Technical Proposal

Minnesota Pollution Control Agency

Remediation Master Contract

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

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Cover Letter

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10 April 2018

Minnesota Pollution Control Agency
520 Lafayette Road N
St. Paul, Minnesota 55155-4194

RE: Request for Proposal for Remediation Master Contract – Category A

To Whom It May Concern:

EA Engineering, Science, and Technology, Inc., PBC* (EA) is pleased to submit this Technical Proposal for Category A: Petroleum, Superfund, MDA, and Closed Landfill Program Environmental Services under the Remediation Master Contract.

As demonstrated in the attached submittal, we are fully prepared and highly qualified to assist the Minnesota Pollution Control Agency (MPCA) in achieving its goals for this contract. We have a passion for the Great Lakes, both for protecting its environment and engineering solutions to investigating and responding to contaminated sites throughout the region. We have integrated science and engineering resources to provide MPCA with a holistic approach to achieving the goals of investigating, identifying, and remediating releases of contaminants that pose a threat to the state's environment and the public's health and safety.

Acceptance of Classification Levels and Rates and Equipment and Supplies List
EA accepts the Classification Levels and Rates (Schedules 1 and 2) provided on page 26 of the RFP and as amended in addendum number 1 and response to questions. EA accepts the Equipment and Supplies List pricing on pages 27-29 of the RFP and as amended in addendum number 1 and response to questions.

Point-of-Contact and Contact Information
As detailed in Section 2 of this submittal, EA is committed to opening an office in Minnesota in response to this contract. We intend to initially manage and staff this contract from our Brighton, MI and Chicago, IL offices. EA's proposed Project Manager, Mr. Arthur Peitsch, PMP, is our designated point-of-contact for this submittal. He can be reached as follows:

Arthur Peitsch, PMP, Project Manager
5918 Meridian Blvd., Suite 4, Brighton, Michigan 48116
734-369-3410 ext. 302, apeitsch@eaest.com
www.eaest.com

EA's History, Capabilities, and Structure
At EA, site characterization and remediation services comprise the core of our business. The majority of our engineers and scientists spend their days investigating, identifying, and remediating the release of contaminants that pose a threat to the environment and the public's health and safety.

Over the past 5 years, we have successfully performed over 1,100 projects matching your scope of services, valued at over $399M, across the country, including in Minnesota. In Minnesota, EA has performed or is currently performing supplemental groundwater remedial investigations, *in situ* and *ex situ* remediation of volatile organic compounds and emerging contaminants (1,4-dioxane), long-term monitoring, and project closeout activities at the 148th Fighter Wing Sites 3 and 25 in Duluth. EA is also working in partnership with EPA and U.S. Steel under the Great Lakes Legacy Act to remediate contaminated sediment at the Spirit Lake Site in the St. Louis River Area of Concern. Under that contract, EA has provided remedial investigation, site assessment, potentially responsible party oversight, permitting, and design services for the past 5 years. EA is currently designing a multi-component remedy

including dredging 700,000 cubic yards of sediment; placement in onsite confined disposal facilities; *in situ* stabilization of lead-impacted soils; and capping or enhanced monitored natural recovery for over 130 acres, rerouting a stream channel, and construction of railroad structures. These two projects are valued at over $9M, and required extensive work under both MPCA and MDH regulations and coordination with MPCA regulators.

EA's qualifications provide MPCA with an experienced and responsive single-source consultant with the ability to successfully implement large-scale investigation and remediation projects, apply knowledge of the regulatory framework, and draw upon established relationships with MPCA regulatory personnel.

Headquartered in Hunt Valley, Maryland, EA is a solutions-oriented environmental engineering and sciences consulting firm. With more than 44 years of continuous services to local, municipal, and state governments; the federal government; and industrial/commercial clients, EA has evolved into a global environmental engineering consulting firm specializing in water, natural resources, and site characterization and remediation. Currently, our firm has over 500 employees in 25 offices nationwide, including 25 employees throughout the Great Lakes Region.

EA provides MPCA with the following advantages:

- ✓ **Zero Learning Curve—**We have direct experience in Minnesota through our work within the St. Louis River Area of Concern and at the Air National Guard 148th Fighter Wing, both located in the greater Duluth area. We know the Minnesota regulations and are ready to begin work on day one.
- ✓ **Unparalleled Contaminated Sediment Expertise—**Since 2012, EA has managed 35 projects for EPA Region 5 valued at over $22M performing sediment remedial investigation and feasibility studies, habitat evaluation and restoration, engineering services to design contaminated sediment remedial action and habitat restoration, construction oversight of remedial action and habitat restoration, and community involvement support.
- ✓ **Integrated Project Team with Holistic Approach—**The integration of engineering and science is core to our business philosophy. We understand the processes, procedures, requirements, and technical issues related to this contract.
- ✓ **Subject Matter Experts—**EA's professionals have extensive experience in both terrestrial and aquatic site investigation, remedial design, remedial action, and regulated and non-regulated chemicals such as PFAS. Since 2000, EA has executed over 5,200 state, municipal, and federal projects valued at over $802M covering the entire MPCA scope of services.
- ✓ **Highly Qualified Local Capacity and National Resources—**The key staff named in this submittal have direct, relevant experience with critical scope elements and have extensive Great Lakes Region experience. If additional experts or resources are needed, we have over 500 professionals across the United States from which to draw upon.

We appreciate the opportunity to be of service to MPCA. Please feel free to contact Arthur Peitsch to discuss our capabilities in detail.

Sincerely,

Jeffrey Boltz, Ph.D.
Senior Vice President

Arthur Peitsch, PMP
Project Manager

* ***EA Engineering, Science, and Technology, Inc., PBC does business in Minnesota as EA Engineering, Science, and Technology, Inc.***

Section 2: Qualifications and Capabilities

Section 2 – Qualifications and Capabilities

2.1 Capabilities

EA is an employee-owned environmental firm headquartered in Baltimore, MD that was founded in 1973. For more than 44 years, we have specialized in environmental site characterization and remediation, health and safety compliance, natural resources, infrastructure, and information technology services. Currently, our firm has over 500 employees in 25 offices nationwide, including 25 employees throughout the Great Lakes Region.

EA's Commitment to Minnesota

Upon award of this contract, EA is committed to opening an office in Minnesota and hiring local staff. We have demonstrated our ability and willingness to relocate our staff and open offices to support new contracts and projects many times.

Below are several examples of EA's ability to efficiently relocate key project staff and effectively hire the right local resources.

- U.S. Environmental Protection Agency (EPA) Great Lakes Region Architect-Engineering Services —Within 13 months of Great Lakes Architect Engineering Services (GLAES) contract award, we opened our Brighton, MI office—a commitment we made in the proposal stage. Dr. Boltz, the Senior Vice President in charge of this contract, also directed the opening and operations of the Michigan office.
- EPA Region 9 Remedial Action Contract (RAC)3—Within the first year of award of the EPA Region 9 RAC3, EA opened an office in Alameda, CA, relocated key senior staff with experience performing EPA RAC contracts, and hired local staff with EPA Region 9 RAC experience. That ramp up has supported $27.5M on 18 Task Orders on the contract.
- Joint Base Cape Cod, MA—EA relocated our Project Manager (PM) and made local hires to execute the environmental work for this $30M contract.
- EPA Region 6 RAC2—In support of work in the western states for the EPA Region 6 RAC2 contract, EA opened our Albuquerque, NM office in 2010. This office has grown to 24 employees, including engineers, geologists, scientists, and GIS specialists.
- Hill Air Force Base—EA relocated staff and hired local staff to open a Salt Lake City, UT office to execute a $70M full service, performance-based contract.

EA will staff the Minnesota office through potential relocation of resources and local hires based on the required skill sets for the contract. When we hire staff members for this contract, EA will implement our standard staff onboarding program to ensure staff are effectively and efficiently integrated into the contract. EA will develop program instructions (similar to what we have completed for our EPA RACs) to facilitate this integration. These instructions will outline contract-specific requirements including, but not limited to: organizational roles and responsibilities of key staff; internal and external (MPCA) communication protocol; reporting and documentation requirements; estimating, scheduling, cost control, and progress reporting; health and safety; data management; roles and responsibilities related to quality; and confidentiality. New hires and junior-level staff will also be mentored by senior staff currently working under the applicable Minnesota regulations. If necessary, staff will attend training to support professional development and enhance performance.

EA's Extensive Experience with the Scope of Services

EA currently holds more than $27M in state contracts including the following:

- Michigan Department of Technology, Management, and Budget
- New York State Department of Environmental Conservation
- Nebraska Department of Environmental Quality
- New Mexico Environmental Department
- Texas Commission on Environmental Quality
- Delaware Department of Natural Resources and Environmental Control
- Maryland Environmental Service

EA's federal clients include the following:

- EPA Regions 3, 5, 6, 9, 10
- U.S. Air Force
- Multiple US Army Corps of Engineers (USACE) Districts
- National Guard Bureau
- National Oceanic and Atmospheric Administration (NOAA)
- National Park Service
- General Services Administration.

Since 2012, our Brighton, MI office has served as the lead office location in support of our GLAES contract with EPA Region 5 – Great Lakes National Program Office. Under this contract, EA provides professional architect/engineer, technical, and management services in support of EPA's sediment remediation efforts under the Great Lakes Legacy Act, including work at Spirit Lake, MN and elsewhere within the St. Louis River Area of Concern. Services include: sediment remedial investigation and feasibility studies, habitat evaluation and restoration, engineering services to design contaminated sediment remedial action and habitat restoration, construction oversight of remedial action and habitat restoration, and community involvement support. To date, EA has managed 35 Task Orders under this contract valued in excess of $22 million.

For the past ten years, EA has been an EPA Prime Contractor on three EPA RACs and the GLAES contract and has executed 219 Task Orders valued at over $214M covering the entire MPCA scope of services. EA has performed Treatability Studies, Remedial Investigation/Feasibility Study (RI/FS), Engineering Evaluation/Cost Analysis (EE/CA), Remedial Design (RD), Remedial Action (RA) Oversight, Technical Assistance (TA), and Potentially Responsible Party (PRP) Oversight at 94 Superfund Sites and 44 hazardous waste, underground storage tank (UST), and former dry-cleaning sites under contract to various state regulatory agencies.

EA's specific expertise includes the following:

- Specific RI/FS and site remediation projects in Minnesota requiring coordination with multiple stakeholders and regulatory programs.
- Thorough understanding of federal, Minnesota, and local regulations, including Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Resource Conservation and Recovery Act (RCRA), Toxic Substances Control Act (TSCA), Clean Water Act (CWA), and Clean Air Act (CAA) by successfully advancing sites through the CERCLA process and accelerating site clean-up.
- Extensive experience at the types of sites where MPCA's scope of services may be conducted (e.g., groundwater sites with challenging geology, manufactured gas plant sites, residential/high access sites, large geographic sites contaminated with mining chat, and large watershed surface water and contaminated-sediment sites).
- Ability to perform simultaneous tasks and staff complex projects with multiple local field teams and technical depth from our team of in-house professionals.

EA provides MPCA with the following advantages:

- ✓ **Zero Learning Curve—**We have direct experience in Minnesota through our work within the St. Louis River Area of Concern and at the Air National Guard 148th Fighter Wing, both located in the greater Duluth area. We know the Minnesota regulations and are ready to begin work on day one.
- ✓ **Unparalleled Contaminated Sediment Expertise—**Since 2012, EA has managed 35 projects for EPA Region 5 valued at over $22M performing sediment remedial investigation and feasibility studies, habitat evaluation and restoration, engineering services to design contaminated sediment remedial action and habitat restoration, construction oversight of remedial action and habitat restoration, and community involvement support.
- ✓ **Integrated Project Team with Holistic Approach—**The integration of engineering and science is core to our business philosophy. We understand the processes, procedures, requirements, and technical issues related to this contract.
- ✓ **Subject Matter Experts—**EA's professionals have extensive experience in both terrestrial and aquatic site investigation, remedial design, remedial action, and regulated and non-regulated chemicals such as PFAS. Since 2000, EA has executed over 5,200 state, municipal, and federal projects valued at over $802M covering the entire MPCA scope of services.

✓ **Highly Qualified Local Capacity and National Resources—**The key staff named in this submittal have direct, relevant experience with critical scope elements and have extensive Great Lakes Region experience. If additional experts or resources are needed, we have over 500 professionals across the United States from which to draw upon.

EA's Headquarters
225 Schilling Circle, Suite 400
Hunt Valley, Maryland 21031

Great Lakes Offices
5918 Meridian Blvd., Suite 4
Brighton, Michigan 48116

444 Lake Cook Road, Suite 18
Deerfield (Chicago), Illinois 60015

2.2 Locations

Headquartered in Hunt Valley, MD, EA has 25 commercial offices and 11 satellite residential offices employing over 500 staff across the U.S. and Guam.

As described in detail in section 2.1 above, EA commits to opening an office in Minnesota should a contract be awarded, something we have successfully done for other clients across the country.

Exhibits 2-1 and 2-2 below show our commercial office locations and the breadth and depth of our project experience in the Great Lakes Region.

Exhibit 2-1: EA's 25 Commercial Offices

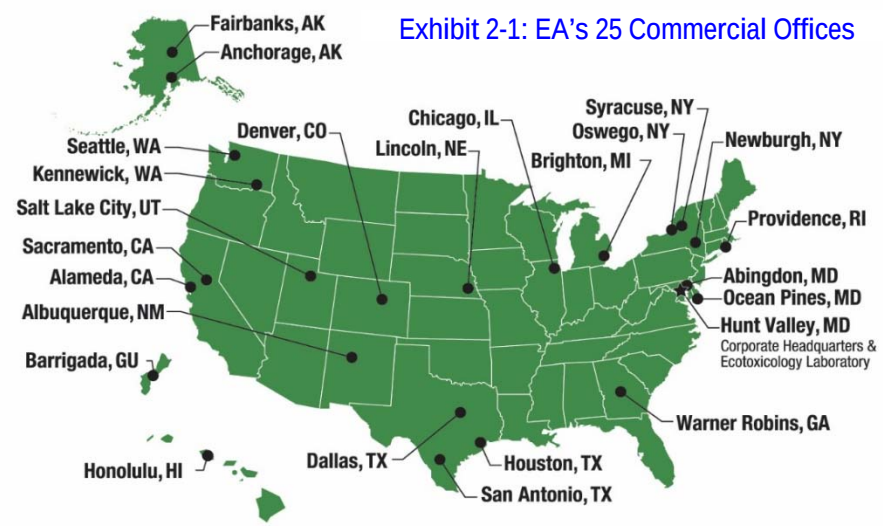
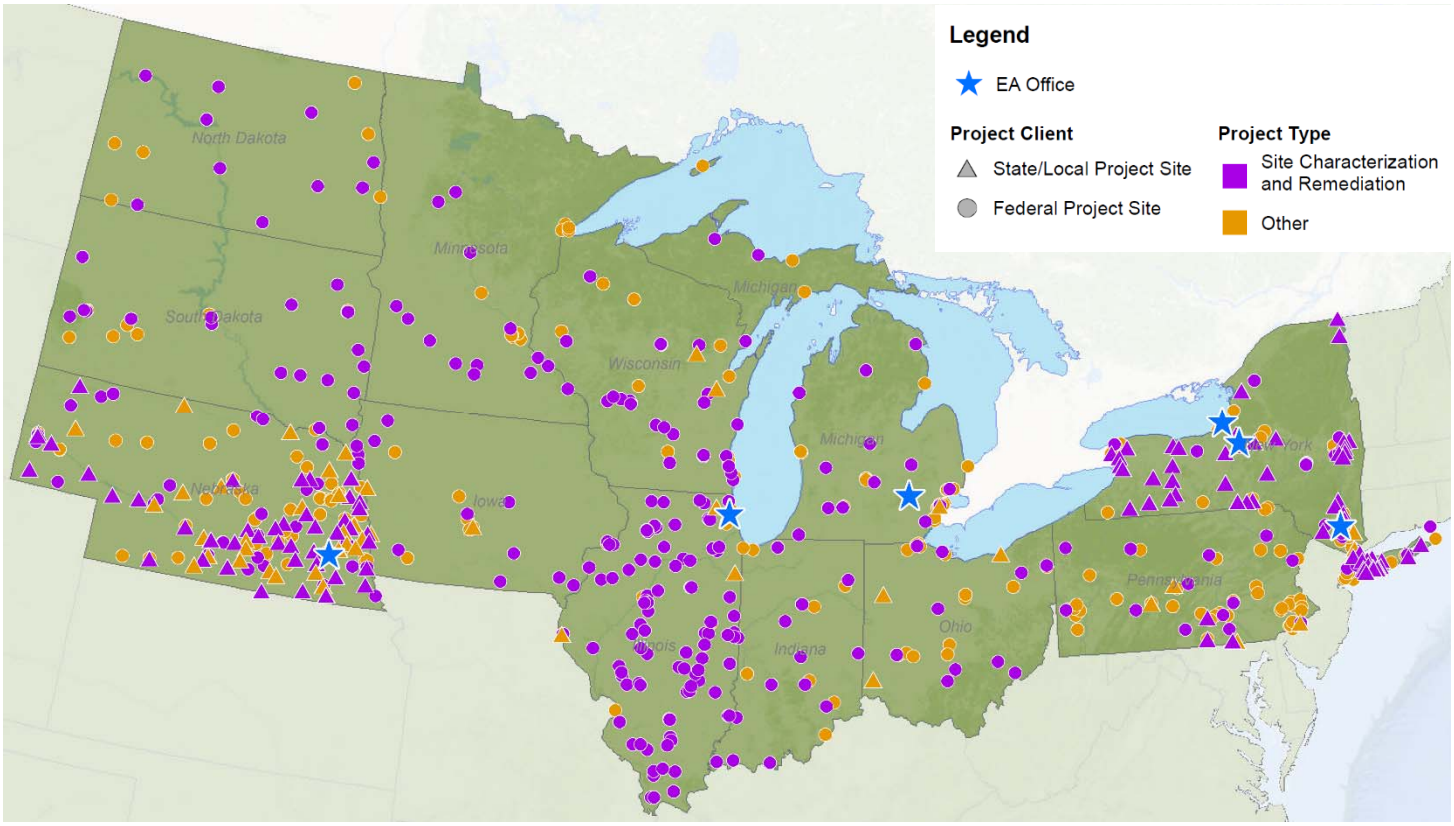


Exhibit 2-2: Representative Great Lakes Region Experience



2.3 Key Staff Capabilities

The table below provides our key staff's qualifications and experience. More details regarding the six scope categories and how they relate to the scope of services in the RFP can be found in Section 3 of this submittal.

Exhibit 2-3: Key Staff's Capabilities, Qualifications, and Experience

Name	Job Classification	Total Years Exp.	Years with EA	Highest Degree	Current Location	Applicable Licenses and Certifications Including OSHA	Experience with Scope of Services: Site Characterization	Planning Documents and Reports	Site Remediation	Remedy Operation/ Optimization	Compliance	Programmatic Support
Jamie Suski, Ph.D.	Ecological Risk Assessor 2	15	1	Ph.D.	Maryland	Post-Doctoral Fellowship, Ecology	♦	♦			♦	♦
Michael Ciarlo	Ecological Risk Assessor 3	22	15	M.S.	Maryland	OSHA HAZWOPER, Site Supervisor	♦	♦	♦	♦	♦	♦
Ryan Darnton, J.D., P.E.	Engineer 1	10	4	M.S.E J.D.	Michigan	P.E., Michigan; Attorney in Good Standing, Michigan; OSHA HAZWOPER	♦	♦	♦	♦	♦	♦
Kevin Kowalk, P.E.	Engineer 2	17	5	M.S.	Michigan	P.E. in Minnesota and 2 other states	♦	♦	♦	♦	♦	♦
James Beaver, P.E.	Engineer 3	23	6	M.S.	Michigan	P.E. in Minnesota and 20 other states	♦	♦	♦	♦	♦	♦
H. Lee Becker, P.E.	Engineer 4	47	30	M.S.	Nebraska	P.E. in Minnesota 14 other states	♦	♦	♦	♦	♦	♦
Stephen Soldner	Field Technician	8	5	B.S.	New York	OSHA HAZWOPER, Site Supervisor, Construction Management	♦	♦	♦	♦	♦	♦
Christopher Swanson	GIS/CADD Specialist	18	14	A.A.S.	Nebraska	MicroStation & GeoPAK Site, GIS Mapping	♦	♦	♦		♦	♦
Cynthia Cheatwood	Human Health Risk Assessor 2	25	18	M.S.P.H.	Maryland	OSHA HAZWOPER	♦	♦	♦	♦	♦	♦
Dan Hinckley, Ph.D.	Human Health Risk Assessor 3	36	27	Ph.D.	Michigan	EA Senior Technical Review Training	♦	♦	♦	♦	♦	♦
Daniel McNeely	On-Site Inspector	13	3	B.S.	Michigan	OSHA HAZWOPER, Site Supervisor, Asbestos Building Inspector	♦	♦	♦	♦	♦	♦
Arthur Peitsch, PMP	Project Manager	20	4	B.S.	Michigan	Project Management Professional, RCRA Hazardous Waste Regulations, OSHA HAZWOPER Site and Supervisor Training	♦	♦	♦	♦	♦	♦
Frank Barranco, Ph.D., P.E., P.G., C.M.Q./O.E.	QA/QC Officer	29	22	Ph.D.	Maryland	Professional Engineer, Professional Geologist, Certified Manager of Quality/Operational Excellence	♦	♦	♦	♦	♦	♦
Hilary Williams	Scientist 1	9	9	M.P.S.	New York	OSHA HAZWOPER Site and Supervisor Training	♦	♦	♦	♦	♦	♦
John Morris	Scientist 2	26	6	B.S.	Maryland	OSHA HAZWOPER Site and Supervisor Training, Confined Space Operations Training, SCUBA Certification	♦	♦	♦		♦	♦

2.4 Resumes

Jamie Suski, Ph.D.
Ecological Risk Assessor 2

Education
Ph.D./Aquatic Ecology/2012
M.S/Environmental Toxicology/2006
B.S./Biology/1999

Years of Experience: 15
Years with EA: 1

Relevant Highlights
- ✓ 15 years of experience in both research and critical review of studies in the field of ecotoxicology; with extensive experience in evaluating effects of anthropogenic stressors to discrete receptors and those seen at the community level.
- ✓ Experience with PFAS, pesticides, and fungicides.
- ✓ Served as a Subject Matter Expert on evaluating industry-submitted aquatic toxicology studies to EPA.
- ✓ Guided the development of Hazard Criteria to be incorporated into new policy used by the National Organics Program.
- ✓ Co-authored 25+ articles/presentations on environmental toxicology and biodiversity studies.

Registrations/ Certifications/ Training
- Post-Doctoral Fellowship at Texas Tech University/University of Maryland on Community Ecology; 2012-2014
- Member of the Society of Environmental Toxicology and Chemistry

Dr. Suski is an aquatic ecotoxicologist with 15 years of experience supporting ecological risk assessments through investigating effects of anthropogenic and natural stressors to ecological receptors. She has worked for EPA where she gained experience in policy interpretation and action, chemical specific hazard characterizations, and risk assessment. While working for the U.S. Army, she developed wildlife toxicity assessments and a laboratory model to assess reptile toxicity to military-unique compounds.

Dr. Suski's skillset includes eco-toxicology, eco-physiology, aquatic ecology, community ecology, hazard characterizations, risk assessment, environmental policy, experimental design and statistical analysis, and field research. She has an established record of publishing peer-reviewed articles, presenting work at professional conferences, and providing professional peer review for Environmental Toxicology and Chemistry and PLoS One. Currently, Dr. Suski is directing laboratory ecotoxicity studies investigating effects of PFAS to fish during critical life-stages and conducting a desktop assessment of PFAS exposure and risk to threatened and endangered species occupying military installations. Her field research includes detailed stream monitoring, monitoring storm water effluent from point and non-point sources (aiding in the preparation of National Pollutant Discharge Elimination System [NPDES] permits), and field research to estimate the health of ecological populations within the Delaware River and Chesapeake Bay.

Dr. Suski has *e*xperience working in support of the Federal Insecticide, Fungicide and Rodenticide Act in the Office of Pesticide Programs, the Toxic Substance Control Act in the Office of Pollution Prevention and Toxics (OPPT) and non-regulatory voluntary programs (High Production Volume Challenge Program, Safer Choice Program) in the Office of Chemical Safety and Pollution Prevention at the EPA. She also guided the development of Hazard Criteria to be incorporated into new policy used by the National Organics Program at the U.S. Department of Agriculture.

Project Experience

Ecological Risk Assessments and Hazard Characterizations; EPA Risk Assessment Division; Ecotoxicologist—Provided expertise on new and existing chemical substances under the Toxic Substances Control Act while working within OPPT. Performed critical reviews of data submitted under Pre-Manufacturing Notices for new chemicals. For existing chemicals, served as a team member or technical team lead on developing and implementing OPPT's 2017 vision of completing 83 chemical assessments by performing screening level risk assessments through evaluating, interpreting, and summarizing published and non-published scientific studies using data deemed appropriate for generating risk quotients to ecological receptors and ultimately reviewing risk assessment discrepancies. Responsible for directing multidisciplinary teams, including chemists, toxicologists, economists, fate assessors, and chemical engineers, to complete assessments. Also served as project lead for developing hazard criteria for inert chemicals added to organic pesticides. This project was in collaboration with the U.S. Department of Agriculture and the National Organic Program. This was a unique project that required meeting needs of another government agency and a non-profit organization. The project also presented challenging scientific tasks, such as addressing potential hazards to soil organisms with little data. Demonstrated subject matter expertise with external stakeholders by participating in international scientific meetings and scientific workgroups. Was nominated by supervisor, with concurrence by the division director, to serve on multi-organization workgroup composed of senior scientists from academia, industry, and government who are tasked with determining the scientific basis and justification for applying the threshold of toxicological concern approach to ecological receptors through Predicted No Effects Concentration modeling.

Ecotoxicologist in the High Production Volume Challenge Program, which was designed to provide the public with knowledge of hazards associated with High Production Volume chemicals so they may make informed decisions related to human and environmental health. In this position, reviewed voluntarily submitted toxicity data from industry for completeness and quality. Following reviews, data were used to generate chemical specific screening level hazard characterizations. Generating hazard characterizations required knowledge and an understanding of mammalian and aquatic toxicity studies as well as chemical fate within aquatic systems. These technical reports were prepared to convey information to the public.

Investigating Potential Risk to Threatened and Endangered Species from Per- and Polyfluoroalkyl Substances (PFAS) on Department of Defense (DoD) Sites; Strategic Environmental Research and Development Program (SERDP); Primary Investigator—This project has two main goals: (1) address the information needs concerning the likely co-occurrence of specific threatened and endangered (T&E) species and per- and polyfluoroalkyl substance contamination at DoD installations and (2) develop a tiered approach to quickly and cost-effectively conduct a screening-level assessment of risk and/or identify important data and modeling needs to reduce uncertainty in assessing risk to T&E species that may be exposed to PFAS on DoD installations.

Per- and Polyfluoroalkyl Substances (PFAS) impacts to Freshwater Invertebrates; Research and Development at EA; Senior Scientist—Investigated the impact of PFAS exposure to freshwater invertebrates over chronic durations. This effort is critical in developing an approach to understanding how PFAS mixtures affect wildlife receptors and which PFASs may be driving the toxicity with respect to freshwater crustaceans.

Per- and Polyfluoroalkyl Substances (PFAS) impacts to Freshwater Fish; Towson University, Maryland; Strategic Environmental Research and Development Program (SERDP); Senior Scientist—Currently directing eight full life cycle toxicity studies on a representative freshwater fish, the fathead minnow (*Pimephales promelas*). The eight toxicity studies will include environmentally relevant PFAS and PFAS mixtures as determined from an analysis of existing toxicity data and environmental occurrence data. Preliminary assessments of the key components to environmentally relevant PFAS include perfluorooctanesulfonic acid (PFOS), perfluorohexane sulfonic acid (PFHxS), perfluorobutane sulfonic acid (PFBS), and perfluorooctanoic acid (PFOA) as key and majority components of PFAS contaminated surface water near DoD sites.

Investigation of Military Unique Compound Toxicity to Reptiles; US Army; Toxicologist and Principal Investigator—Developed a standardized test method to evaluate toxicity to reptiles a widely understudied and under-represented species in ecological risk assessment. Tested multiple military unique compounds using newly developed test methodology to compare hazard/risk estimates generated from avian toxicity data that is widely accepted as protective.

Impacts to Biodiversity Patterns within Aquatic Communities; University of Maryland; Post-doctoral Fellow—Conducted a full-factorial mesocosm study simulating impacts of management tools to freshwater ponds. Research focused measuring changes in biodiversity (local species and compositional turnover) of zooplankton community using principal component analysis.

Safer Choice Program; Ecotoxicologist—Main responsibilities included evaluating chemical specific hazard data to determine if ingredients were safer alternatives to ingredients commonly used in consumer and industrial products. Assisted in determining chemical additions to the Safer Choice Ingredient List through evaluation of available toxicity data and/or generated modeled data to assist in informed decisions. Worked in collaboration with the U.S. Food and Drug Administration to integrate the Safer Choice Program standards and criteria into the Personal Care Product sector.

Endangered Species and Marine Mammal Assessment; Chesapeake Tunnel Joint Venture; Senior Scientist—Modeled impacts of pile driving activity to listed aquatic species as required by Section 7 of the Endangered Species Act (ESA) for the construction of an additional tunnel at the Chesapeake Bay Bridge tunnel. Modeled impacts and Level A and Level B 'takes' to protected marine mammals as required by the Marine Mammal Protection Act in preparation for an Incidental Harassment Assessment prepared for the NOAA.

Michael Ciarlo
Ecological Risk Assessor 3

Education
M.S/Environmental Science/2000
B.S./Biology/1995

Years of Experience: 22
Years with EA: 15

Relevant Highlights
- ✓ Managed/performed 50+ ecological risk assessments of 150+ sites working under CERCLA, RCRA, NEPA, MMRP, dredged material and contaminated sediment management guidance, and state regulations
- ✓ In-depth understanding of state and federal regulatory requirements for assessment, including 100+ meetings with clients and regulators to negotiate methods, present results, and develop remedial goals.
- ✓ Familiar with MPCA Risk Based Site Evaluation Manual, MPCA and MDNR natural resources protection regulations, and Minnesota Environmental Response and Liability Act.
- ✓ Co-authored 32 articles/presentations on ecological/human health risk assessment, environmental toxicology, chemistry, site assessment, and remediation.
- ✓ Maintains standard benchmark databases for 300+ chemicals compiled from federal/state standards and scientific literature.
- ✓ Adjunct Professor at Johns Hopkins University teaching ecotoxicology.

Registrations/ Certifications/ Training
- Department of Defense Risk Communication Course
- ArcView GIS Short Course
- USACE-Approved Wetlands Delineation Course

Mr. Ciarlo has 22 years of experience in the fields of risk assessment, remediation, environmental assessment, and environmental science. He has led successful investigation, assessment, and remediation projects for complex sites requiring use of soil, groundwater, and sediment remediation technologies to address risks from metals, solvents, and pesticides. He has specific experience evaluating spill-related versus spray-related pesticide concentrations in terrestrial and aquatic systems, and modeling risk associated with agricultural scenarios.

Mr. Ciarlo has managed and/or performed over 50 ecological risk assessments from initial approach, development, and data collection to final risk modeling and results application. He has successfully negotiated approval from regulators and stakeholders for all aspects of the assessment process. He has efficiently planned and conducted sampling of various environmental media for evaluation via chemical analyses and bioassays. He has developed risk assessment exposure models; derived benchmarks for military specific compounds; and conducted exposure and effects assessments of plants, aquatic organisms, and wildlife. Mr. Ciarlo incorporates innovative approaches and technology to the risk assessment process, including analyses to determine fate, transport, and bioavailability of metals, and interactive Geographic Information System to facilitate decision making. He has conducted risk assessments on a wide variety of species and taxa, including sensitive species. He has successfully incorporated aspects of population biology and spatially-explicit modeling. He has completed risk assessments under CERCLA, RCRA, dredged material management guidance, National Environmental Policy Act (NEPA), and the Military Munitions Range Program. He has recent **experience applying Minnesota SRVs and performing risk management with MPCA as a coordinating agency on federal remediation work.**

Mr. Ciarlo is experienced and trained in community relations and presenting in high risk, low trust situations. He has presented to community groups, public officials, media, general public, stakeholders, and regulators. He has developed fact sheets, presentations, and roll-out strategies to aid in risk communication under CERCLA.

Project Experience

Spirit Lake Contaminated Sediment Feasibility Study, PDI, and Remedial Design; Duluth, Minnesota; EPA Region 5; Ecological Risk Assessor and Project Manager—Reviewed project planning documents, performed a QA field audit of investigation activities, and provided Senior Technical Review of nine technical memoranda documenting the PDI to support the remediation of polycyclic aromatic hydrocarbon (PAH)- and metals-contaminated sediment. Currently working with MPCA to refine and apply risk-based remedial goals and develop design criteria protective of public use of remediated lands. Managing the RD, which includes dredging 700K cubic yards (CY) of sediment; placement in onsite confined disposal facilities (CDFs); *in situ* stabilization of lead-impacted soils; capping or enhanced MNR for over 130 acres, re-routing a stream channel, habitat restoration, and construction of railroad structures. Design work-to-date has included preparation of spatial model of chemistry results and goal exceedances; baseline hydrodynamic models and HEC-RAS models; groundwater and capping models; geotechnical data evaluation report; CDF and shoreline stability analyses; draft grading plans for CDFs, access and staging areas, and stream channels; draft habitat strategy and framework for habitat conditions analysis; and framework for updated costs using MCACES software.

Remedial Design for Sediment Remediation at Atlantic Wood Industries Superfund Site; Norfolk, Virginia; EPA Region 3; Task Manager—Prepared a technical memorandum to support use of monitored natural recovery of sediments at the site. Performed research regarding sedimentation rates, erosion rates, and the effectiveness of sand capping as a

means of enhancing natural recovery of creosote contaminated sediments. Contributed to pre-design studies of ongoing sources. Oversaw development of O&M Plan—including collection of fish, mussels, and crab samples and benthic community surveys—for performance monitoring.

Programmatic Risk Assessment at U.S. Army Aberdeen Proving Ground (APG), Maryland; APG, Maryland; U.S. Army, Environmental Chemical Corporation; Lead Risk Assessor—Over the past 20 years, led or played a key role in every ecological risk assessment performed for Aberdeen Proving Ground, a 70,000 acre military installation with a wide array of terrestrial and aquatic habitats and over 200 regulated CERCLA sites containing pesticides, metals, polychlorinated biphenyls (PCBs), PAHs, semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), explosives, and military-specific compounds. Led landmarks studies that differentiated source-related contamination from background concentrations, with specific focus on differentiating metals, PAH and DDT spill sites from more ubiquitous sources using statistical and spatial analysis. Prepared study plans for collection of over 2,000 samples of soil, sediment, surface water, groundwater, porewater, and fish, frog, and reptile tissue. Developed laboratory bioaccumulation studies and toxicity test studies for grass, earthworms, fish, and crustaceans. Used data to prepare over 75 risk assessment documents for over 200 individual hazardous waste sites. Performed all aspects of ecological risk assessment, including conceptual model development; constructing and using food web models; interpreting toxicity test and bioaccumulation results; and using specialized chemical analyses to characterize bioavailability. Presented results to regulatory agencies at over 30 meetings, developing a strong foundation of scientific credibility and creating a collaborative working environment that allowed rapid assessment and closure of sites. Prepared presentations for 20 public meetings and led risk communications efforts.

Risk Assessment of Coke Point Offshore Environments; Sparrows Point, Maryland; Maryland Environmental Service; Ecological Risk Assessor—Provided oversight of high profile ecological and human health risk assessments of sediments adjacent to a former steel-manufacturing facility in a heavily contaminated urban estuary with a history of PCB and chromium releases. Evaluated relative risk from a single source compared to influence of ongoing sources/elevated background concentrations. Conducted ecological risk assessment for wildlife and important fisheries species. Planned and oversaw collection of fish and crab tissue as well as performance of laboratory bioaccumulation tests. Performed extensive coordination with regulators to address public health and risk communication concerns. Presented risk assessment results to elected officials, community groups, the media, and stakeholders in private and public meetings. Developed risk-based surface weighted average concentrations as part of a strategy for risk management and risk reduction to inform decisions regarding construction of corrective measures. Supported regulatory negotiations by providing technical expertise regarding risk results.

EVR-Wood Treating and Evangeline Refining Company Site Remedial Investigation/Feasibility Study; Jennings, Louisiana; EPA Region 6; Senior Risk Assessor—Senior Risk Assessor responsible for overseeing performance of an ecological risk assessment of chemicals in soil, sediment, surface water, and hydric soils from a former wood-treating site. Oversaw development of an approach for establishing groupings, assessing multiple lower and upper trophic level receptor groups, and assessing bayou versus riverine habitats. Guided planning of field collection of crayfish and fish tissue, sampling for AVS/SEM analysis, and collecting field parameters to aid in assessing bioavailability. Guided development of approach for development of biota-sediment accumulation factors and for applying them in risk assessment.

Dredged Material Evaluation for Beneficial Use at the Poplar Island Environmental Restoration; Chesapeake Bay, Maryland; U.S. Army Corps of Engineers-Baltimore District; Ecological Risk Assessor—Developed and implemented a framework to predict fate of, and risk from, metals and other chemicals in over 4 million CY of dredged material for use in habitat restoration. Performed field and laboratory studies to determine effects of sediment drying and revegetation on metal chemistry and used results to perform risk-based assessment of potential impacts of soil on restoration success. Performed toxicity testing and uptake studies on wild and agricultural plant species. Utilized sequential extraction procedures for metals to predicting metal bioavailability post-placement. Conducted exposure and toxicity modeling for plants, aquatic organisms, and wildlife. Provided specific management and monitoring conclusions and presented methods and results to stakeholders, incorporating review comments and feedback to achieve consensus.

Remedial Investigation/Feasibility Study, Donna Reservoir and Canal Superfund Site, Donna, Hidalgo County, Texas, EPA Region 3; Senior Ecological Risk Assessor—Led development of a complex ecological risk assessment for a canal and reservoir system where irrigation structures were suspected as a source of PCBs to fish tissue. Evaluated exposure pathways for fate and transport via suspended sediment and bioaccumulation, including transfer of PCBs into game fish, agricultural fields, and agricultural products. Planned studies to determine source of PCBs, including use of passive samplers to determine relative contributions of sediment and water to bioaccumulation in mollusks and fish, suspended sediment analysis, and tissue collection.

Ryan Darnton, J.D., P.E.
Engineer 1

Education
M.S.E./Environmental Engineering/ 2013
J.D./University of Michigan/2005
B.S./Biology/2002

Years of Experience: 10
Years with EA: 4

Relevant Highlights
- ✓ Extensive experience preparing plans, specification, and documentation reports
- ✓ Extensive experience collecting and processing environmental samples of various media
- ✓ Demonstrated ability to oversee field activities during investigations and construction

Registrations/ Certifications/Training
- Professional Engineer—MI (6201066590)
- Attorney in Good Standing—MI (P69450)
- OSHA 40-Hour Hazardous Waste Operations Safety Training
- OSHA 8-Hour Hazardous Waste Operations Supervisor Training
- OSHA 30-Hour Construction Safety
- CPR and First Aid Training

Mr. Darnton has 10 years of experience in the planning and performance of aquatic ecosystem assessments, characterizations of contaminated sediments, habitat restorations, and rural aquaculture systems. He has also worked on projects analyzing water quality and assessing the performance of drinking water treatment technology.

Mr. Darnton's site characterization and environmental surveying experience includes developing work plans, performing field work, processing collected sample materials, analyzing data, compiling results, and drafting summary reports. His field and sample processing activities have included Ponar grabs, sediment coring, use of fish trap setlines, gill nets, benthic community analysis, water sampling, acoustic Doppler current profilers, fish gut content analysis, and bathythermograph and sonde use for creating vertical profiles of environmental conditions. His responsibilities have also included laboratory analysis of chemical contaminants in aqueous solutions, as well as fluorometer analysis to detect chlorophyll levels. He has performed oversight of both land- and vessel-based investigative drilling operations, including vibracore, hollow-stem auger, cone penetrometer, Shelby tube, split-spoon, and sonic coring activities.

Mr. Darnton also has experience with rural aquaculture including initial site assessment and the design of networks of furrows, ponds, and spillways. His responsibilities also included project planning, supervision of pond construction and operations, maintenance of appropriate nutrient levels, and marketing of harvested fish.

Spirit Lake Pre-Design Investigation, Spirit Lake Estuary and Former USS Duluth Works, St. Louis River; Duluth, Minnesota; EPA Region 5 Great Lakes National Program Office; Project Engineer and Field Oversight—Served as field oversight of upland topographical and historical resource surveys. Conducted vessel-based oversight of water sampling and drilling activities for chemical and physical assessments of sediments to provide data for remediation design work. Processed sediment and pore water cores and prepared samples for subsequent laboratory analysis. Performed oversight and data collection for manometer analysis of surface/groundwater interface and prepared a technical memorandum summarizing data.

Remedial Action Operations and Monitoring, Duluth Air National Guard Base; Duluth, Minnesota; U.S. Air National Guard; Waste Management Manager—Coordinated sample analysis and appropriate disposal of investigation derived waste for groundwater well establishment and sampling activities during remediation monitoring.

Assessment of Contaminated Sediments, Upper St. Louis River and Superior Bay; Duluth, Minnesota; EPA Region 5 Great Lakes National Program Office; Sediment Sampling Oversight—Supervised the use of vessel-based dredging and vibracoring techniques to collect and process sediment samples for a characterization of sediment contamination in the St. Louis River Area of Concern.

Zephyr Remedial Action Design Support, Former Zephyr Refinery – Fire Suppression Ditch, Muskegon, Michigan; U.S. Environmental Protection Agency Great Lakes National Program Office; Remediation Permitting—Assisted in the preparation and submittal of permit application materials for a project involving remediation of contaminated sediments within a wetland adjacent to the Muskegon River, and subsequent wetland habitat restoration activities.

Assessment of Contaminated Sediments, St. Louis River; Duluth, Minnesota; EPA Region 5 Great Lakes National Program Office; Field Technician and Oversight—Utilized vessel-based Ponar dredging and vibracoring to collect sediments and processed samples for subsequent laboratory analysis.

Environmental Remediation Services, Selfridge Air National Guard Base – Building 1533; Mt. Clemens, Michigan; U.S. Army Environmental Command; Plan Author, Engineer and Field Technician—Developed Project Management and Work Plans for environmental remediation services to be performed at the site of a former leaking underground storage tank. Project plans included excavation of contaminated soil; injections of oxygen releasing compound; and installation of air sparging, bioventing, and subslab depressurization systems. In addition to the construction activities, the project plans also included operation and maintenance of onsite remediation systems, as well the collection of groundwater and soil gas samples to monitor progress. Performed calculations and layout design work for a new air sparging system consisting of 36 individual sparge wells. Conducted groundwater sampling activities and operations and maintenance site visits for remediation systems.

