

Keith P. Brodock, P.E., P.P.

Principal



Education and Credentials

B.S., Chemical Engineering,
Clarkson University, Potsdam,
New York, 2003

Professional Engineer, Alabama
(License No. 39484), Delaware
(License No. 18630), Illinois
(License No. 062.069589),
New Jersey (License No.
24GE05352100), New York
(License No. 089004), North
Carolina (License No. 044100),
Maryland (License No. 44309),
Montana (License No. 66155),
Texas (License No. 127823)

Professional Planner, New Jersey
(License No. 33LI00638600)

Leadership in Energy and
Environmental Design Accredited
Professional (2009)

Continuing Education and Training

Delaware Valley Safety Council
Basic Orientation Plus (Expires
10-2020)

Hazardous Waste Operations and
Emergency Response 40-Hour
Certification (2003 to present)

Hazardous Waste Operations
Management and Supervisor
8-Hour Certification (2004)

OSHA 10-Hour Construction
Safety Training (2012)

PSMJ Resources, Inc. Project
Management Bootcamp (2011)

Solvay West Deptford Contractor
Training (Expires 10-2020)

Transportation Worker
Identification Credential
(Expires 2024)

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New York, NY 10018

Professional Profile

Mr. Keith Brodock is a licensed professional engineer and program manager with more than 15 years of experience in environmental engineering, remediation design, and construction. As a professional engineer, Mr. Brodock has responsibilities ranging from oversight of investigation and remediation to cost estimation and project execution. His experience includes sites impacted with chlorinated solvents, petroleum compounds, PCBs, and constituents of emerging concern, such as per- and polyfluoroalkyl substances (PFAS). One of his primary responsibilities is serving as president of Integral Engineering, P.C., which provides engineering services in New York, New Jersey, and North Carolina.

Mr. Brodock has overseen projects across the country. He routinely advises clients on due diligence matters, risk management, site investigation and remediation, regulatory climate, and mitigation measures for contaminated properties. Mr. Brodock has considerable experience in developing strategic plans for remediation that meet wide-ranging stakeholder needs. He is a remediation design engineer and serves as resident engineer on multiple construction projects in the New York City and New Jersey areas. Mr. Brodock also has substantial litigation support experience on cases involving a range of remediation issues, engineering cost analysis, and liability allocation.

Relevant Experience

Real Estate Transactions

Private Acquisition of Excess Government Property, Washington, DC—Advised joint venture client on potential environmental liabilities associated with the acquisition of the steam-generating West Heating Plant in Washington, DC. Performed scenario analysis of potential contamination events (in soil, groundwater, and building materials) and developed expected costs therefor. Our evaluation allowed the joint venture client to move forward with and win the auction. During contracting, supported the procurement of environmental insurance for added risk protection. Continuing to support joint venture client with NPDES permit compliance.

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Superfund Property Disposition and Liability Transfer, Wall, New Jersey—Advised on the sale of 650-acre property encompassing a federal Superfund site with more than 600 historical tenants. Assisted with development of the selected remediation proposal for a \$1.5 million shooting range cleanup. Provided review of liability transfer offer, including cost/benefit analysis, insurance funding, and remediation cost-overrun risk using Monte Carlo modeling. Supported negotiations with EPA and the U.S. Department of Justice (USDOJ) to allow private takeover of remediation activities. Performed New Jersey Industrial Site Recovery Act investigation of more than 600 historical tenants as a requirement of the transaction.

Preparatory School Due Diligence, Brooklyn, New York—Evaluated environmental risks as part of a preparatory school taking possession and developing a former fueling and repair station. Negotiated Phase II scope with major petroleum company and its consultant team. Identified significant data gaps in uninvestigated operation areas, spill areas, and offsite impacts. Counseled client team on downside risks in the transaction.

Exit Strategy Development, Seattle, Washington—Developed investigation and remediation strategy as part of a contaminated property portfolio buyout and future sale. Evaluated contamination impacts and prepared remediation options with defensible cost estimates used in negotiations. Utilized RACER and other cost databases to develop estimates.

Real Estate Portfolio Acquisition Support, Staten Island, New York—As part of client’s acquisition of real estate investment trust, advised on environmental risks of the Staten Island property. With a state Superfund manufactured gas plant (MGP) site adjacent to the property, communicated potential liabilities to client. Worked in conjunction with seller’s environmental consultant to conduct a soil gas/indoor air evaluation. Performed critical review of seller’s soil vapor report.

