support for a client that was selling their portfolio of 76 Retail Petroleum/C-Store locations in Ohio and Pennsylvania. Support was initiated by performing Phase I ESAs at 19 of the properties in March 2012, and completed with performing Phase I ESAs at the remaining 57 in July and August 2012. Based on the Phase I findings, Phase II drilling investigation were then performed at 46 of these locations and groundwater was sampled at 10 more to help establish a baseline of current site conditions. Based on this work, 14 new LUST incidents were identified. Using this new and existing information about the open environmental incidents at 38 of these facilities, cost estimates for actions anticipated to be necessary to bring these incidents to resolution and secure “no further action” status were prepared. The purpose of these cost estimates was to allow this liability to be addressed in negotiations and to determine an appropriate escrow to fund the necessary remedial actions. Gary led a team of approximately 60 staff members from 12 offices to accomplish this work over a short time period. The 57 Final Phase Is were delivered within 7 weeks and the entire transaction support scope, including the Phase IIs and remediation estimates were delivered within 10 weeks of the initial Phase I authorization.
- Litigation Support for a joint defense group representing multiple insurance companies in claims made by a rolled steel manufacturer against various environmental policies for five facilities located in four Northeastern States. Evaluated approximately $35 million in invoices submitted for coverage, classifying costs as defense, indemnity, purpose undetermined and eligibility questionable. Lead a team of state experts in documenting project activities, critical events and timelines, project strategies and regulatory frameworks. Provided relevant technical and cost summaries and assisted in identifying areas of interest, lines of questioning and reference documents for depositions of plaintiff’s representatives. Based on documents provided and in-person FOIA reviews of regulatory files, evaluated project lifecycles and projected costs to closure of remediation activities using decision trees and estimated probabilities. Project is ongoing with anticipated further need for support in preparation and during deposition of plaintiff’s experts as well as expert testimony by team members.

- Fractured bedrock investigation and remediation at the Minneapolis, MN main post office. Served as Project Manager for installation of a groundwater and free product recovery system to mitigate a release of petroleum in a downtown urban setting adjacent to the Mississippi River. The geology consisted of approximately 26 feet of soil overlaying 30 feet of Platteville limestone, a discontinuous thin shale layer and the St. Peter sandstone. Supervised installation of a 12" diameter recovery well and three 4" monitoring wells all installed with open-hole construction in the limestone bedrock using foam rotary drilling methods. Assisted in system sighting to house equipment in the existing structure. Also supervised and documented removal of seven 10,000-gallon capacity tanks and impacted soil during facility renovation.
- Spill Prevention, Control and Countermeasures (SPCC) Plans and Storm Water Discharge Permits and Pollution Prevention Plans (SWPPPs) for four bus facilities in the Minneapolis/St. Paul metro area. Served as Project Manager and co-author of SPCC and SWPP Plans for a regional bus company's four metro area facilities. Managed a team including a professional engineer, CAD technician and other staff. The plans were prepared as separate documents with appropriate cross references to simplify management and training where possible.
- Railyard paint shop/lead dust abatement plan for warehouse reuse in Waite Park, MN. Directed the development of a cost-effective remedial approach to address the cadmium and lead dust found within a former 100' by 300' dirt-floor railroad paint shop building used as an equipment and material warehouse. OSHA had cited the facility due to elevated contaminant levels on the dust. The facility was part of a larger Superfund site undergoing response actions. The main objective was to reduce health risks to level suitable for OSHA and end-user standards. The approach involved reasonably removing dust from the materials and equipment stored in the building and the building appurtenances. The next objective was to allow the safe removal of all building contents and appurtenances to allow the previous owners' contractors to excavate impacted soils from the building floor and to install a concrete floor. The project involved negotiations with regulators and the former facility owners' representatives and was successfully completed using the abatement plan.
- Expert opinion regarding devaluation of property due to contamination in Little Canada, MN. Provided assessment and expert opinion to a real estate appraiser and attorney regarding framing of property devaluation considerations in a property transfer to the City. The estate of a client had sold property that was a closed petroleum release site. The value of the property was to be determined considering its environmental impairment. The City's consultant had proposed that the impairment should be based on excavating all impacted soil that could reasonably be removed. Laid out a perspective based on the limit to liability assurance that the City had already secured from the State and the risk considerations under which the site had been closed. He also provided a more realistic and significantly less costly approach as to how re-development of the site could proceed through management of the residual impacts by enrolling in the State Volunteer Program. Based in part on this information, the attorney was able to negotiate a much better value and more favorable terms of the transaction.
- Soil Corrective Action Plan and Development Response Action Plan in Marshall, MN. After monitoring ground water impacts from a petroleum release for several years, it was determined that removing contaminated soil from the source was the most reasonable path to site closure. The facility was also set to undergo redevelopment, requiring that a new water main extend through the defined area of soil impacts. Prepared similar but distinct plans for Soil Corrective Actions around the source area and Development Response Actions along the water main excavation. The plans were approved within two days of submittal to the MPCA's Volunteer Petroleum