Site Characterization and Remedial Design Tasks Former Zephyr Oil Refinery Fire Suppression Ditch; Muskegon, Michigan; EPA Region 5 Great Lakes National Program Office; Field Technician and Data Analysis—Prepared plans for a field investigation to conduct waste characterization and geotechnical analysis in support of a remedial design. Performed field effort involving surveys, sediment collection, and drying/dewatering analysis in wetlands located between a former oil refinery site and the Muskegon River. Reviewed data and drafted technical memorandums presenting results from the field investigation.

Assessment of Contaminated Sediments, Riverbend Area, Detroit River; Detroit, Michigan; EPA Region 5 Great Lakes National Program Office; Permit and Report Preparation and Sediment Sampling Oversight —Prepared and submitted application materials for federal and state permits related to sediment sampling in a Great Lakes waterway. Supervised the use of vessel-based dredging and sonic coring techniques to collect and process sediment samples for a characterization of sediment contamination in the Detroit River Area of Concern. Reviewed and compiled data from the site investigation and prepared a site characterization report identifying potential hotspots of contamination that could be targeted for possible future remediation efforts.

Assessment of Contaminated Sediments, Lower Clinton River; Mt. Clemens, Michigan; EPA Region 5 Great Lakes National Program Office; Sediment Sampling Oversight, Plan and Characterization Report Author—Prepared Quality Assurance Project Plan and Site Safety and Health Plans for a site characterization assessing levels of sediment contamination in the Lower Clinton River. Supervised the use of vessel-based Ponar dredging and vibracoring to collect and process sediment samples. Reviewed and compiled data from the site investigation and prepared a site characterization report identifying potential hotspots of contamination that could be targeted for possible future remediation efforts.

Belle Isle Flatwood Restoration, Belle Isle Park; Detroit, Michigan; Michigan Department of Technology, Management and Budget; Habitat Restoration Engineer—Prepared plans and performed field efforts for pre-design field investigation. Field activities performed included soil bore sampling, wetland delineation, and installation of water level monitoring stations. Oversaw utility, topographic, and bathymetric survey activities, as well as habitat assessment surveys. Reviewed and processed data from the pre-design field activities. Provided support for the design of habitat restoration features to improve hydrology within a wet-mesic forest.

Krispin Drain Technical Assistance, St. Clair River Area of Concern; Clay Township, Michigan; EPA Region 5; Habitat Restoration Monitoring—Developed plans and supported field efforts for monitoring ecological progress following completion of the construction phase of a habitat restoration. Reviewed and processed data from the field events and drafted habitat restoration monitoring reports.

Upper Detroit Riverfront Parks Restoration, Detroit River Area of Concern; Detroit, Michigan; EPA Region 5; Habitat Restoration Engineer—Prepared plans and supported field efforts for pre-design field investigation. Reviewed and processed data from the pre-design investigation and drafted a site sampling technical memorandum. Provided support for the design of habitat restorations within three City of Detroit parks, adjacent canals, and the Detroit River shoreline.

Assessment of Contaminated Sediments, River Rouge/Ecorse Shoreline and Celeron Island Areas; Detroit, Michigan; EPA Region 5 Great Lakes National Program Office; Characterization Report Author—Reviewed and compiled data from site investigations assessing levels of sediment contamination in the Detroit River. Prepared site characterization reports identifying potential hotspots of contamination that could be targeted for possible future remediation efforts.

Kevin Kowalk, P.E.
Engineer 2

Education
M.S./Biosystems Engineering/2002
B.S./Biosystems Engineering/2000

Years of Experience: 17
Years with EA: 5

Relevant Highlights
- ✓ Managed $15M+ in environmental contracts including CERCLA and RCRA investigations, designs, remedial actions, and O&M of remediation systems.
- ✓ Managed 45+ site assessments, RI/FSs, Corrective Action Plans, and RDs under CERCLA, RCRA, and state regulations. Oversaw the development and approval of QAPPs, SAPs, Site Management Plans, HASPs, APPs, Data Summary Reports, EECAs, Design Specifications and Reports, Five-Year Reviews, and RA Reports.
- ✓ 5+ years experience providing environmental services in Minnesota
- ✓ 250+ hours of professional development in green investigation and remediation technologies
- ✓ Remedial technology selection, design, and implementation experience with the following technologies: groundwater pump-and-treat, air sparging/soil vapor extraction, hydraulic and mechanical dredging, in situ chemical oxidation, enhanced bioremediation, sand and reactive caps, monitored natural recovery, soil excavation, and demolition.

Registrations/ Certifications/ Training
- Registered Professional Engineer — MN (No. 55093, 2017), MI, WI
- Interstate Technology Regulatory Cooperation Light Non-Aqueous Phase Liquid Training
- Certified Nutrient Management Planner – ISU National and Michigan; 2010
- OSHA HAZWOPER and Site Supervisor Training

Mr. Kowalk is a registered Professional Engineer in Minnesota with over 17 years of experience in the performance and management of site assessments; remedial investigations; feasibility studies; pilot testing; remedial design; remedial action; construction oversight; and remediation system operation and maintenance (O&M) projects for federal, state, industrial, commercial, and agricultural clients. He has completed projects under CERCLA, RCRA, underground storage tank, and associated state regulations at sites throughout the country with an emphasis on the Great Lakes Region. This includes multiple sites in Minnesota where MPCA water quality rules, underground storage tank program (Chapter 7150), MDH well construction permits, and Minnesota Administrative Rules Chapter 4725 (Wells and Borings) related to *in situ* groundwater remediation were applicable.

Mr. Kowalk's site characterization, remedial design, and remedial action oversight experience includes sites with impacts to soil, sediment, groundwater, surface water and soil gas from fuels, chlorinated solvents, heavy metals, pesticides, PCBs, and emerging contaminants (e.g.,1,4-dioxane). He served as technical lead on numerous projects, overseeing technical aspects of remedial design and operation and maintenance of remedial systems. He has served as technical oversight to lead implementation and troubleshooting issues during remedial action construction activities for various technologies targeting soil, groundwater, soil vapor, and sediment contamination, including but not limited to excavation, in-situ chemical oxidation, enhanced bioremediation, air sparging/soil vapor extraction, air stripping, and LNAPL removal.

Mr. Kowalk has completed multiple Phase I ESA's for commercial clients and led groundwater remedial design and remedation activities at multiple DoD and commercial client sites associated with chlorinated solvent and petroleum impacts to groundwater in Minnesota. Remedial design and remediation activities included design of in-situ chemical oxidation and enhanced bioremediation injection plans and implementation oversight. Mr. Kowalk has also completed extensive agricultural waste conveyance, storage, and treatment design and construction oversight throughout the Great Lakes Region for multiple Concentrated Animal Feeding Operations (CAFOs) including completion of CAFO NPDES Permits in Wisconsin and Michigan.

Project Experience

Remedial Action-Operations, Long-Term Monitoring, and Project Closeout; Sites 3 and 25, 148th Fighter Wing, Duluth, Minnesota, Minnesota Air National Guard, and Site 9, Alpena Combat Readiness Training Center, Alpena, Michigan, Michigan Air National Guard; Project Engineer—Technical lead for groundwater data gap investigations, in situ and ex situ remediation, long-term monitoring, and project closeout at three sites. Activities included field oversight and management of monitoring well installation; direct-push technology soil boring investigation; excavation and disposal of petroleum-impacted soils; groundwater treatment via injections utilizing multiple substrates (EHC, EHC-L, and Nutrisulfate) and bioaugmentation utilizing a dehalcoccoides inoculum; and placement of oxygen release compound Advanced® as an excavation backfill amendment. Activities are scheduled to continue through September 2018. Provided on-site technical oversight of in-situ injection activities at Sites 3 and 25 at the 148th Fighter Wing where difficult geological conditions required field adjustments of injection methods and coordination with MPCA regarding issues encountered. Provided Senior Technical Review for all technical reports, including Remedial Action-Operation work plans and After-Action Reports following completion of remedial activities.

Site Investigation, Feasibility Study (FS), Remedial Design (RD), Remedial Design Support, and Construction Oversight; Former Zephyr Oil Refinery, Muskegon, Michigan; EPA Region 5; Project Manager—Managed a multi-disciplinary technical team through three phases of site assessment and RI activities, risk and impact assessment, FS development, pre-design investigations, treatability studies, community outreach, and RD for the characterization and remediation of 13.6 acres wetlands impacted by petroleum and metals—including hazardous lead concentrations—from a former refinery. Directed preparation of planning documents (Quality Assurance Project Plan [QAPP], Field Sampling Plans, Health and Safety Plan [HASP]), reports (Site Characterization, FS, technical memoranda), and design documents (30, 90, and 100 percent RD plans, specifications, cost estimates). RD consisted of relatively dry excavation, in situ stabilization of characteristically hazardous sediment, dewatering, water treatment, and offsite disposal. Assisted with preparation of construction bid documents. Currently, managing RA construction oversight, RD support, and community outreach. RA is scheduled to be completed by December 2018.

Corrective Action Plan Implementation; Selfridge Building 1533, Selfridge Air National Guard Base, Detroit Arsenal, Michigan; U.S. Army Environmental Command; Project Engineer—Building 1533 is a former gasoline underground storage tank site under the regulatory authority of the Michigan Department of Environmental Quality. Activities have included corrective action work plan development, construction activities consisting of excavation and off-site disposal of impacted vadose zone soils, installation and operation of an air sparge system to treat groundwater impacts in the source area, in situ injection of oxygen releasing compounds to promote aerobic biodegradation of fuel impacts in the source area not accessible to the air sparge system (under and next to building), installation and operation of a sub-slab depressurization and bioventing system beneath the building to both stimulate biodegradation of vadose zone volatile organic com pounds and removal of soil gas volatile organic compounds and methane, monitoring well installation, long-term groundwater monitoring, and operation and maintenance of an existing air sparge system located downgradient of the groundwater plume. Corrective actions completed in 2016 with performance and long-term monitoring in 2017 indicate successful reduction in contaminants of concern across the site.

Remedial Investigation/Feasibility Study Oversight; Patrick Bayou Superfund Site, Harris County, Texas; EPA Region 6; Project Manager—Project Manager for completion of RI/FS Oversight at the Patrick Bayou Superfund Site. Activities included preparing Sampling and Analysis Plan (SAP) and HASP, reviewing the RI, Baseline Human Health Risk Assessment, Baseline Ecological Risk Assessment, characterization, Remedial Alternatives Technology Screening, and FS reports. Additional activities completed to support RI/FS and RD included preparing a Proposed Plan for remedial action and a public notice for availability of the FS for review. Additional activities to be completed include oversight of field sampling efforts during pre-design investigations.

Site Characterizations in the Detroit River; Detroit, Michigan; EPA Region 5; Project Manager—Managed site assessment activities to characterize contaminated sediments at five sites within the Detroit River. Activities included investigating the nature and extent of contamination in surface and subsurface sediments, examining sediment toxicity, and evaluating sediment thickness. Field teams collected 200+ sediment cores and submitted 700+ sediment samples for laboratory analysis. Utilized spatial modeling to develop estimates of contaminated sediment volume and to identify areas for further investigation during development of Site Characterization Reports for each site.

Construction Oversite and Post Construction Monitoring; St. Clair County, Michigan, EPA Region 5; Project Manager— Managed construction oversight, and design support including preparing revised design plans and specifications, community outreach, and post-construction monitoring activities at five sites. Oversight activities included leading multidisciplinary staff to review contract submittals, supporting design changes during construction, managing full-time oversight of construction activities at multiple sites with overlapping construction schedules, weekly report preparation, community outreach, and preparing O&M plans. Community outreach and stakeholder coordination included weekly meetings with EPA, MDEQ, municipalities, township supervisors, and a county drain commissioner. Providing post-construction monitoring at the Harsens Island/Krispin Drain site to document restoration success through two years of seasonal habitat evaluation.

No Further Response Action Planned, Supplemental Site Investigation, and Remedial Investigation Activities at OT106 Deferred Sites, Hill Air Force Base, Utah; Air Force Civil Engineer Center; Project Engineer—Responsible for development of No Further Response Action Planned report documenting the unrestricted closure of multiple deferred sites at Hill Air Force Base. Activities completed to document No Further Response Action Planned include screening historical analytical data, risk analysis, and comparison to background concentrations. Additional activities included preparation of a Supplemental Site Investigation Work Plan to gather data necessary for further risk assessment activities and an RI Work Plan to delineate PCB impacts to site soils at up to seven deferred sites.

James Beaver, P.E.
Engineer 3

Education
M.S./Geotechnical Engineering/1995
B.S./Geological Engineering/1993

Years of Experience: 23
Years with EA: 6

Relevant Highlights
- ✓ Senior Engineer for $120M+ in environmental contracts including CERCLA and RCRA RAs, investigations, designs
- ✓ 5+ years of experience providing environmental engineering services in the State of Minnesota.
- ✓ Senior Engineer on the $8M Spirit Lake Sediment Remediation Project, Duluth, MN.
- ✓ 20+ presentations/publications on contaminated sediment remediation including two posters on sediment remediation at Spirit Lake and a 2017 Battelle presentation – Amendments for Sediment Dewatering and Strength Improvement: Examining Treatability Study and Design Compared to Remedy Construction.

Registrations/ Certifications/ Training
- Registered Professional Engineer in 21 States, including Minnesota (No. 48712, 2011)
- Registered to complete Erosion and Stormwater Management Certification course- May 7-8, 2018
- Construction Specifications Institute—Certified Documents Technologist
- OSHA HAZWOPER and Site Supervisor Training

Mr. Beaver is a Professional Engineer in Minnesota with 23 years of civil/environmental engineering experience and geotechnical engineering. As a project manager, Engineer of Record, or senior technical resource for environmental remediation projects, he has led the various stages of project development including investigation, treatability study, FS, RD, and construction oversight projects within the Great Lakes Region. Mr. Beaver has managed or provided a leading role in complex remediation projects for federal and state agencies with a wide range of services provided, including permitting and stakeholder coordination, archaeological and cultural resources, and habitat restoration integrated with technical requirements. He has experience designing and evaluating mechanical and hydraulic dredging operations, reactive caps (subaqueous, coastal/intertidal, and steep-slope caps), sheet pile cofferdams, waterfront structures, sediment management facilities (including water treatment), confined disposal facilities, and contained aquatic disposal.

Mr. Beaver has experience with geotechnical and civil engineering for facilities, including design of building foundations and earth retention structures for deep excavations, design and construction of foundations and paving for sediment dewatering and water treatment facilities. He has prepared or significantly contributed to work products such as geotechnical and environmental site characterizations, environmental impact statements, remedial investigation/feasibility studies, engineering evaluation/cost analysis studies, remediation work plans, basis of design reports, permit drawings, design drawings and specifications, engineer's cost estimates, and technical strategy documents. His experience also includes geotechnical engineering such as planning/designing dam removals, slope stability risk evaluation including landslide assessments and repairs, liquefaction susceptibility mitigations, mechanically-stabilized walls/slopes, pavements, ground improvements, and construction dewatering systems.

Project Experience

Spirit Lake Sediment Remediation Site Feasibility Study, PDI, and Remedial Design; Duluth, Minnesota; EPA Region 5; Senior Engineer—Led a multidisciplinary team in the completion of treatability studies, RI/FS support, field oversight, benthic community conditions assessment, hydrodynamic modeling, and PDIs for a 300-acre site within a complex hydrodynamic system. Provided project planning, budget tracking, regular progress reporting, and extensive collaboration project team. Led agency and stakeholder outreach; communication and coordination with MPCA, MN Department of Natural Resources, MN State Historic Preservation Office, community groups, and tribes. Supported EPA at public meetings and poster sessions for the community and participated in presentations to natural resource agencies in pre-application and consultation meetings for permits. Serves as Engineer of Record for RD including management and technical direction of multiple remedy elements to address over 700,000 CY of PAH- and metals-contaminated sediment. Remedy elements include sediment removal, capping, enhanced monitored natural recovery, monitored natural recovery, and onsite disposal in two confined disposal facilities. Providing technical lead role for a design team of over 30 people and technical subconsultants to design confined disposal facilities; stream and river diversion structures; dredge prisms and methodologies; staging, access, dewatering, and disposal; access and haul routes; borrow site evaluation; historical railroad protection; construction sequencing; and cost estimating planning and support. Also providing technical coordination for groundwater, hydrodynamic, geotechnical, and spatial modeling. Assisted in the development of remedial action objective implementation strategy. Responsible for technical direction and technical team coordination. Developed design criteria report during preliminary design to facilitate project team coordination. Assisting project manager with oversight of permitting and stakeholder coordination activities.

Remedial Design for Sediment Remediation at Atlantic Wood Industries Superfund Site; Norfolk, Virginia; EPA Region 3; Senior Engineer—Provided senior technical review of dredging and nearshore CDF design, dredged material management and dewatering, including amending with Portland Cement for increased shear strength and bearing capacity, as well as other technical aspects of the basis of design, drawings, and specifications for the remediation of 300,000 CY of PAH-contaminated sediments. Assisted with development of technical and performance criteria for specifications. Responsible for preparation of the dredging specifications and provided technical on related specification sections such as dredged material placement and water treatment. Provided technical input on geotechnical engineering aspects of the project including treatability studies for sediment, use of wick drains and management of consolidation porewater, influences of preload relative to offshore sheet pile wall basis of design and approaches to preloading, and geotechnical instrumentation for settlement monitoring and pore pressure monitoring. Provided senior technical review of final design and engineering during construction review of contractor geotechnical submittals.

Contaminated Sediment Management Support and Design-Build Planning; Cottage Grove, Minnesota; 3M Corporation; Technical Design Manager—Technical lead for design-build team providing technical consulting services to 3M for its Cottage Grove manufacturing facility to plan sediment remediation and provide evaluation of implementation approaches and estimated costs for a remediation feasibility evaluation. Provided technical support for the review of investigation data and development of contaminant extent; sediment remedy evaluation and selection, including remedy approach adjacent to high-use railroad line; and preparation of prepared engineering cost estimate. Developed approach and cost estimate for hydraulic dredging and stream bypass, geotextile tube dewatering in existing ponds, and water treatment for proposed construction.

Lincoln Park Feasibility Study, Remedial Design, and Construction Oversight; Milwaukee, Wisconsin; EPA Region 5; Senior Engineer—EA completed the FS, RD, and construction oversight for the Phase 2 area of the Lincoln Park/Milwaukee River Channel Sediments Site. Toxic Substances Control Act-regulated contaminants (PCBs, PAHs, and non-aqueous phase liquid [NAPL] hydrocarbons) were scattered throughout the site. Provided input on FS alternatives development and strategized with project manager on key technical issues affecting project implementation. Responsible for technical input for remedial alternatives development and cost estimating, and provided senior technical review of RD deliverables. Developed hydraulic dredging alternative for the FS and determined assumptions for using geotextile tube dewatering. Prepared the mass balance calculations to approximate changes in density and relative quantities of water and sediment solids during material handling to estimate disposal quantities and disposal weight for each alternative; this also included a webinar to explain the mass balance approach, results, and conclusions to stakeholders. Worked closely with construction oversight crew and Project Manager during remedial action, and provided engineering support consisting of submittals review, and responses to and evaluation of contractor Requests for Information. From start of the FS to completed remedy took less than three years. EPA, Wisconsin Department of Natural Resources, Milwaukee County Parks, and EA were jointly awarded a National Recognition Award from ACEC in 2017.

Remedial Investigation/Feasibility Study Oversight at San Jacinto River Waste Pits; Baytown/Channelview, Texas; EPA Region 6; Senior Engineer—Site consists of a set of impoundments built in the mid-1960s for the disposal of solid and liquid pulp and paper mill wastes, and the surrounding areas contain sediments and soils impacted by waste materials disposed in the impoundments. The wastes that were deposited in the impoundments are contaminated with dioxins/furans. Physical site changes, including regional subsidence of land in the area due to large scale groundwater extraction, have resulted in partial submergence of the impoundments and exposure of the contents to surface water of the San Jacinto River. Prepared responses to public comments on a controversial proposed plan, with specific responsibility for addressing comments regarding subaqueous capping technical aspects/cap performance/long-term monitoring, dredging and disposal feasibility and implementation, relationship of sediment stability to long term risks/response action outcome achievement, and project risks.

RD Review for West Branch Grand Calumet River Reactive Cap for Reaches 6 and 7, Hammond, Indiana; EPA Region 5; Senior Engineer—Led technical reviews of basis of design engineering submittals, drawings, and specifications prepared by the Non-Federal Sponsor, and provided comments throughout the design. PDIs, pilot-scale testing, and cap modeling results were used to develop a subaqueous reactive cap for containing deeply contaminated sediments impacted with mobile coal tar NAPL and chlorinated solvents with challenging gas ebullition. Provided detailed review of pilot study cap analytical results; groundwater piezometer and pressure transducer upwelling data; and settlement behavior and geotechnical performance of the cap. Led the review of cap modeling input parameters and provided input to cap modeling iterations and sensitivity analyses. Provided technical recommendations to improve cap design life, as well as technical input to the selection of activated carbon and organoclay media percentages. Oversaw and assisted with preparation of the Construction Quality Assurance Plan.

H. Lee Becker, P.E.
Engineer 4

Education
M.S./Civil Engineering/1981
B.S./Civil Engineering/1971

Relevant Highlights
- ✓ 30 years serving at Engineer 4 Level
- ✓ Managed $150M+ of environmental restoration and remediation work including contaminated sediment site assessments, RIs, FSs, RDs, RAs; and restoration planning and implementation projects funded under the Great Lakes Legacy Act and Reauthorization Act and Great Lakes Restoration Initiative within 10 Great Lakes Areas of Concern.
- ✓ 25 years supporting 20+ Superfund Sites. Directed multi-disciplinary staff on projects involving extensive regulatory interaction, cradle-to-grave remediation services, short-term operation and maintenance services, environmental compliance, and environmental analysis.

Years of Experience: 47
Years with EA: 30

Registrations/ Certifications/Training
- Registered Professional Engineer in 15 states, including Minnesota (No. 48868, 2011)
- OSHA 40-hr HAZWOPER
- OSHA 8-hr Hazardous Waste Supervisor Training

Mr. Becker is a Registered Professional Engineer in Minnesota with 47 years of experience managing civil and environmental engineering projects. He is a civil/environmental engineer and has worked extensively on the analysis and development of solid waste management facilities, groundwater, open channel hydraulics, water supply planning and management, flood studies, artificial recharge, system analysis, irrigation, water rights, and water policy assessment. In addition, he has directed RI/FS, treatability studies, and remedial designs at hazardous waste sites. He has served as a project and program manager with delivery order responsibility for projects valued over $200 million. Prior to his employment with EA, he served as a State Hydrologist with the Nebraska Department of Water Resources.

Mr. Becker has extensive experience across the United States in hazardous waste management, stormwater management, water resources, hydrology, hydraulics, water resource system analysis, solid waste management, water/wastewater management, artificial groundwater recharge, infiltration gallery design, water rights, technical support of litigation, and database management. Has served as the engineer of record on Low Impact Development Management Plans and has conducted or participated in numerous hydrologic investigations, including evaluation of surface and groundwater supply sources through computer modeling, streamflows, instream flow assessments, and flood hydrology. Mr. Becker has also developed and directed the operation of landfill facilities, water distribution systems, and flood management systems.

Project Experience

Atlantic Wood Industries Superfund Site Remedial Design; Portsmouth, Virginia; EPA Region 3; Principal Engineer—Provided senior technical oversight, direction, and quality assurance(QA)/Quality Control (QC) review to ensure RD documents and specifications complied with unified facility guidance specification for 48-acre industrial waterfront site contaminated with creosote and pentachlorophenol. Design documents included offshore sheet-pile wall, dredging of contaminated sediments, excavation of contaminated soils, stabilization/solidification of DNAPL-contaminated soil, containment berms for contaminated sediment, site capping, groundwater management, and stormwater management. Provided senior engineering oversight to design and O&M aspects of the project and assessed the technical approach, quality of project deliverables, management of risks, and adherence to schedule and budget. Performed QC oversight of submittals, requests for information, change order requests, and construction progress meetings during RA. Coordinated directly with the Program Manager, PM, geologists, engineers, and technical advisors.

Spirit Lake Sediment Remediation Project; Duluth, Minnesota; EPA Region 5, Great Lakes National Program Office; Principal Engineer— Providing engineering direction, technical support, and Senior Technical Review of the RD for Spirit Lake Sediment Remediation Project, St. Louis River Area of Concern, Minnesota.

Architect/Engineering Services; EPA Region 5 National Program Office; Chicago, Illinois; Principal Engineer— Oversees and directs multi-disciplinary technical staff, tracks staffing and work plan preparation, provides engineering support, and performs Senior Technical Review of engineering products for sediment remediation and habitat restoration projects. Works closely with PMs and Project Engineers to complete FSs, PDIs, treatability studies, RDs, and habitat restoration design projects; and provides senior engineering oversight during RA construction. Has reviewed FS reports, BODRs, plans, and specifications, and construction packages. Has participated in coordination with stakeholders (e.g., MDEQ, MPCA, and Wisconsin Department of Natural Resources), and meetings with EPA. Has served as secondary point-of-contact for EPA throughout the contract.

Environmental Restoration Services Nationwide; MI, AK, FL, GA, LA, MA, MD, ME, NC, RI, GU; NOAA; Principal Engineer— Provides technical support and review of engineering products for habitat restoration projects nationwide under three contracts (31 Task Orders). Projects have included habitat evaluation, habitat restoration, FSs, hydraulic modeling, and streambank stabilization. Worked closely with EA's design staff during technology screening and alternatives development to identify technical approaches and construction constraints for sediment removal; and the treatment of residuals during preparation of the feasibility study for Operable Unit 1 of the Manistique River Area of Concern, MI. Served as subject matter expert for the $1.8M Programmatic Environmental Impact Statement, Deepwater Horizon Oil Spill Restoration Framework. Provided design and permitting support to restore anadromous fish passage through the design/construction of nature-like fishways at two locations along a 3.8-mile stretch of the Acushnet River, MA. Prepared project plans, specifications, and permit documents for inlet and roadway improvements supporting restoration of Gooseneck Cove Salt Marsh, RI and Nonquitt Marsh, MA. Designs included use of excavated sediments as beneficial fill for beach nourishment. Engineer of Record during review and approval of submittals, pay estimate requests, and interim/final inspections for construction of habitat restoration projects.

Remedial Action Contract 3; EPA Region 9; CA, NV, HI, and Pacific Island Crossover Work in MN, OR; Principal Engineer—Provides technical support and engineering direction for remediation projects; reviews scopes and deliverables; participates in project reviews; and recommends and tracks corrective action plans. Oversees preparation of engineering documents and construction packages to support the removal of multiple contaminants (VOCs, perchlorate, asbestos, radionuclides, PCBs, metals, and emergent chemicals) in multiple media (soil, sludge, sediment, groundwater, surface water, indoor air).

Proposed Reintroduction of Mississippi River Water at Violet, Louisiana, National Oceanic and Atmospheric Administration, Violet, Louisiana; Senior Engineer—Served as senior engineer and was responsible for conducting the assessment of various diversion scenarios for reintroduction of Mississippi River water to the Violet Canal under contract with the NOAA Restoration Center. Also provided oversight and review of hydrodynamic modeling conducted characterize the expected hydrologic and salinity changes in the project area to assist the Government in projecting wetland benefits from various diversion scenarios.

Nonquitt Salt Marsh Restoration, National Oceanic and Atmospheric Administration, Nonquitt, Massachusetts; Project Manager—Responsible for preparing project plans, specifications, and permit documents for inlet improvements supporting restoration of the Nonquitt Marsh at Nonquitt, Massachusetts under contract with the National Oceanic and Atmospheric Administration Restoration Center. The project also includes the assessment of marsh response to various open channel and culvert configurations.

Performance-Based Remediation, Kirtland Air Force Base; Albuquerque, New Mexico; U.S. Army Corp of Engineers–Albuquerque District; Engineer of Record—The project includes installation of large diameter groundwater extraction wells into the regional aquifer which occurs at a depth of approximately 460 below ground surface. Additional groundwater monitoring wells will be installed at multiple depths for collection of data supporting the vertical profile of the dissolved-phase ethylene dibromide plume. Dual-walled conveyance lines will be installed from the off-base extraction wells to the groundwater treatment system Building on Kirtland Air Force Base. The groundwater treatment system expansion includes the proposed construction of a second 400-gallon per minute granular activated carbon filter treatment system. EA is responsible for the operation and maintenance of the treatment system and performance of groundwater monitoring at over 130 deep, regional aquifer wells. Discharge options for the treated groundwater will be implemented through installation of additional regional aquifer injection wells and/or injection well galleries and conveyance lines to discharge treated water from the groundwater treatment system Building to the injection area.

Consulting Services, Stormwater Discharge Violation, Roswell Livestock Auction; Roswell, New Mexico; Envirocompliance Services, Inc.—Provided professional consultation services in reaching a negotiated settlement with EPA Region 6 for the Roswell Livestock Auction, Roswell, New Mexico. A detailed engineering evaluation was prepared that refuted the Government claim of repeated stormwater discharges from the facility to a man-made drainage course. Negotiated settlement required construction of a small bioretention cell adjacent to the facility and resulted in a significant reduction in financial penalty from the Government.

Gooseneck Cove Salt Marsh Restoration, National Oceanic and Atmospheric Administration; Newport, Rhode Island; Senior Engineer—Responsible for development of alternatives including installation of additional culverts and removal of a dam to provide restoration of the Gooseneck Cove salt marsh. Responsible for the development of construction plans, specifications, and the engineer's estimate of probable construction cost for project improvements.

Stephen Soldner
Field Technician

Education
B.S./Geology/2007
A.S./Math and Science/2003

Graduate coursework includes: Site Remediation, Aqueous Geochemistry, Environmental Geology, Hydrogeophysics, Introduction to Geographic Information Systems

Years of Experience: 8
Years with EA: 5

Relevant Highlights
- ✓ Extensive experience with various environmental sampling methods for groundwater, surface water, soil, sediment, and air
- ✓ Served as a geologist field technician for over $164M worth of environmental projects over the past 5 years.

Registrations/ Certifications/Training
- OSHA 40-Hour Hazardous Waste Operations and Emergency Response Training
- OSHA 8-Hour Refresher
- OSHA Hazardous Waste Operations and Emergency Response Supervisor Training
- OSHA 30-Hour Construction Management, Safety and Health
- Mine Safety and Health Administration Training
- AT Level I Anti-Terrorism Awareness Training
- CPR/First Aid/Bloodborne Pathogens Training

Mr. Soldner has been a field supervisor and geologist for 8 years. His primary responsibilities include qualitative field assessments, field sampling techniques, technical report writing, developing site characterization work plans, and qualitative/quantitative reporting. Mr. Soldner has experience with geotechnical investigations, soil and groundwater investigations, and remedial investigations.

Mr. Soldner has performed groundwater sampling using low-flow, bladder pump, peristaltic pump, and hand-bailing methods and experience with water parameter instruments, water sample collecting apparatus, air monitoring equipment, flame- and photo-ionization detectors, and well development via purging. He has also performed discrete and composite soil sampling using hand augers, Macrocore, hollow-stem augers, split-spoon Geoprobe as well as air quality sampling. He has performed logging and characterization for bedrock and overburden well installations. He has performed field screening of samples using x-ray fluorescence (XRF) technology. He has also provided oversight on remedial soil cover capping, soil excavation and offsite disposal, subslab depressurization system installation, sediment dredging, and air quality monitoring.

Bianchi-Weiss Greenhouses; East Patchoque, New York; New York State Department of Environmental Conservation; Support Scientist—Conducted discreet soil sample collection and oversight of piezometer installation for remedial action implementation at a former greenhouse facility. Assisted in authoring Final Engineering Report.

Air National Guard Vapor Intrusion Studies; Multiple Sites; National Guard Bureau; Scientist—These studies produced a multiple-lines-of-evidence evaluation to assess and provide recommendations for the management of potential vapor intrusion. Field investigation activities included the collection of sub-slab soil gas, indoor air, and outdoor air samples for volatile organic compound and radon analysis, completion of building surveys using volatile organic compound monitoring equipment (ppbRAE and HAPSITE gas chromatograph/mass spectrometry unit), conducting pressure differential monitoring, and the completion of subject building questionnaires. Assisted with the Vapor Intrusion Technical Memorandums that summarize analytical results and provide recommendations for the future management of potential vapor intrusion. Performed work in Delaware, Montana, Oklahoma, and Wyoming.

Puchack Well Field Superfund Site; Pennsauken, New Jersey; U.S. Army Corps of Engineers–Kansas City District; Sampler/Operator—Operated sodium lactate injection system. Responsible for completing daily calibration of equipment, routine operating and maintenance, and daily setup and take down of the treatment system. Conducted low-flow groundwater sampling using EPA low-flow sampling techniques.

Petersburgh Landfill New York State Superfund Site; Petersburgh, New York; New York State Department of Environmental Conservation; Construction Oversight—Provided oversight of the water treatment plant improvement site work being performed by the New York State Department of Environmental Conservation (NYSDEC) Standby Contractor for a remedial design that addressed perfluorooctanoic acid detections in the Town of Berlin, New York water supply. The remedy included addition of activated carbon filtration process to the plant's existing treatment train. Worked with the Town of Berlin water treatment operator and subcontractors performing work onsite.

Cleanup Investigation, Remedial Action Operations, and Long-Term Management at Tobyhanna Army Depot; Tobyhanna, PA; U.S. Army Environmental Command; Scientist—Led sampling event and collected groundwater samples for metals, volatile organic compounds, and monitored natural attenuation parameters using EPA low flow pumping techniques. Authored Annual Reports.

Yuma Proving Ground Environmental Remediation Services; Yuma, Arizona; U.S. Army Environmental Command/Yuma Proving Ground; Construction Manager/Geologist—Construction Manager and oversight for remedial capping of multiple landfills; locating features using Global Positioning System (GPS); installing swales, gates/fencing, and capping extents using GPS; confirmation soil sampling; overseeing and escorting of material-hauling trucks throughout the Army base; oversight of environmental precautions such as wildlife and avoidance of endangered species during construction activities; oversight of installation of security fencing, signage, and entry/exit points of multiple landfills. Assisted in authoring of Final Engineering Report.

Tuckahoe Former Marble Quarry Site; Tuckahoe, New York; New York State Department of Environmental Conservation; Geologist—As part of a site characterization, served as onsite geologist in charge of installation of five bedrock monitoring wells and three overburden monitoring wells. Logged, characterized, and sampled overburden soils during well installation. Logged and characterized marble bedrock cores from up to 80 feet below ground surface. Oversaw development of all wells and installation of soil vapor point locations. Assessed soil vapor sampling at eight locations and oversaw two ambient air sample collection via 2-hour Summa canisters. Performed groundwater sampling for VOCs, SVOCs, metals/mercury/cyanide, PCBs/pesticides, and PFCs sampling. Oversaw drumming, staging, and eventual disposal of all generated solid and liquid wastes. Assisted in authoring of Site Characterization Report.

Niagara Falls Air Reserve Station Performance-Based Remediation; Niagara Falls, New York; VERSAR, Inc.; Geologist—Conducted operation and maintenance visits for groundwater treatment systems, and conducted groundwater sampling via passive diffusion bag and EPA low-flow methods. Assisted in preparation of annual groundwater reporting for 2015-2017. Reviewed field reports and field sheets and updated master well database.

Camp Smith Remedial Investigation/Feasibility Study; Camp Smith, New York; U.S. Army Corps of Engineers–Baltimore District; Geologist/X-Ray Fluorescence Monitor Operator—Performed sediment sampling using both a 3-inch hand auger and multi-stage sediment sampler. Collected endpoint soil samples and utilized XRF instrumentation to field screen samples and determine lateral extents of lead/projectile contamination. Assisted in completion of Final Range Report.

Lackawanna Incinerator Site, Interim Remedial Measure; Lackawanna, New York; New York State Department of Environmental Conservation; Construction Oversight—Served as NYSDEC construction oversight representative for removal of lead- and arsenic-impacted soils, offsite disposal of contaminated soils, and backfill with clean soil. Collected endpoint soil samples and used XRF instrumentation to field screen samples and determine excavation depths and boundaries. Collected confirmation soil samples for laboratory analysis. Assisted in authoring Interim Remedial Measure Final Report.

Metal Etching Co., Inc.; Freeport, New York; New York State Department of Environmental Conservation; Support Scientist/Sampler—Conducted environmental sampling including low-flow water sampling and indoor air sampling.

Dansville Manufactured Gas Plant; Dansville, New York; New York State Department of Environmental Conservation; Oversight Engineer—Served as NYSDEC construction oversight representative for removal of coal tar-containing sediments and soils. Remediation included the use of sheet-pile installation to demarcate several areas of known contamination to be excavated. Provided construction oversight for sheet-pile installation, excavation and backfill activities, and site restoration. Primary responsibilities included overseeing tree removal and construction of tent structure of housing of contaminated soils, documenting soil removal, completing daily field reports, and public relations.

Saranac River Manufactured Gas Plant Operable Unit 1 Site; Plattsburgh, New York; New York State Department of Environmental Conservation; Oversight Engineer—Served as NYSDEC construction oversight representative for removal of coal tar- containing river sediments and river bank soils. Remediation included the use of a sheet-pile and headwater system to divert the Saranac River around the excavation area. Provided construction oversight for sheet-pile installation, excavation and backfill activities, bridge removal, asbestos abatement, and site restoration. Primary responsibilities included; recording daily river flow and turbidity, overseeing tree removal, documenting soil removal, completing daily field reports, and public relations.

Christopher Swanson
GIS/CADD Specialist

Education
A.A.S./CAD Technology/1999

Years of Experience: 18
Years with EA: 14

Relevant Highlights
- ✓ GIS/CADD Specialist on more than $380M worth of environmental contracts, of which $3M of work conducted in MN
- ✓ Thorough working understanding of metadata, data formats, quality, and sources of error

Registrations/ Certifications/Training
- Computer aided drafting USACE
- Computer Aided Design and Drafting Physics
- AutoCAD Civil Design
- MicroStation and GeoPAK Site
- GIS Mapping
- Database Management/ Development
- Site Grading
- Site Layout and Planning
- Computer-Aided Earthwork Quantity Calculations
- H2O Map

Mr. Swanson is a computer aided design and drafting (CADD) technician with 18 years of experience working on environmental and civil engineering projects for private contractors, municipalities, and state and federal agencies throughout the Midwest, Great Plains, and northeastern United States. His work experience includes subdivision site planning, public utility design, and site grading design. His software experience is AutoCAD Land Desktop R14 through 2009, AutoCAD Civil 3D 2006 through 2015 and AutoCAD Civil Design, MicroStation V8i and MicroStation GeoPAK Site, Global Mapper 14.2 and ArcGIS 10.3.1 – ArcMap.

Mr. Swanson's responsibilities include preparation of construction plans, preliminary plat plans, final plat plans, Natural Resources Conservation Service waste facility plans, municipal construction plans, dam removal plans, wetland restoration plans, and fish passage plans. He is also responsible for oversight of CADD technical staff, quality assurance/quality control review, and preparation of sampling plans.

Computer-Aided Design and Drafting and Computer Applications—Experienced in computer aided drafting packages (e.g., AutoCADTM Land and Civil Desktop, AutoCADTM Civil 3D, MicroStation TM, Global Mapper TM and ArcGISTM,) and computer-aided design processes. Proficient with grading and profiles in AutoCAD Civil Design and Civil 3D. Proficient with word processing software, spreadsheets, information management software, and desktop publishing software. Experience with a range of computer modeling programs, including programs associated with storm runoff and piping networks, where HEC-RAS and Hydraflow are applicable.

Spirit Lake Sediment Remediation Project, St. Louis River AOC; Duluth, Minnesota; EPA Region 5; CADD Manager—Responsible for confined disposal facility, dredging, capping, and stream restoration design, a 70+ sheet construction drawing set that includes production of grading-plan view sheets, profiles sheets, detail sheets, technical specifications for site design, and cost estimating. Assisted in grading design, plan review and production, and supervision of plan sets for design.

Atlantic Wood Industries; Portsmouth, Virginia; EPA Region 3; Portsmouth, Virginia; CADD Manager—Provided CADD support and grading design for portions of Atlantic Wood Industries project. Provided volume calculations for grading design that involved multiple levels of grading from the disposal of contaminated soils to be capped by a protection layer. Provided CADD figures for the dense non-aqueous phase liquid portion of the project to show how to build the capping area and that soils would be protected around capping area.

Bianchi/Weiss Greenhouses Site; East Patchogue, New York; New York State Department of Environmental Conservation; CADD Manager—Produced existing grading surface which was used to make a Geological cross section.

Remedial Investigation and Feasibility at the Old Upper Mountain Road Site; Lockport, New York; New York State Department of Environmental Conservation; CADD Manager—Prepared remedial investigation report for New York State Department of Environmental Conservation in accordance with Department of Environmental Remediation-10 guidelines. Identified remedial action objectives and conducted feasibility study for known environmental impacts associated with former site operations and disposal activities, include an assessment of groundwater and soil impacts and delineation based on field investigation. Provided CADD support, plan preparation, grading design, and supervise CADD staff.

Former Zephyr Oil Refinery Remedial Design; Muskegon, Michigan; EPA Region 5; CADD Manager—Remedial design included relatively dry excavation of 44,000 CY of contaminated sediments from a fire suppression ditch and associated wetlands, in situ treatment of characteristically hazardous sediments (lead), dewatering, water treatment, and offsite disposal. Provided plan preparation for all project phases while also helping with grading design and grading volume calculations.

Lower River Rouge Old Channel Remedial Action Oversight; Detroit, Michigan; EPA Region 5 Great Lakes National Program Office; CADD Manager—Provided oversight in earthwork design, wetland design, and plan production for cooperative remedial design for remediation of over 100,000 CY of coal tar-contaminated sediments across over 1.7 miles of the Lower Rouge River Old Channel.

Lincoln Park Feasibility Study/Remedial Design; Milwaukee, Wisconsin; EPA Region 5; CADD Manager—Field investigation, feasibility study, and public outreach for remediation of over 20,000 CY of TSCA-regulated sediments scattered throughout 2 miles of the Milwaukee River. RD, which targeted 10 scattered deposits of PCBs, PAHs, and fuel oil NAPL for dry excavation and small scale hydraulic dredging and disposal. Set up layout of project sheets and reviewed drawings to assure CADD standards were followed. Assisted in grading design and volume calculations using AutoCAD and GIS-based software.

Platte River State Park Wastewater Design; Platte River State Park, Nebraska; Nebraska Game and Parks Commission; CADD Manager—Served as point of contact with USACE on this $166K contract to provide interim landfill cap maintenance activities and tasks associated with the Storm Water Pollution Prevention Plan to remain compliant with the facility's RCRA permit, and to avoid any notices of violation from the Texas Commission on Environmental Quality. Ensured project execution within budget and schedule and in compliance with environmental regulations and policies.

Omaha Combined Sewer Outfall Green Infrastructure Project; Omaha, Nebraska; City of Omaha; CADD Manager—EA was contracted by the City of Omaha for design of green infrastructure elements at multiple sites to help reduce flows contributing to the combined sewer system. EA was tasked with the preparation of all engineering plans and specifications and bid documents as required for construction contracts. Specific tasks included field investigations, hydrologic and hydraulic modeling, utility coordination, permitting, public involvement, and bid-phase services. The projects included the design and installation of multiple underground storage systems that will serve to reduce the size, as well as lower the costs, of downstream piping and infrastructure. The projects also included enhancements to neighborhood parks as an added benefit to City residents. Involvement in project was to review and help in preparation of specific plans for all phases of project.