Brownfield Program Property Disposition, Manhattan, New York—Supported the transaction of two properties that completed the New York State Brownfields Cleanup Program (NYSBCP). One property contained a school under construction and the other was a vacant lot. Helped to provide the buyer’s team with a complete understanding of the environmental history and prepared an engineering certification attesting to compliance with ongoing monitoring requirements.

Cypress Equities Land Acquisition, King of Prussia, Pennsylvania—Advised on pending land acquisition deal after conducting an in-depth environmental review and limited subsurface investigation at a former heavy industrial manufacturing site. Developed a probabilistic cost estimate spanning the identifiable areas of concern for all of the multiple investigation/remediation scenarios applicable under the Act 2 regulations in Pennsylvania.

Not-for-Profit Land Acquisition and Development, New York, New York—Supported a not-for-profit organization in the acquisition and development of various tracts of land to build a charter school. Assisted with the Phase I evaluations. Prepared scopes of work for Phase II investigations. Managed the development of the regulatory interaction strategy with the New York City School Construction Authority. Provided sound engineering support for the development of subsurface remediation/mitigation measures for the protection of schoolchildren’s health.



Phase I Investigations, Various Properties, New York, New Jersey, Connecticut, Arkansas—Conducted Phase I and Phase I/II hybrid investigations according to the American Society for Testing and Materials (ASTM) standards, both pre- and post-EPA All Appropriate Inquiries. Integrated state requirements into the analyses. Included radon, drinking water, and indoor air analyses, as required.

PFAS Experience

Drinking Water Treatment Design for PFAS Removal, New Jersey—Supported design team in its evaluation of technologies for removal of PFAS in drinking water. Applied lessons learned from prior PFAS removal system operations for holistic evaluation. Assisted with drafting of design plans.

PFAS Soil Remediation, New Jersey—Managed construction of a soil remediation for PFAS constituents. Led the construction team in contingency planning, scheduling, and documentation of construction work. Developed engineering solutions as site conditions changed from design.

Water Treatment Plant Process Construction for PFAS Treatment, New Jersey—Served as owner's representative during successful construction and commissioning of a PFAS treatment plant for a municipal drinking water system. The 1,000-gpm system removes perfluorononanoic acid to nondetect levels (<1 ppt). While managing all facets of construction to the design criteria and requirements, kept change orders—most of which were system upgrades—to less than 3 percent of the original contract value. Performed the work to client satisfaction as part of a litigation settlement agreement and maintained key stakeholder relationships with the settling parties.

Drinking Water PFAS Treatment Plant Operational Monitoring, New Jersey—Led the evaluation of PFAS operational monitoring for a drinking water treatment process. Developed predictive statistical model for PFAS breakthrough that allowed early, accurate predictions to provide sufficient lead-time to order media changeout prior to breakthrough.

PFAS Regulatory Engagement, New York—Counseled clients on the impacts of New York State's (NYS) PFAS listing as a hazardous substance. Advised on potential liabilities, sampling procedures, data evaluation, and implications on current and future remedial actions and construction activity.

Drinking Water Treatment Negotiations for PFAS Removal, New Jersey—Provided senior engineering design and negotiations with municipality regarding a planned PFAS treatment unit add-on for a municipal water source. Collaboratively developed timeline, permitting requirements outline, and responsibilities with municipality's technical and legal teams.

1,4-Dioxane Experience

1,4-Dioxane Liability Evaluation, New York—Counseled client on potential liability associated with 1,4-dioxane, remedial technologies, and NYS rulemaking procedures. Support allowed for development of critical points to raise during high-level agency discussions.



1,4-Dioxane Advisory Services, Manhattan, New York—Currently evaluating detections of 1,4-dioxane at a former commercial/industrial facility and advising client on risk management options.

Brownfields, Engineering Design, Construction

Public Charter School Construction, Mott Haven, Bronx, New York—Managed the environmental remediation and construction for the KIPP Bronx New York City (NYC) school. As owners' representative, assisted with generating specifications for the work that eliminated contractor change orders. Worked with the design engineer to develop the remediation system using green design principles. Led the project team overseeing the implementation of the remediation and led the office team reviewing submittals from the contractors. The remediation included contaminated soil excavation and disposal, installation of a sub-slab depressurization system (SSDS) and vapor barrier, underground storage tank (UST) removal, and petroleum spill closeout. Collaborated with structural, geotechnical, and electrical engineers. Worked with New York State Department of Environmental Conservation (NYSDEC) spills (Region 2) and environmental remediation (Albany) groups, School Construction Authority (Industrial & Environmental Health), and New York City Office of Environmental Remediation (NYCOER) to obtain full regulatory approval. Supported the construction manager in determining eligibility of contractor claims for additional funds based on compliance with the specifications.