Investigation and Cleanup (V-PIC) Unit. He also solicited bids for soil treatment, managed tasks to maximize State "Petrofund" reimbursement and tracked costs separately for these narrowly distinct scopes during implementation.

- Management of contingent liabilities from a corporate sale, Food 'N Fuel to Avanti in MN and SD. The due diligence Phase II ESAs conducted when Food 'N Fuel was purchased by Avanti Petroleum resulted in the identification of 27 petroleum release sites. Led the project team – retained by the client to mitigate the liability from these 27 petroleum release sites – in developing an approach that categorized release sites based on the most efficient path to file closure. Regulatory files were reviewed and eight site files were closed on the team's recommendation that the impacts were indicative of levels present when the previous leak files were granted closure. Two more sites were closed after conducting baseline risk assessments, and investigative drilling was recommended for the remaining 17 sites. Eight of these sites were closed without the need for monitoring wells and extended ground water monitoring, and most of the remaining sites were closed after approximately 18 months of ground water trend analysis.
- Asbestos containing material (ACM) surveys for an office building transaction. Remotely managed a short turn survey of tile mastic beneath carpet in an office building in the spring of 2010. When laboratory analysis of samples indicated that the mastic did contain asbestos, managed short turn around sampling to determine the presence of asbestos in the air, on the carpet and in the air conditioning components as a result of the possible disturbance of remnant floor tile mastic beneath the new carpet.
- Scoped Phase II Investigation work plans and provided investigation oversight of active agricultural chemical storage and distribution facilities in the spring of 2010. Historic storage, use and past sampling indicated the potential for soil and groundwater impacts from fertilizers, pesticides, herbicides, petroleum products and solvents. Sampling protocols included shallow soil sampling using manual methods, direct push probe soil sampling and installing monitoring wells using hollow stem auger drilling.
- Estimated and tracked financial liability for a portfolio of petroleum tank release incidents. Client portfolio consisted of approximately 100 facilities with 20 petroleum release incidents. Estimates were intended to be used for corporate reserves against this liability. Strategies and estimates of the "cost to closure" were developed and progress tracked on a quarterly basis. An evaluation of state fund reimbursement programs and site specific eligibility was also made and estimates developed of anticipated reimbursement of applicable costs.
- Lead contact and primary program content developer for federally mandated, state specific UST Operator Training Programs for multiple states (MN, WI, SD, ND, IL and IA) in the North Central United States. The training program consists of 18 modules that cover required training content including tank system equipment, operation and maintenance, record keeping, regulatory requirements and financial responsibility. In this role, Gary identified state regulatory leads, developed state specific training materials including examinations, communicated and worked with state personnel to gain approval for the training program. Once approved, he supports content transfer to the Antea Group/API online training platform and manages a team that organizes and provides classroom training.

- Managed transactional support for international acquisitions by a large agricultural and food manufacturing company, and a large international industrial manufacturing company. Services including Phase I and II ESAs for environmental due diligence and limited environmental compliance reviews. Provided a central point of contact and managed Antea Group resources for facilities in the United States, and Inogen affiliate resources for facilities in China, Israel, and Bosnia-Herzegovina.
- Provided evaluation of costs for a long term sediment remediation project as part of a litigation support team for an Insurance company client. Developed strategy and data support for separation of costs between multiple project lifecycles and covered verses non-covered actions.
- Ongoing Project Manager for a project for international regulatory content development in the areas of Environmental Health and Safety (EHS). Managed work orders with internet platform host, engagement letters with international Inogen content providers and financials for the overall effort. Team includes internal content and quality assurance managers and more than 25 international content providers.