Design and Permitting of Livestock Waste Control Facilities; Multiple Locations; Multiple Clients; CADD Manager—Lead CADD drafter and organized CADD staff for the design and drafting of figures, grading design, and volume calculations. Collected information from the facility owners and compiled it into a Nutrient Management Plan. Data collected included site maps, application site summaries, cropping history, and yield goals. EA provided engineering services for livestock producers in confined and open-lot operations to meet regulatory requirements in obtaining construction and operation permits. EA performed site surveys, provided engineering design and specifications, prepared site plans and detail drawings, prepared and submitted permit applications for livestock waste control facilities, developed odor minimization plans, O&M plans, and groundwater monitoring plans. Provided engineering evaluation of existing facilities including capacity verification, seepage analysis, potential impacts to groundwater, and verification of contributing drainage areas. EA prepared design alternatives for facilities that were found to have deficiencies. EA also provided construction services including construction staking, construction oversight, and construction certification.

Odessa Chromium I Remedial Design Superfund Site; Odessa, Texas; EPA Region 6; CADD Manager—Site consists of two operable units (OUs): OU 1, which extends into the Odessa City water system to include service to provide an alternate water supply to affected areas, and OU 2, which addresses groundwater contaminated with chromium. This project prepared a pre-final/final remedial design for further expansion of the alternate water supply system to additional properties that are, or may become, impacted by the contaminant plume. Developed an H2ONet model. Prepared construction drawings and technical specifications. Assisted in production of design plans and utility design.

Cynthia Cheatwood
Human Health Risk Assessor 2

Education
M.S.P.H./Environmental Health/2016
B.S./Civil Engineering/1993

Years of Experience: 25
Years with EA: 18

Relevant Highlights
- ✓ Participated in 200+ HHRAs.
- ✓ Performs HHRAs using federal, state, and local agencies regulatory frameworks including CERCLA, EPA Human Health Risk Assessment Guidance for Superfund (RAGS), and multiple state Risk-Based Corrective Action programs.
- ✓ Designed statistically-based sampling programs to support RI HHRAs at NPL sites.
- ✓ Experienced and trained in community relations and presentation in high-risk, low-trust situations. Has presented at public meetings and information sessions to community groups, public officials, the media, the public, stakeholders, and regulators.
- ✓ Developed fact sheets, multimedia presentations, and roll-out strategies to aid risk communication under CERCLA and RCRA.
- ✓ Developed integrated remedial action objectives based on HHRAs and facilitated implementation in remediation.

Registrations/ Certifications/ Training
- OSHA HAZWOPER and Site Supervisor Training
- Confined Space Entry Training
- CPR and First Aid

Ms. Cheatwood has 18 years of experience as a risk assessor completing more than 200 human health risk assessments (HHRAs) from initial approach, development, and data collection to final risk modeling and results application. She has successfully negotiated approval from regulators and stakeholders for all aspects of the assessment process.

Ms. Cheatwood has conducted site-specific assessments for areas that include industrial complexes, parks, landfills, Brownfields sites, recreational areas, manufacturing facilities, and military bases. Her responsibilities include project management, data management, fate and transport modeling, exposure assessment, toxicity assessment, screening, risk calculation, and report writing. She has experience researching toxicity data, identifying site-specific exposure parameters, and developing multi-pathway risk calculations. She has also used various State and private sector risk modeling software for the completion of risk calculations. Ms. Cheatwood has also performed webinars and presentations to train and inform non-risk assessors the process and data needed for risk assessments.

Ms. Cheatwood has utilized GIS and specialized chemical analyses to produce more realistic risk assessment results that are immediately relevant to risk management. With GIS she has identified areas within a site that pose the greatest risk to human health and helped focus potential remedial actions to these areas. She is also familiar with the toxicity databases maintained by governmental agencies for use in determining alternative toxicity values for project use. She is familiar with risk management practices and has played a key role in implementing the findings of assessments in remediation of hazardous waste sites and potential future site reuse. She also has extensive experience in risk communications at a wide range of public meetings, having presented to a broad range of audiences, including audiences in high-risk, low-trust situations.

Project Experience

Remedial Action at the Atlantic Wood Industries Superfund Site; Portsmouth, Virginia; EPA Region 3; Environmental Engineer/Risk Assessor—Reviewed and calculated risk-based exposure concentrations for perimeter air monitoring activities during remedial actions at this Superfund site. Reviewed contractor risk assessments and previous modeling to determine appropriate levels for monitoring to protect residents living offsite.

Remedial Investigation, EVR Wood Treating/Evangeline Refining Company Superfund Site; Jennings, Louisiana; EPA Region 6; Senior Risk Assessor—Performed HHRA to support RI conducted at the site of a former wood-treating facility that preserved timber products with pentachlorophenol, copper arsenate, and creosote. The site also contained a former refinery that produced and stored naphtha, fuel oil, diesel, kerosene, gasoline, jet fuel, and reduced crude. The primary chemicals of concern were dioxin, pentachlorophenol, arsenic, and PAHs. Media evaluated included soil, surface water, sediment, fish tissue, crayfish, and groundwater. To determine potential areas that required remedial actions, performed a risk-based approach for cleanup levels that evaluated site-wide risk reduction.

Canal and Kings Creek Defense Site Environmental Restoration Tracking System Sites; Edgewood Area, Aberdeen Proving Ground (APG), MD; U.S. Army; Risk Assessor—Prepared baseline HHRA for multiple sites on Defense Site Environmental Restoration Tracking System (DSERTS) list. Sites included former laboratories, former chemical agent manufacturing facilities, landfills, disposal areas, munitions filling areas, and incinerator sites. Contaminants of concern (COCs) included PCBs, arsenic, lead, and VOCs. Primary media of concern were soil, surface water and sediment. Risk evaluations were expedited to gain regulatory concurrence of NFA for 14 sites. The risk assessments included over 50 DSERTS Sites resulting in one of the most complex DoD sites ever addressed through

CERCLA. Used pre-HHRA site use/COPC/exposure area evaluations to determine if and how sites could be combined. By grouping the sites, EA significantly reduced the number of risk assessments required, thereby reducing cost by 50% and expediting schedule by reducing regulatory review time. The baseline HHRA included evaluation of over 200 site/exposure pathway/receptor/ environmental media combinations.

Remedial Investigation, North East 2nd Street Superfund Site; Happy, Texas; EPA Region 6; Senior Risk Assessor—Performed HHRA to support Remedial Investigation conducted at the site of a carbon tetrachloride spill. Carbon tetrachloride and ethylene dibromide were identified as potential contaminants in a public water supply well. Evaluated groundwater contamination at the site, and performed evaluation of potential vapor intrusion (VI) from groundwater to indoor air. The groundwater plume underlies residential properties and has affected residential water supply wells. The site evaluation was complicated due to the presence of another groundwater plume contaminated with gasoline products (benzene, ethylene dibromide).

Risk Assessment of Coke Point Offshore Environments, Sparrows Point, Maryland; Maryland Port Administration; Senior Risk Assessor—Performed HHRA for offshore areas adjacent to a former steel-manufacturing facility in a heavily contaminated urban estuary with a history of PCB and chromium releases. Evaluated potential impacts to offshore surface water, sediment, fish, and crab tissue. The risk assessment evaluated separate human exposure scenarios based upon expected re-use of the property. Evaluated fish and crab tissue samples, and the determination of chemical concentrations in fish and crabs using bio-uptake factors. Determined which areas of the offshore sediment contribute significantly to HHRA results to determine where the greatest risk reduction might occur with remedial action. Completed a sensitivity analysis of the risk assessment that evaluated various input parameters including exposure, background evaluations, and toxicity. Participated in 12 public information sessions that involved presenting the results of the risk assessment to elected officials, public interest groups, community group leaders, local press, and the public.

Verona Phase I/II; Howard County, Maryland; Howard County Housing Commission; Senior Risk Assessor—The project involved an apartment complex that the Howard County Housing Commission had contracted to purchase. During the Phase II investigation, it was discovered the site was located adjacent to a gas station that had a release of 10,000 gallons of petroleum in the 1980s. Soil gas sampling surrounding the apartment complex revealed benzene, toluene, ethylbenzene, and toluene levels above EPA VI screening levels. The Howard County Housing Commission made the results of a VI study and risk assessment as a contingency on the sales contract. Recommended sub-slab samples to determine if there are potential concerns with VI since the owner would not allow indoor air sampling. Determined appropriate sampling approach to ensure the quality and strength of the risk assessment. Performed risk assessment based on sub-slab sample results and exposure parameters appropriate for potential residents of the apartment building to ensure that the risk results were indicative of expected exposures.

Vapor Intrusion Remedial Investigation; Aberdeen Proving Ground; U.S. Army Environmental Command; Senior Risk Assessor—Performed baseline HHRA to assess VI risk. Assisted in design of remedial investigation, which was the first to develop a systematic installation-wide VI sampling program for over 150 buildings over 14 groundwater plumes and sources areas at APG to assess VI and indoor air risk. The systematic process was so well regarded that both the Army and EPA Region 3 provided the sampling program/logic to other installations and contractors as a template for VI investigations at DoD facilities. The baseline HHRA assessed risk to on-Base site workers for inhalation of VOCs, with primary concerns for TCE and PCE. Results of the risk assessment were used to eliminate areas and buildings from further VI consideration and identified 2 buildings that required VI mitigation and 13 buildings that required monitoring.

Hidden Lane Landfill HHRA; Sterling, Virginia; EPA Region 3; Senior Risk Assessor—Evaluated and performed an HHRA of groundwater, indoor air, surface water, and sediment contamination from a closed, unlined landfill. The complex hydrogeology at the site warranted a detailed risk assessment of different aquifers at the site and dividing potential receptors into varying exposure areas. The site was further complicated by contamination in adjacent, residential wells which also were evaluated to determine potential concerns to residents who live adjacent to the landfill.

Former Lake Ontario Ordnance Works; Lewiston, New York; USACE; Human Health Risk Assessor—Project Task Manager responsible for all aspects of the HHRA. The HHRA included nine separate areas with seven receptors per area. Main COCs included PCBs, VOCs, PAHs, and arsenic. In addition to soil, surface water, sediment, and groundwater analysis, the risk assessment analyzed the consumption of deer meat, plants, and vegetables. The HHRA also included an indoor air risk assessment and the potential risks associated with groundwater inhalation from outdoor air. Evaluated underground pipelines for exposure to the contents and seepage into the surrounding soils. Participated in public meetings and presentation of risk assessment results and implications to community and project stakeholders. Prepared a Risk Management Decision Document that integrated results from multiple RI reports and risk assessments.

Dan Hinckley, Ph.D.
Human Health Risk Assessor 3

Education
Ph.D./Marine Chemistry, Chemical Oceanography/1989
M.S./Environmental Chemistry/1985
B.S./Chemistry/1983

Years of Experience: 36
Years with EA: 27

Relevant Highlights
- ✓ Performed more than 300 ecological and human health risk assessments; successfully negotiated approval from regulators and stakeholders for all aspects of the assessment process. Experienced conducting risk assessments at CERCLA, RCRA, BRAC, FUSRAP, MMRP, and FUDS sites Nationwide. Worked with risk assessors in more than a dozen states (including NYSDEC) and 7 EPA Regions including Region 5.
- ✓ Program Chemist/Risk Assessor for several EPA RACs, performing and reviewing human health and ecological risk assessments on 11 sites in two regions in the last two years.
- ✓ As EA's technical expert, supported human and ecological risk assessment and risk management decisions integral to chromium assessment and/or remediation for more than 40 sites.
- ✓ Adjunct Professor on Toxicology at John Hopkins University for 10 years.

Registrations/ Certifications/ Training
- Department of Defense Environmental Monitoring and Data Quality Workshops (data quality/treatment, Multi Incremental Sampling, and EPA UFP-QAPPS)

Dr. Hinckley has 29 years of experience managing and performing human health and ecological risk assessments in support of remedial actions on DoD and EPA sites nationwide, and a successful record negotiating approval from regulators and stakeholders for all aspects of the assessment process. He has developed/approved more than 350 QAPPs including 150 UFP-QAPPs under CERCLA, RCRA, and state regulations, working with peers in eight EPA regions (including the upper Midwest, EPA Region 5) and in more than a dozen states. Dr. Hinkley reviews/approves data quality objectives (DQOs) and assists in statistical evaluations to determine confidence levels, tolerable error, false positive and negative rates, and overall verification of DQO attainment; verifies results of statistical programs (Visual Sampling Plan) to determine appropriate sample numbers and alpha and beta error rates; and establishes numbers and type of quality control samples

Dr. Hinckley has developed risk assessment exposure models, derived benchmarks and remedial action objectives, and conducted exposure and effects assessments of plants, aquatic organisms, and wildlife. He has conducted supplemental sampling to support human health assessment of risks from vapor inhalation, plant, fish, and wildlife consumption and developed spatial models of chemicals driving risks as well as risk-based thresholds. He directs interaction with laboratories, validators, and data management professionals to ensure data integrity and quality, and resolve data discrepancies.

Project Experience

Atlantic Wood Industries Superfund Site Investigations and Remedial Designs; Portsmouth, Virginia; EPA Region 3; Program Chemist/Risk Assessor— Contamination of offshore Elizabeth River sediments, site soils, and groundwater have led to a long-term cleanup effort that includes site investigations, remedial investigations, remedial action monitoring, and long-term monitoring. As program chemist, interacts with the regional EPA laboratory to assure that quality assurance/quality control procedures are being complied with, that any problems are dealt with appropriately and followed through. In addition, monitors discharge limits, assists in the preparation and reviews project quality assurance documents, conducts technical reviews, and addresses various chemical issues. Reviewed all QAPPs and chemistry-related work products, amounting to at least 10 documents.

Spirt Lake Pre-Design Investigation; Duluth, Minnesota; EPA Region 5, Great Lakes National Program Office; Program Chemist/Risk Assessor—In support of the latest environmental remediation effort at this CERCLA site, EA performed a comprehensive pre-design investigation which required a major data collection effort within the upland, wetland, and open water portions of the site. As program chemist, assists in sample design, senior technical reviews of all QAPPs and Data Usability Assessment Reviews and assists in chemical and data quality issues that arise during the investigation. Reviewed the sampling plan and all other chemistry-related project deliverables.

Alpena Combat Readiness Training Center Remedial Action-Operations, Long-Term Monitoring, and Project Closeout; Duluth, Minnesota; Michigan Air National Guard; Program Chemist/Risk Assessor—Assisted in sample design, performed senior technical review on UFP-QAPPs, participated in meetings with clients on the QAPP and risk assessments, resolved chemical data quality and sampling issues, and conducted screening level ecological risk assessments. Reviewed most project deliverables including the field sampling plan, HHRA, ERA, RI, FS, and data usability for long-term monitoring.

Aberdeen Proving Ground; Edgewood, Maryland; Air Force Center for Engineering and the Environment; Risk Assessor—Served as a Human Health Risk Assessor at two sites: Site 1, groundwater VI for which the HHRA was performed and at Site 2, the Bush River, a sediment-contaminated site for which the RI report was reviewed. Assisted in VI efforts at both sites as a senior technical reviewer of the QAPP and HHRA, as well as for the ecological risk assessment at Site 2. One analysis performed for this area involved a study of mercury in fish in the creeks draining the Proving Ground. Analysis demonstrated that the fish located in these creeks and adjacent to the proving ground have significantly higher mercury than fish from outside of the area. As a result, the creeks were posted for no fishing.

Great Lakes Architect Engineer Services Contract; 9 Areas of Concern, Indiana, Michigan, Minnesota, Ohio, Wisconsin; EPA Region 5 and Great Lakes National Program Office; Program Chemist/Risk Assessor— Directs the Chemical Quality Program for RI/FS, RD, and PRP Oversight services at 15 sediment-contaminated sites in the Great Lakes Areas of Concern, including one Superfund site. Performed senior technical review on all QAPPs and FSPs in accordance with EPA QA/R-5 and EPA QA/G-9; development of corrective measures study and DQOs; selection of analytical methods; and interacted with regional EPA laboratories to ensure compliance with quality assurance/quality control procedures. Provided senior technical review for all data usability and assessment reviews associated with the program. Assisted PMs with correct methodology and interpretation of results.

Program Chemist/Risk Assessor; U.S. EPA Regions 3, 6, and 9—Serves as program chemist and lead risk assessor for 10-year programs that include all aspects of EPA Regions 3, 6, and 9 responsibilities. This includes site investigations, RIs, remedial action monitoring, and long-term monitoring. As program chemist and risk assessor, interacts with regional EPA laboratories to assure appropriate QA/QC procedures are complied with and that any problems are dealt with appropriately. Reviews and assists in preparation of QAPPs and FSPs.

To date, Dr. Hinckley has worked on more than 25 individual projects, including Conceptual Site Model (CSM) development, QAPP development and review, senior technical reviews, reviewing PRP risk assessments, attending project meetings, performing and reviewing fund-lead risk assessments, assisting in DQO determinations, and other chemical and risk-associated tasks. Example tasks include:

- Oversight and review of multiple Region 6 ecological and human health risk assessments, including those for the Donna Reservoir and Canal, Sandy Beach Road Groundwater Plume, Van der Horst USA Corporation, and Texarkana Wood Preserving Co. Superfund sites.
- Atlantic Wood Industries (AWI) Superfund Site Cleanup; Elizabeth River, Portsmouth, Virginia—Performed risk assessments at a former wood treatment facility contaminated with creosote, PCP, PAHs, dioxins, and metals (arsenic, chromium, copper, lead, and zinc) in river sediments, soil, and groundwater. Developed a methodology to assess the impact of site remediation in an area consisting of multiple habitat types. Performed an assessment of potential re-contamination of the AWI river sediments from upstream sources. Reviewed data quality associated with discharge monitoring limits, reviewed project documents, and provided technical support for chemistry.
- Donna Canal Superfund Site; Donna, Texas—For this assessment of PCB risks in the canal, assisted in sample design, reviewed QAPP, and assisted with ongoing chemical issues. Performed senior technical review for both the human health and ecological risk assessments and sample and analysis plans.
- EVR-Wood Treating Superfund Site; Jennings, Louisiana—Developed an ecological CSM and reviewed human health CSM. Assisted with analytical method selections for the site and reviewed the sample and analysis plan. Subsequently served as senior technical review for the risk assessment, data validation reports, and data usability reports.
- North Penn 6, Pennsylvania—Assessed cumulative risks and met with the EPA Region 3 Remedial Project Manager and Risk Assessor. Collaborated with EPA Risk Assessor on HHRAs and reviewed risk calculations.

Corrective Action Plan Implementation; Selfridge Building 1533, Selfridge Air National Guard Base, Detroit Arsenal, Michigan; U.S. Army Environmental Command; Senior Technical Reviewer—Served as senior technical reviewer for quality assurance project plans for this project. Activities included *in situ* and *ex situ* remediation, long-term monitoring, and remediation system operations and maintenance at Building 1533.

Daniel McNeely
On-Site Inspector

Education
B.S./Geography/2004

Years of Experience: 13
Years with EA: 3

Relevant Highlights
- ✓ Has served on over $10M worth of projects as a field manager during three years with EA
- ✓ Excellent working relationship coordinating with project managers to ensure timely and cost-effective completion of projects
- ✓ Experience with Minnesota environmental regulations

Registrations/ Certifications/ Training
- OSHA HAZWOPER, Site Supervisor, and Construction Safety and Health Training
- OSHA Training Institute – 510: Occupational Safety and Health Standards for the Construction Industry
- Construction Management Association of America University; Construction Safety and Health
- Michigan Asbestos Building Inspector
- Michigan Lead Inspector/Risk Assessor
- U.S. Department of Transportation – Hazardous Materials Transportation
- RCRA/Department of Transportation Training for Generators of Hazardous Waste
- CPR and First Aid

Mr. McNeely has over 13 years of professional experience in environmental, health, and safety compliance; due diligence; environmental remediation; construction and demolition management; decommissioning, and infrastructure upgrade projects for federal, industrial, commercial, and municipal clients. He has extensive experience performing site assessments, environmental sampling, building characterization, RAs, indoor air quality assessments and industrial hygiene, cost estimating, waste management, and coordination of multiple tiers of subcontractors and contractor oversight. He has overseen construction, decommissioning, demolition, and remediation projects and has managed subcontractors, health and safety programs, QAPPs and site-specific HASPs, project schedules and budgets, and responsibility for overall project execution for a variety of project types. Many of his projects have involved complex orchestration between parties including higher and lower-tier contractors, clients, regulators, and community stakeholders, and range in value from less than $25,000 to over $400 million.

Mr. McNeely's areas of specialization include habitat restoration; UST removal and disposal; mercury, lead, PCBs, and asbestos removal/abatement; facility cleaning; and waste management. He has experience performing installation of remediation systems, operation and monitoring of such systems, *in situ* soil and groundwater remediation, and *ex situ* remedies including many offsite disposal (dig/haul) remedial actions for federal, state, and commercial/industrial clients.

Mr. McNeely is additionally familiar with all aspects of due diligence including the development and implementation of site investigation work plans for a variety of clients across all environmental media. He has extensive experience sampling soil, groundwater, surface water, sediment, and air and understands bulk and surface (wipe) sampling of structural components, particularly for lead, asbestos, PCBs, and mercury. He has also undertaken various non-intrusive due diligence activities including historical records reviews and personnel interviews.

Project Experience

Remedial Action-Operations, Long-Term Monitoring, and Project Closeout; Sites 3 and 25, 148th Fighter Wing, Duluth, Minnesota; Minnesota Air National Guard; Site 9, Alpena Combat Readiness Training Center; Alpena, Michigan; Michigan Air National Guard; Field Manager—Field Manager for groundwater data gap investigations, *in situ* and *ex situ* remediation, long-term monitoring and project closeout conducted at the 148th Fighter Wing Sites 3 and 25 in Duluth, Minnesota and at the Alpena Combat Readiness Training Center Site 9 in Alpena, Michigan. Activities include monitoring well installation, direct-push technology soil boring investigation, excavation, and disposal of petroleum-impacted soils, groundwater treatment via injections utilizing multiple substrates (EHC, EHC-L, and Nutrisulfate), and bioaugmentation utilizing a dehalococcoides inoculum, and placement of oxygen-release compound Advanced® as an excavation backfill amendment. Activities are currently ongoing and scheduled to continue through September 2018. Responsible for successfully executing all field activities including ensuring coordination between subcontractors, clients, and regulators, and balancing budgetary and schedule concerns as well as ensuring the health and safety of all onsite personnel are protected during the project.

Environmental Remediation Services, Selfridge Building 1533, Detroit Arsenal; Harrison Township, Michigan; U.S. Army Environmental Command; Field Manager—Served as field lead when EA assumed operations and monitoring of an existing air sparge/soil vapor extraction system. Also served as field manager during remedial construction at this former Nike missile facility that is currently used by the U.S. Customs and Border Patrol for vehicle maintenance. Remedial construction activities completed at the site included soil excavation, excavation dewatering, installation of an air sparge system in combination with oxygen-releasing compound injections to treat groundwater

impacts, and installation of a bioventing and sub-slab depressurization system. Ongoing support for this project includes O&M of the newly installed air sparge system.

Zephyr Remedial Action, Former Zephyr Refinery Fire Suppression Ditch; Muskegon, Michigan; EPA Region 5 Great Lakes National Program Office; On-Site Inspector—Performed construction oversight during remediation of contaminated sediments within a wetland adjacent to the Muskegon River, and expected to continue in this role for most of 2018 including subsequent wetland habitat restoration activities. Remedial design included relatively dry excavation of contaminated sediments, in situ treatment of characteristically hazardous sediments (lead), dewatering, water treatment, and offsite disposal of contaminated sediments. Assisted with community outreach, including participation in public meetings and coordination with local stakeholders.

Habitat Restoration Oversight, St. Clair River Area of Concern; St. Clair County, Michigan; EPA Region 5 Great Lakes National Program Office; On-Site Inspector—Performed construction oversight for a series of habitat restoration and shoreline stabilization projects along the St. Clair River shoreline. Projects included invasive species management, restoration of river stone substrate, removal of seawalls, and installation of woody habitat structures, riprap walls, boulder clusters and breakwaters. Fish passage in a St. Clair River tributary was improved by elevating the creek bed and installing flow control features that included pools, vanes, and riffles along various reaches of the creek within the restoration project area.

Vapor Intrusion Study, Zanesville Air National Guard Station; Zanesville, Ohio; Air National Guard Restoration Branch; On-Site Inspector—During work plan implementation, assessed whether subsurface soil gas and potential vapor intrusion into indoor spaces was a complete or incomplete pathway. Activities included installation of sub-slab sampling points using a hammer drill, leak testing the sampling points, indoor air, and sub-slab air sampling using summa canisters and flow regulators, real-time ambient air quality monitoring and pressure differential monitoring during sampling, and site restoration activities.

Emerging Contaminant Investigation; Multiple Air National Guard Installations throughout the United States; National Guard Bureau; Field Manager—Field manager for the investigation of emerging contaminants (i.e., 1,4-dioxane and perfluorooctanoic acid/ perfluorooctanesulfonic acid) at 7 Sites across 5 Air National Guard Installations throughout the Midwestern United States. Investigation included monitoring well sampling and installation. Investigations are conducted under a global HASP/accident prevention plan and site-specific work plans. Site-specific summary reports will be prepared.

Soil Boring, Screening and Sampling at In-filled Creek Bed; Harrison Township, Michigan; Selfridge Air Force Base; On-Site Inspector—Used a handheld XRF analyzer to determine biased sampling locations for metals within soil cuttings collected from the vicinity of an in-filled former creek. Explored dense vegetation to determine locations of "lost" monitoring wells, and gauged groundwater elevations. Soil samples were gathered using a continuous soil collection method within an acetate liner, screened for VOCs with a photo-ionization detector, and sampled with bias to elevated VOC detections.

Phase II ESA and IR/UV/RF Screening; Quapaw, Oklahoma; Confidential Client; Field Manager—Assisted in the execution of a Phase II ESA. This included conducting contractor oversight, soil classification and soil sampling. Additionally, selected indoor locations were surveyed using a handheld meter for infrared, ultraviolet and radio frequency radiation.

Indoor Air Quality Investigation; Cleveland, Ohio; Confidential Client; On-Site Inspector—This project required indoor air sampling for VOCs using summa canisters as well as air sampling for mercury using adsorbent charcoal tubes. Indoor air quality was also surveyed for mercury vapors using a mercury vapor meter. The scope of work was repeated five times to definitively determine that the level of risk for the planned building use was acceptable. Sampling occasionally occurred on weekends and overnight.

Contractor Oversight and Air Monitoring – Lead Based Paint Removal/Encapsulation; Ann Arbor, Michigan; University of Michigan; Field Manager—Responsible for initiation of daily health and safety tailgate meetings, providing contractor oversight and air monitoring for airborne lead particulate during and after lead-based paint removal activities. The project location was the grounds surrounding the President's Residence. For this project, special precautions including pre-arranged media responses were prepared due to the presence of the nearby Ann Arbor Art Fair.

Arthur Peitsch, PMP
Project Manager

Mr. Peitsch has over 20 years of experience executing technical programs for a variety of environmental services including soil/groundwater investigation and remediation, environmental compliance, due diligence, and construction oversight for state, federal and private industry clients. Mr. Peitsch is well versed in RCRA, CERCLA, and numerous other federal and state regulations, including MPCA and MDH regulations.

As a Project Manager, Mr. Peitsch has served as the main point-of-contact, directed multidisciplinary project teams, oversaw and coordinated with subcontractors, reviewed and interpreted analytical data, and directed the preparation of related plans and technical reports for more than 40 projects. He formerly served as the Program/Contract Manager for the U.S. Coast Guard (USCG) Civil Engineering Unit Cleveland A/E Environmental Services Contract: a 5-year, $12.5 million contract. Responsibilities as Contract Manager included overall contract performance, cost and schedule tracking for the contract, preparing and submitting cost proposals, resource scheduling, preparation of monthly contract and Task Order progress reports, and management of over 25 Task Orders. Projects performed under this contract included site investigations, Phase I environmental site assessments, *in situ* and *ex situ* remediation, compliance plan development, sediment sampling, geotechnical investigations, fuel station design and construction, hydrologic assessments, and wetlands assessments.

Project Experience

Remedial Action-Operations, Long-Term Monitoring, and Project Closeout; Sites 3 and 25, 148th Fighter Wing, Duluth, Minnesota, Minnesota Air National Guard, and Site 9, Alpena Combat Readiness Training Center, Alpena, Michigan, Michigan Air National Guard; Project Manager—Managed groundwater data gap investigations, *in situ* and *ex situ* remediation, long-term monitoring, and project closeout conducted at the 148th Fighter Wing Sites 3 and 25 in Duluth, Minnesota and at the Alpena Combat Readiness Training Center Site 9 in Alpena, Michigan. Activities include monitoring well installation, direct-push technology soil boring investigation, excavation and disposal of petroleum-impacted soils, groundwater treatment via injections utilizing multiple substrates (EHC, EHC-L, and Nutrisulfate) and bioaugmentation utilizing a *dehalcoccoides* inoculum, and placement of oxygen release compound Advanced® as an excavation backfill amendment. Activities are currently ongoing and are scheduled to continue through August 2019. All activities performed in accordance with MPCA/MDH and Michigan Department of Environmental Quality regulations. Responsible for all aspects of the project.

Corrective Action Plan Implementation, Building 1533, Selfridge Air National Guard Base, Detroit Arsenal, Michigan; U.S. Army Environmental Command; Project Manager—Managed *in situ* and *ex situ* remediation, long-term monitoring, and remediation system operations and maintenance at Building 1533. Activities include excavation and disposal of petroleum-impacted soils, groundwater treatment via injections utilizing an oxygen release substrate, installation of a new air sparge system, installation of sub-slab depressurization and bioventing systems, operations and maintenance of the existing air sparge system, and collection of soil gas and groundwater samples for long-term monitoring. Activities are currently ongoing and are scheduled to continue through July 2020. Responsible for all aspects of the project.

Underground Storage Tank Removal and Site Investigation Services, Canton, Michigan; Linde Gas North America; Project Manager—Managed underground storage tank removal and site investigation services at the Linde Gas North America distribution facility in Canton, Michigan. Activities included excavation, removal, and disposal of two

Education
B.S./Biochemistry/1998

Years of Experience: 20
Years with EA: 4

Relevant Highlights
- ✓ Managed 40+ projects with a combined value of $15M+, including CERCLA and RCRA investigations, designs, remedial actions, and O&M of remediation systems.
- ✓ 5+ years of experience providing environmental services in the State of Minnesota.
- ✓ Prepared presentations and presented technical information and data to clients, the public, and other stakeholders, including MPCA regulators.
- ✓ Authored or supervised production of over 250 technical documents, including: Work Plans, Closure Reports, Quality Assurance Project Plans, Data Validation Reports, and others.
- ✓ Managed over 5 projects concurrently while adhering to project scope and maintaining schedule and budget
- ✓ Proven ability to creatively solve problems with a client focus, e.g., proposed concurrent performance of projects in Lake Superior to reduce logistics-related costs by an estimated $500K.

Registrations/ Certifications/ Training
- Project Management Professional (No. 1414815)
- RCRA Hazardous Waste Regulations Training
- OSHA HAZWOPER and Site Supervisor Training
- CPR and First Aid Training

underground storage tanks (one 5,000-gallon acetone, one 10,000-gallon diesel); collection of confirmatory soil and groundwater samples; removal and disposal of the diesel dispenser; site restoration; and preparation and submittal of a Site Assessment Report. Additional site investigation activities included direct-push soil borings, temporary well installation, collection of soil and groundwater samples, site restoration, and preparation and submittal of a Closure Report. Site closure was achieved in January 2018. Responsible for all aspects of the project.

Environmental Remediation Services, Selfridge Air National Guard Base, Mt. Clemens, Michigan; National Guard Bureau; Senior Project Manager—Managed soil and groundwater site assessment, *in situ* and *ex situ* remediation, and long-term monitoring conducted at 25 sites at Selfridge Air National Guard Base in Mt. Clemens, Michigan. Activities included monitoring well installation, direct-push technology soil boring investigation, excavation and disposal of metals- and petroleum-impacted soils, installation of a reducing permeable reactive barrier to eliminate contaminant migration off-base, hot spot groundwater treatment via metals reducing compound and fly ash injections, installation of an asphalt cap over a former landfill area, placement of PermeOx Plus® or potassium permanganate as excavation backfill amendments, performing preliminary assessments/site inspections at 18 new sites, landfill cap inspections, groundwater recirculation, and potassium permanganate injections. Selfridge Air National Guard Base is the largest active ANG Base in the U.S. Responsible for all aspects of the project.

Remedial Action, Site Restoration, and Closeout, Plum Island Light Station, Door County, Wisconsin; United States Coast Guard; Project Manager—Managed *ex situ* remedial action, site restoration, and closeout support activities at an active light station to support the USCG with property divestiture. Removed and disposed of over 600 cubic yards of lead-impacted soil, utilizing trucks via barge for transport. Performed site restoration activities that included institutional controls (installing warning signage) around various structures on the island. Successful completion of restoration allowed the USCG to achieve site closeout and property divestiture under Wisconsin Department of Natural Resources Regulations. The property was successfully transferred to the U.S. Fish and Wildlife Service and is now a part of the Green Bay National Wildlife Refuge. Responsible for all aspects of the project.

Site Investigation, Station Sturgeon Bay, Sturgeon Bay, Wisconsin; USCG; Project Manager—Managed soil, groundwater, and soil gas site assessment conducted at USCG Station Sturgeon Bay in Sturgeon Bay, Wisconsin. The USCG property is currently used as an active search and rescue station. The site investigation was focused on potential contamination from former underground storage tanks. Analytical results indicated the absence of subsurface contamination. Based on the analytical results, the Wisconsin Department of Natural Resource granted Conditional Closure for the site. Responsible for all aspects of the project.

Cleanup to Support Divestiture, Rock of Ages Light Station, Isle Royale National Park, Keweenaw County, Michigan; USCG; Project Manager—Managed interior cleanup of the Rock of Ages Light Station located within Isle Royale National Park in Keweenaw County, Michigan. The Rock of Ages Light Station is currently used as an active aid-to-navigation. The interior cleanup was performed to remove hazardous materials, construction debris, and general rubbish in anticipation of property divestiture to the National Park Service. The site is located on a remote Island and posed logistical challenges with respect to mobilizing personnel and equipment to the site and removing hazardous and non-hazardous materials. Responsible for all aspects of the project.

Remedial Action Coordination, Passage Island Light Station, Isle Royale National Park, Keweenaw County, Michigan; USCG; Project Manager—Managed negotiations and coordination for a planned lead-in-soil remedial action performing site restoration at an active light station located within the boundary of Isle Royale National Park. Prepared and performed scoping session with National Park Service employees to negotiate limits of remedial action. Led bidding walk with potential subcontractors and negotiation session with USCG and third-party property recipient to identify critical areas of restoration and site-specific requirements. Following completion of remedial action and restoration, the property will be divested under the USCG-specific CERCLA process developed in conjunction with EPA Region 5 and transferred to the National Park Service. Responsible for all aspects of the project.

Phase II Assessment of Contaminated Sediments, St. Louis River Area of Concern, Duluth, Minnesota; EPA Region 5; Project Scientist—Project Scientist responsible for assisting with work plan development associated with Phase II Assessment of contaminated sediment activities at the Zone 1 and Zone 2 project areas. Investigation activities included the advancement of up to 75 sediment cores to delineate impacts noted during Phase I investigation activities. Results were summarized in a Site Characterization Report. Sampling activities were completed in August 2014.

Frank Barranco, Ph.D., P.E., P.G., C.M.Q./O.E.
Quality Assurance/Quality Control Officer

Dr. Barranco plays a central role in EA's Quality Management Program as the Director of QC and, as such, authors and implements EA's company-wide QA and QC policies, guidance documents, and standard operating procedures. Dr. Barranco participates in hundreds of Project and Program Reviews and quality audits across the company on a quarterly basis, using these sessions to mentor staff, support issue identification (and resolution), and ensure quality work products are delivered to our clients. In addition to developing quality-related manuals and standard operating procedures, one or more of the Technical Chiefs conducts quarterly project reviews with the project managers across the company. As Technical Chief Geologist, Dr. Barranco participates in hydrogeology-related Project and Program Reviews, participates in proposal development and client service, provides technology transfer to geologists, and tracks geologic licensure requirements.

Dr. Barranco's specific area of technical expertise relates to the occurrence, fate, persistence, and cleanup of subsurface non-aqueous phase (LNAPL and DNAPL) and aqueous phase hydrocarbons in hydrogeologic settings. Dr. Barranco has worked with state, private industry, federal, and municipal clients. He has managed and/or served in a senior technical capacity for site assessment and subsurface remediation of soil and groundwater impacted with petroleum and/or hydrocarbon constituents at sites located across the U.S. Commensurate with this role, Dr. Barranco serves as a senior resource for former Manufactured Gas Plant Services. As an EA specialist in innovative *in situ* cleanup of soil and groundwater, he has conducted pilot- and full-scale NAPL source remediation and groundwater plume management involving product recovery, chemical oxidation, steam enhanced remediation, surfactant/co-solvent injection, augmented bioremediation, aquifer air sparging/soil vapor extraction, UVB in-well stripping, and monitored natural attenuation. In addition, Dr. Barranco's academic research has addressed issues related to the transport, transformation, and fate of DNAPLs (viscous and non-viscous), including complex organic liquid mixtures, within subsurface porous soil and fractured rock settings. His academic research has resulted in several key peer-review publications addressing the subsurface mobility, entrapment, and remediation of manufactured gas plant coal tar, chlorinated solvents, and other DNAPLs.

Project Experience

Spirit Lake Sediment Remediation Site Feasibility Study, PDI, and Remedial Design; Duluth, Minnesota; EPA Region 5; QA/QC Officer—EA has completed treatability studies, RI/FS support, field oversight, benthic community conditions assessment, hydrodynamic modeling, and a multi-phase pre-design investigation in support of the remediation of this 300-acre site within a complex hydrodynamic system. EA is currently preparing the RD, which includes multiple remedy elements to address over 700,000 CY of PAH- and metals-contaminated sediment. Reviewed multiple project plans, provided technical expertise on treatability study implementation, evaluated the selection of analytical methods and specialized testing, and oversaw preparation of and subcontractor adherence to corrective action plans.

Education
Ph.D./Environmental Science and Engineering/1998
M.S./Geology/1988
B.S./Geology/1984

Years of Experience: 29
Years with EA: 22

Relevant Highlights
- ✓ 11 years as EA's Corporate Quality Officer for $600M of federal contracts including investigation/design/ remediation/LTO/LTM.
- ✓ Oversees and assists with development of QAPPs and Program Plans to specify project methodology, sampling plans, analytical objectives, data management, and construction specification adherence.
- ✓ Analytical QA/QC activities include monitoring analytical subcontractor quality, conducting laboratory technical qualification auditing, and assessing subcontractor's quality management program.
- ✓ Expertise in source area and groundwater remediation, site characterization and non-aqueous phase liquid detection, remedial feasibility and treatability studies, and hydrogeologic and subsurface contaminant modeling.
- ✓ Adjunct Professor at Johns Hopkins University teaching course on Environmental Programs.

Registrations/ Certifications/ Training
- Certified Manager of Quality/Operational Excellence
- Registered Professional Engineer—Maryland
- Registered Professional Geologist—Tennessee
- OSHA 40-HAZWOPER
- CPR and First Aid Training

Remedial Action-Operations, Long-Term Monitoring, and Project Closeout; Sites 3 and 25, 148th Fighter Wing, Duluth, Minnesota, Minnesota Air National Guard, and Site 9, Alpena Combat Readiness Training Center, Alpena, Michigan, Michigan Air National Guard; Senior Technical Reviewer—EA is conducting groundwater data gap investigations, *in situ* and *ex situ* remediation, long-term monitoring, and project closeout at three sites. Activities include monitoring well installation, direct-push technology soil boring investigation, excavation and disposal of petroleum-impacted soils, groundwater treatment via injections utilizing multiple substrates (EHC, EHC-L, and Nutrisulfate) and bioaugmentation utilizing a *dehalcoccoides* inoculum, and placement of oxygen release compound

Advanced® as an excavation backfill amendment. Activities are currently ongoing and are scheduled to continue through August 2019. All activities performed in accordance with MPCA/MDH and Michigan Department of Environmental Quality regulations. Performed senior technical review of work plans and provided technical expertise/guidance.

Remedial Design Services, Atlantic Wood Industries Superfund Site; Portsmouth, Virginia; and North Penn 6 Superfund Site, Lansdale, Pennsylvania; EPA Region 3; Senior Remediation Specialist—In charge of performing in situ RD services. Prepared design-basis calculations, conceptual plans, and cost estimates relating to intrinsic (and induced) groundwater flow from site aquifers to hydraulic interceptor trenches and installed sheet pile wall for impacted sediment containment. Passive treatment design will equate to an estimated 75% savings in construction and O&M costs. Served as Lead Senior Technical Reviewer for engineering designs related to *in situ* stabilization of coal tar DNAPLs by deep soil mixing, storm drain relocation, and sediment dredging and onsite placement. Performed senior technical review on multiple reports and memos.

Boomsnub/Airco Superfund Site O&M; Vancouver, WA; Linde North America; Senior Technical Expert—Oversaw preparation of detailed FS,design, and implementation of monitored natural attenuation study for site with observed chlorinated DNAPL and chromium impacts to groundwater and soil. Coordinated extensively with EPA to select remedial options, which included source removal, downgradient plume management involving augmentation of reductive dechlorination of dissolved chlorinated compounds, and chromium reduction followed by precipitation with sulfides and/or co-precipitation with iron oxyhydroxides. Completed RD for chromium reduction/precipitation/co-precipitation geochemically and hydrologically modeled (MINTEQA2 and MODFLOW/MT3D, respectively).

RI/FS, Hidden Lane Landfill; Sterling, Virginia; EPA Region 3; Senior Project Engineer—Directed RI/FS at a high profile former landfill in Northern Virginia with unapproved waste resulting in release of trichloroethylene to deep bedrock fractures within the subsurface. Designed treatment pilot program during the FS to: (1) evaluate the effectiveness of distributing bioremediation amendments to the source area, and (2) assess the breakdown of trichloroethylene through *in situ* biological and chemical reduction. Characterized complex hydrogeologic conditions and updated conceptual site model with information on fracture flow through a complex network of low-angle bedding-plane partings and higher-angle fractures of highly variable orientation. Pilot study sought to distinguish the relative importance of specific fracture sets and bedding planes as well as to evaluate the overall effectiveness of the pilot treatment and delivery method.

Puchack Well Field Superfund Site; Pennsauken Township, New Jersey; U.S. Army Corps of Engineers (Kansas City District); Senior Technical Expert—Responsible for RD and injection strategy for *in situ* chromium-contaminated groundwater geochemical fixation treatment in aquifers. Design calculations were compliant with goal of chromium reduction to below New Jersey groundwater quality standards; adequate reducing agent loading to convert dissolved phase hexavalent chromium (Cr^{6+}) to trivalent chromium (Cr^{3+}); and reaction equilibrium to form immobile Cr^{3+} precipitate. Prescriptive requirements for critical remedial components, including injection system design; well spacing and locations; reducing agent requirements, concentrations, injection rates; injection sequencing, system evaluation and RA/operation process. Prepared and obtained site access agreements.