Former Manufacturing Facility, Beacon, New York—Provided testimony before the City of Beacon Planning Board regarding the environmental impacts of a proposed residential development on a closed NYS Inactive Hazardous Waste site. The site was a former manufacturing facility that stored and used various drums of volatile organic compounds, which contaminated the soil and groundwater. Additionally, provided engineering support for mitigating vapor intrusion and potential resident exposure.

Former Dry Cleaner Investigation on 9th Avenue, Manhattan, New York—Principal-in-charge for the investigation and remediation of a former dry cleaning facility enrolled in the NYSBCP. Managed teams to complete a comprehensive remedial investigation of all media present at the site, including a multi-day investigation into bedrock. Led client and NYSDEC communications. Served as the engineer for a vapor intrusion mitigation system pilot test, and is currently leading the remedial efforts.

Hotel Cooling Water Discharge Permitting Claim, Chicago, Illinois—Project manager and senior engineer advising insurance carrier regarding a claim for defense and indemnification in relation to litigation from the State of Illinois. Evaluated the environmental policy, the conditions of the expired NPDES permit, and the facts of the case to provide an opinion to the carrier.

Subsurface Engineering Support for Operational Manufacturing Facility, North Carolina—Principal engineer and project manager evaluating control measures for expansive soils causing building deformation. Oversaw the standardization of heave surveying measures and the evaluation of collected data. Assisted the onsite client team with evaluating various foundation



support systems for new manufacturing equipment. Selection of foundation support was complicated by expansive soils, and both high and low pH liquids.

Former Dry Cleaner Investigation and Vapor Intrusion Mitigation on 1st Avenue, Manhattan, New York—Project manager and senior engineer for the remedial investigation and vapor mitigation system installation at a former dry cleaning facility. Oversaw a team of scientists and engineers to investigate soil, soil vapor, indoor air, groundwater, and bedrock. Served as the senior engineer for the design of a vapor barrier and SSDS, and currently overseeing the operations and maintenance of those systems.

Ferry Point Golf Course SSDS Design and Construction, Bronx, New York—Engineer in responsible charge for the rapid design and construction of an SSDS designed to exhaust methane gas from the former landfill upon which the golf course comfort station was built. Working with the NYC Department of Parks & Recreation, performed an SSDS pilot test, design, and system construction within 7 days. As part of the design, submitted design drawings and specifications to NYSDEC and received approval within the 7-day timeframe.

Former Winchester Repeating Arms Manufacturing Facility, New Haven, Connecticut—Prepared Phase I and Phase II investigations for century-old manufacturing facility with 160 areas of concern. Developed site investigation work plan to investigate all areas of concern, including shallow and bedrock groundwater. Conducted sub-slab soil vapor investigation and supervised the soil/groundwater/bedrock investigation field team. Led data collection, evaluation, and reporting teams.

Environmental, Geotechnical, and Green Infrastructure Evaluations, Multiple Public Park Sites, New York City—Principal-in-charge for multiple investigations of public parks throughout all five boroughs of New York City. Overseeing a team of managers, engineers, and scientists to evaluate the presence or absence of contaminants at public park development sites. Additionally, serving as lead engineer for green infrastructure evaluations and preliminary designs. Geotechnical engineer subcontractor is evaluating site geotechnical properties in preparation for development design.

Basement Dewatering Evaluation for Sewer Discharge, Manhattan, New York—Supported a building owner with an evaluation of water pooled in the basement of a building prior to discharge to the sewer. Confirmed that the water met the requirements of the NYC Department of Environmental Protection discharge permit, allowing the client to quickly remove the water in anticipation of leasing the space.

Former Bridge Cleaners Soil Vapor Extraction and Air Sparge Design, Long Island City, New York—Engineer in responsible charge and manager for air sparge/soil vapor extraction design and construction in the NYSBCP. Evaluated onsite and offsite chemical and forensic data to identify nearby responsible parties. Coordinated filings with the NYC Department of Buildings and cleared drawing revisions with plan examiner directly. Managed communications with NYSDEC within and outside of the NYSBCP.



Former Dry Cleaning Chemical Distribution Facility Investigation/Mitigation, Williamsburg, Brooklyn, New York—Directed the NYSBCP investigation and vapor intrusion mitigation system operation. Working with NYSDEC Region 2, developed a full, approved remedial investigation work plan in less than 3 weeks and supervised the technical implementation. Completed membrane interface probe (MIP) and hydraulic profile tool (HPT) as the initial phase of the remedial investigation. Designed operational upgrades to the existing mitigation system for enhanced reliability and data collection. Managed communications with NYSDEC to keep participant in the NYSBCP. Developed a full remediation estimate based on the remedial investigation results.