Presentations

- Turgeon, Watson, Schaepe, Thompson, Hannu, Panel Presentation on “Affects of Minnesota Pollution Control Agency Fact Sheet Revisions on Petroleum Release Investigations & Site Closure,” Minnesota Petroleum Marketers Convention
- Turgeon, Ryan, Thompson, “Community Concerns on Petroleum Release Investigation and Cleanup at the Cottonwood County Highway Shop,” Public Meeting, Windom, Minnesota
- Turgeon, Vieau, Bratsch, Stahman, Panel Presentation on “Working with the New MPCA and Petrofund Rules on Cleanup,” Minnesota Petroleum Marketers Convention

Curriculum Vitae

Christopher J. Vandegrift, PE

Title
Senior Project Manager

Education
BS – Civil Engineering, University of Pittsburgh, Johnstown, PA

Professional Registrations
Professional Engineer:
Pennsylvania, West Virginia, Ohio, Delaware, Maryland, and Georgia
West Virginia Licensed Remediation Specialist

Professional Associations
Member, National Society of Professional Engineers

Member, National Council of Examiners for Engineering and Surveying

Languages
English

Experience Summary

Christopher J. Vandegrift is a licensed Professional Engineer and the Office Leader in our Pittsburgh, PA office. He has over 25 years of experience in the environmental consulting and contracting field. Chris has managed all facets of project work from initial assessment activities through site closures. He has managed annual gross operating revenues of over $5 million and has been responsible for remedial action at a variety of facilities including retail petroleum, refining, manufacturing, mining, chemical distribution and aviation located across the eastern United States and California.

Chris has managed large-scale remedial actions including landfill caps, secondary containment structures, excavations, impoundment closures, system installations, and facility decontamination and demolition. He has designed and implemented detailed remedial approaches with multiple remedial technologies including single and multiple well extraction, air-sparging, soil vapor extraction and bio-sparge/venting processes. He has designed various vapor treatment process including granular activated carbon, air-stripping, thermal/catalytic oxidation and internal combustion engines. Chris conducts remedial engineering design assurance, continuous improvement of remedial system performance and system optimization consistent with project closure goals and client objectives for multiple treatment facilities located in Pennsylvania, New Jersey, West Virginia, Ohio, Kentucky, North Carolina, South Carolina, Georgia, Florida, New York and Indiana. Chris has facilitated cost reductions of up to 50% with reduction of unscheduled shutdowns and increased efficiency. He is proficient in the utilization of risk-based strategies to drive remedial sites to closure, and regularly provides the expertise to identify system endpoints and modifications to accelerate site cleanup strategies.

Chris successfully managed these activities with various clients, regulatory agencies and client counsel to ensure minimal business interruptions, compliance with applicable orders and environmental regulations and with limited exposure to third party liabilities. In addition to his management experience, his additional responsibilities have included business development, strategic business planning, emergency response, AST and UST compliance, profiling and transportation of hazardous and non-hazardous wastes, and the preparation of facility plans.

Project Management

- Portfolio Manager for an out-source contract with a convenience store chain. Responsible for all aspects of environmental oversight on 250 sites in 13 states managed through 10 operating divisions. Accountable for national strategic planning, authoring and managing proposals, administering performance metrics, and managing the financial accrual of a four-million-dollar budget. Responsible for continuous feedback on performance, information sharing on technology and policies, management and project strategies, and operational issues.
- Project Manager and lead engineer for environmental assessment and remediation of over 120 petroleum sites and facilities including: retail service stations for major and mid-stream petroleum clients and petroleum bulk storage facilities, in southwestern Pennsylvania, West Virginia, and eastern Ohio. Managed and performed investigation, remediation, UST closure, remedial system installations and groundwater monitoring programs. Responsible for development of cost to closure estimates, remedial budgets, development of remedial options, development of work plans and corrective action plans and for negotiating with various regulatory agencies to obtain regulatory closure of petroleum spill cases.
- Office Manager responsible for a local operating division covering three states with a staff of 21 personnel. Managed and developed four major oil accounts with annual budgets exceeding one million dollars.
- Responsible for overall engineering management of approximately 15+ operating remediation systems, including pump and treat, soil vapor extraction, air sparging, multi-phase extraction, vapor-enhanced pumping, chemical injection and bioremediation. Daily tasks include scheduling of field personnel, ordering system components, managing system data, maintaining database of system performance including permits and evaluating system performance criteria.
- Remediation engineer for development of work plans for feasibility testing for aquifer characterization and construction details. Created piping and instrumentation diagrams for treatment systems. Completed air emission, mass recovery and system performance calculations and evaluation. Maintained and submitted permit information related to all systems.