Sprague Road Groundwater Plume LTRA; Odessa, TX; EPA Region 6 RAC 2; EPA Fund Lead Superfund Site; Senior Technical Reviewer— Provided valued input to remedial system optimization of hydraulic control and groundwater treatment system with ex-situ ion exchange for removal of dissolved chromium. Optimization strategy involved replacing costly ion exchange treatment with innovative titanium-dioxide catalyzed chemical reduction.

Van der Horst USA Corporation RI/FS; Terrell, TX; EPA Region 6 RAC 2; EPA Fund Lead Superfund Site; Senior Project Engineer—Instrumental in providing design direction to cost effectively couple *In Situ* Chemical Reduction (of hexavalent chromium) with Enhanced Reductive Dechlorination (of TCE). Relative to other remedial alternatives, this optimized and coupled treatment will allow the EPA to realize significant savings.

Texarkana Wood Preserving Co. RI/FS, RD, RA, LTRA; Texarkana, TX; EPA Region 6 RAC 2; EPA Fund Lead Superfund Site; Senior Technical Reviewer— Provided senior technical review of design, including *In Situ* Stabilization (ISS) of creosote contamination in soil by grout stabilization and Monitored Natural Attenuation (MNA) of groundwater. Inclusion of MNA in the design afforded robustness, while providing a protective, defensible, and economical solution to long-term monitoring of groundwater following source treatment by ISS.

Hilary Williams
Scientist 1

Education
M.P.S./Watershed Management and Forest Hydrology/2013
B.S./Environmental Science and Policy/2009

Years of Experience: 9
Years with EA: 9

Relevant Highlights
- ✓ Has served as a project scientist on environmental projects valued at $283M+ at sites across the United States, including Minnesota.
- ✓ Experience coordinating field activities, preparing technical correspondence and reports, observing field activities, and sampling environmental media.

Registrations/ Certifications/ Training
- OSHA HAZWOPER and Site Supervisor Training
- CPR and First Aid Training

Ms. Williams is an Environmental Scientist with over 9 years of experience writing technical reports, participating in and leading field efforts, and processing laboratory samples. She has effectively and efficiently participated in and/or managed terrestrial and aquatic monitoring of existing conditions. She also has experience reviewing and editing various technical documents and writing technical reports for federal and state agencies across the central and eastern United States.

Ms. Williams frequently writes QAPPs, Work Plans, Site Sampling Technical Memorandums, Site Characterization Reports, RI Reports, Data Summary Reports, Spill Prevention Control and Countermeasure Plans, and Annual Reports for Remedial Action Operations as Long-Term Monitoring sites for a variety of clients including the New York State Department of Environmental Conservation, DoD, and EPA. She also has experience preparing Environmental Assessments according to NEPA.

Ms. Williams' experience with field environmental sampling includes collecting and overseeing the collection of surface water, groundwater, soil (GeoProbe), sediment, and benthic samples for chemical and biological analyses using a variety of techniques and equipment in aquatic and terrestrial habitats. She has participated in the collection of water quality samples for laboratory analysis, including surface water sampling using EPA's clean-hand/dirty-hand sampling techniques under an Operational Range Assessment Program Phase II project. Her skills extend beyond field work to the use of ArcMap GIS software to conduct environmental data analysis and geo-spatial mapping for a variety of reports including site characterization work plans and summary reports. Ms. Williams has utilized database platforms such as EQuIS, Microsoft Access and Excel, and Environmental Resources Program Information Management System to manage environmental chemistry data and related field data (e.g., lithology and well construction) for various projects.

Project Experience

Assessment of Contaminated Sediments, Upper St. Louis River and Superior Bay, St. Louis River Area of Concern; Superior, Wisconsin; EPA Region 5 Great Lakes National Programs Office; Scientist—Served as field team leader for expanded investigation of the St. Louis River area of concern, focusing on the Upper St. Louis River and Superior Bay project areas. Investigation activities included the advancement of 68 sediment cores to define the horizontal and vertical extent of sediment contamination. Sediment samples were analyzed for PAHs, PCB-Aroclors, metals, and dioxins/furans. Communicated directly with EPA's PM, data management team, and subcontractors. Responsibilities included the collection and processing of sediment cores and Ponar grab samples and preparation and shipment of sediment samples to appropriate laboratories. Produced two reports--the Site Sampling Technical Memorandum described the field effort and methods and the Site Characterization Report interpreted the data.

Bianchi-Weiss Greenhouses; East Patchogue, New York; New York State Department of Environmental Conservation; Scientist—Provided field support for composite soil sampling to supplement the Remedial Investigation at the former commercial nursery. Assisted with data management after remedial activities, which included preparing EQuIS electronic data deliverables for submission to the client. Also provided GIS services, creating a gridded map of sample results to inform excavation decision-making in the clean-up process at the site.

Assessment of Contaminated Sediments, Superior Waterfront Characterization, St. Louis River and Bay Area of Concern; Superior, Wisconsin; EPA Region 5 Great Lakes National Program Office; Scientist—Served as field team leader for investigation of the Superior Waterfront project area within the St. Louis River area of concern. Investigation activities included the advancement of 59 sediment cores to define the horizontal and vertical extent of sediment contamination. Sediment samples were analyzed for a full suite of compounds including PAHs, PCBs as Aroclors, metals, VOCs, SVOCs, dioxins/furans, pesticides, acid volatile sulfide/simultaneously extracted metals, organotins, triclosan, and toxicity. Communicated directly with EPA's PM, data management team, and subcontractors. Responsibilities included collection and processing of sediment cores and Ponar grab samples. Produced two draft

reports—the Site Sampling Technical Memorandum which described the field effort and methods, and a Site Characterization Report which interpreted the data.

Niagara Falls Air Reserve Station Performance-Based Remediation, Niagara Falls, New York; Versar, Inc.; Scientist—Assisted with site-specific Quality Assurance Project Plan and Optimized Exit Strategy report assembly. Performed semi-annual groundwater monitoring and sampling event. Provided office and field support for the Unrestricted Use Investigation and Pre-Design Investigation at several sites on the base, which included well installations (overburden and bedrock core holes) and soil sampling using GeoProbe. Performing data management using the New York State Department of Environmental Conservation EQuIS, Air Force Civil Engineering Center Environmental Resource Program Management Information System, and Niagara Falls Air Reserve Station base formats.

Picatinny Arsenal Remedial Action-Operation Long-Term Monitoring; Picatinny Arsenal, New Jersey; U.S. Army Environmental Command; Scientist—Assist PM with Task Order under the Environmental Remediation Multiple Award contract for the performance of remedial action-operation and long-term management activities at 84 sites at Picatinny Arsenal, New Jersey. Task Order consists of performing multi-media sampling (surface water, groundwater, sediment, and biological tissue) as part of site monitoring programs, land use and land use control inspections, remedial injections to address impacted groundwater, well abandonment, wetland assessments, subcontractor oversight, and report writing. Assisted in proposal development, procuring quotes from labs and data validators. Provided support in preparation of the QAPP and Work Plan, prepared Annual Reports for sites included within the Remedial Action-Operation Long-Term Monitoring Program, and provided QC for sampling efforts.

Dzus Fastener Company, Inc.; West Islip, New York; New York State Department of Environmental Conservation; Scientist—Assisted with field efforts related to the remedial investigation of OU-3, a project garnering high interest from the surrounding community, state legislature, and the New York State Department of Environmental Conservation. Prepared the RI document for OU-3, which focused on evaluating floodplain soils, soils in school athletic fields adjacent to the area of concern, and filling data gaps relating to sediments in Willets Creek. Task manager for field efforts related to the remedial investigation of OU-4 (Lake Capri), a follow-up investigation resulting from the recommendations set forth in the OU-3 remedial investigation.

Camp Smith Remedial Investigation/Feasibility Study; Camp Smith, New York; U.S. Army Corps of Engineers–Baltimore District; Scientist—Assisted with the remedial investigation of a metals-impacted tidal marsh at Camp Smith, New York. Assisted in proposal development, procuring quotes from labs and data validators. Provided support in preparation of the QAPP and Work Plan. Provided field support for Phase I and Phase III sediment and surface water sampling event in the Camp Smith tidal marsh. Responsible for logging sediment cores, compositing intervals, and sampling. Prepared Supplemental Operational Range Assessment Phase II Report, and supporting abbreviated Ecological Risk Assessment, to summarize Phase I through III data. Next steps include investigation of the Range 1A/1B complex and creation of a Management/Maintenance Plan for the marsh.

Light Non-Aqueous Phase Liquid Recovery Interim Remedial Measure, Oasis Fuel Point; Fort Drum, New York; U.S. Army Corps of Engineers–Baltimore District; Scientist—Performed baseline in situ and ex situ water quality parameter monitoring of nested ozone monitoring points for an ozone sparging pilot test. Sampled groundwater from ozone monitoring point wells during mid-pilot and post-pilot events using QED bladder pumps. Assisted with data reduction and reporting efforts. Conducted groundwater sampling and well gauging for Parcel 1 and quarterly sampling events. Performed dual-phase extraction optimization testing through conductance of bucket tests. Managed dual-phase extraction and vacuum-enhanced skimming summary database. Created groundwater plume contours in GIS.

Hudson River Polychlorinated Biphenyl Sediments, Operable Unit-2 Site; Upper Hudson River, New York; New York State Department of Environmental Conservation; Scientist—Field team coordinator and lead responsible for post-remedial sediment monitoring along a 40-mile stretch of the Hudson River to evaluate the performance of the EPA-led Operable Unit-2 Site dredging and monitored natural recovery remedy. Coordinated sampling at over 1,600 locations during a 3-month period to collect data points sufficient for powerful statistical analysis and to establish baseline post-dredging concentrations of PCBs in the Upper Hudson River to use as comparison points in determining estimated sediment recovery.

John Morris
Scientist 2

Mr. Morris is a Senior Marine Scientist and Project Manager offering EA clients 26 years of experience in marine, limnological, and environmental sampling, oceanographic instrument deployment, and advanced geophysical surveys, including unexploded ordnance/munitions detection. His multi-disciplinary experience includes involvement in wide array of shallow water, coastal, and deep ocean projects performed in the Great Lakes, North Atlantic, North Pacific, and Gulf of Mexico. This experience includes the performance of major field programs for the USACE, EPA, USCG, U.S. Navy, and NOAA. He has a demonstrated ability as a team leader to analyze complex technical data from various media and collection formats and present it clearly to clients with recommendations.

Mr. Morris holds insight into the resources available to EA and its clients in terms of research vessels, equipment suppliers, and specialty subcontractors towards the efficient completion of data collection operations. His projects have included lake and seafloor and deeper seabed characterization, benthic habitat assessments, as well as comprehensive physical, chemical and biological oceanographic investigations at marine, estuarine and aquatic sites. He is familiar with technical survey techniques including single- and multi-beam bathymetry; side scan sonar, sub-bottom profiling, several types of coring and surface grab sampling, sediment-profile imaging, underwater video, sediment tracers, dredged material disposal plume fate and transport measurements, and bottom-boundary layer investigations. Mr. Morris is also well versed in the use of bottom-mounted, moored, and underway instrumentation, including various types of electro-magnetic, mechanical and acoustic single-point current meters, current profilers, current-following drogues, drifters, wave and tide recorders, salinity and temperature recorders, turbidity meters, and alike.

Project Experience

Spirit Lake Pre-Design Investigation; Duluth, Minnesota; EPA Region 5, Great Lakes National Program Office; Scientist—In support of the latest environmental remediation effort at this CERCLA site, EA performed a comprehensive pre-design investigation which required a major data collection effort within the upland, wetland, and open water portions of the site. Performed a hydrographic survey consisting of high-resolution, single-beam bathymetry and side scan sonar which was merged with LiDAR and shoreline topography information to produce a seamless digital elevation model of the entire site. Managed the collection of continuous core samples using a sonic coring rig plus the installation of observation wells in the center of the impacted marsh. Oversaw full-scale mobilization of facilities, equipment, and personnel to the site, as well as daily subcontractor coordination and oversight, monitoring of health and safety protocols, and client interaction.

Education
B.S./Marine Sciences Coastal Resource Management/1990

Years of Experience: 26
Years with EA: 6

Relevant Highlights
- ✓ 26 years of experience in marine environmental sampling, oceanographic instrument deployment, remote sensing, and advanced geophysical surveys
- ✓ Leadership role in over $57M worth of environmental projects for EA in the past 6 years
- ✓ Comprehensive experience in underwater remote sensing techniques including geophysical, sediment chemistry, benthic habitat characterization and oceanographic studies
- ✓ Experience with comprehensive site assessments including hydrographic surveys and bathymetric characterization efforts in the Great Lakes and in coastal waters

Registrations/ Certifications/ Training
- OSHA HAZWOPER, Site Supervisor, and Construction Supervisor Training
- Confined Space Operations Training
- Open Water Survival and Helicopter Underwater Egress Training
- SCUBA Certification, Open Water Diver
- CPR and First Aid Training

Atlantic Wood Industries Superfund Site Remedial Design and Remedial Action; Portsmouth, Virginia; EPA Region 3; Senior Technical Reviewer—EA facilitated multiple sequential surveys of heavily contaminated subtidal areas along the Elizabeth River. As the Senior Technical Reviewer, developed a detailed scope of work and participated in the selection of a suitable subcontractor capable of performing precision, multibeam hydrographic surveys on short notice to map debris and obstructions, as well as verify progress of the remediation dredging operations. Responsibilities in support of this project also included the interface with USACE and EPA project participants, guidance on the use and limitations of high frequency, swath sonar imagery, bathymetric and side scan sonar data validation, as well as review of all data products and reports prior to submittal.

Sparrows Point Offshore Investigations; Bear Creek, Maryland; Sparrows Point Environmental Trust and EPA Region 3; Scientist—Conducted a series of comprehensive site investigations in the shallow waters of Bear Creek, a sizable tributary in Maryland's Patapsco River system, to evaluate contaminant transfer from the abandoned steel mill complex and associated landfills at Sparrows Point into surface waters and surrounding sediments. Field efforts included

a creek bed condition assessment consisting of precision, single beam bathymetry, side scan sonar and surface sediment grab sampling. A benthic habitat map of the area based on acoustic backscatter was rendered utilizing collected data. Follow-on efforts performed included sediment collection via vibratory coring for geotechnical and geochemical analyses, as well as in situ sediment pore water extraction for chemical analyses. An EE/CA effort was undertaken to evaluate remedial options and costs for a specific area of Bear Creek that was heavily impacted by run-off conveyed by Tin Mill Creek while the steel mill was in operation.

Upper Hudson River PCB Residual Sediment Collection and Testing; Schuylerville, New York; New York Department of Environmental Conservation (NYDEC); Scientist—These studies delineated the distribution, extent, ecological impacts, and risk to human health posed by PCB contamination within river sediments. EA supported this multi-phase, multi-year program to evaluate current conditions within the area of highest concern (Operable Unit 2) with a comprehensive sediment sampling project requiring the collection of discrete sediment grab samples from over 1,600 locations distributed over eight reaches of the river. Fielded three sampling vessels and twelve field staff to obtain, process and ship sediment samples to a contract laboratory for analysis. Selected equipment and prepared EA-owned sampling vessels; trained and oversaw of field staff to ensure compliance with Work Plan and Health and HASP requirements, as well as daily safety briefings, plus operation and maintenance of sampling vessels.

Lower Darby Creek/Folcroft Landfill Site Assessment; Philadelphia, Pennsylvania; EPA Region 3; Scientist—Conducted a hydrographic survey of Lower Darby Creek and its confluence with the Delaware River to evaluate the accumulation of fine-grained, estuarine sediments in various reaches of the water body. Single beam bathymetry was employed to collect seafloor topography data and high-resolution sub-bottom profiling was used to interrogate the top 5 meters of the seabed. This was used to measure the thickness of soft sediment deposits. Fine-grained sediment deposits more than 0.5 m were identified using remote sensors and targeted for sampling to complete detailed chemical characterization of the sediment column in near and far-field locations associated with the former Folcroft Landfill.

Edwin B. Forsythe Wildlife Refuge Headquarters Water Balance Study; Oceanville, New Jersey; AMEC-Foster Wheeler; Scientist— Federal funding provided to the U.S. Fish and Wildlife Service via the Hurricane Sandy Disaster Relief Supplemental Appropriations Act of 2013 was used to support studies related to the re-design of an impoundment system that was heavily impacted by the November 2012 storm event. Water levels and wave action that occurred during Hurricane Sandy and resulting physical damages indicated that the long-term resilience of an existing gravel dike network was insufficient. EA conducted bathymetric and topographic survey work plus water level monitoring within the impoundment system using real time kinematic techniques to assess existing conditions, as well as provide insights into the storage capacity and conveyance of freshwater from upland sources. This information was merged with light detection and ranging (LiDAR) survey data and used to support a detailed water balance study that established water level to basin volume relationships between freshwater sources to the Northwest and Southwest Pools. Additional work related to the feasibility of converting the East Pool into a brackish or freshwater impoundment was also performed.

Cove Point Temporary Laydown Area 1 Hydrographic and Cultural Resources Assessment; Patuxent River, Maryland; Dominion Resources; Scientist—Performed a multi-phase underwater site characterization project consisting of a hydrographic survey and underwater cultural resources assessment at an area of interest within the Patuxent River, Solomons, Maryland on behalf of Dominion Resources. Survey work was conducted over a potential construction site for a temporary pier facility and shore side laydown area to support the proposed expansion of the liquefied natural gas terminal at Cove Point. Conducted a precision single-beam bathymetry survey in the subtidal area and topographic mapping of the upland and intertidal areas to provide data at the Land-Water Interface and allow the development of a seamless digital elevation model for areas likely to be impacted by pier construction. Follow-on work included the completion of a high resolution marine geophysical survey. Side scan sonar, sub-bottom profiling and marine magnetometer data were processed and provided to nautical archeologists for review and identification of any evidence of Native American settlements, colonial era artifacts, shipwrecks, etc. that would require preservation and protection from seabed/shoreline disturbance associated with construction activity and use of the pier. Oversaw field operations which included EA survey vessel operations, re-acquisition of items of interest, as well as supervising scientific diving operations.

2.5 Experience with Federal and State Agencies or Departments

Since 2000, EA has worked with over 150 federal clients in all 50 states – including Minnesota – as well as the District of Columbia, Guam, and Puerto Rico, to complete over $988M worth of environmental work. During that time, we performed over $633M worth of federal site characterization and remediation services for more than 110 clients; over $328M of that work has been performed in the last 5 years.

Federal site characterization and remediation clients include the following:

- EPA Regions 3, 5, 6, 9, 10
- USACE Districts – Alaska, Baltimore, Huntsville, Kansas City, Mobile, Norfolk, Omaha, Fort Worth, Louisville, Sacramento, Tulsa, and Philadelphia
- National Guard Bureau
- National Oceanic and Atmospheric Administration
- Air Force Civil Engineering Center
- US Fish and Wildlife Service
- National Park Service
- US Department of Agriculture
- Defense Logistics Agency
- General Services Administration

Since 2000, EA has worked with over 390 state and municipal clients in 34 states – including in Minnesota – performing over $243M worth of environmental work. During that time, we performed over $93M worth of site characterization and remediation services to over 125 clients in 18 states; over $45M of that work has been performed in the last 5 years.

State and municipal clients include the following:

- City of Duluth, Minnesota
- New York State Department of Environmental Conservation
- Nebraska Department of Environmental Quality
- Rhode Island Department of Environmental Management
- New Mexico Environmental Department
- Texas Commission on Environmental Quality
- Delaware Department of Natural Resources and Environmental Control
- Maryland Environmental Service

2.6 Knowledge of Applicable Documents

EA has gained knowledge of relevant guidance documents and policies through experience performing projects in Minnesota, as well as through maintaining an understanding of applicable Minnesota programs and regulations. We have gained considerable experience with Minnesota-specific regulations through our work at the Spirit Lake Site and the 148th Fighter Wing, both located in Duluth, over the past five years. While each project will have its own unique goals and objectives, EA will coordinate with MPCA during the project planning stages to identify the relevant guidance documents and primary policies specific to each project, and evaluate other supporting federal and local guidance, policies, or technical requirements that may apply.

We understand that various programs within the MPCA and Minnesota Department of Agriculture (MDA) have specific guidance and policies, and that the requirements within each program may vary. EA routinely works with regulators to efficiently coordinate between programs and maximize efficiency during project planning to develop a plan that incorporates all the applicable requirements. For example, in our experience with the Spirit Lake site in Duluth, remedial activities have been governed over the years through various programs and in accordance with multiple regulations including the state superfund program and regulations; voluntary investigation and clean-up programs and regulations; petroleum programs and regulations; and through Federal-sponsored initiatives in the Great Lakes and the corresponding federal requirements. The project design has required coordination with multiple state, federal, and local stakeholders and compliance with multiple programs and regulations.

Based on our experience and understanding of MPCA and MDA programs, a discussion of the relevant Minnesota guidance documents that may be applicable to project work under this contract are summarized in the subsections that follow. EA will bring our experience to each project and work with MPCA early on to identify and marry the appropriate and applicable requirements on a project-specific basis.

MPCA Risk-Based Site Evaluation (RBSE) Manual

The RBSE Manual provides a decision-making framework based on a tiered risk evaluation. Risk evaluations begin at Tier 1 (evaluation utilizing generic cleanup criteria and based on limited site-specific data) and can progress to Tier 2 (utilizing more site-specific data) and Tier 3 (utilizing site-specific data to generate site-specific cleanup objectives), as appropriate. EA has a strong understanding of the RBSE process and the associated checklist, incorporated guidance documents, and processes. We further understand that the RBSE process incorporates various key guidance documents and policies, including but not limited to, the following:

- Air Impacts Evaluation
- Best Management Practices for the Off-Site Reuse of Excess Fill from Development Sites
- Community Involvement in Risk-Based Decision Making
- Draft Guidelines: Groundwater Policy Document
- Draft Guidelines: Guidance on Incorporation of Planned Property Use in Site Decisions
- Guidelines for Monitoring for Landfill Gas at and Near Former Dumps
- Guidelines: Natural Attenuation of Chlorinated Solvents in Groundwater
- Draft Guidelines: Remedy Selection
- Draft Guidelines: Risk-Based Site Characterization and Sampling Guidance
- Draft Guidelines: Risk-Based Guidance for the Soil-Human Health Pathway
- Sediments – Human Health and Ecological Evaluation
- Soil Leaching Values Guidance
- Draft Guidelines: Surface Water Pathway Evaluation User's Guide

UST/AST Release Cleanup and Petroleum Remediation Program Guidance Documents and Fact Sheets

EA recognizes that releases associated with USTs and above ground storage tanks (ASTs) are managed through the Petroleum Remediation Program, and that this program has specific guidance associated with the investigation and remediation of petroleum-related releases from USTs and ASTs. We understand that the following key documents, grouped by activity, are incorporated into the investigation and remediation process, as applicable:

General Guidance

Provides general/overarching guidance documents associated with the following: general overview, mission, and requirements of the Petroleum Remediation Program (c-prp1-01), information requests (c-prp1-02), spatial data collection (c-prp1-03), and procedures for assessing large AST sites (fact sheet).

Release Reporting

Provides requirements for reporting of petroleum releases from USTs and ASTs, including defining volumes requiring reporting, timing of reporting, what evidence or circumstances require reporting, and who needs to report (c-prp2-01). Additional documents provide a management strategy for light NAPL (c-prp2-02 and c-prp2-03), guidance for responding to recent releases from petroleum tanks (c-prp2-04), and guidance on providing information (c-prp2-05) and notification follow-up (c-prp2-07 and c-prp2-08).

Soil Excavation and Treatment

This set of documents provides guidance on excavation (c-prp3-01), treatment/disposal (c-prp3-03, c-prp3-13, c-prp3-15, and c-prp3-17), and assessment (c-prp3-16) of petroleum-contaminated soils. Included in these documents are worksheets that are utilized to document the excavation and corrective action conducted at the site (c-prp3-02/02a), applications for treatment/spreading/composting (c-prp3-04, c-prp3-05, and c-prp3-08), and forms for notifications of treatment (c-prp3-06) and monitoring results (c-prp3-07).

Site Investigation and Risk Evaluation

This set of documents provides guidance on planning and performing site investigations and assessing risk at sites with petroleum contamination. Specific documents include soil, groundwater, and vapor assessments (c-prp4-01/01a), risk evaluations (c-prp4-02), assessment of natural attenuation (c-prp4-03), soil and ground sample/analysis procedures (c-prp4-04 and c-prp4-05, respectively), and investigation and monitoring reporting (c-prp4-06 and c-prp4-08, respectively). Additional guidance documents are also available for selective conditions, such as groundwater investigations in Karst areas, assessment of sensitive groundwater conditions, and requirements for investigation of ethanol-blended releases.

Corrective Action

This set of documents provides guidance on evaluating, planning, and performing corrective actions to address petroleum contamination. The primary document (c-prp7-01) provides guidance on designing and implementing the corrective action. Supporting documents provide guidance on preparing the corrective action design (CAD) report (c-prp7-02), preparing a work plan (c-prp7-03) and report (c-prp7-04) for focused investigation activities, preparing a work plan (c-prp7-05) and report (c-prp7-06) for a pilot test, preparing a remediation system or excavation detailed CAD report (c-prp7-07a and c-prp7-07b, respectively), preparing a system operation monitoring report (c-prp7-08), air emissions control (c-prp7-09a) and screening (c-prp7-09b), and discharge of contaminated groundwater (c-prp7-10).

UST/AST Installation/Closure and Notifications

In addition to cleanup guidance, we are familiar with the UST and AST notification and reporting process associated with installation and closure of USTs and ASTs under the Tank Compliance and Assistance Program. We have a thorough understanding of tank system requirements through review of the review of MPCA fact sheets, guidance documents, forms, and regulations.

Minnesota Department of Agriculture Guidance Documents

Given the potential for projects to involve spills and releases associated with agricultural-related chemicals, EA recognizes that investigations and releases in these scenarios would be managed under the MDA. EA understands that similar to the Petroleum Remediation Program and Superfund and Voluntary Investigation and Cleanup (VIC) Program, the MDA Incident Response Unit has developed guidance documents to be utilized during applicable projects. The guidance documents are generally grouped into the following categories:

General Information for Incidents

These documents provide guidance on reporting incidents (GD1), managing sudden releases (GD2), managing historical incidents (GD3), and disposal of old pesticides containers (GD4). In addition, guidance has been developed to provide an understanding of the Agricultural Voluntary Investigation and Cleanup (AgVIC) Program (GD5), the relationship between AgVIC and the Agricultural Chemical Response and Reimbursement Account (GD6), and the written associated with AgVIC (GD7). The final document in this section (GD8) provides an overview of the MDA Incident Response Program, including a discussion of the various components of the program.

Site Investigation and Cleanup Guidelines

This set of documents provides guidance on planning and performing investigations and remediation at agricultural chemical-related sites. These include guidance on preparation of a remedial investigation and work plan (GD9), preparation of a remedial investigation report and corrective action plan (GD10), preparation of an Agricultural Phase I Environmental Site Assessment (GD14), and preparation of a corrective action report (GD15). Guidance associated with sampling includes soil sampling (GD11), groundwater sampling (GD12), pre-construction soil sampling (GD18), and soil sampling at golf courses (GD30). Remediation guidance includes preparing a proposal to land applied soil from incident sites (GD13), determination of soil and groundwater cleanup goals (GD19 and GD28, respectively), evaluating natural attenuation of contaminated soil and groundwater (GD20), and performing a bioremediation treatability study (GD17).

Consultants/Laboratories/Landspreaders

The final set of documents provides guidance on selection of environmental consultants (GD21 and GD22), pre-approved laboratories (GD23), fixed and mobile laboratory quality control plans (GD24 and GD25, respectively), analytical lists (GD26), laboratory data review (GD29), and a list of those companies that provide land spreading of agricultural chemical contaminated soil services (GD27).

Voluntary Investigation and Cleanup Program Guidance Documents

The VIC Program utilizes the RBSE Manual, as well as several other guidance documents previously discussed. Examples of guidance documents utilized in the VIC Program include the following:

- Guidance for Collecting Spatial Data
- Corrective Action Design Guidance Policy
- Offsite Use of Regulated Fill Policy
- Brownfield Program Guidance Documents (Phase I and II Investigations, investing and remediating asbestos-containing waste).

Other Relevant Documents

In addition to the program-specific guidance documents listed above, EA is also familiar with the following guidance and policies that are relevant to the potential work to be conducted as part of this contract:

Vapor Intrusion

EA recognizes that vapor intrusion (VI) risks may occur at sites within all of the MPCA programs. Therefore, having a working knowledge of the MPCA VI guidance and policies is necessary. We have identified the following as key documents with respect to VI investigation and mitigation:

- Best Management Practices for Vapor Investigation and Building Mitigation Decisions (c-rem3-06e) and associated supporting documents (soil gas list, sub-slab sampling methodology, recommended number of samples, building survey form, etc.)
- Intrusion Screening Values and VI (c-rem3-14)
- VI Map Templates (c-s4-10)

Green and Sustainable Remediation

Although developed for the Petroleum Remediation Program, the consideration and application of green and sustainable remediation (GSR) practices is likely to be relevant to many, if not all, projects that would be conducted under this contract. We are familiar with the systematic program established in the MPCA guidance document (c-prp1-10), as well as practices discussed in other GSR documents published by EPA, Interstate Technology and Regulatory Council (ITRC), and the Sustainable Remediation Forum.

Perfluorochemicals

EA recognizes PFAS as an increasingly prevalent emerging contaminant and understands that MPCA is on the forefront of the management of PFAS. We are familiar with the Investigating PFAS in Minnesota: Current Status document (c-pfc-01) published in 2009. To keep up to date with perfluorinated compounds (PFCs) policies in Minnesota, we subscribe to the Minnesota Department of Health (MDH)'s PFAS email updates. For example, we understand that a review of guidance associated with perfluorobutane sulfonate (PFBS) were initiated in August 2017, and a review of perfluorobutyrate (PFBA) resulted in no change to the existing guidance value in August 2017. We further understand that several PFCs are listed on the December 2017 Nominated Contaminants Status Table for the Contaminants of Emerging Concern to be further reviewed.

Minnesota Department of Health

In addition to MPCA documents/policies and as noted in the PFAS discussion above, EA is familiar with MDH's role in constantly evaluating existing and emerging contaminants and developing health based standards utilized by MPCA, MDA, and other state agencies. For example, EA is familiar with the use of Health Risk Limits (HRLs), Health-Based Values, and Risk Assessment Advice for evaluating contaminants in groundwater. Additionally, we are familiar with the use of Soil Reference Values developed by MDH, as well as other criteria established by others, in conjunction with risk evaluations. We are also aware of the fluent nature of these standards and the potential for them to be revised on a regular basis as new information is obtained by MDH and evaluated, including the mandatory three-year review cycle for those chemicals identified as "Chemicals of High Concern" and "Priority Chemicals". EA is committed to staying up to date with health-based standards and revising our project plans to incorporate changes to any health-based standards. As an example, following MPCA approval of the remedial action work plan for the ANG site at Duluth (see provided project experience), the HRL for trichloroethylene changed from 5 micrograms per liter (ug/L) to 0.4 ug/L. EA identified this change immediately upon its being published in November 2015, and incorporated the change into the performance monitoring program associated with the remedy implementation. To maintain an up-to-date knowledge of MDH (and MPCA) guidance/criteria, we subscribe to notifications and review fact sheets and documents published by the State of Minnesota. In addition to the state level, we also participate in ITRC workgroups (including the current PFAS and optimized *in situ* treatment workgroups), and are members of multiple professional organizations that are tasked with reviewing and developing the latest guidance and best management practices.

2.7 Knowledge of Applicable Acts and Regulations

Similar to the discussion in Section 2.6, through performance of projects within Minnesota, as well as review of published information, EA has gained a thorough understanding of the Minnesota acts and regulations that may be applicable to work conducted under this contract. Additionally, we have a strong understanding of federal acts and regulations that may be applicable to the work. To demonstrate this knowledge, EA has prepared the following summary of several key Minnesota and federal acts and regulations relevant to completion of work under this contract.

Minnesota

Minnesota Statutes

EA recognizes that the majority of the Statutes relevant to the work to be completed are located in Chapters 114C through 116I of the 2017 Minnesota Statutes that cover Environmental Protection, as well as Chapters 18D and 18E that cover Agriculture. However, there are additional Statutes that may be relevant to work performed under this contract, including Natural Resources (Chapter 84), Conservation (Chapter 84D for example), and Health (Chapters 144 and 156A). Chapter 138 covers historic preservation in the event that projects involve historic sites.

Minnesota Rules

EA recognizes that Minnesota Rules associated with the MPCA are primarily contained within Chapters 7000 through 7190, although it is understood that lead abatement in soil is contained within Chapter 4760, and some solid waste rules are located within Chapters 9210, 9215, 9220, and 9400. EA further understands that there are Rules associated with the MDH that may be applicable to the work conducted under this contract, including Environmental Health, Public Water Supplies, Wells and Borings, Explorers and Exploratory Borings, Ionizing Radiation (for use of x-ray fluorescence instrumentation), Laboratory Accreditations, and Residential Lead Abatement in Chapters 4717, 4720, 4725, 4727, 4732, 4740, and 4761, respectively. We recognize that additional Rules exist that may be applicable to project work, including Chapter 1800 and 1805 that contains Rules associated with the licensing of Professional Engineers and Geoscientists and Professional Conduct of these individuals, Chapters associated with the Department of Natural Resources (such as Endangered, Threatened, and Special Concern Species), and Chapters associated with the Board of Water and Soil Resources (such as Wetlands Conservation). EA is committed to ensuring that the work is done in compliance with all applicable Rules.

Minnesota Environmental Response and Liability Act

The Minnesota Environmental Response and Liability Act (MERLA) was enacted in 1983 and is found in Minn. Stat. 115B. MERLA provides a framework for the identification, investigation, and remediation of contaminated sites that are not otherwise enrolled in a Federal program. MERLA complements the federal CERCLA. MERLA identifies what constitutes a responsible party and provides an administrative process for managing a site through the investigation and remediation process. MERLA also establishes procedures for management of sites through the VIC Program. EA understands the role of MERLA in conducting investigation and remediation projects as part of this contract.

Land Recycling Act

The Land Recycling Act was enacted 1992 and is found in Minn. Stat. 115B. This act provides a framework for performance of voluntary response actions. The goal of the Act is to stimulate redevelopment of contaminated sites through liability protection. Work conducted in the VIC Program is guided by this Act. We understand the components of a voluntary program, and the importance of this program in promoting cleanup and redevelopment of brownfields and other underutilized properties, as well as the relationships that are the basis of successfully completing the work.

Landfill Cleanup Act

The Landfill Cleanup Act was enacted in 1994 and is found in Minn. Stat. 115B. This act provides a voluntary mechanism to initiate cleanup and perform long-term operation and maintenance of closed state-permitted landfills. The goal of this act is to remove the landfill site from the Superfund process and conduct the cleanup in a more effective and efficient manner. We recognize the role that this act plays in performing work under the Closed Landfill Program and the potential to move projects forward towards a beneficial reuse.

Waste Management Act

The Waste Management Act was enacted in 1980 and is found in Minn. Stat. 115A. This act outlines waste management practices, including management of solid and hazardous waste, disposal facilities, and recycling. The provisions of this act will be relevant to work conducted under this contract with respect to characterization, treatment, and disposal of solid and hazardous waste generated during investigation (investigation-derived waste) and remediation. We understand the policies set forth in this act, as they also relate to RCRA.

Comprehensive Groundwater Protection Act

The Comprehensive Groundwater Protection Act was enacted in 1989 and is found in Minn. Stat. 103H. This act was established and mandates that the MDH review, develop, and adopt HRLs and groundwater quality monitoring procedures. As previously discussed, EA recognizes the role that the MDH plays in developing soil and groundwater criteria that is used are part of investigation, risk evaluation, and remedial actions.

Agricultural Chemical Response and Reimbursement Act

The Agricultural Chemical Response and Reimbursement Act (ACRRA) was enacted in 1989 and is found in Minn. Stat. 18E. This act establishes a financial assistance program for eligible parties cleaning up agricultural chemical contamination. Funding for this program is provided through annual surcharges to pesticide and fertilizer manufacturers, applicators, distributors, and dealers. Reimbursement is up to 80% of costs (up to 60% for recontamination situation) meeting a minimal threshold with a maximum amount of reimbursement of $279,200 (80% of $350,000). EA understands that there is MDA oversight and third-party reviews, as well as other costs, which are ineligible for repayment. We are prepared to support MPCA in performance and oversight of any activities associated with this program.

Other Applicable Minnesota Acts and Regulations

In addition to the acts and regulations listed above, other acts and regulations may apply to work performed under this contract, including:

- Minnesota Historic Sites Act
- Minnesota Historic Districts Act
- Minnesota Private Cemeteries Act
- Minnesota Environmental Rights Act
- Wetland Conservation Act
- Minnesota Environmental Policy Act (MEPA)

Federal

Comprehensive Environmental Response, Compensation, and Liability Act, as amended

CERCLA, enacted in 1980 and amended in 2986, established Superfund and provided an avenue to revise the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). CERCLA authorizes short-term and long-term remedial response actions and established a systematic approach to investigate and remediate sites through site discovery, remedial investigation/feasibility study, proposed plan/record of decision, and remedial design/action. EA has a strong understanding of CERCLA and the associated processes, and the complementary nature of CERCLA with respect to MERLA.

National Contingency Plan

The NCP provides framework for reporting, investigating, and remediating hazardous substance releases. The NCP also established the National Priorities List (NPL). Sites are scored utilizing a Hazard Ranking System to determine if they should be included on the NPL, and to what extent further action may be warranted. The NPL, along with CERCLA, establish procedures to be followed for investigation and remediation, and EA has a thorough understanding of the Superfund program and associated policies.

Resource Conservation and Recovery Act

RCRA was enacted in 1970 and establishes procedures for managing and cleaning up soil and hazardous waste. RCRA regulations are found in 40 Code of Federal Regulations (CFR) Parts 239 through 282. Of note, Minnesota's state-administered RCRA Program was approved in accordance with 40 CFR 271, as documented in 40 CFR 272.1201. Additionally, Minnesota's state-administered UST Program was approved in accordance with 40 CFR 281, as documented in 40 CFR 282.73. The RCRA program establishes cradle-to-grave management of waste and details transportation, treatment, disposal, reporting, and documentation requirements. EA has a strong understanding of waste management procedures under both RCRA and the Minnesota-administered RCRA program.

Occupational Safety and Health Act

Work conducted under this contract will be performed in accordance with the Occupational Safety and Health Act (OSHA), including ensuring that works have the proper training and personal protective equipment. Additionally, health and safety plans will be prepared in accordance with OSHA regulations to ensure worker safety during the performance of site activities.

Other Applicable Federal Acts and Regulations

In addition to the acts and regulations listed above, other acts and regulations may apply to work performed under this contract, including:

- National Historic Preservation Act
- Archaeological and Historic Preservation Act
- American Indian Religious Freedom Act
- Archaeological Resources Protection Act
- Abandoned Shipwrecks Act
- Native American Graves Protection and Repatriation Act
- National Environmental Policy Act (NEPA)
- Endangered Species Act

2.8 Examples of Two Remedial Investigations

Remedial Investigation
Project: Supplemental Remedial Investigation, Remedial Action-Operations, Long-Term Monitoring, and Project Closeout
Location: 148th Fighter Wing Sites 3 and 25, Duluth, Minnesota and Alpena Combat Readiness Training Center Site 9, Alpena, Michigan
Client: National Guard Bureau

EA has performed or is currently performing supplemental groundwater remedial investigations, in situ and ex situ remediation, long-term monitoring (LTM), and project closeout conducted at the 148th Fighter Wing (FW) Sites 3 and 25 in Duluth, Minnesota, and at the Alpena Combat Readiness Training Center (CRTC) Site 9 in Alpena, Michigan. Activities include monitoring well installation, supplemental groundwater remedial investigations and LTM, direct-push technology soil boring investigation, excavation and disposal of petroleum-impacted soils, groundwater treatment via injections utilizing multiple substrates (EHC®, EHC-L®, and Nutrisulfate®), and bioaugmentation utilizing a *dehalcoccoides* (DHC) inoculum, and placement of oxygen release compound (ORC) Advanced® as an excavation backfill amendment. Activities are currently ongoing and are scheduled to continue through August 2019.

Site Description

The 148th FW Site 3 is identified as the former Defense Reutilization and Marketing Office (DRMO). According to the Record of Decision (ROD), a gravel storage pad area, formerly located at the southwest corner of the DRMO facility, was used from 1965 to 1980 to store surplus equipment, including: petroleum, oil, and lubricants; waste oils; solvents; and various chemicals. At any one time, a maximum of 80 to 100 55-gallon (gal) drums were stored on the gravel storage pad, and minor drum leaks reportedly occurred. Drums of chemicals have not been stored at Site 3 since 1980. Two groundwater plumes have been identified at the site: a larger L-shaped plume associated with a former storage pad and a smaller plume associated with a septic leach field.

The 148th FW Site 25 is identified as the Old Motor Pool Area. This site is a former motor pool for the 148th FW and includes former Building 239, and Buildings 240 and 242. Building 240 was originally the Motor Pool building, but has served as the Transportation Office, Management Office, as well as the Base Supply Packing and Crating facility since the early 1990s. The site encompasses an area of approximately 1.2 acres that was used as the Base Motor Pool from 1948 until 1975. The site includes the old motor pool and two adjacent areas of related motor pool activities: a former 1,000-gal gasoline underground storage tank (UST) area and the old motor pool floor drain outfall that flowed southeast from the old motor pool area. The 1,000-gal gasoline UST was removed in September 1994. Two groundwater plumes have been identified at the site: a larger plume adjacent to the east and south of the former USTs, and a smaller plume located south of the larger plume. Site 25 also includes the former sites of one 10,000-gal gasoline UST, one 10,000-gal diesel fuel 4 UST, and one 500-gal waste solvent UST. These three tanks were removed in 1995.

The Alpena CRTC Site 9 is identified as the Radar Tower/AGE Maintenance Shop. The site is adjacent to Building 417 which is used to maintain ground equipment for aircraft operations. The site consists of vegetated land with two trees on the southern portion, and wooded land on the northern portion of the Site across I Street. A trailer and aboveground piping associated with a former air sparge system are located on the

Relevant Highlights
- ✓ Prepared corrective action design documents
- ✓ Prepared health and safety plans
- ✓ Oversaw site investigation services for soil boring advancement and monitoring well installation using standard drilling methods and direct-push methods
- ✓ Conducted groundwater sampling
- ✓ Conducted remedial investigations
- ✓ Arranged for transportation, storage, and proper management of wastes
- ✓ Oversaw subcontractors during investigation and cleanup
- ✓ Prepared and evaluated reports
- ✓ Evaluated data quality and data verification reports
- ✓ Arranged for site access
- ✓ Prepared QAPP in accordance with state and federal requirements
- ✓ Designed comprehensive remedial action remedy
- ✓ Conducted and oversaw remedial investigation
- ✓ Oversaw installation of remedial action
- ✓ Prepared presentations and presented information at meetings

Client Contact:
National Guard Bureau
James King, COR
240-612-8763

Completion Date: Ongoing

Contract Value: $1.69M

Proposed Staff Who Worked on This Project:
A. Peitsch
K. Kowalk
D. Hinckley
D. McNeely
F. Barranco
R. Darnton

southern portion of the site. According to the ROD, a UST was reportedly located in the vicinity of the site, which is likely the source of contamination at the site.