Petroleum Spill Remediation and Bedrock Analysis, 2nd Avenue, Manhattan, New York—Led negotiations with NYSDEC Region 2 spills group to investigate and remediate fuel oil #6 spill. Identified potential pathways and confining layers at site to evaluate fate and transport. Oversaw preliminary bedrock fold/fracture analysis to assess if/how spilled fuel oil was connected to petroleum intrusion in nearby subway operations. Secured site closure without lengthy remediation or bedrock investigation.

Petroleum Spill Investigation, Flatbush, Brooklyn, New York—Supported local church to remove gasoline tanks from former 1950s filling operations on the church property. Evaluated historical and current data; concluded that petroleum spill did not originate from the tanks, but more likely a neighboring property. Obtained spill closure on behalf of the client.

Remediation Cost Estimation, Gainesville, Virginia—Developed various excavation and disposal remediation cost estimates. Evaluated cost differential between onsite and offsite disposal.

Petroleum Remediation System Design and Implementation, Gravesend, Brooklyn, New York—Provided professional engineering services to repair and restart a pneumatic petroleum recovery system in accordance with a NYSDEC-approved remedial action plan for a major oil storage facility on the water. After that system was destroyed in Superstorm Sandy, evaluated and implemented a skimmer recovery system to remove the petroleum. Provided oversight for the preparation of engineering estimates and schedules for completion.

RCRA Storage Area Closure, Long Island City, New York—Managed the closure of a hazardous waste storage area under the NYS RCRA program. Developed and certified (as the engineer of record) the RCRA closure plan. Oversaw the investigation and subsequent disposition of the impoundment area. Sealed the closure report and worked with NYSDEC to conduct the final facility inspection as the final step to closure.

Slag and Sewage Site, Past Costs and River Sediment Evaluation, Fox Point Park, Wilmington, Delaware—Managed the past cost evaluation, including human health risk assessment, and the sediment investigation of more than 200 acres of the Delaware River. Evaluated past costs from Delaware Department of Natural Resources and Environmental Control (DNREC) for investigation and remediation liability attributable to the client. Worked with the risk assessment group to evaluate whether site risk was a cause for remediation, and whether the unacceptable risk was



related to the client's alleged site constituents. Led communications with DNREC, Delaware Department of Justice, and federal trustees regarding natural resource damages, cooperative assessment, and scope of work for the RI/FS of OU-2 (Delaware River).

Industrial Scrap Recycling Site, Bronx, New York—Engineer in responsible charge for petroleum storage and stormwater management compliance. Oversaw preparation of spill prevention, control, and countermeasures; stormwater pollution prevention plan; and multi-sector general permit documentation under NYSDEC. Determined feasibility of industrial stormwater discharge to either a surface water body or a city storm sewer. Evaluated historical bulkhead construction using photogrammetry techniques to determine wetland adjacent area status.

Superfund Remediation Process Optimization, La Marque, Texas—Evaluated groundwater treatment system to develop recommendations for streamlined unit processes. Completed migration of an aging programmable logic controller (PLC) system to a modern system. Developed a robust network setup that allows for controlled local and remote access by multiple users. Leading the evaluation of enhanced separation of dense nonaqueous-phase liquid for reduced operations and maintenance time/cost.

Petroleum Spill Closure and PCB Investigation for Redevelopment, Long Island City, Queens, New York—Managed a UST removal/closure, petroleum spill closure, and PCB investigation for the redevelopment of a former warehouse into a large distribution facility for a national shipping carrier. Worked with NYSDEC to develop the scope of investigation and remediation. Oversaw the soil materials management at the site. Concluded that PCBs identified onsite resulted from 1950s historical filling and successfully closed the matter with NYSDEC.

Investigation Work Plan Development for Former Landfill, Staten Island, New York—Led the development of a remedial investigation work plan for a former landfill. Evaluated previous investigations and sensitive utility corridors to develop the statistical scope of work. Work plan is currently under review by multiple city and state agencies.

Warehouse Expansion on Waterfront Superfund Site, Maspeth, Queens, New York—Provided professional engineering services developing the site remedial design of a NYSDEC engineered cap. Assisted in developing the construction phasing to minimize potential exposure to site workers and the community. Oversaw the site stormwater treatment design by the site civil engineer.