Remediation System Design, Operation and Maintenance

- Senior Project Manager for an operational/optimization study for a former manufacturing facility in upstate New York, which is impacted by metals and VOCs. The facility has a Hazardous Waste Post Closure Management Permit in-place with the NYDEC. Post closure care includes operation and maintenance of a groundwater extraction system, which maintains hydraulic control of impacted groundwater as well as site wide inspections and maintenance of a soil cover system and RCRA cap area. Tasks include review of current groundwater elevation, groundwater flow, pumping flow rates and development of a strategy to optimize the remediation system and reduce long term operational costs.
- Project Engineer for a chlorinated solvent release at an industrial dry-cleaning facility in Columbus, Ohio. Prepared and implemented a work plan for a high vacuum dual phase extraction (HVDPE) pilot test to remove DNAPL. Designed HVDPE system including drawings, bid specifications, and selection of contractors. Completed discharge permitting and installed a four well extraction system. Operated and maintained system for a 9-month period with 100% run time. The HVDPE system attained closure goals and was decommissioned. A sub-slab depressurization (SSD) system was designed and installed as the final engineered remedy.

- Project Engineer for an engineering assessment of all remediation systems transitioned to Antea Group from an out-going supplier in the spring of 2007, and supervised the retooling efforts of inefficient systems that required control and communication upgrades.
- Project Engineer instrumental in the reuse of remediation system equipment inventory for an international chemical manufacturer, demonstrating cost savings over the need to purchase new components or systems.
- Project Manager for the installation of an air sparging/passive vent system at a former northern New Jersey vegetable oil refinery during site redevelopment activities. The system required the trenching of 2,800 linear feet and the installation of 16,000 feet of air sparge piping to 31 sparge wells, placement of 1,700 linear feet of passive vent piping and 15 passive vent risers, construction of an air injection system including a 75 Hp compressor, air dryer, wet and dry air receivers and distribution manifold.
- Prepared design specifications for a LNAPL recovery system to increase recovery volumes and decrease system operational lifecycle. Installed solar-powered LNAPL recovery pumps in remote areas of the site to eliminate fixed power capital requirements on 3rd party owned property.
- Design, installation, and operation of four dual phase extraction systems in West Virginia to remove LNAPL while minimizing groundwater recovery.
- Design and installation of an acid injection system to control the formation of iron deposits on the pump and piping ultimately reducing O&M from weekly to monthly.

Landfills

- Project manager during capping activities at a 4-acre land disposal area generated from the facility's operation. The closure consisted of erosion and sedimentation control, grading and compaction of the subgrade, placement of a geosynthetic clay liner and composite drainage net and the transportation and placement of cover material.
- System Engineer for a leachate management system at a 3.5-acre inactive hazardous waste landfill, which was associated with a former resin manufacturing facility. Work is conducted under the Superfund Program with EPA oversight. Requires the management of approximately 1,000 gallons of oil and treatment of approximately 400,000 gallons of leachate a year. Responsible for O&M of landfill cap, leachate collection and treatment system. Participate in ongoing negotiations with PADEP, USEPA Region 3, and the local treatment facility. Manage system upgrades with USEPA Region 3 and PADEP involvement. Maintain and sample large groundwater monitoring network including on-site and off-site monitoring wells. Facilitate emergency response activities during upset conditions or large rainfall events at the landfill.
- Project Engineer for the operation and maintenance of a Superfund landfill site in Cumberland, Maryland consisting of two separate parcels of land that accepted commercial, residential, and demolition waste throughout the 1960's and 1970's. The O&M efforts consist of quarterly facility inspections, biannual mowing, monitoring well and fence maintenance, routine brush clearing along the fences, annual groundwater gauging and sampling and annual reporting.