Project Description

Project Planning – 148th FW

At project inception, EA prepared and submitted a Quality Control Plan (QCP) to the client. This document summarized the overall quality control program to be implemented by EA for this project. The QCP identified personnel, procedures, controls, test records, and forms to be utilized by EA to demonstrate that the work was completed in general accordance with client objectives and within acceptable standards of good engineering practice. As part of the quality control process, EA prepares and submits Monthly Progress Reports no later than the 10th of each month which document: project status; work completed during the reporting period; problems, proposed solutions, and corrective actions; deliverables completed; payment milestones achieved; projected work for the upcoming period; and project schedule.

At the 148th FW Sites 3 and 25, EA prepared and submitted a Remedial Action-Operations/LTM Work Plan to describe the objectives, procedures, and activities to occur at these two sites. The Work Plan was prepared in accordance with the client Statement of Objectives and Minnesota Pollution Control Agency (MPCA) regulations, and utilized existing data in combination with a planned supplemental groundwater remedial investigation to evaluate current site conditions and develop an appropriate response activity for impacted groundwater at the two sites. The Work Plan included: a site-specific Health and Safety Plan; a client-required Uniform Federal Policy (UFP) Quality Assurance Project Plan (QAPP); approved Minnesota Department of Health Monitoring Well Permit Applications and Injection Variance; and a client-required project schedule in Gantt chart format. MPCA regulators were consulted at multiple intervals during preparation and review of the Work Plan, and ultimately the Work Plan was approved by the MPCA.

Monitoring Well Installation and Supplemental Remedial Investigation – 148th FW

Following Work Plan approval, EA installed two monitoring wells at the 148th FW Site 3 and three monitoring wells at the 148th FW Site 25. EA performed the supplemental groundwater remedial investigation sampling at both sites to further characterize the horizontal and vertical extent of residual contamination and to help refine the planned injection strategy prior to remedy implementation. EA collected samples from 36 monitoring wells at both sites for analysis of primary contaminants of concern (COCs) (volatile organic compounds [VOCs], petroleum-related compounds, and emerging contaminants [1,4-dioxane]) and enhanced in situ bioremediation (EISB) indicators. All samples collected were submitted to a Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP)-accredited analytical laboratory.

Enhanced In-situ Bioremediation Injections with Bioaugmentation – 148th FW

During initial injection activities at the 148th FW Site 3, significant daylighting of EHC® was observed at distances up to 20 feet away from the injection points. After attempting to continue injections at a variety of dilutions and pressures, it was determined that the slurry-like composition of the material was likely the cause of the problem. The subsurface formation was tighter than anticipated and the EHC® injectant was finding preferential pathways to flow to the surface. In response, EA immediately began discussions with the client and MPCA and proposed to deliver the EHC® to the subsurface via trenching methods. A letter-style Work Plan Addendum was prepared and submitted and subsequently approved by MPCA. In total, approximately 1,000 pounds (lb) of EHC® was delivered during the initial injections at six locations, and the remaining 5,750 lb of EHC® was delivered via approximately 105 linear feet of trench to a maximum depth of 15 feet below ground surface. Thirty-four additional injection points were utilized to deliver 8,400 lb of EHC-L®, 700 lb of pH buffer, and 27 liters of DHC inoculum. EA collected groundwater samples from eight monitoring wells at 45, 90, and 330 days post-injection for analysis of primary COCs and EISB indicators to monitor performance. All samples were submitted to a DoD ELAP-accredited laboratory. At the 148th FW Site 25, EA delivered 3,360 lb of EHC-L®, 200 lb of pH buffer, and 15 liters of DHC inoculum at six injection points. EA also delivered 25 gal of liquid Nutrisulfate® (at varying dilutions) at each of 34 injection points. EA collected groundwater samples from eight monitoring wells at 45, 90, and 330 days post-injection for analysis of primary COCs and EISB indicators to monitor performance. All samples were submitted to a DoD ELAP-accredited laboratory.

EA conducted a second round of injection activities at the 148th FW Site 3 during Summer 2016. EA utilized the results of the performance monitoring events to further refine the injection strategy to target areas in which additional EHC-L® was warranted based on the groundwater data. A total of approximately 7,800 lb of EHC-L® was injected into the groundwater via 37 injection points (58 pounds of EHC-L® per point in six points and 240 pounds of EHC-L® per point in 31 points). Additional EHC® and DHC inoculum were not introduced to the subsurface during this event. EA collected groundwater

samples from eight monitoring wells at 120 days post-injection for analysis of primary COCs and EISB indicators to monitor performance. All samples were submitted to a DoD ELAP-accredited laboratory.

Following completion of the final performance monitoring event, EA prepared and submitted an After Action Report (AAR) for the 148th FW Site 3. The AAR documented the implementation of remedial actions at the site, summarized the performance monitoring results, and recommended moving into LTM. Due to concerns about missing the end of the 2017 field season, EA conducted discussions with MPCA about the AAR while it was still in review. Following discussions, MPCA concurred with the recommendation, and EA was able to complete the first LTM event at Site 3 prior to Winter 2018.

Additional Investigation Activities – 148th FW

Analytical results from the supplemental remedial investigation and the three rounds of performance monitoring performed at the 148th FW Site 25 indicated that there may be additional, unknown source material present in the vicinity of the former underground storage tank cavity. EA advanced eight direct-push soil borings and installed three permanent monitoring wells in the area to further characterize site conditions and develop a remedial alternative to treat source material. Soil characteristics were logged and soils were screened with a photoionization detector for organic vapors. EA did not collect discrete soil samples for analysis, as historic soil samples indicated that residual contamination is limited to dissolved-phase contaminants in groundwater. Following installation and development, groundwater samples were collected from all three wells and submitted for analysis of VOCs and total petroleum hydrocarbons (TPH) diesel range organics (DRO). Additionally, samples were collected from one of the new wells and submitted for EISB indicator analyses (alkalinity, ammonia nitrogen, chloride, nitrate, nitrite, sulfate, total Kjeldahl nitrogen, sulfide, total organic carbon, ferrous and ferric iron, and dissolved gases [methane, ethane, ethane]). The existing RAO Work Plan was utilized to direct this additional work at the site. Draft analytical results indicated concentrations of contaminants in groundwater in the area of the former UST cavity are significantly higher than the historic groundwater concentrations indicated while the multi-phase extraction system was in operation. EA is currently preparing a letter-style Work Plan Addendum to install six new monitoring wells and resample all site wells for VOCs and TPH-DRO to determine the lateral extent of groundwater impacts at the site and to advance up to 10 direct-push borings near the northeast corner of Building 240 to determine the lateral and vertical extent of residual soil impacts at the site.

Project Planning – Alpena CRTC

At Alpena CRTC Site 9, EA prepared and submitted an Addendum to the Response Activity Work Plan to describe the objectives, procedures, and activities to occur at the site. The Work Plan was prepared in accordance with the client Statement of Objectives and Michigan Department of Environmental Quality (MDEQ) regulations and utilized existing data to evaluate site conditions and develop an appropriate response activity for impacted groundwater at the site. The Work Plan included: a site-specific Health and Safety Plan, a client-required UFP QAPP, and a client-required project schedule in Gantt chart format. MDEQ regulators were consulted during preparation and review of the Work Plan, and ultimately the Work Plan was approved by MDEQ.

Excavation and Backfill Amendment – Alpena CRTC

EA coordinated with the Alpena CRTC Environmental Manager to secure a Base Dig Permit, and then excavated and disposed of approximately 755 tons of contaminated soil to a maximum depth of 20 feet below ground surface. EA then amended clean backfill with 1,840 lb of ORC Advanced® pellets, to promote the continued aerobic biodegradation of residual contamination below the water table. EA collected groundwater samples from three monitoring wells at 60, 120, and 180 days post-excavation for analysis of primary COCs (VOCs and lead) and petroleum-degrading bacteria to monitor performance. All samples were submitted to a DoD ELAP-accredited laboratory.

Groundwater LTM Activities – Alpena CRTC

Following the 180-day sampling event, the site moved into the LTM phase. EA prepared and submitted a Response Action Report (RAR) for the Alpena CRTC Site 9. The RAR documented the implementation of remedial actions at the site, summarized the performance monitoring results, and recommended moving into LTM. The RAR was reviewed and approved by MDEQ.

EA performed four rounds of LTM at the Alpena CRTC Site 9. EA collected groundwater samples from seven monitoring wells on a quarterly basis for analysis of VOCs and total and dissolved lead to monitor long-term conditions at the site. All samples were submitted to a DoD ELAP-accredited laboratory. Groundwater analytical results indicated that no COCs were detected at concentrations greater than applicable health-based drinking water values throughout the Site. Based on these results, EA has recommended No Further Action for Site 9 based on LTM results.

Personnel Roles

Art Peitsch, PMP, acted as project manager for the entire scope of work, and performed data validation for all samples collected on this project. Kevin Kowalk, P.E., acted as lead remedial design engineer and assisted in writing/reviewing project documents, including all work plans, LTM reports, and the AAR and RAR for the 148th FW Site 3 and Alpena CRTC Site 9, respectively. Dan McNeely provided onsite inspection and oversight services for monitoring well installation, groundwater sampling, and injection/trenching activities at the 148th FW Sites 3 and 25; and direct-push soil investigation, remedial action oversight, and groundwater sampling at Alpena CRTC Site 9. Mr. McNeely was also responsible for authoring or co-authoring reports including work plans, LTM reports, and the AAR and RAR for the 148th FW Site 3 and Alpena CRTC Site 9, respectively. Lee Becker was responsible for providing senior engineering review of project documents. Dan Hinckley was responsible for quality assurance/quality control and senior chemist review of data validation reports.

Subcontracted Tasks

At the 148th FW sites 3 and 25, EA subcontracted: private utility locating services; surveying services; drilling services for direct-push investigation, monitoring well installation/development, and subsurface injections; construction services for trenching; environmental services for groundwater sampling; analytical laboratory services; and waste transportation and disposal services.

At Alpena CRTC Site 9, EA Subcontracted: private utility locating services; surveying services; drilling services for direct-push investigation and monitoring well installation; construction services for site clearing, excavation, and site restoration; analytical laboratory services; and waste transportation and disposal services.

Outcome Achieved

At the 148th FW Site 3, EA has achieved over 70 percent reduction in source material concentrations (tetrachloroethene and trichloroethene) in groundwater based on the results of the first LTM event conducted in December 2017. Three additional LTM events are scheduled throughout 2018.

At the 148th FW Site 25, EA identified an unknown source along the eastern edge of the site that had previously been masked due to the operation of a dual-phase extraction system. EA is currently working to characterize the nature and extent of this previously unidentified source area.

At Alpena CRTC Site 9, EA has recommended No Further Action based on four consecutive quarters of groundwater analytical results that indicate that no COCs were detected at concentrations greater than applicable health-based drinking water values throughout the Site. EA is currently awaiting review of this request.

Remedial Investigation

Project: Spirit Lake Remedial Investigation and Sediment Remediation

Location: St. Louis River AOC, Minnesota

Client: USEPA Region 5 and Great Lakes National Program Office

The U.S. Environmental Protection Agency (USEPA) and U.S. Steel (Non-Federal Sponsor) are working in partnership under the Great Lakes Legacy Act to remediate contaminated sediment at the Spirit Lake Site in the St. Louis River Area of Concern. EA has provided remedial investigation, site assessment, potentially responsible party oversight, permitting, and design services over the past 5 years for this large-scale remediation and restoration assisting USEPA Region 5 with progressing the project from site characterization through remedial design. EA is currently designing a multi-component remedy including dredging 700,000 cubic yards of sediment; placement in onsite confined disposal facilities (CDFs); in situ stabilization of lead-impacted soils; capping or enhanced monitored natural recovery for over 130 acres, rerouting a stream channel, and construction of railroad structures.

Site Description

The Site is located adjacent to the former U.S. Steel Duluth Works site in Sections 34 and 35, T49N, R15W; and Sections 2 and 3, T48N, R15W in the southern part of the City of Duluth, Minnesota, in St. Louis County. The estuary portion of the Site is located in an open water reach of the St. Louis River referred to as Spirit Lake, approximately 8 miles upstream from Lake Superior. A small creek and community stormwater conveyance channel, referred to as Unnamed Creek, carries flow from approximately 2,000 acres of upstream watershed into Spirit Lake. Unnamed Creek enters the upland portion of the Site through a large culvert on the western edge, flows through the western portions of the Site, and discharges into Spirit Lake. The Site is bounded by the Morgan Park neighborhood of Duluth to the north, the uncontaminated portions of the St. Louis River site (Spirit Lake section) to the east, the Canadian National Railway property to the west, and the U.S. Steel Corporation (U.S. Steel)-owned former steel mill facility to the south.

Project Description

EA coordinated project planning and execution with USEPA, including extensive coordination with U. S. Steel and the Minnesota Pollution Control Agency for project direction. EA assisted USEPA with tribal consultation, and coordinated with various natural resource agencies, Minnesota historical society, and community groups for stakeholder feedback during the feasibility study and EA's advancement of project permitting. EA led regular project team progress update calls and weekly (or biweekly) progress update calls with USEPA throughout the course of the project.

EA led key components of the remedial investigation to support the feasibility study, including the following:

- Provided innovative sediment profile imaging (SPI) studies using a leading SPI expert to evaluate benthic habitat conditions, biological species diversity, and shallow sediment physical conditions.
- Worked with Non-Federal Sponsor to collect 20 sediment and 38 porewater samples, including 19 locations for porewater passive sampler peeper deployment, and evaluation of sediment-porewater partitioning to support ecological risk screening and remediation goal development.
- Performed review of Non-Federal Sponsor reports and feasibility study, providing detailed comments to USEPA and participating in meetings to review data with regulators and permitting agencies.

Relevant Highlights

- ✓ Prepared corrective action design documents
- ✓ Prepared health & safety plans
- ✓ Oversaw site investigation services for soil boring advancement and monitoring well installation using both standard drilling methods and direct-push methods
- ✓ Conducted groundwater, soil, surface water, and sediment sampling
- ✓ Conducted remedial and pre-design investigations
- ✓ Arranged for transportation, storage, and proper management of wastes
- ✓ Evaluated, monitored, and designed contaminated sediment and other necessary restorative actions
- ✓ Gathered and evaluated bathymetric data
- ✓ Oversaw subcontractors during investigation
- ✓ Prepared and evaluated reports
- ✓ Evaluated invoices
- ✓ Evaluated data quality and data verification reports
- ✓ Arranged for site access
- ✓ Prepared QAPP in accordance with state and federal requirements
- ✓ Conducted and oversaw remedial and pre-design investigation

Client Contact:
USEPA Region 5
Bill Murray, TOCOR
312-353-6324

Completion Date: Ongoing

Contract Value: $7.56M

Proposed Staff Who Worked on This Project:
J. Beaver
L. Becker
M. Ciarlo
D. Hinckley
F. Barranco
J. Morris
R. Darnton
C. Swanson

- Performed preliminary assessment of habitat restoration opportunities and provided technical assistance for identifying project cost implications for achieving habitat stakeholders' vision of Spirit Lake restoration.

EA designed and carried out a treatability testing program, including:

- Geotechnical physical and engineering tests as well as sediment composite testing to support dredging logistics assessment and mass balance assessment of waste streams
- Dredging Elutriate Tests and Elutriate Effluent Tests, and column settling tests to assess water quality during dredging.
- Geotextile tube, polymer, and amendment bench tests to evaluate dewatering processes.
- U.S. Army Corps of Engineers simplified laboratory runoff procedure, sequential batch leachate testing, and waste characterization to evaluate transport pathways after CDF placement.
- Shear strength, consolidation, and compaction to support CDF geometry and stability analyses.

EA coordinated closely with USEPA quality assurance staff to establish data quality objectives and secure plan approvals. EA provided permitting support/community outreach/impact assessment for permitting agency consultations and permit applications, which included:

- Led key meetings with stakeholders and permitting agency representatives.
- Consulted with U.S. Fish and Wildlife Service and Minnesota Department of Natural Resources regarding sensitive species and habitats.
- Assisted USEPA with public meetings including meeting participation and development of materials
- Led preparation of archaeological reports to support cultural resources coordination with tribes and the State Historic Preservation Office.

Performed a two-phase pre-design investigation to collect a broad array of data to support design, including:

- Effectively and efficiently procured and managed 13 different subcontractors.
- Prepared Quality Assurance Project Plan and Field Sampling Plan documents and coordinated extensively with Non-Federal Sponsor.
- Obtained permits and access agreements for fieldwork.
- Completed aerial LiDAR, estuary bathymetry, and side-scan sonar debris surveys.
- Completed real property review and mapped property lines and utilities.
- Completed 11 geotechnical borings for CDF design, 9 lead delineation borings, 1 pumping test well and 3 observation wells, 3 deep test trench transect excavations with 2 geotechnical borings for borrow site characterization, 22 chemical delineation sediment cores, 23 capping area cores, 6 groundwater seepage meter clusters, groundwater pumping test and groundwater elevation monitoring, chemical stabilization treatability study, and investigation-derived waste characterization.
- Prepared Pre-Design Investigation data evaluation memoranda for all investigation activities.
- Prepared real estate requirements report with real property technical support, including legal boundary survey by licensed surveyor and coordination with tribes and City of Duluth.

Provided analytical support, laboratory procurement and oversight, and data validation for 53 porewater, 304 sediment, 176 soil, and 15 water samples. Managed field and analytical data in the Great Lakes Architect-Engineer Services program EQuIS database; submitted Great Lakes Sediment Database deliverables, analytical laboratory reports, Region 5 electronic data deliverables, data validation summary reports, and location data.

Subcontracted Tasks

At the Spirit Lake Site, EA has subcontracted a variety of services, including: surveying services; site security services, land clearing, drilling services for direct-push and sonic coring investigation, sediment vibracoring services; seepage investigation; cultural resources investigation; monitoring well installation/development; environmental services for groundwater sampling; analytical laboratory services; and waste disposal services.

Outcome Achieved

EA is currently completing remedial design for dredging/excavation, capping, enhanced monitored natural recovery, CDF construction, water diversion, and habitat restoration, including specifications, plan sets, permit applications, and basis of design; work is ongoing with key accomplishments to date that include:

- Completion of updated spatial model of chemistry results and goal exceedances
- Strategy for applying risk-based remedial goals based on new spatial models
- Baseline hydrodynamic models and HEC-RAS models, developed in conjunction with Barr Engineering, as well as groundwater models and capping models
- Geotechnical data evaluation report and CDF and shoreline stability analyses
- Draft grading plans for CDFs, access and staging areas, and stream channels
- Drafts of key specifications and layouts of plan sets
- Draft habitat strategy and framework for habitat conditions analysis
- Framework for updated costs using MCACES software.

Section 3:
Scope of Services

Section 3 – Scope of Services

We have organized each of the 52 scopes of service from Section 4 of the Request for Proposal into six general service categories that logically span the continuum of services required for this contract as shown on **Exhibit 3-1**. For each of the scope items, we have graphically illustrated 5 similarly-scoped master contracts where EA as the prime has performed the listed services using in-house staff. In addition, we have provided specific examples below for each general service category.

Exhibit 3-1: MPCA Scope of Services Contract Experience Matrix		DNREC Multiple Contracts including Remediation Services	NYSDEC Standby Engineering Services at State Superfund Sites	EPA Region 3 Response Action Contract 2 – Full Environmental Service Contract	EPA Region 5 Great Lakes Architect Engineering Services	EPA Region 6 Remedial Action Contract 3
Maximum Contract Value		N/A	$50M	$60M	$25M	$300M
3.1 Site Characterization	Phase I and Phase II, Limited Site Investigations	♦	♦	♦	♦	♦
	Remedial Investigation (RI)	♦	♦	♦	♦	♦
	Engineering Evaluation/Cost Analysis (EE/CA)			♦	♦	
	Soil Boring Advancement and Monitoring Well Installation Using Standard Drilling Methods and Direct-Push Methods	♦	♦	♦	♦	♦
	Groundwater, Soil, Surface Water, Sediment, and Air Sampling, and Monitoring	♦	♦	♦	♦	♦
	Vapor/Air Monitoring for Health and Safety (H&S) and Air Quality Criteria	♦	♦	♦		♦
	Install Stainless-Steel Soil Gas Sampling Ports Using Electric Drill to Bore through Floor Slabs	♦	♦	♦		
	Surface Water, Groundwater, Air, and Vapor Receptor Surveys	♦	♦	♦	♦	♦
	Oversee Construction to Complete Sediment Sampling and Conduct Non-Construction Sediment Sampling		♦	♦	♦	♦
	Conduct Geophysical Activities	♦				♦
	Search, Gather, and Evaluate Bathymetric Data		♦	♦	♦	
	Surface Water, Groundwater, and Hydrodynamic Modeling	♦	♦	♦	♦	♦
	Hydrogeologic Investigations Including Fate and Transport Modeling, Capture Zone Analysis, and Pump Tests	♦	♦	♦	♦	♦
	Human Health Risk Assessments (HHRAs) and/or Ecological Risk Assessments (ERAs)	♦	♦	♦	♦	♦
3.2. Planning Documents and Reports	Health and Safety Plans (HASPs)	♦	♦	♦	♦	♦
	Quality Assurance Project Plans (QAPPs) and Sampling and Analysis Plans (SAPs) in Accordance with State and Federal Requirements	♦	♦	♦	♦	♦
	Arrange for Site Access	♦	♦	♦	♦	♦
	Coordinate Utility Locates and if Applicable Coordinate Traffic Control	♦	♦	♦	♦	♦
	Evaluate Data Quality and Data Verification Reports	♦	♦	♦	♦	♦
	Investigation Reports, Monitoring Reports, Free Product Recovery Reports	♦	♦	♦	♦	♦
	Corrective Action Design Documents	♦	♦	♦	♦	♦
3.3 Site Remed-iation	Feasibility Study (FS) and Treatability Studies	♦	♦	♦	♦	♦
	Bench Scale Lab Treatability Studies, Pilot Testing, and Field Demos	♦		♦		
	Pilot Testing of Remediation Systems	♦	♦	♦	♦	♦

Exhibit 3-1: MPCA Scope of Services Contract Experience Matrix		DNREC Multiple Contracts including Remediation Services	NYSDEC Standby Engineering Services at State Superfund Sites	EPA Region 3 Response Action Contract 2 – Full Environmental Service Contract	EPA Region 5 Great Lakes Architect Engineering Services	EPA Region 6 Remedial Action Contract 3
	Design Comprehensive Remedial Action (RA) Remedies and Remediation Systems	♦	♦	♦	♦	♦
	Bid Specifications	♦		♦		
	Remedy Planning, Restoration Planning, and End Use Planning	♦	♦	♦	♦	♦
	Construction to Mitigate Vapors and Conduct Non-Construction Mitigation Measures	♦	♦			
	Evaluate, Monitor, Design, and Remediate Contaminated Sediment		♦	♦	♦	
	Oversee Subcontractors and State Contractors during Investigation and Cleanups and Tank Removals	♦	♦			
	Oversee Installation of RAs and Remedial Systems	♦	♦	♦		♦
3.4 Remedy Operations/ Optimization	Operate and Maintain Remediation Systems	♦	♦	♦		♦
	Conduct or Oversee Operation and Maintenance (O&M) on Remedial Systems	♦	♦	♦		♦
	O&M System Review and Optimization	♦	♦	♦		♦
3.5 Compliance	Arrange Transportation, Storage, and Proper Management of Wastes	♦	♦	♦	♦	♦
	Oversee Implementation of Alternative Drinking Water Supply	♦	♦			
	Stormwater Pollution Prevention Plan (SWPPP)	♦	♦	♦		
	Coordinate and Cooperate with Other State-Contracted Services Such as Sampling and Analytical, Emergency Response Contractors, and Hazardous Waste Services	♦	♦			
	Oversee Stormwater Program Requirements during Construction Activities	♦	♦	♦	♦	♦
	Field and Laboratory Data for Electronic Submittal	♦	♦	♦	♦	♦
	Asbestos Identification and if Necessary Oversee Asbestos Abatement and Removal	♦	♦			
3.6 Programmatic Support	Third Party Review and Analysis of Technical Information	♦				♦
	Support Analysis and Development of Program Policy and Guidance	♦	♦			
	Five-Year Reviews and Site Reviews	♦		♦		♦
	Decision Documents and Other Documents Such as Grant Applications	♦				
	Research, Evaluate and Implement Innovative Technologies	♦				♦
	Prepare Presentations and Present Information at Meetings	♦	♦	♦	♦	♦
	Technical Assistance to the State in the Evaluation and Interpretation of Data and Information	♦	♦			
	Oversight of Responsible Party and Voluntary Party Contractors during Site Investigations or Response Actions	♦	♦			♦
	Evaluate Invoices	♦	♦	♦	♦	♦
	Assist and Provide Training as Requested by MPCA or MDA	♦	♦			
	Follow Green Remediation Practices/Procedures consistent with MPCA guidance	♦	♦	♦	♦	♦

3.1 Site Characterization

EA's expertise covers the full site characterization spectrum from initial site inventories and Phase I inspections through complicated multi-media RIs at challenging geologic, intercoastal, and aquatic settings. We have used multiple sampling techniques for screening and definitive sampling of all environmental media including soil, groundwater, surface water, porewater, sediment, air (e.g., indoor, sub-slab, particulate), and tissue. Where appropriate, we have employed site screening technology and TRIAD sampling strategies to support initial site characterization efforts, guide remediation activities in real-time, and validate conceptual site models. Our field staff are knowledgeable in the calibration and use of: x-ray fluorescence (XRF) analysis for metals, immunoassay for organic constituents, direct-push boring and temporary well installation, laser-induced fluorescence technique, membrane interface probe, and Tar-specific Green Optical Scanning Technology (TarGOST®). Our experience also includes conventional drilling methods (hollow-stem auger, mud/air rotary), Rotosonic drilling, barge-mounted vibratory coring of sediment, passive sampling devices (e.g., diffusion samples FLUTE technology), vapor intrusion (VI) screening/sampling (e.g., passive samplers, indoor air, and sub-slab), bathymetric surveys, side-scanning sonar, and surface and borehole geophysics.

3.1.1 Site Characterization Experience Ranging from Phase I Site Assessments to Complex Remedial Investigations

EA has performed over 3,000 Phase I and Phase II investigations, RIs, extended site inspections (Sis), EE/CAs, Resource Conservation and Recovery Act Facility Investigations, and other hazardous site investigation and characterization projects, including 94 Superfund sites for U.S. Environmental Protection Agency (EPA) and 44 sites for state regulatory agencies. Under these various contracting mechanisms, EA has addressed sites contaminated with petroleum products at underground storage tank (UST) and refinery sites, pesticides and fertilizers constituents at commercial agricultural and agricultural chemical manufacturing facilities, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs) (including large wood treating facilities and manufactured gas plants), phenolics, acids, organometallics, unexploded ordnance, explosives, heavy metals, volatile and chlorinated hydrocarbons, VI, asbestos, lead-based paint, and radiological parameters, as well as emerging contaminants (e.g., 1,4 dioxane, per- and polyfluorinated alkyl substances [PFAS], Triclosan, and alkylphenols). Representative examples include:

- Conducted more than 2,000 Phase I Environmental Site Assessments in accordance with ASTM International Standards.
- Conducted more than 100 Comprehensive Environmental Response, Compensation, and Liability Act Preliminary Assessments for Department of Defense, EPA, and State regulatory agencies nationwide.
- Completed more than 100 Environmental Baseline Surveys for Base Realignment and Closure Act sites under contract to U.S. Army Corps of Engineers (USACE), Navy, Air Force, and other Department of Defense agencies.
- Executed SI program for 1,4-dioxane (and PFAS at some locations) at 21 facilities across 19 states for National Guard Bureau. Project required development of 21 facility-specific Work Plans (WPs), coordination of 5 sampling teams, collection of 150+ environmental samples .and completion of reports for review by 19 state regulatory agencies.
- Conducted PFAS sampling and analysis for New York State Department of Environmental Conservation (NYSDEC) at facilities where PFAS may have been used or were present, including Clinton West Plaza, Ithaca, NY; Metal Etching Site, Freeport, NY; and William Benson Landfill, Livonia, NY.
- EA is currently conducting VI and emerging contaminant SIs at 33 Installations in 27 States for the National Guard Bureau.

As required by the RFP, the following projects below are specific examples of investigation/remediation experience with agricultural chemical sites.

- **Ryeland Road National Priorities List (NPL) Site (Agricultural Facility), Womelsdorf, PA—**EA is currently performing a supplemental RI at an agricultural site that has contaminated groundwater, underlying soil, and intermittent stream that flows through several residential properties with arsenic. The site was a former Standard Chemical Works Corporation and Alleghany Chemical Corporation property where pesticides, fungicides, paints, and varnishes were manufactured and disposed. Activities include groundwater monitoring well installation, and collection and analysis of groundwater, surface water, seep, and sediment samples. EA is also completing a pilot study for phytoremediation of arsenic-impacted shallow soils at the site using A Chinese brake fern (*Pteris vittata*). Remedial alternatives are under development for the FS.

- **Price's Dairy Groundwater Monitoring and Remedial Alternative Assessment, Sandoval, NM—**Compiled report spanning 20 years of data to support petition for alternative standards for arsenic in groundwater to the New Mexico Environment Department. Developed conceptual site model for perched groundwater unit isolated from regional groundwater to evaluate arsenic plume stability and concentration trends. Provided expert testimony before Commission in hearing regarding conceptual site model, nature and extent of groundwater impacts, protectiveness of proposed alternative standards, and institutional controls for permanency. Evaluated *in situ* denitrification pilot test utilizing molasses for dissolved-phase arsenic immobilization. Designed and installed groundwater extraction system with raw discharge to city publicly-owned treatment works. Prepared petition for Alternative Abatement Standards before New Mexico Water Quality Control Commission. No Further Action issued by New Mexico Environment Department.

- **Bianchi/Weiss Greenhouses Site, East Patchogue, NY—**EA completed an extensive two-stage immunoassay field program to quickly and reliably delineate chlordane impacts in onsite soil for NYSDEC. The RI determined that elevated concentrations of pesticides (primarily chlordane) and metals (lead, mercury, and zinc) were present in surface and subsurface soil across much of the 13-acre site. EA used analytical results and interpreted results from the RI to analyze current and potential exposure pathways to contaminants in soil, groundwater, and the sediments and surface waters of Abets and Moss creeks. Direct-push technologies were used to collect subsurface soil samples at the former greenhouse and former/current UST/aboveground storage tank (AST) locations. EA performed groundwater monitoring well geophysical logging, gauging events, slug testing, a tidal study, stream gauging, groundwater sampling, and the installation of new monitoring wells to supplement the existing monitoring well network. EA also completed an FS report that evaluated soil and groundwater remediation alternatives. Alternatives considered for soil included excavation and offsite disposal or treatment, *in situ* bioremediation, and *in situ* thermal treatment; alternatives considered for groundwater included long-term monitoring and containment via hydraulic control and treatment. The chosen alternative included the excavation and offsite disposal of onsite soil, and sump and foundation upgrades to nearby residential buildings to prevent groundwater infiltration into their basements. This alternative was accepted by NYSDEC in a 2012 Record of Decision.

Additional investigation/remediation experience is provided below for a variety of contaminated terrestrial and aquatic environments including landfills, former industrial site, DOD site, Great Lakes Areas of Concern (AOC), and a PFA-impacted community drinking water supply.

- **148th Fighter Wing Sites 3 and 25, Duluth, MN and the Alpena Combat Readiness Training Center Site 9, Alpena, MI—**EA is currently performing supplemental groundwater RIs, *in situ* and *ex situ* remediation, long-term monitoring, and project closeout conducted at the 148th Fighter Wing Sites 3 and 25 in Duluth, MN and at the Alpena Combat Readiness Training Center Site 9 in Alpena, MI. Activities include monitoring well installation, supplemental groundwater RIs and long-term monitoring, direct-push technology soil boring investigation, excavation and disposal of petroleum-impacted soils, groundwater treatment via injections utilizing multiple substrates (EHC®, EHC-L®, and Nutrisulfate®) and bioaugmentation utilizing a *dehalcoccoides* inoculum, and placement of oxygen release compound Advanced® as an excavation backfill amendment.

- **Spirit Lake Sediment Site Investigation and Remediation Project, St. Louis River Area of Concern, MN—**EA has provided RI, site assessment, potentially responsible party (PRP) oversight, permitting, and design services over the past 5 years for this large-scale remediation and restoration assisting EPA Region 5 with progressing the project from site characterization through remedial design (RD). EA is currently designing a multi-component remedy including dredging 700,000 cubic yards (CY) of contaminated-sediment; placement in onsite confined disposal facilities (CDFs); *in situ* stabilization of lead-impacted soils; capping or enhanced monitored natural recovery (MNR) for over 130 acres, rerouting a stream channel, and construction of railroad structures.

- **Folcroft Superfund Site, Lower Darby, PA—**Hydrographic survey, bathymetry, and sub-bottom profiling and Vibracore sediment characterization of 1,750 samples. Turtle tissue sampling through Contract Laboratory Program using Scribe. Submitted EQuIS database to EPA.

- **Hernwood Municipal Landfill, Baltimore, MD—**Conducted pre-design assessment of groundwater using tracer tests, borehole geophysics, and packer tests to determine groundwater velocities/flow paths in trichloroethene (TCE)-impacted fractured bedrock. Data were used to design and install *in situ* passive bioremediation groundwater treatment system as a more sustainable, green, and cost-effective alternative to pump and treat.

- **Atlantic Woods Industries (AWI) Superfund Site, Portsmouth, VA—**Extensive pre-design sampling conducted on terrestrial and river environments. Used immunoassay and dioxin screening on site to refine vibratory core and land-based boring locations to aid in dredge prism design and placement of onsite disposal facility.

- **Moose Creek Site, AK—**Conducted vertical aquifer profiling and low-stress, incremental sampling for groundwater every 20 feet between 100 and 285 feet below ground surface to assess vertical extent of a 2-mile off-base portion of a 6-mile long perfluorooctanesulfonic acid (PFOS)/perfluorooctanoic acid (PFOA) groundwater plume outside of Eielson AFB. This process aided in delineation of preferred groundwater flow paths presenting potential exposure routes to private wells in the area.

3.1.2 Multi-Media Data Visualization, Synthesis and Modeling Experience

EA uses state-of-the-industry multi-media fate and transport modeling techniques to deliver informative analyses of chemical fate in the environment and improve remedy effectiveness, decrease remediation costs, and address stakeholder concerns. We have extensive modeling experience with groundwater fate and transport models (e.g., MODFLOW, Visual MODFLOW, MT3D, MODPATH, SVFLUX, etc.) to predict changes in chemical form, degradation rates, and exchange between media. We conduct hydrodynamic and sediment transport modeling (e.g., POLLUTE, ECOMSED, BASINS, SEDZLJ) to characterize interchange between groundwater, pore water, sediment, and surface water. We also provide the full range of air modeling, indoor air modeling for VI (e.g., Johnson and Ettinger), long-range transport of airborne dust from mine sites, and modeling fugitive emissions from landfills (e.g., AERMOD and BREEZE). We have successfully used visualization models (e.g., ArcView and Environmental Visualization Software (EVS)) to link multiple media, develop strong conceptual understandings of contaminated sites, and deliver cost-effective and protective remedies. In other instances, our in-house IT experts have developed customized analytical and database software applications to meet unique specifications, such as our work for the American Chemistry Council. EA understands that developing robust models starts with a strong conceptual understanding of the site to focus models on key project needs. This understanding results in efficiency and effectiveness of field data collection planning and leveraging of data sources from past work. Representative projects include:

- **Data Collection and Modeling, Manistique River Site, MI—**Compiled 15 years of sediment, water, tissue, and pore water data for PCBs into consolidated ACCESS and EQUIS databases to complete three-dimensional (3-D) modeling. Incorporated years of information on bathymetry and sediment lithology to overcome challenges associated with buried plank wood and sawdust. Defined target areas for remediation and developed a comprehensive site model that considered horizontal and vertical extent, depth, changes in bathymetry over time, bioaccumulation, and hydrodynamics. Identified areas of erosion, estimated remedial volumes, and predicted disposal volumes using ArcGIS. National Oceanic and Atmospheric Administration commended EA for developing easily-comprehensible graphic representations of complex concepts.

- **Geographic Information System (GIS) Modeling, Lincoln Park, WI—**Used 3-D spatial models performed in ArcView and EVS to define target zones for Toxic Substances Control Act (TSCA) and non-TSCA zones of PCB and PAH in scattered sediment deposits along 1.7 miles of the Milwaukee River. Used mass balance models to identify the most cost-effective means of handling and dewatering. Selected methods that reduced disposal volumes—and disposal costs—compared to other FS options.

- **Material Disposal Modeling, Former Zephyr Refinery, MI—**Used EVS to delineate separate non-hazardous and hazardous target volumes for removal using 3-D spatial models of total petroleum hydrocarbons and metals in sediment. Predicted final disposal quantities in support of funding requests using mass balance models.

- **Air and Bioavailability Modeling, Iron King Mine and Humboldt Smelter Superfund Site, AZ—**Used FLUENT **to** Model long-range suspension and deposition of metals in airborne dust from a mine and smelter site. Estimated metal bioavailability and bioaccumulation based on arsenic and lead speciation.

- **Thermal Plume Model and §316(a) Demonstration to Assess Planned Power Uprate at Point Beach Nuclear Plant, Two Rivers, WI—**Collected bathymetric data using boat-mounted sonar with Global Positioning System and surveying equipment to develop a 3-D hydrodynamic model using DHI-MIKE3. Output from the hydrodynamic model was used as input to a 3-D Environmental Fluid Dynamics Computer Code model to simulate the hydrothermal plume.

- **PAH Modeling, AWI Superfund Site, VA—**Developed a 3-D model of PAHs in sediments using EVS to develop dredge cell design for dredge materials and cover. Modeled sediment burial and PAH degradation rates to

demonstrate effectiveness of MNR. Developed emission rate models with atmospheric dispersion factors to assess PAH losses from dredging activities for comparison against occupational exposure limits.

- **Contaminant of Concern (COC) Modeling, Sparrows Point Dredged Material Containment Facility, MD—** Developed 3-D spatial models for COCs to: (1) determine groundwater flow rates and seep inputs to shallow surface water, (2) understand influence of nearshore hydrodynamics on surface water and sediment COCs, and (3) develop two-dimensional (2-D) contours of summed risks to assess human health and ecological risk exposures.

- **Groundwater Transport Modeling, Millsboro Municipal Well Field, DE—**Completed a MODFLOW/MODPATH groundwater transport/capture zone modeling for the Millsboro Public Well TCE site to assess the minimum pumping rate(s) for two public wells to capture the leading edge of the groundwater contaminant plume. Fifteen groundwater pumping scenarios were performed to identify the minimum pumping rate required to capture groundwater particles from the source area.

- **Environmental Investigation and Remediation, Former Georgetown Dry Cleaners, Georgetown, DE—**Utilized the Johnson and Ettinger VI Model and risk assessment to assess potential for groundwater-to-indoor-air transport for a residential home. Completed a soil gas study and evaluated remedial alternatives for addressing VI at the former Georgetown Dry Cleaner.

- **AWI NPL Site, Portsmouth, VA—**Developed comprehensive MODFLOW groundwater model to assess aggregate hydraulic impacts of retaining wall construction along shoreline, *in situ* stabilization of subsurface waste, low-permeability cap placement, utility relocation, and aid in monitored natural attenuation (MNA) network placement.

- **Boomsnub NPL Site, Vancouver, WA—**Developed a ModFlow/MT3D transport model to simulate TCE and hexavalent chromium transport and removal during operation of groundwater extraction/treatment remediation system that treats co-mingled contaminant plume containing TCE and hexavalent chromium, originating from two different sources. The model was used to simulate various groundwater extraction scenarios to predict remedial timeframe with and without targeted TCE source removal. Additional simulations were run to assess how groundwater extraction could capture TCE migration from both plumes to simultaneously treat groundwater with one system.

3.1.3 Risk Assessment Methodologies

EA follows EPA risk assessment methodologies or State regulatory guidelines/procedures, when available, to evaluate potential human health and ecological risks from exposure to environmental media. EA has successfully worked with EPA and State agencies to establish acceptable risk-based cleanup criteria at hundreds of sites nationwide—developing environmentally-sound strategies that are economically attainable and proactive. EA has successfully compared site media to published federal and state standards for soil, water, sediment, and residential/commercial/industrial land uses—for the benefit of our clients and to protect the environment. EA scientists are experienced in risk estimation using various software and models including SmartRisk, CALTOX, and Monte Carlo-based programs (e.g., @RISK). Under our EPA contracts, we have conducted 27 HHRAs and 18 ERAs for EPA Superfund sites across the country.

- **Ryeland Road National Priorities List (NPL) Site (Agricultural Facility), Womelsdorf, PA—**EA is currently performing HHRAs and ERAs related to arsenic exposure from a former agricultural site. Exposures routes include groundwater, contaminated soil, and an intermittent stream that flows through several residential properties. The risk assessment considered current and future site uses and additional residential development of adjacent properties.

- **12 EPA Region 5 Contaminated Sediment Sites—**Including Celeron Island and Detroit River Area of Concern, EA utilized Sediment Quality Calculated Probable Effects Concentration Quotients to predict the potential for ecological toxicity in sediments from metals, PAHs, and PCBs. EA used equilibrium sediment benchmark toxic units (ESBTUs) to evaluate ecological risk associated with exposure to porewater based on measured concentration of contaminants in sediment.

- **Harper-Thiel Former Electroplating Facility Site, Wilmington, DE—**Under EA's existing Delaware Department of Natural Resources and Environmental Control (DNREC) contract, we have performed eight HHRAs and ERAs and reviewed a previously-submitted HHRA for the Harper-Thiel Former Electroplating Facility site. We identified issues with non-compliance with DNREC and EPA risk assessment guidance and revised the HHRA to address pathways and aspects of EPA guidance that were not considered in the original HHRA. The revised HHRA identified hexavalent

chromium, Aroclor 1254, and lead in soil and concrete as COCs, driving potential risks in exceedance of the DNREC acceptable risk range for future site use receptors (commercial and construction workers).

- **Sandy Beach Superfund Site, Pelican Bay, TX—**EA identified unacceptable residential risks and acceptable ecological risks from a 226-acre TCE and DCE groundwater plume in a residential community using EPA RAGS/SLERA and comparison to TCEQ Protective Concentration Levels (PCLs). EA developed risk-based cleanup goals. Pathways included groundwater and drinking water volatiles through air and aquatic environments. Human receptors included campers, residential occupants, and construction workers. Ecological receptors included plants, soil invertebrates, aquatic/benthic organisms, etc.