Risk Assessment and Building Engineering Control Evaluation, Former MGP Site, Manhattan, New York—Professional engineer and project manager for annual engineering control (waterproofing and air exchange system) inspections and repairs, as needed. Led team of vapor intrusion experts and risk assessors to evaluate potential human health effects for construction workers in subsurface structure rebuilding damaged mechanical, electrical, and plumbing systems, including the air exchange system engineering control that were damaged during Superstorm Sandy.



State Superfund Remediation and Stormwater Design, Maspeth, Queens, New York—Acted as engineer in responsible charge of the design of a state Superfund remedial cap. Remedial cap was designed for direct discharge of stormwater to Newtown Creek. Collaborated with NYS Department of Transportation (NYSDOT) and NYSDEC to develop a design consistent with the needs of both agencies. NYSDOT would be constructing the designed cap as part of its construction of a nearby bridge.

Sampling Plan Development for School Expansion, Monmouth, Maine—Evaluated historical arsenic impacts from a former apple orchard and developed a soil sampling plan to support design, construction, and materials management for the expansion of a school.

Residential Development, City Island, Bronx, New York—Supported the construction of a residential development on City Island by providing certainty on cost and schedule. Collaborated with NYCOER to develop a scope of work to define remediation areas. Provided strategy for the remedial action, and assisted with the integration of remediation into construction.

Mixed-Use Development at Former Dry Cleaner Site, Manhattan, New York—Provided engineering oversight for vapor intrusion evaluation and mitigation design at a NYSBCP site. Engineer in responsible charge for NYSBCP activities. Worked with NYSDEC, client, and the current property owner to identify a mitigation strategy to prevent future infiltration of soil gas with elevated chlorinated solvent concentrations. Currently overseeing the preparation of investigation work plan to delineate known soil and groundwater concentrations of dry cleaning fluid.

Former Woodhaven Bowl Site, Forest Hills, Queens, New York—Managed the team to concurrently satisfy five regulatory agencies (including NYS and NYC agencies), a then current landowner inexperienced at brownfield redevelopment, and a demanding future tenant with an extremely tight construction schedule to facilitate redevelopment. Utilized careful, advanced planning to facilitate the evaluation of each stakeholder's objectives. Used direct-sensing equipment (MIP) to quickly evaluate the potential release areas. Designed and oversaw the construction of an SSDS serving 40,000 square feet of retail space. Achieved the project objectives by delivering a building ready for development by the tenant.

Residual Light Nonaqueous-Phase Liquid (LNAPL) Investigation/Remediation, Long Island City, New York—Designed and managed the investigation and remedial actions at a former fueling depot. Identified data gaps in the previous consultant's work and designed a characterization plan to reduce the uncertainties in the conceptual site model. The characterization plan was integrated with the remedial action plan so only one field mobilization was necessary. Design included an *in situ* chemical oxidant injection as the remedial action. The remedial action is currently being implemented.

Subsurface Investigation and Tank Removal, Jersey City, New Jersey—Managed a subsurface investigation at a warehousing property that contained railroad sidings, improperly closed USTs, and an aboveground fueling operation. Coordinated the removal/closure of the fueling operation



and building demolition. Provided consultation on the investigation results to assist the client in securing financing for the property.

Former Oil Terminal Investigation and Remediation, Brooklyn, New York—Supported the property owner through negotiations with NYSDEC as part of a groundbreaking deal where NYSDEC agreed to clean up a state Superfund site that was owned by a private entity. Assisted the intergovernmental team with triad planning and design to achieve a rapid subsurface investigation/characterization. Developed a work plan that included demolition and disposal of PCB-containing equipment.

Dual-Phase Extraction and Discharge Compliance Engineering, Northern New Jersey—Led a team to design and install ion exchange treatment to lower the concentrations of non-compliant water being discharged to a river, where 60 percent of the chemicals causing the exceedance could not be identified by conventional laboratory techniques. Implemented enhancements to a high-vacuum, dual-phase extraction (DPE) remediation system, resulting in increased mass removal rates and system uptime. Achieved long-term cost savings in the form of decreased time onsite and automated task development. Developed new PLC ladder logic for more precise control. Created a U.S. Securities and Exchange Commission (SEC)–compliant cost estimate model that encompasses various remediation strategies through end-of-project lifecycle.

Surfactant Soil Remediation, Margate City, New Jersey—Project engineer and subcontractor manager for the remediation of a #2 fuel oil release beneath a residence. Applied an innovative surfactant flushing program to mobilize and extract adsorbed fuel oil from the soils. Careful planning and immediate reaction to changing site conditions were necessary to prevent further oil migration or the settling of a \$3 million mansion. Successful management of multiple subcontractors led to a soils closure within the project deadline.