Soil Excavation

- Project Manager for the implementation of a comprehensive soil remediation project at a former northern New Jersey vegetable oil refinery during site redevelopment activities. Managed approximately 30,000 cubic yards of material and 600,000 gallons of groundwater/surface water impacted by VOCs. The soil was segregated on-site, sampled and based on the level of impact, either encapsulated on-site or incinerated off-site. Water was managed in a series of 20,000-gallon tanks and treated through a series of filters. The remedial action secured a NFA from the NJ DEP for soil.
- Project manager for the ex-situ remediation of 3,500 cubic yards of soil impacted with volatile organic compounds via vapor extraction and bioventing at a US international airport. Work was completed in Level C PPE and included the construction of four treatment cells. Concentrations of volatile organics were monitored daily during the 5 months of treatment with a continuous emission monitor. Once attainment samples confirmed that the soil was no longer characteristic for benzene, a petition was submitted to the US EPA Region 3 for an exemption of the Land Disposal Restrictions.
- Project Engineer responsible for the on-site treatment of chlorinated and aromatic VOCs and SVOCs from a former waste oil recycling facility in central New York. Site preparation activities included establishing temporary facilities, clearing and grubbing, solid waste removal, establishment of an exclusion zone, relocation of existing utilities, establishing sediment and erosion control measures and abandonment of existing monitoring wells. Construction of five treatment cells covering approximately 14,000 square feet to handle 2,700 tons of impacted soil. The soil was excavated, transported on-site and covered in Level B PPE. Two soil vapor systems comprised of 3 Hp regenerative blowers were utilized to remove volatile compounds from the soil. Once the soil clean-up levels were attained, the soil was returned to the excavation and the site was regraded. The site was capped with six-inches of topsoil, seeded and mulched.

Emergency Response

- Emergeny Response Coordinator for a 6,000-gallon toluene tanker release in southwestern Pennsylvania. Responsibilities included release characterization, elimination of immediate threats to receptors, close interactation with client operations and regulatory agencies, waste management and recovery system design, installation and operation.

Decontamination and Demolition

- Project Engineer responsible for the removal of all surface structures associated with a former mining operation. The detailed scope of work included the development and implementation of a site specific health and safety plan, installation and maintainance of the erosion and sedimentation control including the installation of a temporary dam, the removal and disposal of PCB oil pole transformers and the demolition and removal of a coal storage silo, two railroad bridges and a mine shaft elevator. All disturbed areas were graded, seeded and mulched prior to demobilization.

- Completed the decommissioning and salvage work associated with the removal of inactive petroleum and wastewater pipelines, three steel support structures and two aboveground storage tanks on a former refinery site. Prior to the dismantling activities and removal of the items, the pipelines were drilled, tapped and samples were collected to profile the material at approved disposal facilities. A licensed electrician identified all the power sources in the work area and preformed appropriate lock/tag-out procedure. An asbestos survey was conducted and identified transite siding and roofing material on the former transformer building. Supervised the purging, cleaning and removal of over 10,000 feet of inactive pipeline and two large above ground storage tanks. The project recycled 138 tons of steel and 2,620 gallons of motor oil. Disposed of approximately 1,500 gallons of hazardous liquid and 2,000 gallons of non-hazardous liquid off-site. The property now poses less risk to the environment, as well as having an increase in marketability.

Other Related Projects

- SPCC and SWPPP development and technical amendment reviews for refineries, bulk fuel terminal, oil & gas well pads, and other industrial and commercial facilities.
- Conducted energy assessments for metals manufacturing facilities, identifying opportunities for improving employee awareness and developing capital and non-capital cost saving initiatives.
- Document review and strategic support for expert witness testimony in an underground storage tank release case.
- Professional engineer responsible for the investigation of potential impacts associated with a discharge from an underground mine pool to a major water body. Evaluated the hydrologic balance and inorganic loading to a wetland ecosystem as well as ground water resources. Reviewed mine maps, collected water quality samples, and reviewed current site conditions to determined there was minimal impact to the ecosystem.

Curriculum Vitae

Jonathan Zimdars

Title
Consultant

Education
BS – Geology
University of Wisconsin-Madison
Madison, WI

Interdisciplinary Analysis of Mining Dependent Communities, University of Wisconsin – Madison

Containing and Controlling Groundwater, NGWA – Orlando, FL

Soil Vapor Extraction Symposium, Stevens Institute of Technology

Groundwater Pollution and Hydrology, NWWA – Princeton University

Professional Registrations
Professional Geologist:
Pennsylvania

Transportation Worker Identification Credential (TWIC) Holder

Global Entry Card Holder

Languages
English

Experience Summary
Jonathan Zimdars is a Consultant with 24 years of consulting experience. He has extensive experience designing and conducting aquifer and vadose zone pilot tests, remedial alternative analyses, treatment system design and permitting, treatment system performance and optimization analysis, risk-based site closure advocacy, portfolio lifecycle cost to closure modeling, and Environmental Liability Transfer (ELT) portfolio management. He has managed hydrocarbon remedial investigation projects in Alabama, Delaware, the District of Columbia, Connecticut, Illinois, Michigan, Minnesota, New York, New Jersey, Pennsylvania, Virginia, West Virginia, and Wisconsin, as well as property transaction and facility compliance projects in Azerbaijan, China, Colombia, Egypt, India, and Kenya.