3.2 Planning Documents and Reports

As an experienced environmental contractor, we have developed more than 200 WPs, Sampling and Analysis Plans (SAPs) for EPA and state regulatory agency projects that can be used in the development of project plans for other similar sites—saving time and money. EA has developed and refined quality management plans for EPA and state regulatory agencies (including Minnesota). EA will prepare all maps and GIS deliverables in accordance with MPCA spatial data requirements, to ensure that these products and associated metadata are fully-compatible with MPCA's GIS databases, data standards, and formatting requirements. EA will prepare a QAPP for Task Orders (TOs) requiring environmental measurements, data collection, or sampling. Each QAPP will be prepared in accordance with MPCA QAPP Guidance (February 2012; Document p-eao2-13). Establishing data quality objectives is a major part of the planning process for TOs that require collecting or using environmental measurements, samples, and data. EA uses EPA's 7-step data quality objectives process to ensure that the type, quantity, and quality of data are sufficient to meet overall TO objectives. Data validation will be conducted on subcontracted laboratory data by qualified personnel to systematically evaluate sample preservation, sample handling, laboratory analysis procedures, and analytical results and determine the attributes of the data set. EA's internal review process for deliverables is applied to all deliverables on all EA contracts. Deliverable reviews will consist of a three-level review process, involving technical, editorial, and final quality reviews.

EA has an established HS) Program that complies with OSHA standards 1910.120 and 1926.65. Our Corporate H&S Program outlines H&S roles and responsibilities by project function; development of Safety Plans; a hazard communication program; identification and evaluation of chemical, physical, explosive, and biological hazards; emergency response plan; medical surveillance; personal protective equipment; employee training; environmental monitoring; site control; confined space entry; spill containment; and proper reporting. These plans, policies, and guidance documents are incorporated into our Corporate H&S Program Manual and associated documents and provide company-wide policies governing all phases of field-related work. Safety Plans will be prepared for each project where on any field sampling or field activities are required. We require that all our subcontractors strictly adhere to our Safety Plans and are current on all required safety training and medical surveillance.

For all fieldwork, site-specific HASPs are prepared for each project addressing site conditions and hazards, the nature of the field activity, and ensuring compliance with EA's H&S Program Manual as well as with federal, state, and local H&S regulations. The HASP describes site-specific procedures, equipment, and personal protective equipment to be used onsite to protect authorized site personnel from potential H&S hazards specific to the work to be conducted. No individuals are allowed to access the project site without verification that they have read and understand the HASP and meet all training and competency requirements described in the HASP. The HASP outlines clear lines of communication and authority. EA's H&S Program is reviewed annually from leading third-party compliance networks such as BROWZ, ISNETWORLD, and PICS—from which we have received strong safety ratings. These third-party safety evaluation organizations review relevant Corporate H&S Program documents, OSHA Logs, and H&S-related forms (e.g., accident/incident investigation forms). The organizations also require completion of an extensive H&S questionnaire that drills down into the details of the various H&S training programs that may be required for a particular client or job site.

3.3 Site Remediation

EA has evaluated, designed, and implemented a range of traditional and innovative remedial technologies for cleanup of soil, water, groundwater, sediment, and VI mitigation—including landfill capping, tank removals, soil vapor extraction (SVE), slurry walls, light non-aqueous phase liquid (LNAPL) recovery, VI mitigation, chemical oxidation, cryogenic-compression and condensation (C3), enhanced product recovery, *in situ* bioremediation and bioaugmentation, sediment management, consolidation and remediation, *in situ* stabilization/solidification, radioactive material decontamination, MNA, groundwater extraction and treatment, institutional controls, excavation, metals filtration, vapor-phase granular activated

carbon (GAC), air stripping, ion exchange, ultraviolet light-activated titanium dioxide catalyst treatment, and environmental dredging of contaminated sediment. We have utilized innovative approaches to address contaminated sediment and habitat restoration such as sediment profile imaging to evaluate benthic habitat conditions; stream tube mapping weighted average concentration assessments and visualization techniques to reduce limits of remediation; armoring to prevent migration of contaminated sediments; DRET and EET elutriate tests to evaluate water quality during dredging and settling behavior with resuspension; and evaluation of sediment leachability within CDFs using simplified laboratory run-off procedure, sequential batch leachate testing, and waste characterization. Technologies incorporated included subaqueous caps, enhanced MNR, CDFs, and hybrid remedies.

3.3.1 Feasibility Studies and/or Treatability/Pilot Studies

Representative examples of FS and/or treatability/pilot studies implemented to support the FS or remedy pre-design are provided below:

- **AWI Superfund Site, Portsmouth, VA—**EA performed two treatability studies for two separate remedy components. The first treatability study determined the most appropriate mixed design of an *in situ* solidification and stabilization remedy for a former waste pond area, inactive for about 30 years. The treatability study assessed various additives that would be added to soil mass, including cement, bentonite, organophilic clay, and GAC. Samples from the pond area were used in the bench-scale treatability study. Each test varied mix proportions and additives, and was assessed for ability to immobilize dense non-aqueous phase liquid (DNAPL) sufficiently to withstand compressive loads and facilitate beneficial reuse of the area. Leaching from the amended soil mass was evaluated by Synthetic Precipitation Leaching Procedure and semi-dynamic leach methods. The second treatability study determined the most-effective proportions of cement to be added to dredged PAH-contaminated river sediments for placement in two containment areas. A bench scale test assessed the impact of varying moisture contents on performance (compressive strength following curing) and the addition of cement to dredged sediments at a 15% ratio (by dry weight) was selected as the best alternative. The results of these two treatability studies were included in bidding documents for two separate RAs. Full–scale sampling has confirmed the compressive strengths observed in the bench-scale testing.

- **Bandera Road Groundwater Plume Superfund Site, San Antonio, TX—**Under contract with EPA Region 6, EA performed an FS to develop a remedial strategy for a 0.5-mile by 1-mile tetrachloroethene (PCE)-chlorinated solvent plume in three karst aquifers, including the Edwards Aquifer (which is the sole-source drinking water aquifer for the region). To support the FS, EA analyzed fate and transport of contaminants using AquaTrack™ and Wavefront injection to determine the MNA zone potential. Performed an *in situ* bioremediation injection pilot testing (using bio-traps baited with dehaleococoties in wells injected with 3-D-Microemulsion) and an SVE pilot test to evaluate feasibility of recovering shallow soil vapor. Collected sub-slab samples to evaluate indoor air pathways including five commercial structures, five apartment complexes, one residential structure, and two secondary schools.

- **Trolley Boulevard Site, Gates, NY—**EA completed an FS to determine potential alternative onsite RAs that were protective of human health and the environment and met the RA objectives of the site. RAs considered included: excavation/disposal of PCB-contaminated soil, groundwater pump-and-treat, *in situ* chemical reductions of chlorinated volatile organic compounds (CVOCs) in the bedrock aquifer, *in situ* bioremediation, *in situ* thermal treatment, and MNA. Ultimately, the FS recommended excavation and disposal of soil and MNA for groundwater.

- **Former Zephyr Oil Refinery, North Muskegon, MI—**For EPA Region 5, EA conducted pre-construction treatability studies to determine physical treatment methods for excavated sediments. Physical amendment testing was conducted to determine the optimal amendment concentration for sediment solidification. Three amendments—an EnviroBlend® product with solidification agent, an EnviroBlend® product with solidification agent and metal stabilizer, and Portland cement—were evaluated for their ability to reduce leachable lead levels to below the Resource Conservation and Recovery Act-regulated level (5 milligrams per liter).

3.3.2 Remedial Technology Experience

Exhibit 3-2 is a list of remedial technologies that EA has evaluated, designed, and implemented, demonstrating the breadth and depth of remediation experience for a wide variety of contaminated media. We have also highlighted where we have incorporated green and sustainable concepts into the remedial approach.

Exhibit 3-2: Remedial Technologies that EA has Evaluated during FSs, Designed, and Implemented

We evaluate and utilize a combination of remedies to achieve more effective site cleanup.

Medium		Technologies that EA has evaluated during FSs, Designed, and Implemented	VOCs	Metals	PAHs	Pesticides	Dioxins/Furans	PCBs	Rad/Mixed Waste	Munitions Constituents Including CWM	Emerging Contaminants	# of Evaluated/ Designed/ Implemented Systems	Representative Sites (EA has implemented technology to address one or more of the contaminants)	Green or Sustainable Features*
Soil	*Ex Situ*	Excavation/Onsite Reuse or Transport and Disposal	■	■	■	■	■	■	■	■	■	100+	Garland Creosoting Company Superfund Site, TX	B, I, J, M
		Low-Temperature Thermal Desorption	■		■	■		■		■	■	6	Maryland Sand Gravel and Stone, Elkton, MD	D, J, M
		Soil Washing		■					■			5	Wilmington Waterfront Development Project, DE	B, I
		Landfarming	■		■							14	Griffiss AFB, Rome, NY	A, B, I
		Incineration			■	■	■	■		■		25	Frankford Arsenal, Philadelphia, PA.	
		UST Removal/abandonment	■		■			■				400+	Exxon/Mobil Corporation, Sites in TX, OK, AR, LA	J
		Capping/Landfill Construction	■	■	■	■	■	■	■			12	Garland Creosoting Company Superfund Site, TX	A, K, M
	In Situ	SVE/Multi-Phase Extraction	■		■							50+	State Road 114 Groundwater Superfund Site, TX	A, D, I
		Bioremediation	■		■	■		■		■		24	Sol Lynn Superfund Site, Houston, TX	E, F, G, I, M
		Bioventing	■									80+	Gasoline Alley, Fort Drum, Watertown, NY	A, D, F, I, M
		Slurry Walls	■	■	■	■	■	■			■	9	Ouachita-Nevada Wood Treaters Superfund Site, AR	B, D
		Non-Thermal Chemical Destruction	■		■							10	Air National Sites Alpena, MI/Duluth, MN	I
		Surfactant Flushing	■		■	■						3	Oasis Fuel Site, Fort Drum, Watertown, NY	F
		Enhanced Resistive/Conductive Heating/ Steam-Enhanced Extraction	■			■						2	Former PR-58 Nike Missile Site, North Kingstown, RI	I
		Phytoremediation		■					■			7	BNSF Lincoln-Hudson Railyard, Milford, NE	E, H
		Solidification/Stabilization	■	■	■					■		15	Texarkana Wood Preserving Superfund Site, TX	I, J
		Chemical Oxidation	■		■						■	12	Air National Sites Alpena, MI/Duluth, MN	I, J
Groundwater		Natural Attenuation	■	■	■				■	■		50+	Exxon/Mobil Corporation, Sites in TX, OK, AR, LA	E, F, I
		Bioremediation	■		■						■	37	Sol Lynn Superfund Site, Houston, TX	E, F, I
		Aquifer Air Sparging	■									50+	Exxon/Mobil Corporation, Sites in TX, OK, AR, LA	A, I
		Permeable Reactive Wall (Zero Valent Iron [ZVI])	■	■						■		4	U.S. Coast Guard, Support Center, Elizabeth City, NC	D, G, I
		Mulch Barriers or *in situ* Bioreactors	■	■								2	Hill AFB, Operable Unit (OU) 4 (NPL site), Layton, UT	
		Non-Aqueous Liquid Recovery	■		■			■			■	200+	State Road 114 Groundwater Plume Superfund Site, Levelland, TX	A, D

* Green or Sustainability Features Legend

A- Alternative sources of power (e.g., wind- or solar-powered equipment).
B- Beneficial reuse of contaminated material for made-land construction, habitat restoration, or onsite containment.
C- Plant–based (e.g., coconut tree) or shell-based (chitin) carbon media for aqueous-phase COC sequestration or treatment.
D- Recycled or repurposed components or materials (e.g., ZVI, organic mulch, crab shell, etc.).
E- Sustainable or self-regenerating remedial components (e.g., MNA, MNR, engineered wetlands, biomats, etc.).
F- Biodegradable food-grade substrates and natural *in situ* biological processes.
G- Passive remediation that requires little or no O&M or produced energy consumption.
H- Plant-based remedial components (e.g., phytoremediation).
I- Onsite treatment to reduce carbon footprint compared to offsite treatment and disposal (soil).
J- Alternately fueled or high-efficiency construction equipment.
K- Alternative natural systems that promote resource conservation or habitat enhancement (e.g., evapotranspiration caps, infiltration galleries, groundwater re-injection).
L- Recycled or repurposed waste streams (landfill gas conversion to energy or recovered solvents/fuel products for reuse).
M- Water conservation.

Exhibit 3-2: Remedial Technologies that EA has Evaluated during FSs, Designed, and Implemented

We evaluate and utilize a combination of remedies to achieve more effective site cleanup.

Medium	Technologies that EA has evaluated during FSs, Designed, and Implemented	VOCs	Metals	PAHs	Pesticides	Dioxins/Furans	PCBs	Rad/Mixed Waste	Munitions Constituents Including CWM	Emerging Contaminants	# of Evaluated/ Designed/ Implemented Systems	Representative Sites (EA has implemented technology to address one or more of the contaminants)	Green or Sustainable Features*
Groundwater	Phytoremediation		■								6	Hill Air Force Base (AFB), OU5 (NPL site), Layton, UT	B, C, E, G, H, I
	Bioslurping	■		■							30	Fort Drum, Gasoline Alley, Watertown, NY	A, D
	G t Carbon	■								■	200+	State Road 114 Groundwater Plume Superfund Site, TX	C
	Air Stripping	■									80+	State Road 114 Groundwater Plume Superfund Site, TX	A, K
	Fluidized Bed Reactor	■		■			■				2	Spring Gardens Former MGP Site, Baltimore, MD	A, E, K, I
	In situ Bioreactors	■	■								3	Hill AFB, OU4 (NPL site), Layton, UT	A, I
	Coagulation/Flocculation		■								7	Sprague Road Superfund Site, TX	L
	Thermal/Catalytic Oxidation	■									13	Gasoline Alley, Fort Drum, Watertown, NY	A, J
	In-well Stripping	■									4	Belmont TCE Site, Charlotte, NC.	D, I, K
	Groundwater Pump and Treat	■	■	■						■	22	Sprague Road Groundwater Plume Superfund Site Odessa, TX	A, B, C, D, L, M
	Ion Exchange/Filtration		■					■			12	Sprague Road Groundwater Plume Superfund Site Odessa, TX	M
	Surfactant Flushing	■		■	■						3	Oasis Fuel site, Fort Drum, Watertown, NY	F, L
	Steam-enhanced Extraction/ Enhanced Resistive Heating	■									2	Former PR-58 Nike Missile Site, North Kingstown, RI	L
	Reductive Chemistry (*in situ* fixation)		■								4	Van Der Horst Site, Lovelland, TX	F
	Chemical or Advanced Oxidation	■	■		■					■	22	Municipal Well # 4 Superfund Site, Dover, NJ	A
Sediment & Surface Water	*In Situ* Treatment	■	■	■			■		■	■	4	New O-Field, Aberdeen Proving Ground, MD	B, D, E, M
	Dredging, Containment, and Disposal	■	■	■	■	■	■		■	■	5	Lincoln Park, Zephyr, Spirit Lake	B, I, J, M
	Capping	■	■	■		■	■		■	■	5	Lincoln Park, Zephyr, Grand Calumet, Spirit Lake	B, C, D, E, G, I, J, M
	Monitored Natural Recovery	■	■	■	■		■		■		5	St Clair, Zephyr, Lincoln Park	E, G
Vapor Intrusion	Active Sub-slab Depressurization	■									20+	Former Pappas Dry Cleaners, Dansville, NY	G
	Passive Sub-slab Mitigation	■									2	MEW Superfund Site, Mountain View, CA	G
	Vapor Barriers	■									5	Former Axiohm Facility OU2, Ithaca, NY	G
	SVE (for VI mitigation)	■									2	Bandera Road Superfund Site, TX	G

* Green or Sustainability Features Legend

A- Alternative sources of power (e.g., wind- or solar-powered equipment)
B- Beneficial reuse of contaminated material for made-land construction, habitat restoration, or onsite containment
C- Plant–based (e.g., coconut tree) or shell-based (chitin) carbon media for aqueous-phase COC sequestration or treatment
D- Recycled or repurposed components or materials (e.g., ZVI, organic mulch, crab shell, etc.).
E- Sustainable or self-regenerating remedial components (e.g., MNA, MNR, engineered wetlands, biomats, etc.)
F- Biodegradable food-grade substrates and natural *in situ* biological processes.
G- Passive remediation that requires little or no O&M or produced energy consumption.
H- Plant-based remedial components (e.g., phytoremediation).
I- Onsite treatment to reduce carbon footprint compared to offsite treatment and disposal (soil).
J- Alternately fueled or high-efficiency construction equipment.
K- Alternative natural systems that promote resource conservation or habitat enhancement (e.g., ET caps, infiltration galleries, groundwater re-injection).
L- Recycled or repurposed waste streams (landfill gas conversion to energy or recovered solvents/fuel products for reuse).
M- Water conservation.

3.3.3 Remedial Design

Our engineers are adept in the design process (30%, 60%, 90%, and 100% submissions) and produce bidding-level documents (plans, specs, design reports, and cost estimates). Because we are also experienced in performing design-build-operate remediation, we have construction and O&M professionals on-board to perform constructability/operability reviews during the investigation and design process that routinely make suggestions saving time and money. EA's designs have progressed beyond innovative treatment measures to include recycling and reuse of treated materials, achieving waste reduction and significant cost savings. EA has proven expertise in designing and preparing packages for bidding of fixed price construction contracts and for projects that will be subcontracted to other contractors.

EA's work spans the entire project lifecycle, from investigation and design through remediation and operations. We have seen first-hand how poor designs can affect field construction and operations, making us especially qualified to perform effective bidding, constructability, and operability reviews for designs. Such reviews routinely result in recommendations that save time and money. EA draws from our experience to increase the quality of our designs, reducing the risk of cost increases and schedule delays.

- **RD, Five Sites, EPA Region 3 Remedial Action Contract (RAC)—**For one site, AWI, EA produced seven RDs modules for various remedy components, including containment facilities, environmental dredging, relocation of storm drains, expansion of an existing wetland, *in situ* stabilization/solidification of a DNAPL-contaminated pond, and a shoreline stabilization wall. The dredging of approximately 300,000 CY of PAH-contaminated sediment and chemical amendment prior to permanent onsite placement into two constructed containment cells. All designs were constructed while the site owner continued onsite concrete fabrication operations. As an additional challenge, a new concrete bridge was constructed directly across the site, and the concrete bridge piers and trusses were fabricated and stored onsite. EA coordinated with the bridge construction contractors and the site owners early in the design to account for very crowded work conditions. EA conducted early, regular, and detailed communications to facilitate fabrication and storage of bridge components, bridge construction, and on-schedule completion of dredging projects.

- **RD and Engineering Services, Eight Sties, EPA Region 6 RAC—**EA has completed RDs and provided engineering services during construction at 8 sites, including 30, 90, and 100% plans and specifications, bid documents, pre-design investigations, and treatability studies. At the Sandy Beach site, EA designed a multi-phase remediation system to treat a 226-acre TCE-contaminated groundwater plume within a residential neighborhood along a shallow ravine. System included: (1) groundwater pump-and-treat system to contain the plume and prevent further migration into City of Pelican Bay or Eagle Mountain Lake, (2) SVE system to address source area, and (3) deep-water supply wells to replace shallow wells in a contaminated aquifer. The groundwater extraction design included horizontal extraction wells positioned beneath roadways and right-of-ways to maximize capture while minimizing access issues. Developed separate design packages of individual remedy components, keeping the project on-schedule by facilitating implementation in accordance with budget constraints.

- **RD and Engineering Services, Four Sites, EPA Region 5 Great Lakes Architect-Engineer Services Contract—**EA has completed RDs and provided engineering services during construction at 4 sites, including 30, 90, and 100% plans and specifications; bid documents; pre-design investigations and treatability studies. At Lincoln Park, EA prepared an RD for remediation and restoration to address Beneficial Use Impairments for the Milwaukee River Area of Concern. Sediments contained TSCA-level PCBs identified in previous studies as a source of contamination. EA worked cooperatively with EPA and the Non-Federal Sponsors—Wisconsin Department of Natural Resources and Milwaukee County Parks—through weekly calls and correspondence to plan and execute pre-FS sampling, FS, design, and permit applications in under 18 months. EA developed a range of options for river-bed and shoreline restoration. RD included components for excavation behind coffer dams and hydraulic dredging to maximize efficiency. Supported EPA during procurement of RA construction contractor and performed oversight of construction, playing a key role in ensuring compliance with design specifications. At Former Zephyr Oil Refinery Site, MI (EPA Region 5)—EA prepared RD, plans, and specifications for a remedy including removal of >58,000 CY of impacted wetland/sediment material. Removal employed excavation techniques to move impacted materials to an upland staging area for dewatering (utilizing drying agents) prior to offsite transport/disposal. Approximately 1,400 CY of wetlands sediment will be chemically amended to pass Toxicity Characteristic Leaching Procedure-lead and paint filter tests.

- **Plans and Specifications, Bid Documents, and Engineering Services, Eight Sites, NYSDEC—**Prepared 30, 60, 90, and 100% complete plans and specifications; prepared bid documents; and provided engineering services during construction at 8 sites. We developed a VI RD at Former Capitol Scrap Yard Site that consisted of conducting a soil

gas study and designing a vapor barrier during installation of a building on OU 2. Completed the soil gas study and installed/tested the vapor barrier.

3.3.4 Remedial Action Experience

In addition to the RDs highlighted above EA has also self-performed design-build-operate for a variety of sites. Several of EA's EA innovative remedial approaches are summarized below:

- **New O-Field Site, Edgewood, MD—**Completed design-build-operate consisting of engineered tidal wetland restoration, *in situ* bioremediation of groundwater, *in situ* capping of contaminated sediments in conjunction with habitat restoration, and onsite capping of landfill that resulted in a sustainable remedy that saved Army $4 million compared to prior remedy alternative of excavation and offsite disposal.

- **Contaminant Soil Excavation and Debris Removal Activities—**EA performed interim remedial measure (IRM) activities at the former Lackawanna Incinerator facility, including excavation and disposal of 7,873 CY of impacted soil containing lead and arsenic at concentrations exceeding the restricted residential criteria. EA provided real-time XRF field screening of excavated soils in conjunction with confirmatory sampling with laboratory analysis. Coordinated with NYSDEC, City of Lackawanna, and adjacent property owners from initial planning through end of IRM implementation. Prepared bid documents and procured subcontractors to transport and dispose of debris and contaminated soil at Harper-Thiel Facility, segregated then recycled steel debris, generating income for the project and reducing disposal costs. Excavated over 600 tons of petroleum-impacted soil at the J&G Auto site and removed over 1,500 tons of soil at the Truck Tire America site from a former UST area. Completed vacuum excavation services for utility clearance at the Pearson's Corner Site prior to completion of the direct-push delineation sampling events due to the numerous private utilities located throughout the area.

- **Bioventing Systems, SVE Systems—**EA manages the operation of a single-blower SVE system with off-gas treatment for an active building at National Heatset. EA also designed and installed five additional horizontal SVE wells to further address impacted vapor beneath the building. Designed, installed, and operated SVE and aquifer air sparge systems at J&G Auto and Uncle Ted's, two challenging groundwater sites. Implemented a chemical oxidation program (activated persulfate) to augment the aquifer air sparge/SVE remediation system and accelerated site closure at Uncle Ted's station.

- **Bioremediation of Petroleum, Oil, and Lubricant-Contaminated Soil—**At the Clinton West Plaza State Superfund site, EA implemented an enhanced anaerobic bioremediation system involving the injection of HRC® to address CVOC contamination in the groundwater near a former dry cleaner site in a commercial/residential area. Once injected, the HRC® began a chemical process that slowly released molecular hydrogen into the contaminated groundwater, providing native dechlorinating bacteria with a long-lasting fuel source to naturally break down the contaminants into harmless by-products.

- **Building 525 TCE Plume, Vehicle Testing Facility; Aberdeen, MD—**EA competed a design/build/operate of an *in situ* bioremediation system to treat PCE, TCE, and other daughter chlorinated volatile organic compounds in commercial area. Temporary VI mitigation measures were implemented during groundwater remediation.

- **Groundwater Extraction and Injection Wells—**Installed 20 temporary injection wells at the Uncle Ted's and Auto Doctors sites to perform *in situ* chemical oxidation treatment. At the Millsboro Public Well TCE site, *in situ* chemical oxidation treatment included the injection of ~900 gal of Modified Fenton's Reagent. Post-60-day results indicated a percent TCE reduction in the range of 42-99%. Invited to present the methods utilized for assessing the mass distribution and destruction of TCE at the Seventh International Conference on Remediation of Chlorinated and Recalcitrant Compounds in May 2010.

3.4 Remedy Operations and Optimization

EA has performed value engineering and remedy optimization studies to identify opportunities for reducing project cost while accomplishing remediation goals defined in the design report, identify constructability issues that could lead to additional costs, and propose mediation measures for reducing the risk of occurrence. Relevant examples include:

- **Sol Lynn Industrial Transformers Superfund Site, TX—**Conducted a value engineering study during RA and identified cost savings by evaluating constructability and revising implementation of the remedy. EA's value engineering study concluded that a revised strategy would realize cost savings between $100,000 and $600,000.

- **Atlas Missile Site 10, York, NE—**EA designed modifications to a groundwater treatment system/SVE system, including improvement options for blower and variable drive components; added pitot air flow measuring ports; and conversion of one system from a single-phase power supply with a three-phase converter to a three-phase line power operation. Revitalization, repair, and optimization of the existing treatment system, as compared to configuration of a site-wide pump-and-treat, reduced both greenhouse gas emissions (8,863 metric tons [MTs] versus 17,872 MTs) and total energy consumed by half (157,000 million British thermal units (MMBTUs) versus 365,000 MMBTUs). The system component reliability increased by 50% and overall on-line operation time of RA systems met 99% of on-line operation time requirements.

- **Remedy Operation and Monitoring, National Heatset Printing Site, Babylon, NY—**EA operates three density-driven convection groundwater treatment systems and an SVE system installed to treat volatile organic compound (VOC)-contaminated soil. EA also installed and operated an ozone remediation system at a former dry cleaner site and performed weekly monitoring of the system throughout the ozone injection to ensure ozone was being properly dispersed throughout the well field.

- **Long-term Operations and Monitoring, 21 Sites, NY—**Under an NYSDEC contract, EA has conducted groundwater sampling and monitoring at a former landfill for VOCs, semivolatile organic compounds (SVOCs), pesticides, and metals, and groundwater sampling and monitoring at former dry cleaner sites for VOCs and CVOCs. EA conducted multiple remedial system optimizations evaluations of existing remedies including leachate collection and management at former Busy Bee Landfill; groundwater pump and treat systems at the Roxy Cleaner site; and multiple groundwater density-driven convection treatment systems at the National Heatset Printing site. Remedial system optimization activities include a detailed review of site-related historical documentation, performance evaluation of existing remedy, cost analysis of the remedy, and an alternatives analysis for potential system optimization strategies and/or change in remedy to expedite remedial timeframes and overall remedial costs.

- **North Penn 6 Sites, Montgomery County, PA—**Re-designing (optimizing) treatment systems bypassing unnecessary GAC treatment and pumps will save a projected $53,000.

- **Air Force NPL Site, MMR, Cape Cod, MA—**Continuously assessing residential VI and groundwater impacts. Developing/implementing an optimization strategy to reduce remedial timeframes for ethylene dibromide-contaminated groundwater by >40%. Power for groundwater remediation provided by alternative energy source (three wind turbines).

- **Puchack Superfund Site, NJ—**Optimized treatability study design based on field conditions using pressurized feed of fixation agent instead of gravity feed. Completed work in residential area, with minimal impact on surrounding neighborhood.

3.5 Compliance

EA provides environmental H&S and sustainability auditing; multi-media compliance; solid waste management; asbestos monitoring and abatement; storage tank; petroleum, oils, and lubricants management; and wastewater and water quality management services.

3.5.1 Waste Stream, Asbestos. and Lead-based Paint Experience

EA has in-house certified hazardous waste material managers, asbestos and lead-based paint inspectors. We perform initial inventories/inspections, classification, design and oversight of removal/abatement contractors. Examples are provided below:

- **Transportation/Storage/Treatment/Disposal to Offsite Facility, Including Signing Manifests—**At the J&H Auto site, disposed of investigation-derived waste produced during well installation activities on a continual basis to avoid long-term storage of investigation-derived waste in a residential area. At Hamilton Park, a total of 432 loads, containing >4,500 tons of soil, was transported for offsite disposal. Coordinated with DNREC on the signing of manifests.

- **PCB, Asbestos, and Lead Paint Removal/Disposal—**Prepared work plans, bid documents, and procured subcontractors for the removal of asbestos, PCBs, and lead containing materials at the Harper Thiel site. An asbestos survey and abatement were performed in several buildings. Utilized DNREC's field screening laboratory for PCB analysis to expedite efficient decision-making in the field, reducing downtime.

- **PCB, Asbestos, and Lead Paint Removal/Disposal—**At Tonawanda, NY, EA managed an IRM of a former industrial dump, involving the excavation and disposal of PCB-contaminated subsurface drums and visibly impacted surrounding soil. A total of 348 partially-full and empty buried drums was recovered and four 85-gallon drum over-packs were filled with drums and liquid drum contents during the excavation effort. The mixed waste, including PCBs exceeding the TSCA limit of 50 parts per million, lead, and TCE, was stored onsite in secured roll-offs until EA could secure an appropriate offsite disposal facility.

3.5.2 Stormwater Pollution Control Experience

EA also provides engineering expertise for evaluation of existing stormwater facilities and their receiving streams in order to determine their current level of effectiveness (both permanent and temporary during construction). EA can recommend remedial maintenance measures and retrofit or replacement of failing facilities in accordance with state and local applicable standards. For example, we assessed best management practices efficiency by reviewing the monitoring data, calculating inflow and outflow event mean concentration (EMCs) and conducting statistical comparisons between them. We also have experience in designing and implementing a variety of traditional and low impact best management practice types, including retention and detention ponds, biofilters, grassed filter strips, porous pavement, wetlands, illegal dumping, pet waste programs, and others. Relevant examples include:

- Since 2004, EA, in its ongoing partnership with the Air Force Reserve Command Installations, is providing a wide array of storm water compliance support services. We have developed more than 50 SWPPPs Baseline, Updates, and 5-Year Reviews at Air Force Reserve Command installations.

- For DC Water's Municipal Separate Storm Sewer System (MS4) compliance program, EA provided program management and oversight support including preparation of National Pollutant Discharge Elimination System permit applications and SWMPs, and development of total maximum daily load compliance strategies and implementation. In support of DC Water's MS4 Compliance Program, EA also performs evaluation of existing stormwater facilities and their receiving streams in order to determine their current level of effectiveness.

3.5.3 Alternate Drinking Water Supply Experience

We also provide onsite "point of use **treatment or alternative drinking water supplies** for communities and governmental facilities where pollutants have threatened public safety. Representative examples include:

- **Moose Creek Perfluorinated Compound (PFC) Sampling and Treatment, USACE–AK District, AK—**EA addressed PFOA and PFOS contamination in the Moose Creek community's drinking water, which was impacted via offsite migration from Eielson AFB. Collected >700 drinking water samples from 174 properties for EPA Method 537M analysis with no incidence of cross-contamination in the field or laboratory results. Results from 169 properties exceeded target threshold PFOA/PFOS criteria (i.e., one half the EPA Lifetime Health Advisory). Designed and oversaw the installation of point-of-use GAC drinking water treatment systems at 66 residential properties, and above- and belowground water storage tanks at 93 properties. Properties included 140 single-family homes, 13 apartment, complexes, 3 commercial-size apartment buildings, 4 commercial facilities/bars, 3 churches, and one fire station.

- **PFC Sampling and Impacts, Multiple Sites, NYSDEC—**PFOA was classified as a hazardous substance in New York, under, 6 New York Code of Rules and Regulations Section 597, in June 2016; freeing up state funds for regulatory enforcement and drinking water source mitigation. EA is addressing PFC impacts to a local community water supply and providing treatment design services, specifications and construction oversight of a 350-gallon-per-minute municipal water treatment plant GAC retrofit for the municipality of Berlin, NY.

- **SI at New Castle Air National Guard Base, New Castle and Other Locations, Department of Natural Resources and Environmental Control, Solid and Hazardous Waste Management Section, DE—**Under a contract with DNREC, EA conducted groundwater sampling and PFAS analysis at the New Castle Air National Guard Bureau facility to support a site investigation that confirmed offsite migration and impacts to a local drinking water supply. EA

modeled PFAS transport in relation to nearby private residential wells to identify locations for potential sampling and/or point of use drinking water treatment system installation.

3.6 Programmatic Support

EA can provide highly qualified professional staff to successfully support the various phases of MPCA regulatory programs from oversight of responsible party remediation projects to ensure compliance with design specifications, third-party review of technical documents, research of innovative technologies, decision document support, presentations and meetings, training, and support in sustainable and green practices.

3.6.1 RI/FS and RD/RA Oversight Support

EA can provide support in all phases of site investigation through post-construction oversight. We can provide onsite seasoned field sampling technicians, quality control/quality assurance assistance, construction inspectors, field superintends, cost and schedule analyst, and multi-disciplined engineering support. Our experienced construction oversight/management has worked with governmental and commercial construction to outline and implement strategies for analysis, documentation, and resolution of contract disputes, claims analysis, shop drawings review, errors and omissions analysis, and scheduling. Representative oversight support TOs are as follows:

- **West Branch Grand Calumet River, IN (EPA Region 5)—**EA reviewed pre-design investigation, treatability study, and RD submittals by the Non-Federal Sponsor. SI and cap modeling results indicated that a traditional cap alternative would not be effective for containing deeply-contaminated sediments impacted by former manufactured gas plant operations with mobile coal tar non-aqueous phase liquid (NAPL) in specific reaches of the west branch of the Grand Calumet River. EA provided technical input into a pilot study to evaluate effectiveness of an innovative subaqueous cap using combinations of sand, activated carbon, and organo clay. The pilot cap was monitored for porewater chemistry, groundwater upwelling, potential gas pressure buildup below the cap, and effects of NAPL ebullition on the cap.

- **Highway 71/72 Refinery Superfund Site, LA (EPA Region 6)—**EA oversaw PRP-led design, installation, and startup operations for a dual-phase extraction system to treat LNAPL in a residential/high access area. EA provided expedited review of the WP and RD—allowing the PRP to meet EPA-directed schedule. EA also identified design modifications, eliminating system tie-in of monitoring wells. Conducted oversight of PRP's post-corrective measures inspections for VI into houses and apartments and split indoor air samples with the PRP's consultant. EA oversaw field staff to confirm PRP construction met the Record of Decision, consent decree, and EPA-approved WPs.

- **Folcroft Superfund Site, Lower Darby, PA—**EA is providing RI/FS technical support to another EPA contractor at a site with contamination from two former landfills, located in the John Heinz National Wildlife Refuge. EA collected data including: bathymetric surveys, sub-bottom profiling, 1,750 sediment samples from 75 locations, turtle tissue samples, sediment toxicity tests, and surface sediment bioaccumulation tests. EA coordinated the submission of sediment and tissue samples to the EPA Contract Laboratory Program laboratory using Scribe software, and processed resultant data using EQuIS database. EA submitted a comprehensive Field Report of data collection efforts and the EQuIS database to EPA Region 3 and their RAC2 contractor. At Bally Superfund Site, PA, EA reviewed PRP RD for installation of a municipal well and associated pipelines to ensure compliance with industry standards. EA provided Oversight during the construction phase, including inspection of construction and startup of the new well and water supply line—and reviewed PRP-supplied O&M documents. EA assisted EPA with fact sheet preparation and presentation for the public meeting.

3.6.2 Green and Sustainable Practices Experience

EA has integrated sustainability and innovative green remediation technologies into project delivery through formal systems, enhanced communication, and expanded staff training. EA staff actively participate in leading sustainability technical committees and organizations including U.S. Green Building Council Leadership in Energy and Environmental Design (LEED) (our Corporate Headquarters is in a LEED Platinum building), ASTM International E-60 (Sustainability), and ASTM International E-50 (Green Remediation). For all projects, EA evaluates green practices and regularly performs sustainable activities on remediation projects, including the following:

- **Field Investigations—**Single mobilization; use small equipment to increase fuel efficiency and decrease noise and physical impacts; field screening to reduce work area footprint—Circle Court, West County Road 112, Sprague Road Groundwater Plume, Iron King Mine, Many Diversified Interests, and Midessa Groundwater Plume).

- **Remediation—**Use of passive approaches when possible (permeable reactive barriers, MNA, *in situ* bioremediation), modular groundwater treatment systems, and gravity flow—Ouachita-Nevada Wood Treaters and Sol Lynn Industrial Transformers.
- **Recycle/Re-Use Site Materials—**Composting/onsite reuse as ground cover and landscaping; backfill of excavated soil with onsite treated soil; and reuse of treated groundwater effluent for process water, dust suppression, irrigation, or wetland enhancement—State Road 114 Groundwater Plume and Garland Creosote Company.
- **Renewable Energy Sources—**Use of solar, product recovery, and bio-gas recovery—Ouachita-Nevada Wood Treaters, Iron King Mine, and State Road 114 Groundwater Plume.

The SiteWise™ Tool for Green and Sustainable Remediation is a spreadsheet-based tool designed to quantify the environmental footprint of remedial alternatives with metrics such as greenhouse gas, energy usage, criteria air pollutants, water usage, resource consumption, and accident risk. EA has used SiteWise™ to quantify the benefits of optimization, sustainability, and green remediation efforts on our remediation projects. Detailed project examples of EA's use of Green Remediation, sustainable solutions, and optimization with the SiteWise™ calculations include:

- **Green/Sustainable Remediation—**Sediment Remediation FS, RD, and Construction Oversight, Lincoln Park/Milwaukee River, Glendale, WI (EPA Region 5)—Designed/oversaw implementation of sediment remedy and 1.7 miles of river habitat improvement (including two oxbow lakes). Excavated/disposed of 50,000 CY of sediment containing PCBs, PAHs, and NAPLs, with special handling of 480 tons of TSCA waste. Mechanical dredging of contaminated sediments, as compared to hydraulic dredging, reduced greenhouse gas emissions by 1,750 MTs and decreased total energy usage by 19,500 MMBTUs. Additional sustainable elements paramount to design included: (1) wetland construction using native seed mixes, (2) planting of upland native tree species, (3) habitat improvements with root wads and boulder clusters, and (4) use of corn cobs in place of cement as a sediment stabilizing agent during material handling.
- **Waste Reduction, Sustainable Design—**Sediment Remediation Pre-Design Investigation, Treatability Study, FS, RD, Spirit Lake, St. Louis River Area of Concern, Duluth, MN (EPA Region 5)—Completed pre-design investigations, treatability studies, FS, and RD to support execution of a sustainable RA, including removal of 100,000 CY of contaminated sediment. Waste will be placed onsite in upland containment disposal facilities and/or in submerged confined aquatic disposal cells. Use of sustainable onsite containment disposal facilities, as compared to alternative non-green remediation techniques (i.e., transport/disposal in offsite landfill), will reduce greenhouse gas emissions by 2,321 MTs and energy consumption by 43,500 MMBTUs.
- **Use of Recovered Materials—**C3 Recycling Recovered Product, State Road 114 Superfund Site, Levelland, TX (EPA Region 6)—Minimized environmental footprint during cleanup of a 1.2-mile-long contaminant plume through: value engineering, engagement of project stakeholders, and incorporation of innovative green technology known as C3, a process waste stream technology used to control and recover organic vapors. Since September 2009, a cumulative total of 356,886 gallons of commercially-viable petroleum distillate has been sold to a commercial fuel blender. The C3 system has prevented 600 MTs of onsite emissions, as compared to traditional GAC treatment system. Project was presented by EPA Headquarters to as a "Case Study in Green Remediation" at 2010 NARPM meeting and EPA's CLU-IN webinar series.
- **Waste Reduction—**Habitat Conservation/RA Plan Modifications, Former Camp Claiborne, Alexandria, LA (EPA Region 6)—Sampled media associated with former wastewater and water treatment structures and received LA Department of Environmental Quality permission to close structures with sediment in place. Beneficial reuse of three 10,000-gallon tanks for endangered bat habitat prevented 2,700 MTs of greenhouse gas emissions and reduced RA energy consumption by 169 MMBTUs, compared to deconstruction and offsite disposal of tanks.

3.6.3 Other Program Support Services

Since 2011, EA has conducted Five-Year Review and prepared Five-Year Review Reports for EPA to evaluate the effectiveness of the remedy to protect human health and the environment. During that time, we identified potential remedy deficiencies, made recommendations for improvement, and updated the administrative record to include updated toxicity data, revised regulations or new information pertinent to the site remedy. These services were completed at Pab Oil & Chemical, Louisiana; Dutchtown, Louisiana; Hardage-Criner, Oklahoma; Mountain Pine, Arkansas; Delatte Metals, Louisiana; Gulf Coast Vacuum Services, Louisiana; Cleve Reber, Louisiana; DL Mud, Inc., Louisiana; Sprague Road, Texas; and Highland Acid Pits, Texas. In addition, we have provided support during Proposed Plan public meetings, community outreach at high-profile sites located within residential areas where sampling or remediation was conducted on or near residential properties and supported Restoration Advisory Board (RAB) meetings.

Section 4:
Project Descriptions

Section 4 – Project Descriptions

Hazardous Waste Site

Project: Site Characterization, Remedial Design, Remedial Action, Construction Oversight, and Technical Assistance

Location: Atlantic Wood Industries (AWI) Superfund Site, Portsmouth, Virginia

Client: United States Environmental Protection Agency Region 3

EA has completed activities related to site characterization, remedial design, remedial action, and construction oversite to address the remediation of sediment and soils contaminated with polycyclic aromatic hydrocarbons (PAHs) at a former creosote facility adjacent to the Elizabeth River in Portsmouth, Virginia.

Site Description

This large, complex Superfund site consists of approximately 48 acres of heavily industrial land in Portsmouth, Virginia, adjacent to the Elizabeth River and a U.S. Naval Base. The industry that was known as AWI made railroad ties and utility poles from the 1920s to the 1980s resulting in a creosote site that has contaminated the soil, groundwater and river sediments. Since the contamination from the site extends beyond the site boundaries, the surrounding properties are in some way stakeholders to the AWI remediation project and each has been involved in some way with the environmental remediation project. For example, about three years into EA's involvement with investigation, design and remedial action services to EPA, the bridge across the Elizabeth River was torn down and need to be replaced. The impact of this was that space at the site was extremely limited, with hundreds of large concrete bridge pieces awaiting installation spread across the entire AWI site. However, with careful, detailed and frequent coordination with all the stakeholders, progress on both the both the bridge project and the environmental remediation of the AWI property proceeded unhindered.

Project Description

EA has conducted various activities at the site since 2008, including but not limited to the following:

- Collected 173 vibracores to characterize PAH contamination in river sediments to fill data gaps. Used cost-effective immunoassays to analyze sediment cores, saving approximately $100,000 in laboratory costs and accelerating the project schedule by 2 months.
- Conducted two treatability studies: (1) selected stabilizing agent for in situ stabilization (ISS) of a former waste pond impacted by dense non-aqueous phase liquid, and (2) determined mix design to amend the dredged sediments.
- Assessed habitat value of a mud flat that became part of a water-based disposal area.
- Developed seven separate remedial design construction packages for: (1) the dredging of approximately 350,000 CY of PAH-contaminated river sediments; (2) two dredged material containment facilities; (3) a 1,100-foot-long steel sheet pile wall for one side of a containment facility; (4) ISS for a former creosote waste pond; (5) a shoreline stabilization retaining wall; (6) removal of metals-contaminated soils, and (7) a wetland expansion. These design components were part of an overall integrated and site-wide remediation.
- Specified beneficial reuse of 143,000 CY of PAH-contaminated dredged sediments; created valuable new waterfront land for local community and saved EPA over $10 million in offsite disposal costs.
- Managed/evaluated over 100,000 data records using EQuIS to aid in remedial design and remedial action activities for multiple remedy components, including excavation and removal, dredging, and ISS.