Subsurface MGP Investigation, Manhattan, New York—Evaluated and interpreted the results of more than 700 samples collected during a subsurface investigation at a former MGP site. Composed the data analysis portion of the site characterization report for submittal to NYSDEC. Also supported subsurface field activities while acting as client liaison to the public.

Dual-Phase Remediation System Improvements, Newark, New Jersey—Analyzed performance issues of a catalytic oxidizer, part of a DPE remediation system. Determined that the control system was failing and causing false alarms. Led the team to implement a redesigned alarm system to better diagnose system trouble conditions.

Heavy Metal Statistical Source Separation, Virginia—Supported team in separating heavy metal contamination sources through electron microscopy and elemental analysis. Based on the differing elemental properties of various sources of lead, employed the use of statistical analysis to parse the portion of contamination that was likely attributable to the client from the entire mass, thereby saving money in remediation costs.



Biennial Certification Reporting, Various Locations, New Jersey—Oversaw biannual monitoring activities and biennial certification filings as part of New Jersey Department of Environmental Protection (NJDEP) agreements. Coordinated scheduling with clients and tenants for biannual property inspections. Completed biennial certification reporting process to NJDEP and various local entities.

Vapor Intrusion

Vapor Intrusion Mitigation Design and Construction, Manhattan, New York—Designed and oversaw the installation of a passive SSDS and vapor barrier. Negotiated remediation actions with NYCOER, securing the uncommon approval of a passive SSDS. Worked with other design engineers and the contractors to solve issues related to vapor barrier and SSDS construction.

Soil Vapor Intrusion Investigation, Brooklyn, New York—Principal-in-charge overseeing a soil vapor intrusion evaluation required by construction refinancing. Developing investigation parameters and negotiating acceptance with the lender's environmental professionals.

Pilot Test and SSDS Installation, Lakewood, Washington—Senior technical oversight for SSDS pilot test and installation for a national car rental location. Evaluated vapor intrusion conditions and prepared potential mitigation strategies. Supported staff in developing a scope of work for subcontractor, and advised on testing and installation coordination and execution.

Vapor Intrusion Investigation, Williamsburg, Brooklyn, New York—Professional engineer for vapor intrusion investigation at a former dry cleaning fluid distribution facility applying for the NYSBCP. Reviewed offsite soil vapor data to develop a conceptual site model as the basis for a soil vapor intrusion investigation program. Supported the application of the facility to the NYSBCP.

Vapor Intrusion Evaluation, Woodside, Queens, New York—Developed strategy for vapor intrusion evaluation and potential mitigation to protect residents and move forward with refinancing. Reviewed strategy with NYSDEC and New York State Department of Health (NYSDOH). Worked with the lender to satisfy their requirements to continue with refinancing.

Farrand Controls State Superfund Site, Valhalla, New York—Identified source and fate and transport of vapor-phase chlorinated solvents within a commercial/industrial operation to support the construction of a mitigation action. Traced the airflows from four distinct heating/cooling zones throughout the building to understand mixing and transport of the chlorinated solvents, as the highest readings of vapors did not match the site conditions. Identified the entry point of the vapors from contaminated groundwater beneath the site. Performed a pilot test for and designed an active SSDS for the slab-on-grade portions of the building. Recommended a cost-effective solution to mitigate vapor intrusion in the building basement.

Vapor Intrusion Investigation, Cranford, New Jersey—Managed vapor intrusion investigation on properties adjoining a chlorinated solvent spill. Negotiated access agreements with abutting property owners and tenants. Organized subcontractors' work to minimize business interruption



while still maintaining the integrity of the investigation. Educated the neighboring property owners on the significance of the results and communicated continuing action plans to them.

Mayflower Cleaners State Superfund Site, Great Neck, New York—Evaluated the fate and transport of multiple sources of tetrachloroethylene (PCE; dry cleaning fluid) to support the preparation of a remedial action. The fate and transport evaluation included a known source beneath the slab of the building and a potential source from the adjacent dry cleaning operation. Developed a conceptual airflow model. Created the communication strategy with the regulatory agencies. Designed and managed the implementation of an interim remedial measure to mitigate the flow of PCE vapors from beneath the slab to the occupied tenant space. Currently implementing the record of decision with NYSDEC.

Vapor Intrusion Mitigation and Groundwater Investigation, Mahopac, New York—Designed and installed an SSDS after performing a sub-slab communication test for NYSDOH and NYSDEC. Responsible for coordination of annual system inspection and reporting, and tenant/owner education and guidance. Also coordinated quarterly groundwater sample reporting to NYSDEC.