Related Projects
- Managed a corrective action portfolio that consisted of 40 projects with annual budgets totaling $1.8MM. Responsibilities included remediation strategy cost/benefit analyses, budget preparation and financial tracking, client meetings with technical performance review, field safety coordination, state reimbursement submittal support, and investigation closure strategy development and regulatory agency advocacy.
- Evaluated portfolio cost to closure models, incorporating individual site projected work scopes, project schedules, labor and subcontractor budgets, and technical/regulatory threats to achieving incident closure. Evaluations incorporated life-cycle cost threats including potential corrective action activities, regulator responses, and duration of out-year groundwater sampling.
- Managed $10MM lifecycle cost to closure chlorinated solvent risk evaluation and remediation project at a former industrial facility in Ontario, Canada. Project elements included: cost-benefit performance evaluation of existing pump and treat groundwater remediation system, area sensitive receptor evaluation, stakeholder management, bankruptcy trust lifecycle cost settlement negotiations, and local contractor management.

- Managed six projects in Delaware, Illinois, Maryland and West Virginia that utilized magnesium sulfate solution injection to enhance anaerobic bioremediation of dissolved-phase BTEX. Project elements included regulator technology review meetings, aquifer suitability pre-qualification, CAP preparation, field injection oversight, and post-injection monitoring and closure suitability evaluation.
- Provided daily engineering oversight during the eight-month closure and capping of an 18-acre landfill in Milwaukee County, Wisconsin. Project elements included the installation of 18 methane extraction wells, 1.25 miles of HDPE header pipe, and five condensate tanks; relocation of the existing blower/flare system; installation and compaction of a 2-foot clay cap; blower/flare system startup, system operation maintenance and monitoring; contractor technical performance evaluation; and surface drainage grading with prairie grass re-vegetation.
- Provided work team coordination and field oversight during the emergency response following the release of 55,000 gallons of gasoline from a refined product distribution pipeline; responsibilities included: field safety monitoring, impacted soil excavation oversight and sidewall soil sample collection, domestic well sampling program development and staff schedule coordination, core logging and impact screening during roto-sonic rig delineation and recovery well installation, and field data evaluation and staff/contractor coordination during the initial LNAPL recovery from the bedrock well network.
- Managed emergency response remedial evaluation and contractor oversight at multiple incidents involving fuel oil distribution tanker truck accidents at commercial, residential and public space properties in Wisconsin and Illinois. Oversight activities included initial spill abatement, spill reporting and regulatory compliance, disposal coordination, site restoration contractor supervision, and regulatory closure reporting.
- Provided delineation design and historical records review for a retail hydrocarbon investigation impacted with chlorinated solvents. The results of the soil and groundwater delineation and historical records review documented an off-site source for site area solvent impact.
- Managed the permitting, contractor coordination, and demolition oversight of a residential structure with hydrocarbon impact to the foundation and basement enclosure.
- Coordinated state air permits for the controlled burn of two abandoned residential structures. The client-owned structures were donated for local fire department training.
- Managed the client field liability evaluation during the emergency response phase of an incident involving the surface discharge of 18,000 gallons of fuel oil.
- Provided corrective action pilot testing and RAP development for an active industrial laundry facility impacted with chlorinated solvents; project elements included regulatory advocacy, permitting, venting system pilot testing and design. The system operated with 100% run time achieving soil gas target concentrations.
- Provided project management of a corrective action site with LPH in multiple wells 20 feet below grade at an active third-party operated facility. After three years of AS/SVE system operation, over 2,500 equivalent gallons of hydrocarbons were recovered and LPH was no longer observed; termination of system operation and compliance sampling was completed achieving incident closure.
- Provided project management of a corrective action site in Illinois with LPH in multiple wells. After 20 months of SVE system operation, over 2,700 equivalent gallons of LPH were recovered and the regulatory incident was closed after demonstrating no LPH rebound during monthly gauging and quarterly sampling.