Relevant Highlights

- ✓ Evaluated, monitored, and designed the remediation of contaminated sediments
- ✓ Conducted sediment sampling
- ✓ Performed treatability studies
- ✓ Prepared corrective action design documents
- ✓ Oversaw subcontractors
- ✓ Managed and evaluated data
- ✓ Oversaw construction and restoration
- ✓ Coordinated with stakeholders

Client Contact:
EPA Region 3
Randy Sturgeon, RPM
215-814-3227

Completion Date: 2018

Contract Value: $18.6M

Proposed Staff Who Worked on This Project:
J. Beaver
L. Becker
C. Swanson
M. Ciarlo
D. Hinckley
C. Cheatwood
F. Barranco
J. Morris

- Led investigation to support risk assessment and performed ERAs to address PAHs, metals, PCBs, and dioxins in soil, sediment, surface water, and biota. Developed innovative sampling methods to support field collection of multi-increment samples for risk assessment. Performed studies of the hyporheic zone to look for seeps from groundwater into sediment in support of risk assessment of benthos. Interpreted bioaccumulation testing and bioassays.
- Conducted air monitoring for workers employed by the onsite manufacturing facility using risk-based criteria developed from guidance provided in EPA's Risk Assessment Guidance for Superfund and Regional Screening Levels for Superfund Sites.
- Coordinated remedial design and remedial action work with seven stakeholders, including U.S. Navy; City of Portsmouth; Atlantic Metrocast, Inc.; Virginia Department of Environmental Quality; and three private developers.
- Coordinated an elevated bridge replacement over the site by a private stakeholder. Worked with the bridge contractor for 3 years to review the bridge plans/schedule and coordinate with the environmental restoration work conducted by EPA. Both projects were completed on time.
- Provided daily construction services for three remedial action components to support the dredging of approximately 350,000 CY of PAH-contaminated sediment. Performed construction support (including submittal review, requests for information, and engineering services) for three additional remedial action components.

Subcontracted Tasks

Activities at the site that were subcontracted for this project include, but are not limited to, the following: land surveying, utility location, site maintenance and fencing, soil drilling, third-party review of engineering designs, treatability studies, cultural resources survey, shoreline redevelopment, and analytical testing.

Outcome Achieved

EA completed six remedial actions under CERCLA within 4 years of project initiation to meet the cleanup requirements of the Record of Decision. Presented at the 2015 Design and Construction Issues at Hazardous Waste Sites Symposium in Philadelphia, Pennsylvania.

Agricultural Chemical Investigation
Project: Bianchi/Weiss Greenhouses Site
Location: East Patchogue, New York
Client: New York State Department of Environmental Conservation

EA has performed remedial investigation/feasibility study (RI/FS) activities associated with historical chlordane contamination at the Bianchi/Weiss Greenhouses site in East Patchogue, New York. Activities included: interim remedial measures (IRM) to remove potential sources of contamination and to address safety concerns at the site; a remedial investigation that includes collection of soil, groundwater, surface water, and sediment samples to delineate the nature and extent of contamination; identification of potential exposure pathways, receptors, and risks to human health and the environment; and feasibility study activities including remedial alternative selection, remedial design, and oversight of remedial actions.

Relevant Highlights
- ✓ Conducted groundwater, soil, surface water, and sediment sampling
- ✓ Prepared planning documents and technical reports
- ✓ Collected, managed, and evaluated data
- ✓ Evaluated potential receptors and human and ecological risks
- ✓ Oversaw subcontractors and construction
- ✓ Prepared and evaluated contractor bids
- ✓ Designed and oversaw remedial actions
- ✓ Arranged for transportation and disposal of wastes

Client Contact:
NYSDEC
Brian Jankauskas, P.E.
518-402-9626

Completion Date: Ongoing

Contract Value: $708K

Proposed Staff Who Worked on This Project
S. Soldner
H. Williams
C. Swanson

Site Description
The Bianchi/Weiss Greenhouses site is a flat, undeveloped parcel of approximately 14 acres in size surrounded by residential properties. The site operated as a nursery and commercial greenhouse from 1929 to 2005. Evidence of soil and groundwater contamination with pesticides and metals was discovered after the property was sold, and in 2006, the site was added to New York State Department of Environmental Conservation (NYSDEC) Registry of Inactive Hazardous Waste Sites as a Class 2 Site. Historical structures on the site included six greenhouses, underground drainage structures, three aboveground storage tanks (ASTs), one underground storage tank (UST), and planting fields on the eastern and western portions of the site.

The site lies within the Coastal Plain deposits with soil consisting of sands and loams and groundwater encountered at depths between 5 and 10 feet below ground surface. Regional shallow groundwater flow is in a south-southwest direction towards Moss Creek and Abets Creek, which are located approximately one-quarter mile south/southwest of the site. The local groundwater is hydraulically connected to and influenced by tidal fluctuations within the creeks and Patchogue Bay.

Project Description

Background
Previous investigations determined that onsite soil and groundwater were contaminated with pesticides and metals likely due to historical operations. Elevated concentrations of pesticides (primarily chlordane) and metals (lead, mercury, and zinc) were present in surface and subsurface soil across much of the site. Chlordane contamination was detected in surface soil, with the highest concentrations in the footprints of the former greenhouses. The sources of soil contamination were identified as direct application of chlordane, poor housekeeping procedures during greenhouse operations, and migration through historical construction activities. Historical sampling also identified elevated concentrations of semi-volatile organic compounds (SVOCs), metals, and chlordane in the soil within the onsite subsurface drainage structures. It is likely that chlordane was directly discharged into surface water and subsurface drainage via the greenhouse watering and collection systems found onsite, and ultimately entered site groundwater. Chlordane was detected in onsite ponding water and in the basements of two neighboring residences. Chlordane and metals were also detected at elevated concentrations in onsite groundwater samples and in offsite wells south of the site.

NYSDEC tasked EA to perform an RI/FS, remedial design, and remedial action construction oversight at the Bianchi/Weiss Greenhouses Site located in East Patchogue, New York.

Project Planning
Prior to performing work at the site, EA produced a site-specific Quality Assurance Project Plan (QAPP) Addendum, Field Sampling Plan Addendum, and Health and Safety Plan Addendum for this project. EA performed a hazard analysis based on the site characteristics, potential contaminants of concern (COCs), and field activities to determine that Level D personal protective equipment and air monitoring would be appropriate for the planned fieldwork. The QAPP Addendum

identified analytical test parameters, sample containers, preservatives, holding times, and laboratory method detection limits to be used in this project. EA also produced a site-specific Community Air Monitoring Program, describing the continuous air sampling activities for volatile organic compounds (VOCs) and particulates, action levels, and corresponding responses for VOCs and particulates and planned intrusive investigation defined in the work plans. Following approval of the work plan documents, EA conducted various activities at the site, as described below.

Interim Remedial Measures

EA performed an IRM prior to remedial investigation field activities to address the aesthetic, environmental, and safety concerns at the site. Historic demolition activities at the site generated three stockpiles of demolition debris which consisted of bricks, concrete, piping, and soil. The debris was sampled, removed, and disposed of. A limited excavation was conducted at nine drainage structures and surrounding soil, confirmatory sampling was conducted, and the structures were backfilled with clean soil. Following the removal of debris and excavation of the drainage structures, a general site resurfacing was completed with 3 inches of mulch to limit the potential for fugitive dust migration to the surrounding residences. Silt fencing/hay bales were installed to limit potential migration of site soil, to limit surface water runoff, and to fill open pits, trenches, and holes that provided safety concerns. EA submitted an IRM summary report to NYSDEC upon completion of the IRM.

EA produced fact sheets about the site and canvased the surrounding neighborhood to inform the community about the work being done at the Bianchi/Weiss Greenhouses site. As part of IRM mitigation activities at the residential structures located within the immediate vicinity of the site, EA worked with NYSDEC and a standby immediate response contractor to mitigate exposure to contaminated water intrusion into the residences' basements. EA designed sump collection, filter treatment, and discharge systems to effectively eliminate this potential pathway.

Remedial Investigation

As part of RI activities, EA completed an extensive two-stage immunoassay field program to quickly and reliably delineate chlordane impacts in onsite soil. Using the immunoassay field testing procedures, 231 surface soil samples were collected and analyzed. If the results indicated the soil had been impacted by chlordane, EA would then collect a subsurface sample 1 foot deeper than the previous sample. Subsequently a total of 544 subsurface soil samples were collected using a hand auger at depths up to 5.5 feet below ground surface. Confirmatory laboratory samples were selected based on immunoassay results and used to validate the field results.

EA collected an additional 50 surface soil samples, and submitted them for laboratory analysis for a suite of potential COCs, including pesticides, target analyte list metals, VOCs, and SVOCs. Direct-push technologies were used to collect 13 additional subsurface soil samples at the former greenhouse and former/current UST/AST locations for waste characterization purposes.

EA conducted a groundwater evaluation program which included monitoring well geophysical logging, gauging events, slug testing, a tidal study, stream gauging, groundwater sampling, and the installation of 10 new monitoring wells, 4 temporary wells, and 5 piezometers to supplement the existing monitoring well network. A total of 53 groundwater samples were collected using low-flow methodologies. EA also collected 6 surface water and sediment samples from Abets and Moss creeks to determine whether they had been impacted from operations at the site.

EA collected and interpreted groundwater analytical and hydrogeological data to produce a model of a groundwater chlordane plume of approximately 2,900 feet in length and 460 feet in width extending from the site to the edge of Abets Creek, which is approximately one-quarter mile southwest of the site. During the groundwater delineation efforts, EA determined, through analysis of filtered and unfiltered samples, that chlordane impacts were associated with colloidal transport mechanism and not a dissolved-phase chlordane solute plume.

Investigative-derived waste was collected in 55-gallon drums and disposed of offsite (approximately 12 soil drums and 5 water drums).

Following collection and analysis of data, EA produced electronic data deliverables in NYSDEC EQuIS format for analytical results, uploaded them to an internal database, and submitted them to NYSDEC to upload into their database. EA also produced maps depicting sampling locations and analytical results, an interpreted chlordane isopleth map, and a figure of vertical chlordane concentrations throughout the length of the groundwater plume. These were completed using ArcGIS to demonstrate the horizontal and vertical extent of contamination onsite and offsite.

Risk Assessments

Because the site is surrounded by a residential neighborhood, the neighborhood residents, onsite workers, and trespassers are potential receptors. Future onsite workers, future residents, and future visitors are also considered potential receptors. For this reason, EA used the 6 NYCRR Part 375 UU and Residential Use Standards, Criteria and Guidance for analyzing risk to human health. EA estimated that approximately 73,784 tons of site soil were above the Part 375 UU Soil Cleanup Objectives (SCO) for *alpha*-chlordane, and 45,109 tons of site soil were above the residential use SCO for *alpha*-chlordane.

Exposure to the primary COC, chlordane, can cause digestive and neurological issues in humans. EA used analytical results and interpreted results from the remedial investigation to analyze current and potential exposure pathways to contaminants in soil, groundwater, and the sediments and surface waters of Abets and Moss creeks. After screening analytical results against state and federal criteria, EA determined that concentrations of chlordane in the surface water of sediments in the creeks did not pose a risk to human health, while concentrations of chlordane in soil, offsite groundwater, temporary ponding water onsite and offsite, and air did pose potential threat. EA then evaluated potential exposure scenarios based on current and future uses for the site and surrounding areas, to conclude that there were actual and potential pathways through which populations onsite and offsite could be exposed to potentially hazardous chemicals related to the site.

Plants and wildlife that reside in habitats found within one-half mile of the site, including urban settings (pets, squirrels, robins, garden plants), tidal creeks (aquatic weeds, minnows, young marine fishes), successful fields (wildflowers, shrubs, sparrows), and maritime forests (hardwood trees, deer, vines) were considered potential receptors. Although the site and its immediate surroundings are not considered valuable habitats for fish and wildlife, the site's hydrogeologic characteristics indicated that there was potential for impacts to the nearby valuable habitats of Abets and Moss creeks. Numerical criteria used in the Fish and Wildlife Resource Impact Analysis were obtained from NYSDEC Water Quality Regulations: Surface Water and Groundwater Classifications and Standards. Analytical results for surface water and sediment samples from the creeks did not show impacts from site operations. Therefore, EA concluded no significant impact to nearby fish or wildlife from site contamination.

EA produced a remedial investigation report that described field activities including IRM activities, sampling methods, analytical results, delineations of the nature and extent of contamination, interpretation of contamination sources/ pathways, analyses of potential impacts to human health and ecological resources, and the conceptual site model. EA's remedial investigation report concluded that contamination from activities at the former Bianchi/Weiss Greenhouses was the source for onsite contamination of soil and groundwater, which has since migrated offsite and presents a threat to current and future human populations. EA identified data gaps and recommended an analysis of remedial action alternatives and institutional controls to limit human exposure to contaminants from the site.

Feasibility Study, Remedial Design and Remedial Action

EA completed a Feasibility Study report that evaluated soil and groundwater remediation alternatives using 6 NYCRR 375-1.8(f) and DER-10 Section 4.2 criteria. Alternatives considered for soil included excavation and offsite disposal or treatment, in situ bioremediation, and in situ thermal treatment; alternatives considered for groundwater included long-term monitoring and containment via hydraulic control and treatment. The selected alternative included the excavation and offsite disposal of onsite soil, and sump and foundation upgrades to nearby residential buildings to prevent groundwater infiltration into their basements. This alternative was accepted by NYSDEC in a 2012 Record of Decision.

EA performed a three-phase pre-design investigation collecting an additional 49 discrete soil boring samples, 104 composite soil samples, and 22 additional groundwater samples, including samples from the sump of one residential home and the backyard of another, to fill data gaps.

During the remedial design phase, EA produced contract documents, including specifications, detailed engineer's cost estimate, and design drawings. EA distributed the contract documents and bidding documents to bidders, held a pre-bid meeting, and reviewed contractor bids.

EA performed construction oversight of the selected remedy during the remedial action phase. EA had an onsite inspector during excavation and offsite disposal of approximately 46,444 tons of contaminated soil, UST removal, and backfilling with clean soil. EA reviewed contractor submittals to ensure compliance with contract documents, and monitored contractor performance, schedule, and budget. EA is currently producing a Site Management Plan, which is under NYSDEC review, and a Final Engineering Report for the site.

Subcontracted Tasks

Activities at the site that were subcontracted for this project include, but are not limited to, the following: site maintenance and cleanup, historical records data search, land surveying, utility location, drilling and monitoring well installation, removal and disposal services, third-party engineering review, analytical testing, data validation, and construction inspection.

Outcome Achieved

EA's activities at the site have restored the property to residential criteria, with institutional controls governing groundwater for any future site use and/or redevelopment.

Hazardous Vapor Intrusion Site
Project: National Guard Bureau Vapor Intrusion Studies
Location: Nationwide – DE, OH, MT, WY, OK, CA, MI, ND, OR
Client: National Guard Bureau – Air National Guard

Relevant Highlights
- ✓ Collected air/vapor samples
- ✓ Conducted human health exposure analysis
- ✓ Evaluated analytical data
- ✓ Coordinated with agencies and stakeholders

Client Contact:
National Guard Bureau
Mark Dickerson, COR
240-612-8366

Completion Date: Ongoing

Contract Value: $1M

Proposed Staff Who Worked on This Project:
S. Soldner
D. McNeely
C. Cheatwood
D. Hinckley

EA is performing vapor intrusion studies and developing conceptual site models at eight Air National Guard (ANG) installations nationwide. The studies vary in complexity, from types of buildings and foundations, HVAC systems, utility clearances, out-reach and dissemination of sampling program; to occupational workers and ANG leadership; to multiple contaminants (chlorinated solvents, volatile organic compounds [VOCs], and emerging contaminants of concern [COCs]) in multiple media (outdoor air, indoor air, and soil gas).

Site Description
Vapor intrusion activities were conducted in various occupational building types and constructions including administrative, maintenance shops, hangars, offices, and warehouses. The sites were primarily contaminated with chlorinated solvents and petroleum hydrocarbons. The investigations ranged in size from single-building evaluations up to 11 individual buildings at an installation.

Project Description
EA developed installation specific work plans, including UFP QAPPs and Health and Safety Plans during the project planning phase. Work plans were reviewed by NGB and state regulatory agencies for compliance with EPA guidance on VI, state VI guidance documents, and in accordance with industry standards. EA led installation kick-off meeting with base peronnel and state regulatory staff to describe and outline the overall VI sampling strategy and reporting requirements. These stakeholder meetings supported development of the work plans, gaining input on installation specific requirements and state agency preferences.

EA collected more than 1,000 air/vapor samples and 150 radon samples, and utilized historical site investigation data (soil and groundwater) to design and optimize sampling programs. EA installed more than 340 sub-slab soil gas points to complete sub-slab soil gas sampling beneath buildings and foundations. Geophysical surveys were completed at multiple installations to ensure that subsurface utility corridors and infrastructure were not damaged during installation of semi-permanent stainless steel sub-slab soil gas sampling ports. EA also utilized radon sampling to evaluate the potential for background sources and estimate building-specific attenuation rates. EA employed the use of HAPSITE meters to track, identify, and sample potential indoor air sources of VOCs currently being stored or used in the occupational settings. EA coordinated sampling schedules and building access with installation personnel to facilitate the duration and impact of activities at each installation.

EA conducted a multiple-lines-of-evidence evaluation to discern if the vapor intrusion pathway is complete or incomplete at each site. Lines-of-evidence include sub-slab soil gas and indoor air, background outdoor air, real-time indoor air screening and analysis, differential pressure monitoring, radon sampling, COC ratio assessment, and groundwater spatial data. EA also performed baseline risk assessment using EPA's Risk-Based Screening Levels for indoor air.

Data generated from the vapor intrusion studies were used to assess building operational conditions and COC concentrations in the sub-slab environment. These conditions can be applied to design specifications for mitigating the vapor intrusion pathway if required.

Activities required addressing both federal- and state-specific regulatory requirements, as well as stakeholder needs. EA coordinated with these groups to finalize work planning and the investigation approach.

Subcontracted Tasks
Activities that were subcontracted for this project include the following: geophysical surveys (i.e., utility location), radon analysis, analytical laboratory testing, and data validation.

Outcome Achieved

EA provides recommendations, based on analytical results, to assist an informed risk management decision regarding future management of the vapor intrusion pathway (as needed) that would be the most appropriate, cost effective, and protective of human health and the environment. Based on an analysis of the results of these studies, if future actions are required, recommendations may include additional investigation prior to a final risk management decision, no further action, or mitigation.

Section 5:
Scenario A

Section 5 – Scenario A

Based on a review of the information provided for this scenario, as well as our knowledge of the applicable programs, regulations, and guidance, EA has developed a technical approach for further investigation and potential remediation of the sample site. Additionally, we have developed a roadmap for remediating the site, including an evaluation of the appropriate remedial technologies for the various types of contamination at the site. Our overall understanding of the site and approach is summarized in the section below. For ease in review, EA has prepared the following upfront discussion that establishes the current site status and provides a justification for the overall approach for moving the project forward. As requested in the Request for Proposal, the work plans for the remedial investigation (RI) and remedial design (RD)/remedial action (RA), which include the technical details for performing the RI and RD/RA, follow this discussion. This upfront discussion, combined with the work plans, provides a complete analysis of the thought process behind our evaluation of the site conditions, data gap assessment, work plan approach and rationale.

5.1 EA's Understanding of the Project

The site consists of a former agricultural (ag) chemical plant that operated from 1960 to 1991. Through review of available documentation, several high risk areas of contamination were identified at the site. Previous investigations conducted at the site identified the presence of chlorinated ethenes (most notably trichloroethene [TCE]) and several ag chemicals in soil and groundwater (GW) above applicable Minnesota agency criteria. Additionally, vapor intrusion (VI) sampling indicated concentrations of vapors that may pose an unacceptable risk. Through our review, we have identified the following high risk areas at the site that warrant further investigation:

- Former dry fertilizer building
- Service garage
- Equipment parking areas
- 500-gallon underground storage tank (UST) and trench drain
- North of service garage
- 500-gallon fuel oil aboveground storage tank (AST)
- 1,000-gallon gasoline UST
- Discolored soil north of fertilizer building
- Stream
- Waterfill supply well area
- Scale area
- Site-wide GW impacts
- Offsite residential properties (drinking water wells and VI).

The objectives of the Scenario A project are to (1) complete an RI and (2) develop an RD/RA approach that incorporates the following remedial components, where appropriate:

- Granulated activated carbon (GAC) treatment
- Installation of subslab depressurization to mitigate VI risk
- Submission of a pilot test to support the remedy implementation at the garage
- Corrective actions to address soil and GW contamination associated with tank impacts and former ag activities.

The above remedial components may not be all inclusive of what is required to complete the site remediation since some data gaps remain. However, once the RI is complete, a more thorough understanding of the site conditions will be rendered. Based on the results of the RI, in conjunction with prior site sampling conducted, we intend to refine the existing conceptual site model (CSM) and develop a unified and comprehensive remedial strategy for the entire site that is compliant with all three applicable Minnesota regulatory programs (Non-Petroleum, Petroleum, and Ag Chemical), as well as federal, where applicable. To the extent practical, we will combine sampling or reporting to limit redundancies and streamline the approach without sacrificing data integrity or completeness of the site remedy for all contaminants of concern (COCs). From the existing data, it is evident that, at a minimum, soil VI mitigation and GW and soil remediation are warranted due to volatiles, nitrates, and pesticides in GW and soil. It is conceivable that other COCs (e.g., per- and polyfluoroalkyl substances [PFAS] from potential use of firefighting foam to extinguish the historic fire and petroleum, oils, and lubricants [POLs], other volatile organic compounds [VOCs], or metals from maintenance and other site operations)

may also be present at concentrations that require remediation in order that the site meets regulatory cleanup standards for future use as a golf course.

Conceptual Site Model

As part of the site evaluation, EA has developed an initial CSM that identifies exposure media, pathways, and potential receptors based on the information provided in Scenario A. **Exhibit 5-1** provides a visual CSM and **Exhibit 5-2** provides a graphical CSM. The components of the CSM are discussed below.

Exhibit 5-1:
Conceptual Site Model

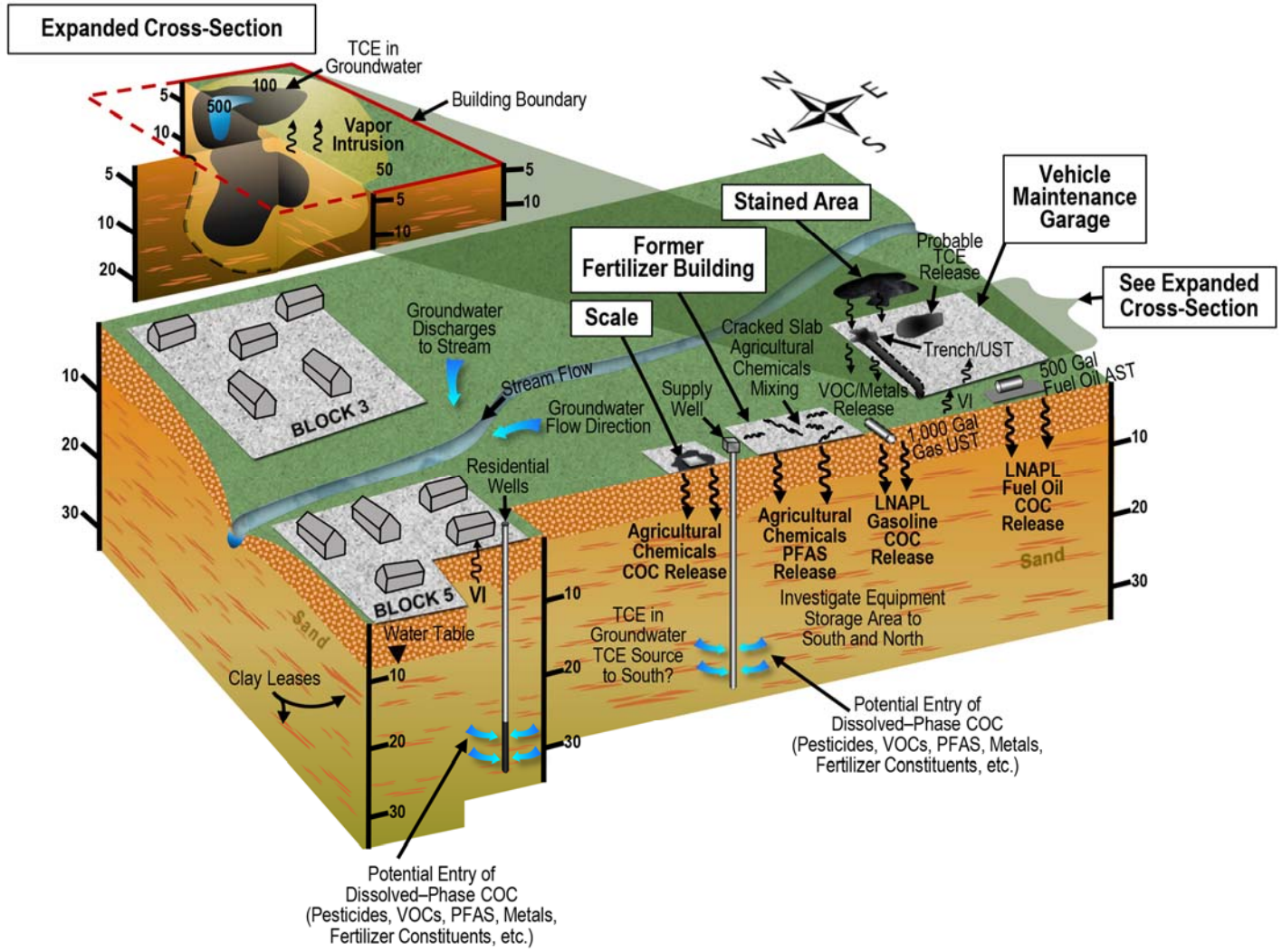
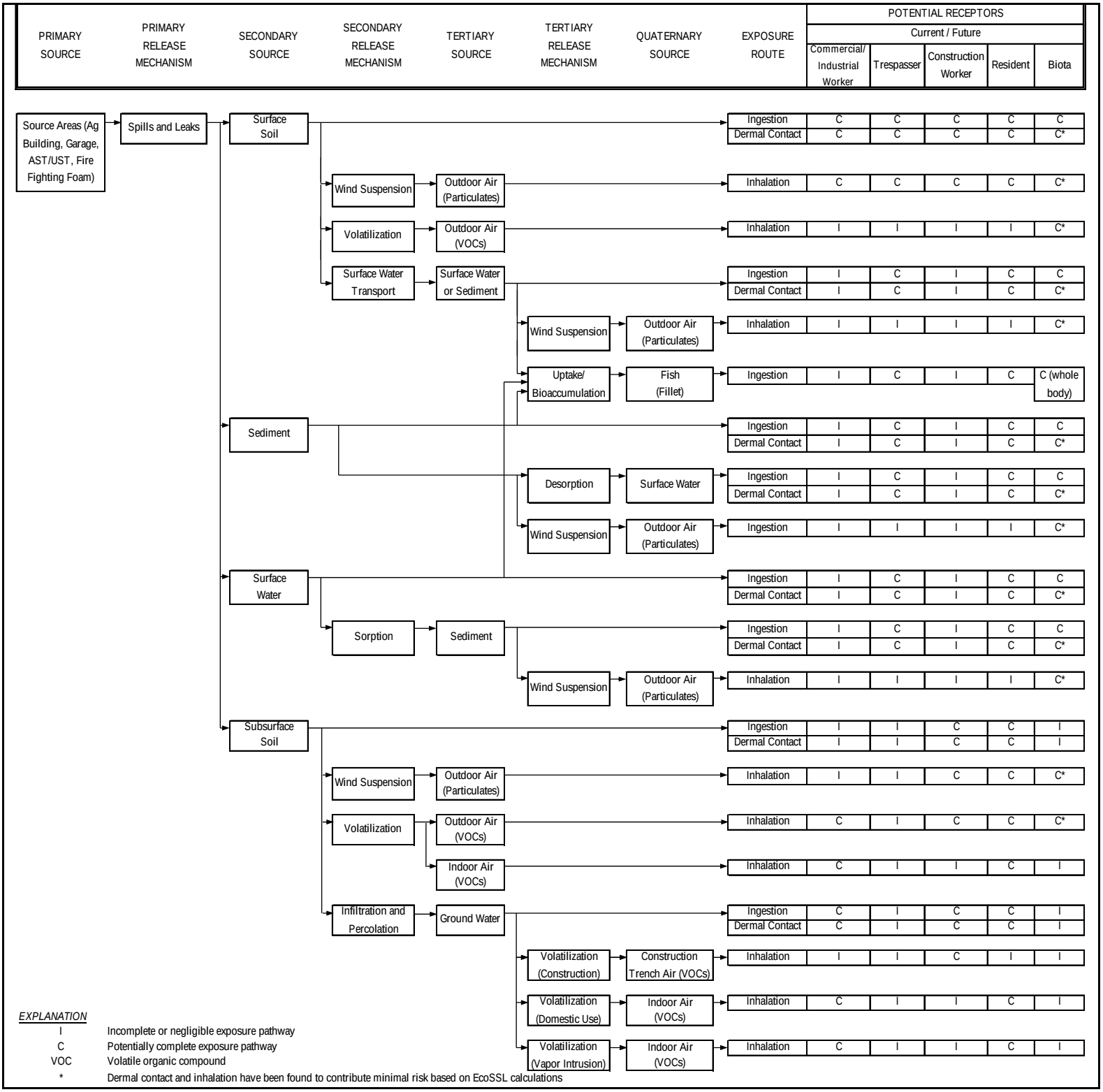


Exhibit 5-2:
Conceptual Site Model



Contaminants of Concern Sources

Based on information provided, portions of the site historically stored and handled fertilizers and pesticides and used various volatile solvents, degreasers, and petroleum-based constituents to fuel and maintain vehicles. Past ag products and vehicle maintenance chemicals were not only used and stored, but may have also been improperly handled during unloading, weighing operations, or storage in other portions of the site (e.g., ag equipment storage/parking areas north and south of fertilizer building) resulting in soil contaminated with these chemicals or releases from a leaking AST and UST. The UST and AST may be sources of volatile organics, most notably TCE, but other petroleum-based constituents such as benzene, total petroleum hydrocarbons, or naphthalene may have also been released to the subsurface. It is likely that multiple sources of VOCs, fertilizers, and pesticides and/or daughter products have contributed to soil contamination, which have subsequently migrated to onsite GW, offsite GW, and potentially discharged to surface water (SW). Stream sediment may be impacted from GW discharge or erosion of contaminated surface soil. In addition, the potential direct application of aqueous film-forming foam (AFFF) in 1999 to control a fire may have contributed PFAS to soil, GW, and potentially SW/sediment contamination. Dioxin and furans may also be a potential concern at the location of the former fire.

COC Release Mechanisms

COCs associated with surface and shallow subsurface soil above the GW table may have been released from spillage or direct discharge to the ground surface or from a leaking AST. COCs associated with deeper subsurface soil above the GW table may have been released from a leaking UST. The primary PFAS release mechanism is seepage of AFFF into surface soil, runoff into SW drainage pathways, or collection and conveyance of PFAS-containing liquids into natural or man-made drainage features. Dioxins and furans could be produced through burning of chemical products associated with the fire that occurred. Precipitation and/or major weather events would be capable of producing downward migration (leaching) for mobile contaminant fractions remaining in soil and lateral erosion of soil into the stream.

COC Migration Pathways

Potential soil migration pathways include erosion along surface drainage pathways and fugitive dust migration during dry periods. The dissolved-phase contaminants in GW will follow preferential flow pathways within the shallow aquifer, with the contaminants likely moving horizontally, rather than vertically, since it is presumed that the stream to the north acts as a local shallow GW discharge point. However, there is a potential for COCs to be present at the site that have more potential to migrate vertically (i.e., chlorinated solvents). Based on topography and stream location and flow direction, GW flow on the south side of the stream is toward the north-northwest. This stream flows to the west and likely restricts GW from migrating further to the north. Although the natural GW advection is controlled by local topography and stream, hydraulic capture from the onsite supply well and offsite private well withdrawals may act as localized points of dissolved-phase contaminant convergence or “sinks.” Dissolved-phase contaminant migration is an important factor to consider for this site because of the use of the aquifer and the documented GW impacts from nitrogen, TCE, and several pesticides. The potential for offsite migration of other dissolved-phase COCs is also present. For example, long-chain PFAS (e.g., perfluorooctanoic acid [PFOA] and perfluorooctanesulfonic acid [PFOS]) derived from AFFF formulations, in general, leach from soil and are relatively mobile in GW. Comparatively, PFOA and PFOS migrate in GW at slightly lower rates relative to more common organic constituents (i.e., benzene) but are highly recalcitrant and do not readily degrade or transform under normal geochemical conditions. Because of this persistence, PFOA and PFOS can migrate in GW over long distances without appreciable decline in concentrations, meaning that PFOA and PFOS plumes can be large in comparison to other VOC plumes that are amenable to degradation. VOCs in GW are of significant enough concentration to present a potential VI risk to the onsite garage and/or offsite private dwellings.

COC Exposure Routes/Receptors

For surface soil-based source areas, potential receptors would include trespassers, site personnel, or contractors that may be required to work in the impacted areas during site redevelopment, and future groundskeepers of the proposed golf course. Additionally, although limited, potential future receptors may include users of the golf course if the contamination is not addressed. Biota, including plants, invertebrates, mammals, and birds may also be exposed to COCs in surface soil. Incidental direct contact and inhalation or ingestion of fugitive dust are potential exposure routes. COC-impacted surface and subsurface soil may also be a direct contact exposure concern for receptors that are involved in earthwork during subsequent site redevelopment. Impacted soil may also be a continuing source for GW and soil vapor contamination. The primary GW migration pathway is continued downgradient (northwest) migration of dissolved-phase COCs. Contaminated GW in the shallow aquifer will ultimately discharge to the stream with limited potential to migrate beyond the creek. However, GW may be directed toward private wells that are located west of the site. Even though these wells are 30 feet (ft) deep, they have the potential to capture dissolved-phase contaminants that have migrated from the site (including chlorinated solvents that dive vertically into the GW). Exposure to impacted GW can occur from extraction and ingestion/direct contact from private wells or from the onsite supply well, as well as potentially from future irrigation

activities associated with the proposed golf course (if irrigation water is sourced from the site GW). The VOCs within GW also have the potential for off-gassing to shallow subsurface soil, presenting a potential for VI exposure via the inhalation pathway within buildings overlying the plume. Human exposure to COCs in shallow GW may occur in the future via human contact during site redevelopment activities. Ecological and human receptor exposure may also occur from direct contact with SW, sediment, or fish living in the adjacent stream.

Data Gap Analysis

Based on our evaluation of the provided site information, we have performed a data gap analysis and identified data gaps for each high risk/sampling area. These data gaps are listed in **Exhibit 5-3**, as well as the types of RI data required and how that data will be used to achieve the project objectives.

Exhibit 5-3: Anticipated Data Needs

Scenario A – Existing Data		
Data Source	**Data Use**	**Notes**
• Historical photos, interviews, inspections, etc. from MDA • Limited push probe soil/GW samples • Limited vapor survey • Borings and passive vapor samples at garage	• Source of data for hydrogeological, geochemical, and bulk chemical analyses in soil and GW used to locate additional soil samples, borings, and wells for RI • GW contaminant preferential migration pathways and trends will be assessed to refine CSM	• Prior investigations did not address all sources of TCE in GW and soil vapor • Prior investigations did not address AFFF use and release of PFAS • Prior investigations did not address all potential sources of ag chemicals • UST and discolored soil areas not characterized • Prior investigation did not fully characterize VI • No risk evaluation conducted and existing data not of sufficient quality/quantity to complete a risk evaluation
Scenario A – Anticipated Data Needs		
RI Requirements	**Data Use**	
Ag Building Area • Quantify extent of COCs in soil with surface soil and direct-push subsurface soil sampling • Identify COC source areas • Evaluate COC concentrations and mobility in GW • Evaluate water supply well influence on GW flow and COC mobility • Quantify other COC risks for environmental media	• Determine if stained soil north of building has been impacted from fertilizer or pesticides • Determine if UST released gasoline constituents (including light non-aqueous phase liquid) to surface and subsurface soil and/or GW; assess nature and extent • Assess whether AFFF use released PFAS into soil and/or GW in the surrounding area; assess nature and extent • Refine CSM; estimate volume of impacted soil • Exposure point calculation for risk evaluation • Support remedial alternative development to address source and GW COCs; GW remedy may be developed for entire site	
Garage Area • Quantify extent of COCs in soil • Identify COC source areas • Evaluate COC concentrations and mobility in GW • Quantify VI risk • Quantify other COC risks for environmental media	• Determine if stained soil north of building has been impacted from discarded POLs or solvents • Determine if trench/UST released petroleum hydrocarbons, solvents, or metals to subsurface soil and/or GW; assess nature and extent • Refine CSM; estimate volume of impacted soil • Exposure point calculation for risk evaluation • Collect VI data during opposite heating/non-heating season that was previously sampled • Determine VI pathway complete and poses risk that requires mitigation • Support remedial alternative development to address source and GW COC; GW remedy may be developed for entire site • Assess soil physical characteristics to determine *in situ* remedies and GW extraction options	
SW/Sediment • Quantify extent of COCs in sediment and SW • Quantify COC risk • Evaluate COC mobility	• Assess GW/SW interface and evaluate the potential for offsite migration of COC in SW or sediment • Exposure point calculation for risk evaluation	

Scenario A – Anticipated Data Needs (continued)	
RI Requirements	**Data Use**
GW • Identify source(s) of TCE • Quantify extent of COCs in GW from all sources • Evaluate COC concentrations and mobility in GW • Quantify COC risk in GW • Quantify aquifer physical characteristics	• Determine nature and extent of COC in GW • Assess fate and transport characteristics of COCs • Exposure point calculation for risk evaluation • Conduct aquifer test analysis to evaluate contaminant migration as well as for remedy development
Private Residences • Quantify COC risk in GW • Quantify VI risk	• Collect potable well and VI data from residences not previously sampled • Collect VI (soil gas) data during opposite heating/non-heating season that was previously sampled • Exposure point calculation for risk evaluation • Determine if VI mitigation is required

For purposes of developing a sampling approach to fill these data gaps, refine the CSM, and develop a remedial strategy, we have subdivided the site into high risk/sampling areas (as previously noted) with further subdivision by potential affected media as shown in **Exhibit 5-4**. For each of these subdivisions, we have identified data gaps for each environmental media of concern, what data are required to fill those data gaps, and how that data will be used.

Understanding the Regulatory Environment and Stakeholders

Based on our review of the information, we understand that the site is being proposed for future development as a golf course and have developed our approach in line with that proposed future use. Given this proposed use, and the data collected to date, we have identified the following stakeholders: current site owner/operator, nearby residents, future land developer, future site owner/operator, and future site users. As discussed in Section 2a, EA has a strong understanding of the regulatory environment in which this work will be conducted, including oversight by the Minnesota Pollution Control Agency (MPCA) and MDA. Our approach has been developed to meet the requirements of each program within these agencies, while combining investigative activities, where possible, to streamline the investigation and reduce overall cost. We recognize that MPCA has established two approaches to remedy selection: a traditional RI/feasibility study (FS) process and a streamlined process. Based on the complexity of the site, contaminants, and risks, we believe that a traditional RI/FS approach is applicable to this site and have developed our approach accordingly. As part of project planning, EA would facilitate and hold a meeting with appropriate representatives from each of the MPCA/MDA programs to discuss the project objectives and ensure that components of all programs are properly incorporated into the project plan.

Exhibit 5-4: High Risk Sampling Areas, Contaminants of Concern, Analytical Requirements										
	Former Ag Building Area			Garage Area			Stream	GW		Offsite Private Residences
	Building Floor	Scale Area	1,000-Gallon UST	Building Floor Floor	500-Gallon AST	Trench/ UST		Onsite	Site Boundary	
Surface Soil Samples	Sample around slab with focus on west side and discolored area to north and former building; analysis for A, D, and G Sample around ag equipment storage north and south of building; analysis for A	Sample below gravel; analysis for A and D	Sample around dispenser; analysis for A, C, and D	Sample in discolored area to north analysis for A through F	Sample around AST in stained area analysis for A and B	NA	NA	NA	NA	NA
Subsurface Soil Samples	Sample below areas where surface soil samples are collected and beneath slab (where cracked); analysis for A, D, and G	Sample below areas where surface soil samples are collected; analysis for A and D	Borings/soil samples around UST; analysis for A, C, and D	Sample around AST below stained area analysis for A through F	Sample around AST below stained area analysis for A and B	Soil boring and sample collection outside northwest corner of building; analysis for A through F	NA	NA	NA	NA
VI	NA	NA	NA	Perform additional round of soil gas sampling during opposite heating/non-heating season than was previously sampled during; analysis for H	NA	Include as part of building; VI sampling	NA	NA	NA	Conduct soil gas sampling at residences (two events) with high priority to residence occupied by pregnant woman; analysis for H

Exhibit 5-4: High Risk Sampling Areas, Contaminants of Concern, Analytical Requirements

	Former Ag Building Area			Garage Area				GW		Offsite
	Building Floor	Scale Area	1,000-Gallon UST	Building Floor Floor	500-Gallon AST	Trench/ UST	Stream	Onsite	Site Boundary	Private Residences
GW	Sample water supply well; analysis for A through F	Refer to onsite GW column	Refer to onsite GW column	Refer to onsite GW column	Refer to onsite GW column	Refer to onsite GW column	NA	Conduct direct-push screening area south of building; analysis for C Install and sample permanent monitoring wells across the site based on prior sampling results and direct-push soil screening/temporary well sampling of area south of buildings around highest prior TCE detection: analysis for A through F	Install and sample monitoring wells along west property boundary; analysis for A through F	Sample private drinking water wells; analysis for A through F
SW/ Sediment	NA	NA	NA	NA	NA	NA	Sample up-, mid- and downstream along site boundary; analysis for A through F	NA	NA	NA

Analytical requirements:
A = MDA pesticides, (List 1 and 2), Total Kjeldahl nitrogen (TKN), nitrate.
B = VOCs, diesel range organics (DROs).
C = VOCs, gasoline range organics (GROs).
D = PFAS.
E = Target Analyte List metals.
F = VOCs.
G = Dioxin/furans.
H = TO-15 (VOCs in air).
NOTE: NA = Not applicable.

5.2 EA's Approach

This section outlines our overall approach and conceptual work breakdown structure, including intermediate tasks and activities and measures that will be implemented throughout the project life cycle. Work plans for implementing this approach, through completion of an RI and RD/RA Work Plan, follow and provide more specific details on the activities to be performed.

RI Framework

Based on the results of the limited data collected from the site to date, the site has not been properly characterized with respect to all media of concern (soil, GW, SW, sediment, and soil vapor) for the COCs previously identified. Therefore, further investigation through the performance of an RI is warranted to address the data gaps previously noted. In addition to characterizing the site, the data collected will be utilized to develop a remedy to address unacceptable risks identified. The RI will incorporate guidance from MPCA and MDA, including, but not limited to, the Risk-Based Site Evaluation Manual and associated documents and the MDA Guidance Document 9 for performance of an RI. The RI will consist of the components summarized below.