Chemical Release Investigation with Vapor Intrusion Testing and Mitigation, Ridgefield, New Jersey—Oversaw field investigation to delineate a diving chlorinated solvent plume in a windowed confining layer. Developed a permanent vapor intrusion mitigation plan after conducting an indoor air investigation that revealed potential impacts to human health. Assisted in designing, permitting, and installing the SSDS intended to disperse organic vapors before entering the office building. Implemented risk mitigation plan that included automatic remote notification if the SSDS were to fail.

Financial Analysis and Reporting

Streamlined SEC Environmental Liability Reporting, Seattle, Washington—Using Lean techniques, developed a streamlined budgeting and liability reporting process that increases value while adhering to reporting regulations. With focus on increasing stakeholder value, merged the budget process that the consultant team used with the SEC liability reporting process that the client desired. Developed software to automate the reporting and updating procedure. Worked with the corporate liability manager to conform to both SEC and internal accounting policies.

Real Estate Portfolio Valuation, Long Island, New York—Developed defensible liability estimates, which led to a \$7 million savings in an IRS settlement. Working with a real estate appraiser, evaluated the assets and environmental liabilities in a 17-property portfolio at three key points in time. A remedial strategies matrix for the different time periods was merged into a decision tree with the properties' contamination characteristics using Monte Carlo simulation. An effective combination of computer estimation/simulation tools (RACER and Monte Carlo) was used to justifiably support the estimates to the IRS.

Environmental Remediation Estimates Using Monte Carlo Analysis, Various Locations, U.S.—Determined and communicated environmental remediation cost risk to clients. Assisted owners with their internal budgeting process to communicate to their management the likely, best, and



worst case scenarios. By understanding the range of costs associated with the project, management was equipped to make better decisions on expense allocation. Certain projects incorporated the management science of decision-tree analysis to consider alternate remedial technologies. In fact, the client was able to select a remedy based on the risk profile.

Remedial Strategy Selection through Probabilistic Estimating, Central Vermont Public Service, Vermont— Provided probabilistic estimating for different remedial strategies that helped the client to decide which decision-tree path was most appropriate for its business model. Utilized decision management tools in conjunction with cost estimates and sensitivity analyses to provide a full understanding of the likely results of choosing one strategy over another.

Remedial Scenario Cost Estimating, Various Locations, U.S.— Developed large-scale remediation cost estimates using RACER for an automobile-industry client. Based on the remedial investigation data results, created low/medium/high range cost estimates that encompassed a “no further action” option all the way to installing and operating high-end remediation systems for many years. These cost estimates were presented to the court as part of a package to support emerging from bankruptcy.

Defensible Environmental Liability Reports, Various Locations, U.S.— Performed multiple mathematical simulations for cost estimation and disclosure under Sarbanes-Oxley reporting requirements for environmental liability. Incorporated decision management structures into multiple-site and multiple-option estimates. Results provided were defensible estimates that evaluated entire liability portfolios.

Geothermal Testing and Design

First-Ever Standing Water Column (Open-Loop) Geothermal Study, New Haven, Connecticut— Designed first-ever geothermal standing water column exchange study to characterize the thermal capacity of the proposed geothermal cooling system. The study simulated system loads and observed subsurface effects to qualify wells to sustain continued operations while preventing emergency discharges (bleed-off) to the local sewer authority. Results include determining the effects of various temperature differentials, load cycling, and high-permeability zones. The study results were subsequently used to design the optimal geothermal well network by minimizing the cost of the wells while ensuring adequate thermal capacity during peak loading. This work was performed as part of an overall sustainable design effort under the Leadership in Energy and Environmental Design (LEED) New Construction program. The project was awarded LEED Platinum certification.

Standing Water Column Geothermal Design, New Haven, Connecticut— Conducted a geothermal response test for a private developer constructing a 700,000-square-foot residential/retail complex. The results of the geothermal response test were used to design the optimal geothermal network that would provide an efficient level of heating/cooling for the building. This project has been selected by the U.S. Green Building Council as a pilot project for the LEED Program for Neighborhood Development.



Automated Closed-Loop Geothermal Analysis, Cambridge, Massachusetts—Assisted in constructing an automated geothermal closed-loop test that conformed to American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) building specifications. Modified existing open-loop thermal response testing equipment to perform unmanned closed-loop tests of shallow geothermal wells. Automated the system to perpetually adjust to stay in conformance with ASHRAE test methods. The equipment included a remote monitoring component for instantaneous data review and troubleshooting.

Property Management

Building Environmental Management, New York, New York—Oversaw emergency response to building water intrusion events to prevent the growth and subsequent abatement of mold spores. Conducted property visits to review Phase I action item implementation.