RI Work Plan

Prior to fieldwork, a Work Plan would be developed to document the proposed field activities. The scope of the RI is based on the CSM developed for the site. The Work Plan would include a summary of the work conducted to date, identification of the data gaps and the need for further investigation, and the methodology for completion of the investigation. In addition, appropriate subplans (i.e., Health and Safety Plan and Quality Assurance Project Plan) will be developed. Additional details regarding the contents of the Work Plan are discussed in the attached Work Plan.

Field Investigation

The field investigation will be developed to address the data gaps and consist of sampling all media of concern for the applicable COCs on a media-specific basis. The focus of the investigation will include the high risk areas identified at the site. EA is proposing the completion of the RI in a phased-approach including an initial phase and a follow-up phase. The initial phase will include collection of samples from all media in the high risk areas with GW samples being collected from existing wells (monitoring, potable, and onsite supply) and temporary monitoring wells. The follow-up phase will consist of addressing any remaining data gaps and include installation and sampling of permanent monitoring wells, as warranted. By conducting the investigation in a phased approach, initial data collected will be used to focus in on areas of concern during the follow-up phase, resulting in the collection of a higher quality data set and reduction of costs associated with the investigation.

Risk Evaluation

Following completion of the field investigation and receipt of the analytical data, human health and ecological risk evaluations will be performed. The risk evaluations will be conducted in accordance with the MPCA risk-based guidance (human health) and MPCA/U.S. Environmental Protection Agency (EPA) guidance (ecological) and include a tiered approach to identify the potential risk and the COCs that drive that risk. Appropriate up-to-date MPCA/MDH/MDA/EPA media-specific criteria will be utilized in the risk evaluations. The risk evaluations will evaluate the exposure mechanisms, pathways, and receptors (receptor survey) and the site CSM will be updated based on the evaluation findings. The conclusions of the risk evaluations will be utilized to determine a path forward with respect to the need for RA, and identification of what areas/media/COCs warrant further action.

Remedial Investigation Report

The results of the RI and risk evaluations will be provided in an RI Report. The report will include a discussion of the field effort, the data collected, results of the sample analysis, methodology and results of the risk evaluations, and conclusions and recommendation with respect to further action, as warranted. The RI will include an updated CSM based on the data collected and identification of unacceptable risks at the site.

RD/RA Framework

Once the RI is complete, an FS will be completed following the traditional remedy selection process. For the purposes of this proposal and with respect to the scope requested as part of the proposal, effort to perform the FS is not included. However, EA has completed numerous FSs and is familiar with applicable guidance governing the performance of an FS. The results of the FS would drive the remedy selection based on the findings of the RI. Remedy selection will incorporate the evaluation processes developed by MPCA and MDA. Due to the cross-program nature of the site, a remedial scoping meeting will be held with representatives of MPCA and MDA to ensure that requirements of both agencies are met. Since

the RI is not complete, the site has not been fully characterized and risk to potential receptors quantified, it is premature to prescriptively outline a remedy at this point. However, based on what is currently known about the site, and what we anticipate based on the site history and prior work at similar sites, we have identified the following general Remedial Action Objectives (RAOs) for each medium known or anticipated to present an unacceptable risk, in excess of MPCA/MDA remedial standards, or continuing source to GW, SW, and/or indoor air.

Soil RAOs

- Prevent human receptor ingestion/direct contact with COCs in site soil that present a risk from exposure or exceed promulgated standards
- Prevent impacts to biota from ingestion/direct contact with surface soil causing toxicity or impacts through the terrestrial food chain
- Prevent the migration of site-related contaminants in soil that would result in SW or GW contamination.

GW RAOs

- Prevent human receptor ingestion of GW with contaminant levels exceeding drinking water standards or health advisories
- Prevent contact with or inhalation of volatiles from contaminated GW
- Mitigate VI
- Restore GW aquifer to pre-release conditions, to the extent practicable.

SW/Sediment RAOs

- Prevent human receptor ingestion of SW/sediment with contaminant levels that present a risk from exposure or exceed promulgated standards
- Prevent impacts to biota from ingestion/direct contact with SW/sediment causing toxicity or impacts through the food chain.

Soil Remediation Technology Screening

As part of this proposal, we completed a focused screening evaluation of the most likely soil remedial technologies **(Exhibit 5-5)** to support our decision to develop a site remedy that would meet RAOs and restore impacted media to acceptable standards.

Exhibit 5-5: Soil Remediation Technology Evaluation Matrix

Technology	Excavation and Disposal	Stabilization	*In Situ* Bio	Containment/ Capping	ISCO	*In Situ* Chemical Reduction
Effective for Nitrate TKN, and Metals	Yes	Yes	No	Yes	No	Yes
Effective for PFAS and VOCs, Pesticides	Yes	Partially (generally not used for highly volatile contaminants)	Partially (not for PFAS)	Yes	Yes (except some PFAS)	Partially (not for PFAS)
Waste Stream Generation Volume/Treatment	High (possibly Moderate if soil can be land applied at other location)	Moderate	Low	Low	Moderate	Moderate
Long-Term Monitoring Requirements	None	Moderate	Moderate	High	Moderate	Moderate
Infrastructure requirements	Low	Moderate	Low	Moderate	Low	Low
Overall Relative Cost	High	Moderate	Low	Moderate-High	Low	Moderate

NOTE: ISCO = *In situ* chemical oxidation.

As a first step in evaluating soil remedial technologies, we considered the current site layout, location, probable depths of impacted soil, and effectiveness of a potential technology. In completing that assessment, it was evident that surficial and subsurface soil contamination exists and will present a risk in some instances and present a continuing source if left in place. Since the site will be developed into a golf course, there will be frequent irrigation that, in addition to promoting a good groundcover, will increase leaching of certain contaminants. As such, capping, although effective, will likely not be practical for impacted soil areas unless placed under a low permeability cover (i.e., asphalt). In addition, a capping approach does not effectively remove contaminant mass or reduce the toxicity or mobility. Several *in situ* methods may be partially effective, but none will address the full suite of organics and inorganics, if collocated.

In the final analysis, a combination of excavation with offsite disposal of soil will likely be the preferred remedial alternative for most (if not all) soil source areas above the water table. This would include surface soil, and subsurface soil where accessible, around the AST, UST, and even below the former ag building slab, which ultimately will be removed. However, if PFAS and inorganic COCs are not collocated with other VOCs, then several of the *in situ* methods may be appropriate for pilot-scale testing and as part of the final site remedy. An evaluation of the potential to land apply soil contaminated with ag chemicals will be made, as this would result in less volume of soil to be treated and beneficial reuse of that material.

GW Remediation Technology Screening

Similar to the soil areas of concern, we completed a screening to evaluate applicable GW remedial technologies capable of meeting RAOs based on contamination identified or anticipated to be present at the site (**Exhibit 5-6)**. To the extent practicable, the remedy would provide mitigation from the potential for continued GW migration, reduce COC levels in GW, and/or eliminate GW VOC concentrations that contribute to VI risk.

Exhibit 5-6: Primary Groundwater Remediation Technology Evaluation Matrix

Technology	P&T/Air Stripper	P&T – GAC	P&T – Ion Exchange Resin	*In Situ* Bio	ISCO	MNA and LUCs	Non-Aqueous Phase Liquid Recovery	VI Mitigation for VOCs
Effective for PFAS and VOCs, Pesticide	VOCs, yes; not for PFAS and pesticides	Yes	Yes	Partially	Potentially except for some PFAS	Yes, in tandem with active remedy for VOCs, not PFAS	Yes, for VOCs, non-aqueous phase liquid	Yes
Effective for N, TKN, and Metals	No (unless pre-treated)	No (unless pre-treated)	Yes	No	No	Yes, in tandem with active remedy	NA	NA
Waste Stream Generation	Low-Moderate	High	Low-Moderate	Low	Low	None	Low-Moderate	None
Operation and Maintenance	Moderate	High	high	Moderate	Moderate	None	Moderate	Low
Infrastructure	High	High	High	Moderate	Moderate	Low	Moderate	Low
Ex Situ	Yes	Yes	Yes	No	No	NA	Yes	No
In Situ	No	No	No	Yes	Yes	NA	No	Yes
Hydraulic Containment	Yes	Yes	Yes	No	No	No	Some	No
Overall Costs	High	High	Moderate	High	Moderate	Low	Low-Moderate	Low

NOTES: LUC = Land use control.
MNA = Monitored natural attenuation.
P&T = Pump and treat.

If PFAS were released to GW due to AFFF usage, they are considered an emerging contaminant and applicable treatment/destruction technologies have not been widely demonstrated at full-scale remedial sites other than point of use (POU) drinking water treatment. Currently, PFAS are primarily being treated in drinking water using GAC or ion exchange resins. Our team has been at the forefront of PFAS investigation and remediation, and provides the State of Minnesota the benefit of having executed investigations and RDs for PFAS, as well as side-by-side pilot-scale demonstrations of GAC and ion-exchange resins to assess removal efficiencies and projecting long-term operating costs for PFAS treatment. This experience allows EA to use real-world data to guide decisions on the most effective remedial technology. EA has provided POU GAC treatment system installations and monitoring to more than 170 private dwellings, schools,

and commercial establishment at a PFOA/PFOS-impacted community of Moose Creek, Alaska. We have also designed and provided construction oversight of larger community GAC treatment systems for PFAS-affected drinking water supplies in New York State. Several EA personnel are members of the Interstate Technology and Regulatory Council PFAS workgroup.

Based on our knowledge of PFAS/VOCs/pesticides treatment in GW, we have identified a list of proven, widely acceptable remedial technologies that can effectively meet RAOs. We also consider TKN or nitrates in GW as an ancillary pre-treatment issue if coupled with one of the listed primary GW treatment technologies. Although it is premature to recommend a specific GW remedy, there are several factors to consider as part of the final remedy selection:

- Whether the source will be removed as part of soil remedial component.
- Whether COC migration has equilibrated at the site and offsite, primarily due to the stream's, onsite supply well's, and offsite private wells' hydraulic influence on local GW flow and the age of the site.
- Whether preferred GW flow paths, rates, and geochemical conditions are relatively static.
- Whether the stream will prevent further COC migration in the shallow aquifer to the north.
- There are currently no federally-promulgated cleanup criteria for PFOA/PFOS; however, GW guidance values (HRLs, HBVs, and/or RAAs) have been developed by MDH for several PFAS compounds, including PFOS and PFOA.
- There are likely current (and potentially future) VI risks from the shallow VOC plume.
- In the future, local GW may be extracted and used for golf course irrigation.

In light of the above factors, RAOs for this site, and what may prove to be significant changes to PFOS/PFOA regulations and remediation technology over the next several years, we conceptualize a remedial approach that will restore GW in a realistic remedial timeframe to include, but is not limited to, a combination of MNA, extraction well network, and potential *in situ* remedies (if proven at full scale) to limit exposure and achieve COC mass removal/destruction and/or plume containment. Additionally, we considered the possibility that the final remedy must either allow for, or alternately place restrictions against, the use of local GW for irrigation. Other technical considerations must include achievable rates of GW extraction that may be a limiting factor from a remediation timeframe perspective and how VI risk will be mitigated as part of the overall GW operable unit remedy.

At one extreme, the selected GW remedy may rely primarily on natural attenuation mechanisms, LUCs, and simple VI mitigation measures (i.e., subslab depressurization systems); and, if it is determined that the site poses no immediate or future GW exposure risk, the plume is constrained by natural hydrogeological conditions, and offsite houses and onsite supply well can be retrofitted with treatment system or provided with alternate water supply. The 5-year review process, or more frequently if warranted, may also be used to assess the remedy once PFOA/PFOS regulations and treatment technology are updated in the future.

If a more aggressive approach is warranted, GW extraction may be selected where treatment may include air stripping (VOCs), GAC, ion exchange with synthetic resin technology (PFAS), or a combination of these technologies. Air stripping is a well-known process for removing VOCs from GW, but not pesticides or PFAS (if present). GAC and ion exchange are more flexible in terms of treatment options for pesticides and PFAS. While ion exchange resin technology requires a modest initial capital investment above a typical GAC technology, the full life-cycle costs (i.e., operation and maintenance) and sustainability of a regenerative adsorptive resin media outweigh traditional GAC treatment processes that are less efficient at removing branched and shorter chain PFAS, and specifically PFOA that, if at higher concentrations in the aquifer, requires more frequent media replacements, and is viewed as a less sustainable treatment process for PFAS that do not attenuate over time.

Sediment/SW Remediation

At this stage, we do not anticipate that sediment and SW will require an extensive remediation effort and, accordingly, do not deem it necessary to conduct a remedial technology screening for sediment/SW. We expect that once surface soil sources have been remediated (i.e., prevent sediment erosion/transport), subsurface soil sources remediated (i.e., reduce/eliminate COCs leaching into the GW system), and GW remedies are in place (reduce GW/SW interface COC flux), SW and sediment will not require any additional active remediation, with the potential exception of isolated sediment removal.

Vapor Mitigation

Existing data indicate that there is likely unacceptable risk associated with inhalation of indoor air within the onsite garage building, and at least one of the offsite residences occupied by a pregnant woman (potential for more residences with unacceptable risk following soil gas sampling as part of RI). To mitigate these risks, a subslab depressurization system would be installed within the garage and residences to capture vapors prior to entering the buildings. If the residences were constructed on footers without a slab-on-grade, the system would be modified to capture vapors in the crawlspace or other relevant area of the structures to prevent migration into the occupied portion of the residences. Evaluation of the need for treatment of the captured vapors will be performed. The vapor mitigation systems would remain operational until the building is no longer occupied (garage) and/or treatment of GW is completed to the extent that the concentrations remaining in GW do not result in migration of vapors into the buildings that result in unacceptable inhalation risk. Based on the concentrations of COCs in soil gas, the construction of the structures, and the anticipated time period for GW treatment to be completed, other best management practices would also be considered, including installation of vapor barriers within the residence and passive mitigation systems.

Combined Site Remedy Recommendation

Based on the current information available and our list of screened remedial technologies for soil and GW, we have recommended a comprehensive approach for this site, for which a design will be prepared (**Exhibit 5-7 on page 5-15**). The remedial approach for this site will achieve the following:

- Remove identified sources of contamination or risk
- Provide treated water for onsite supply well and offsite private drinking water supply wells
- Mitigate VI
- Utilize the results of a pilot study to address soil and/or GW contamination at the garage
- Achieve GW protection standards consistent future and current site use
- Address PFAS, to the extent practical, in accordance with MDH GW values.

Pilot Study

Once the RI is complete, we will assess the site conditions relative to RAOs and determine if a pilot study is warranted to address soil or GW contamination at the garage or elsewhere. Once this is done, we will prepare a treatability study plan that details the elements of our treatability study, provides details for a field scale pilot study to demonstrate the efficacy of potential treatment trains, and provides a detailed evaluation of performance parameters and processes. At this time, candidates for the pilot study include:

- *In situ* bioremediation (ISBR) will be evaluated if conditions are favorable for either anaerobic (chlorinated) or aerobic (petroleum) biodegradation and if direct access to the treatment area is difficult due to the building footprint. We will evaluate if the suite of contaminants and location of contaminants are amenable to source reduction by this method. ISBR will destroy organics in saturated zone.

- *In situ* soil vapor extraction (SVE) will be evaluated if either chlorinated or petroleum organics are present in soil and excavation is difficult due to the building footprint. An SVE system will remove organics from vadose zone and aid in VI mitigation.

- ISCO will be evaluated if either chlorinated, petroleum, or pesticide organics are present in soil or GW (and PFAS are not present in GW) and direct access is difficult due to the building footprint.

Where required, EA will utilize a mobile treatment system unit to position in the immediate vicinity of the study area along with the appropriate treatment train and waste containment vessels. Treatment train performance monitoring will be conducted during the study to include collection of the appropriate process and performance data.

Remedial Design

EA will complete an RD for the site that will identify and incorporate established RAOs/Preliminary Remediation Goals and will detail each element of the selected remedial alternative required to achieve site cleanup objectives. We will prepare the following RD plans for review and comment:

- **Preliminary (Concept) Design (30 Percent [%])**—The 30% design report will include the results of the RI and treatability study, a site survey of existing topography, the basis of design, preliminary specifications and drawing set, an estimated construction/implementation schedule, as well as an initial engineer's cost estimate. Supporting data, documentation, and design calculations will be provided with the design documents defining the functional and performance aspects of the remedy.
- **Intermediate Design (60%)**—The 60% design report will incorporate MPCA comments on the 30% design and will include the updated specifications and drawing set, a revised estimated implementation schedule, a proposed bid schedule with expected unit price items and estimated quantities, as well as an updated engineer's cost estimate.
- **Final Design**—The final design will be completed based on comments received from MPCA from the 60% intermediate design report submittal. EA will ensure that the final design meets all design-related guidance for hazardous waste systems and any supporting addenda when completing the final design report and ensure consistency between the final design and bid schedules, specifications, drawings, etc.

Exhibit 5-7: Combined Remedy Matrix					
	Ag Building Area Soil and GW	Garage Area Soil and GW	UST/AST at Ag and Garage	GW (Onsite)	Private Residences
GAC	Retrofit water supply well with GAC to treat organics (including PFAS); use only when well water is required, not a continuous P&T system	NA	NA	P&T system not recommended at this point; may be revisited after completion of RI or if additional water supply is required for golf course maintenance	POU treatment as temporary solution on affected houses with VOC, pesticides, and PFAS; *pre-treatment for metals or TKN*
VI Subslab Depressurization		Subslab depressurization system			Subslab depressurization system (or other appropriate system) on houses with VI risk – locations to be determined
Pilot/ Treatment		Pilot for elevated TCE and other VOCs, refer to pilot study narrative above		GW – implement full-scale technology from pilot study in "hot spots" to remove continued source to GW impacts; consider potential MNA in other portions of aquifer; PFAS in GW will be addressed as a POU treatment (which will remove PFAS from extracted GW); however, at this time, no other PFAS plume treatment is indicated	
Excavation/ Treatment and Disposal	Address soil impacted in the vadose zone, remove residual source of PFAS, pesticides, fertilizer, other COCs as appropriate	Address soil impacted above water table, remove residual source of VOCs, and possibly removal of soil with ag chemical contamination that may be land applied at an appropriate site	Address soil impacted above water table, remove residual source VOCs; due to shallow water table, remove light non-aqueous phase liquid from excavation; if required, install temporary recovery well, bail, or skimmer	If source of TCE is identified, potential to excavate and remove source above water table	
Extend Community Water Supply					Long-term option instead of continued POU systems – *may be outside the purview of the RD/RA for this project*

MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

RI Work Plan

Project Title: **Remediation Master Contract – Category A Scenario A**

1. Project Summary

The site consists of a former ag chemical plant that operated from 1960 to 1991. Through review of available documentation, several high risk areas of contamination were identified at the site. These areas were summarized in Section 5.1 of this proposal and are listed in the Proposed Sampling Strategy provided later in this Work Plan. Previous investigations conducted at the site identified the presence of chlorinated ethenes (most notably TCE) and several ag chemicals in soil and GW above applicable Minnesota agency criteria. Additionally, VI sampling (subslab and passive vapor) indicated concentrations of vapors that may pose an unacceptable risk. We have also identified several other potential COCs, including PFAS, dioxins, furans, and petroleum constituents based on operations at the site. Based on the results of the previous investigations and data gaps identified at the site, additional investigation is warranted.

2. Statement of Problems, Opportunities, and Existing Conditions

Existing data from the site indicate that unacceptable risk may be present at the site and nearby properties due to exposure to contaminated soil, GW, and indoor air (from VI). Through review of available information, data gaps were identified that warrant additional investigation. A summary of the site status and identified data gaps is provided in EA's Understanding of the Project (Section 5.1) attached to this Work Plan. In general, the data gaps associated with the former ag building, garage area, SW and sediment, GW, and the private residences were identified based on the use of the property and existing data. To address these data gaps, an RI is proposed at the site. The overall approach for the RI and future action is provided in EA's Approach (Section 5.2) attached to this Work Plan. Specific details as to the methodology of the RI are included in this Work Plan. The RI will be performed in accordance with MPCA and MDA guidance, including, but not limited to:

- MPCA Risk-Based Site Evaluation Manual and associated guidance (Risk-Based Site Characterization and Sampling Guidance, etc.)
- MPCA Soil and GW Assessments Performed during Site Investigations (prp4-01)
- MPCA VI Assessments Performed during Site Investigations (prp4-01a)
- MPCA Soil Sample Collection and Analysis Procedures (prp4-04)
- MPCA GW Sample Collection and Analysis Procedures (prp-05)
- MDA RI and Work Plan (GD9)
- MDA Soil Sampling Guidance (GD11)
- MDA GW Sampling Guidance (GD12).

3. Goals, Objectives, Tasks, and Subtasks

The goal of the project is to address any site contamination that results in unacceptable risk to onsite and offsite receptors. To accomplish this goal, the first objective is to complete an investigation at the site to adequately characterize sources of unacceptable risk at the site. This objective will be accomplished through performance of the following Tasks:

Task A: RI Work Plan

Prior to initiation of fieldwork, a site visit will be held to observe the site conditions and an RI Work Plan will be developed. The Work Plan will include a summary of the work conducted to date, identification of the data gaps and the need for further investigation, and the methodology for completion of the investigation. Included in the Work Plan will be a list of soil borings, monitoring wells, and sample locations that will be part of the field effort. Figures showing the proposed locations will be prepared. The Work Plan will be developed based on a review of existing guidance documents associated with all of the relevant MPCA/MDA programs (discussed above and summarized in Section 2.6 of this proposal) and through collaborative discussion with representatives of these programs during project planning. The investigative plan will be developed to satisfy all the program requirements, while identifying opportunities to combine sampling efforts to perform the investigation in the most efficient manner possible. Additionally, where possible, the plan will incorporate green and sustainable practices, such as the use of field instrumentation and phased investigation to minimize the number of samples required. The Work Plan will be submitted to MPCA/MDA for review.

Following review, EA is prepared to address any comments received and prepare a revised Work Plan for approval.

Task B: Field Investigation

Following approval of the Work Plan, the field investigation will be initiated. The investigation will consist of the subtasks summarized below.

Subtask 1: Pre-Mobilization Preparation
Prior to mobilization, EA will perform the following tasks:

- Obtain permission to access the site and identify any existing onsite limitations that warrant adjustment to proposed sample locations
- Obtain necessary permits (well permits, etc.)
- Perform a utility location/clearance.

Subtask 2: Soil Borings and Sample Collection – Initial Phase
Following completion of the pre-mobilization preparation, the field team will mobilize to the site to perform the investigation activities. EA is proposing completion of the RI in a phased-approach, including an initial phase and a follow-up phase. The initial phase will include collection of samples from all media in all the high risk areas with GW samples being collected from existing wells (monitoring, potable, and onsite supply) and temporary monitoring wells. The follow-up phase will consist of addressing any remaining data gaps and include installation and sampling of permanent monitoring wells, as warranted. By conducting the investigation in a phased approach, initial data collected will be used to focus in on areas of concern during the follow-up phase, resulting in the collection of a higher quality data set and reduction of costs associated with the investigation. The initial phase will consist of the following:

- Collection of surface soil samples for analysis
- Advancement of soil borings to collect subsurface soil for analysis
- Completion of selected soil borings as temporary monitoring wells for GW sample collection
- Collection of GW samples from the onsite supply well and offsite residential potable wells
- Collection of sediment samples from the adjacent river
- Collection of SW samples from the adjacent river
- Collection of soil gas/subslab samples from the onsite garage and offsite residences
- Performance of a geophysical survey to identify the location of the UST and any underground utilities that may act as subsurface conduits for contaminant migration in areas of identified soil contamination.

Soil collected from the site will be field screened utilizing a photoionization detector. In addition, soil from areas of petroleum impact will be evaluated via a petroleum-saturated soil screening test for the presence of free-phase petroleum. The samples will be collected following MPCA/MDA protocols and submitted for laboratory analysis of various constituents, including VOCs, DROs, GROs, PFAS, metals, dioxins/furans, MDA pesticides (List 1 and 2), TKN, and nitrate. The COCs, proposed number of soil borings/samples, sample intervals, and analyses for the high risk areas are summarized in the table below. Additionally, the target areas of the investigation are discussed in the Section 5.1 attached to this Work Plan. The proposed locations, number of borings, and analyses may be adjusted based on what is observed in the field. Additional analyses may be added to samples based on the observations at other locations. Selected soil borings will be completed as temporary monitoring wells based on site observations and field screening. The temporary monitoring wells will be sampled for the same parameters as the soil within those borings following MPCA/MDA protocols. In addition to the parent samples, appropriate quality control/quality assurance samples will be collected, including field blanks, trip blanks, blind duplicates, matrix spike/matrix spike duplicates, and rinsate blanks. Additionally, data will be submitted for data validation.

Proposed Sampling Strategy

High Risk Area	COCs	Proposed Number of Borings/Samples	Sampling Intervals**	Laboratory Analysis
Former Dry Fertilizer Building	Ag Chemicals, PFAS, VOCs, dioxins/furans	9 borings	Non-Petroleum 0-4 feet bgs (2-6 inches for surface) and 4-12 feet bgs, deeper as needed to evaluate soil impacts to GW Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft)	VOCs by EPA Method 8260, PFAS by EPA Method 537, dioxins/furans by EPA Method 8290A Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Service Garage	VOCs, SVOCs (PAHs), GROs, DROs, Ag Chemicals, metals, PCBs	3 borings	Non-Petroleum 0-4 feet bgs (2-6 inches for surface) and 4-12 feet bgs, deeper as needed to evaluate soil impacts to GW Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft) Petroleum 2 samples per boring depending on observations (borings to 5 feet into GW or 10 ft below contamination	VOCs by EPA Method 8260, SVOCs by EPA Method 8270, DROs/GROs by WI DNR Methods, RCRA metals by EPA Method 6010, PCBs by EPA Method 8082, grain size Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Parking Areas	Ag Chemicals	6 borings (3 on north and 3 on south)	Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft)	Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Trench Drain/500-Gallon UST	VOCs, SVOCs (PAHs), GROs, DROs, Ag Chemicals, metals	7 borings (4 around tank, 3 along drain line)	Non-Petroleum 0-4 feet bgs (2-6 inches for surface) and 4-12 feet bgs, deeper as needed to evaluate soil impacts to GW Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft) Petroleum 2 samples per boring depending on observations (borings to 5 feet into GW or 10 ft below contamination	VOCs by EPA Method 8260, SVOCs by EPA Method 8270, DROs/GROs by WI DNR Methods, RCRA metals by EPA Method 6010, PCBs by EPA Method 8082, grain size Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2

High Risk Area	COCs	Proposed Number of Borings/Samples	Sampling Intervals**	Laboratory Analysis
North of Service Garage	VOCs, GROs, DROs, Ag Chemicals, metals, SVOCs (PAHs), PCBs	4 borings along stream	Non-Petroleum 0-4 feet bgs (2-6 inches for surface) and 4-12 feet bgs, deeper as needed to evaluate soil impacts to GW Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft) Petroleum 2 samples per boring depending on observations (borings to 5 feet into GW or 10 ft below contamination	VOCs by EPA Method 8260, SVOCs by EPA Method 8270, DROs/GROs by WI DNR Methods, RCRA metals by EPA Method 6010, PCBs by EPA Method 8082, grain size Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
500-Gallon Fuel Oil AST	DROs, SVOCs (PAHs), VOCs	3 borings around tank	Petroleum 2 samples per boring depending on observations (borings to 5 feet into GW or 10 ft below contamination	VOCs by EPA Method 8260, SVOCs by EPA Method 8270, DROs by WI DNR Method, grain size
1,000-Gallon Gasoline UST	GROs, VOCs	4 borings around tank	Petroleum 2 samples per boring depending on observations (borings to 5 feet into GW or 10 ft below contamination	VOCs by EPA Method 8260, GROs by WI DNR Method, grain size
Discolored Soil North of Fertilizer Building	Ag Chemicals, VOCs	3 borings	Non-Petroleum 0-4 feet bgs (2-6 inches for surface) and 4-12 feet bgs, deeper as needed to evaluate soil impacts to GW Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft) *Possible petroleum sampling based on field observations/screening*	VOCs by EPA Method 8260 Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Stream	VOCs, SVOCs, DROs, GROs, Ag Chemicals	6 SW/sediment samples	Sampling spaced along stream	VOCs by EPA Method 8260, SVOCs by EPA Method 8270, DROs/GROs by WI DNR Methods Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Site-Wide TCE Data Gaps	VOCs	6 borings as temporary monitoring wells*	6 GW samples	VOCs by EPA Method 8260

High Risk Area	COCs	Proposed Number of Borings/Samples	Sampling Intervals**	Laboratory Analysis
Waterfill Supply Well Area	VOCs, Ag Chemicals	3 borings	Non-Petroleum 0-4 feet bgs (2-6 inches for surface) and 4-12 feet bgs, deeper as needed to evaluate soil impacts to GW Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft), deep subsurface (25 ft or at GW table)	VOCs by EPA Method 8260 Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Scale Area	Ag Chemicals	3 borings	Ag Chemical Composite surface (0-6 inches bgs), composite subsurface (2-2.5 ft bgs), discrete subsurface (4.5-5 ft), deep subsurface (25 ft or at GW table)	Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Residential Area – GW	VOCs (possibly Ag Chemicals)	Sample 5 potable wells	5 GW samples	VOCs by EPA Method 8260 Ag Chemicals by EPA Method 8270D_AgChem (List 1), EPA Method 8151A/B (List 2), nitrate by EPA Method 353.2, and TKN by EPA Method 351.2
Residential Area – VI	VOCs	2 subslab samples at each of 9 houses (2 events) 20 subslab samples at garage (1 event opposite season of previous event) = total of 56 samples	Subslab/soil gas (depending on building construction)	VOCs via EPA Method TO-15

* These locations are in addition to other proposed boring locations that will also be sampled for VOCs to evaluate site-wide TCE concentrations. EA is proposing to analyze all GW samples collected for VOCs.

** In addition to intervals prescribed by MPCA/MDH guidance, field observations and soil screening will also be utilized to determine depths from which samples are collected.

NOTES: bgs = Below ground surface.
PAH = Polycyclic aromatic hydrocarbons.
PCB = Polychlorinated biphenyls.
RCRA = Resource Conservation and Recovery Act.
SVOC = Semivolatile organic compound.
WI DNR = Wisconsin Department of Natural Resources.

Subtask 3: Additional Sample Collection and Monitoring Well Installation and Sampling

Following receipt and evaluation of data collected from the initial phase, a follow-up phase will be conducted at the site. The sample locations, number of samples, and analytical methodologies will be based on the findings of the initial phase. The goal will be to further refine the extent of contamination and address any remaining data gaps. As part of this follow-up phase and based on the results on temporary monitoring well/supply well/potable well sampling, permanent monitoring wells will be installed at the site and sampled. The wells will be installed in accordance with MDH regulations and will be properly developed. GW flow will be determined/verified and hydraulic properties will be evaluated (i.e., slug tests, etc.), as appropriate. The monitoring wells will be sampled utilizing low-flow methodology in

accordance with MPCA and MDA guidance. Field water quality parameters will also be collected as part of determining stabilization prior to sampling. Applicable QC/QA samples will also be collected as noted in Subtask 2 and data will be validated. As part of this second phase, the second round of VI sampling will be conducted. Unless the initial round of sampling indicates an exceedance of the 33X ISV values, samples will be collected from the same locations. If the 33X ISV value is exceeded in the initial round, additional samples are not warranted at that location, as mitigation is required. The samples collected from the site during the follow-up round will be analyzed via the same methodologies listed above, as appropriate.

Task C: Risk Evaluations

Following completion of the field investigation and receipt of the analytical data, human health and ecological risk evaluations will be performed. The risk evaluations will be conducted in accordance with the MPCA risk-based guidance (human health) and MPCA/EPA guidance (ecological) and include a tiered approach in order to identify the potential risk and the COCs that drive that risk. Appropriate up-to-date MPCA/MDH/EPA media-specific criteria will be utilized in the risk evaluations. The risk evaluations will evaluate the exposure mechanisms, pathways, and receptors (receptor survey) and the site CSM will be updated based on the findings of the risk evaluation. The conclusions of the risk evaluations will be utilized to determine a path forward with respect to the need for RA, and identification of what areas/media/COCs warrant further action.

Task D: Report

The results of the investigation and risk evaluations will be summarized in an RI Report. The report will include a discussion of the field effort, data collected, results of the sample analysis, methodology and results of the risk evaluations, and conclusions and recommendations with respect to further action, as warranted. The RI Report will be prepared in accordance with the MPCA Risk-Based Site Evaluation Manual guidance, MPCA Petroleum Remediation Program Guidance (Investigation Report, prp4-06), and MDA Guidance (Ag Chemical Incident RI Report and Corrective Action Plan, GD10). The RI Report will be submitted to MPCA/MDA for review. Following review, EA is prepared to address any comments received and prepare a revised RI for approval.

Objective 1 Timeline: It is anticipated that the work will be conducted on the following timeline:

- Draft Work Plan – 30 days
- Final Work Plan – 15 days (following receipt of MPCA/MDA comments)
- Initial Phase (including laboratory analysis) – 45 days
- Review and evaluation of initial phase data and follow-up phase planning – 30 days (following receipt of initial phase data)
- Follow-Up Phase (including laboratory analysis) – 45 days
- Risk Evaluation – 21 days (following receipt of follow-up phase data)
- Draft RI Report – 45 days (following receipt of follow-up phase data)
- Final RI Report – 15 days (following receipt of MPCA/MDA comments).

Objective 1 Deliverables: Deliverables for this objective include the following:

- Draft and Final RI Work Plan
- Draft and Final RI Report.

MINNESOTA POLLUTION CONTROL AGENCY
520 Lafayette Road North
St. Paul, MN 55155-4194

Attachment B
*Example Scenario Project Spreadsheet

*EXAMPLE ONLY - ADD OBJECTIVES/TASKS/CLASSIFICATIONS WHERE APPLICABLE

Project title: Remediation Master Contract - Category A - RI Sampling Plan

	1. Personnel																2. Subcontracting	3. Equipment		4. Other Expenses			Total (Extended)
Project Budget	Ecological Risk Assessor 2	Ecological Risk Assessor 3	Engineer 1	Engineer 2	Engineer 3	Engineer 4	Field Technician	GIS/CADD Specialist	Human Health Risk Assessor 2	Human Health Risk Assessor 3	On-Site Inspector	Project Manager	QA/QC Officer	Scientist 1	Scientist 2	Total (Hours)							
*** Objective 1**																							
Task A: Work Plan				20	8			20				8	8	60	40	164	NA	NA	NA	NA	NA	NA	
Task B: Field Investigation				40			160	8				16	8		40	272	NA	NA	NA	NA	NA	NA	
Task C: Risk Evaluation	80	40							80	40						240	NA	NA	NA	NA	NA	NA	
Task D: Report	8			20	8			20	8			16	8	80	40	208	NA	NA	NA	NA	NA	NA	
Total for Objective 1 Hrs	88	40	0	80	16	0	160	48	88	40	0	40	24	140	120	884	NA	NA	NA	NA	NA	NA	
Total Project Hours	88	40	0	80	16	0	160	48	88	40	0	40	24	140	120	884							

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RD/RA Work Plan

Project Title: **Remediation Master Contract – Category A Scenario A**

1. Project Summary

The site consists of a former ag chemical plant that operated from 1960 to 1991. Through review of available documentation, several high risk areas of contamination were identified at the site. Previous investigations conducted at the site identified the presence of chlorinated ethenes (most notably TCE) and several ag chemicals in soil and GW above applicable Minnesota agency criteria. Additionally, VI sampling (subslab and indoor air) indicated concentrations of vapors that may pose an unacceptable risk. Based on the results of the previous investigations (and pending results of the additional investigation to be performed), RA is likely warranted at the site to address unacceptable risks associated with COCs in various media at the site. A summary of the site status and potential site risks is provided in Section 5.1 attached to this Work Plan.

2. Statement of Problems, Opportunities, and Existing Conditions

Existing data from the site indicate that unacceptable risk may be present at the site and nearby properties due to exposure to contaminated soil, GW, and indoor air, and possibly sediment and SW. Therefore, RA is warranted to address the unacceptable risk at the site. To address these risks, an RD must be completed to develop an approach for remediating the site and an RA Work Plan must then be developed to provide the methodology for implementation of the RD. The overall approach for RD/RA Work Plan and evaluation of potential remedial alternatives is provided in Section 5.2 attached to this Work Plan. Specific details as to the methodology of the RD/RA Work Plan are included in this Work Plan.

3. Goals, Objectives, Tasks, and Subtasks

The goal of the project is to address any site contamination that results in unacceptable risk to onsite and offsite receptors. To accomplish this goal, the first objective is to complete an investigation at the site to adequately characterize sources of unacceptable risk at the site (which will be conducted under a separate Work Plan). Once characterized, the next objective will be to develop the RD and RA Work Plan. This objective will be accomplished through performance of the following Tasks:

Task A: Remedial Design

Following receipt of data from the additional investigation and completion of an FS to identify and evaluate potential remedial alternatives, an RD will be prepared for the site. The RD will include the following: (1) summary of existing conditions, (2) summary of investigations conducted at the site and identified risks, (3) identification of RAOs, (4) identification of applicable cleanup criteria/remedial goals, (5) RA design components, (6) design for verifying attainment of the RAOs, (7) design for post-RA monitoring (as warranted), and (8) reporting requirements. Components of the RD will include design basis and parameters for erosion and sediment control, excavation, injection, waste management, sampling and analysis, LUCs, quality control/quality assurance, and other relevant activities, as applicable. In addition, the RD will include the results of pilot studies performed at the site, as warranted. The RD will be based on the intended future use of the site as a golf course (Recreational Land Use), but will also consider potential risks associated with the current use until converted to a golf course, as well as risks to offsite receptors. EA will employ our senior technical review process, which calls for internal senior engineer review by personnel independent of the design preparer. In addition, the design will be conducted in accordance with our Corporate Quality Management Plan. In developing the RD, the requirements of all applicable programs (MPCA Non-Petroleum, MPCA Petroleum, and MDA Incident Response) will be incorporated into the design, including, but not limited to, the following guidance:

- MPCA Remedy Selection
- MPCA Guidance on Incorporation of Planned Property Use in Site Decisions
- MPCA Petroleum Remediation Program Corrective Action Design and Implementation
- MPCA Petroleum Remediation Program remedy-specific guidance (pilot test, remediation system design, excavation design, land treatment, etc.)
- MDA Ag Chemical Incident RI Report and Corrective Action Plan

- MDA remedy-specific guidance (Proposal to Land Apply Soil, Bioremediation Treatability Study Fact Sheet, Natural Attenuation).

Based on review of the existing data and as summarized in the Scenario A narrative, a combined remedy approach is likely warranted for the site consisting of one or more of the following components:

- GAC treatment of contaminated GW
- ISBR, *in situ* SVE, and/or ISCO to treat soil/GW (based on results of the pilot study)
- Excavation and transportation/disposal of contaminated soil
- Subslab depressurization systems to mitigate VI risks
- MNA of GW (if active treatment is not warranted in certain areas)
- LUCs (i.e., deed restrictions, GW use restrictions combined with providing alternate drinking water supply to nearby residents and onsite workers, etc. to prevent current/future exposure to residual contamination).

The following RD documents will be prepared:

- ***Preliminary (Concept) Design (30%)***—The 30% design report will include the results of the RI and treatability study, a site survey of existing topography, the basis of design, preliminary specifications and drawing set, an estimated construction/implementation schedule, as well as an initial engineer's cost estimate. Supporting data, documentation, and design calculations will be provided with the design documents defining the functional and performance aspects of remedy.
- ***Intermediate Design (60%)***—The 60% design report will incorporate MPCA/MDA comments on the 30% design and will include the updated specifications and drawing set, a revised estimated implementation schedule, a proposed bid schedule with expected unit price items and estimated quantities, as well as an updated engineer's cost estimate.
- ***Final Design***—The final design will be completed based on comments received from the MPCA/MDA from the 60% intermediate design report submittal. EA will ensure that the final design meets all design-related guidance for hazardous waste systems and any supporting addenda when completing the final design report and ensure consistency between the final design and bid schedules, specifications, drawings, etc.

Task B: Remedial Action Work Plan

Following approval of the RD, an RA Work Plan will be prepared. The RA Work Plan will provide a summary of the proposed methodologies for implementation of the RAs documented in the RD. The RA Work Plan will include the following: (1) summary of the previous investigations and design; (2) summary of RAOs and applicable cleanup criteria/goals; (3) methodologies for implementing the RA; (4) methodology for verifying attainment of the RAOs; (5) proposed post-RA monitoring (as warranted); (6) reporting requirements; and (7) schedule of implementation, reporting, and post-RA monitoring. Components of the RA Work Plan will include methodologies for site preparation, erosion and sediment control, excavation, injection, waste management, sampling and analysis, establishment of LUC, quality control/quality assurance, health and safety, and other relevant activities, as applicable. The RA Work Plan will establish the processes and procedures for field personnel to follow when conducting the RA. In developing the RA Work Plan, the requirements of all applicable programs (MPCA Non-Petroleum, MPCA Petroleum, and MDA Incident Response) will be incorporated into the Work Plan. A draft version of the RA Work Plan will be submitted to MPCA/MDA for review and comment. Following receipt and incorporation of comments, a Final version of the document will be prepared and submitted to MPCA/MDA for approval.

Objective 1 Timeline: It is anticipated that the work will be conducted on the following timeline:

- Preliminary Design (30%) – 60 days
- Intermediate Design (60%) – 45 days (following receipt MPCA/MDA comments)
- Final Design – 45 days (following receipt of MPCA/MDA comments)
- Draft RA Work Plan – 45 days (following approval of Final RD
- Final RA Work Plan – 15 days (following receipt of MPCA/MDA comments.

Objective 1 Deliverables: Deliverables for this objective include the following:

- Preliminary Design (30%)
- Intermediate Design (60%)
- Final Design
- Draft RA Work Plan
- Final RA Work Plan.

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Attachment B
*Example Scenario Project Spreadsheet

*EXAMPLE ONLY - ADD OBJECTIVES/TASKS/CLASSIFICATIONS WHERE APPLICABLE

Project title: Remediation Master Contract - Category A - RD/RA

	1. Personnel																2. Subcontracting	3. Equipment		4. Other Expenses			Totals (Extended)
Project Budget	Ecological Risk Assessor 2	Ecological Risk Assessor 3	Engineer 1	Engineer 2	Engineer 3	Engineer 4	Field Technician	GIS/CADD Specialist	Human Health Risk Assessor 2	Human Health Risk Assessor 3	On-Site Inspector	Project Manager	QA/QC Officer	Scientist 1	Scientist 2	Total Hours							
*** Objective 1**																							
Task A: Remedial Design			80	120	40	16		40				20	16		40	372	NA	NA	NA	NA	NA	NA	NA
Task B: Remedial Action Work Plan			40	80	20	8		16				20	16	40	80	320	NA	NA	NA	NA	NA	NA	NA
Total for Objective 1 Hrs	0	0	120	200	60	24	0	56	0	0	0	40	32	40	120	692							
Total Project Hours	0	0	120	200	60	24	0	56	0	0	0	40	32	40	120	692							