Litigation

Litigation Support for PCB Remediation and Cost Claims, Edgewater, New Jersey—Borough of Edgewater v. Waterside Construction, LLC et al., Civ. No. 2:14-cv-05060 (U.S.D.C. D.N.J.) and North River Mews v. Alcoa et al., Civ. No. 2:14-cv-08129 (U.S.D.C. D.N.J.): Provided expert witness services related to PCB remediation and cost recovery. Evaluated compliance of the remediation with the National Contingency Plan, and prepared remediation cost estimates. Ongoing.

Litigation Support for Petroleum and Chlorinated Solvent Releases, Edgemere, Queens, New York—Alprof Realty v. Corporation of the Presiding Bishop of The Church of Jesus Christ of Latter-day Saints, Civ. No. 09-cv-05190 (U.S.D.C. E.D.N.Y.): Provided litigation support for the church against a plaintiff that alleged responsibility for a chlorinated solvent plume allegedly migrating to the plaintiff's site from the defendant's property. Analyzed the subsurface information and identified erroneous depictions in the other expert's work. Identified potential release points and developed transport mechanisms utilizing the scientific method that demonstrated that contamination from defendant's property did not significantly flow onto plaintiff's property. Settled.

Litigation Support for Past Cost Evaluation, Port Washington, New York—Long Island Lighting Company d/b/a LIPA v. H2M Group, et al., Index No. 08-021792 (Supreme Court, State of New York, Nassau County): Provided litigation support for defendants against plaintiff seeking cost recovery for remediation of a cable fluid release. Developed observations regarding plaintiff's alleged damages, as contained in 4,000 cost line items. Generated deposition question matrix to drill down into specific cost expenditure items. Prepared an independent cost estimate for environmental cleanup based on the scope of work presented to NYSDEC.

Litigation Support for Cost Evaluation, Kalamazoo, Michigan—Georgia Pacific Consumer Products, LP et al. v. NCR Corporation et al., Case No. 1:11-cv-483 (U.S.D.C. W.D. Mich.): Provided litigation support for a defendant against plaintiffs seeking cost recovery under CERCLA. Evaluated 4,400 expended cost line items pursuant to various Administrative Orders on Consent. Compared plaintiff's expended costs to those of certain defendant's costs, and allocated costs according to cost-sharing agreements.



Litigation Support for Petroleum Source Identification and Cleanup Evaluation, Poughkeepsie, New York—Marist College and Marist Real Property Services, Inc. v. Chazen Engineering Services Inc., et al., Index No. 2365/09 (Supreme Court, State of New York, Dutchess County): Provided litigation support for Harris Corporation against plaintiffs alleging widespread petroleum contamination from a former owner’s UST. Demonstrated that few petroleum impacts, if any, were attributable to Harris, and that the vast majority of excavated materials were either not contaminated or contaminated from other sources. Further demonstrated that most of the soils were excavated for construction purposes, rather than for remediating a petroleum spill, and, therefore, only the incremental cost of disposal would be attributable to the petroleum impacts.

Litigation Support for Construction Defect Claim, Portsmouth/Tiverton, Rhode Island—Cashman Equipment Corporation, Inc. v. Cardi Corporation, Inc., et al., C.A. NO. PC 11-2488 (Rhode Island Superior Court): Provided litigation support for a construction contractor against a subcontractor. Supported expert engineer in applying photogrammetry techniques to site construction photos in order to evaluate the placement of structural foundation elements (now encased in concrete). Concluded that the structural elements were not placed in accordance with the design drawings.

Litigation Support for Lead Impacts, Carteret, New Jersey—Reichhold, Inc. v. United States Metal Refining Company, et al., Civ. No. 03-453 (U.S.D.C., D.N.J.): Provided litigation support for a large, multinational mining and refining company against a plaintiff that alleged responsibility for lead impacts at a previously owned site. After review of the data, developed visual aids for court showing that the lead impacts were generally limited to areas where the plaintiff raised the grade with fill. Supported the science and legal teams during trial preparation and throughout the trial by gathering additional supporting evidence and generating opinions on new evidence submitted by plaintiff and testimony by plaintiff’s consultants.

Litigation Support for an Oil Spill Investigation, Long Island City, Queens, New York—DMJ Associates, L.L.C. v. Capasso, et al., Civ. No. 07-285 (U.S.D.C., E.D.N.Y.): Provided litigation support for a NYC developer that resulted in rapid settlement of the case. Designed and executed a field investigation to locate preferential pathways for mobilized LNAPL across multiple properties and a local waterway. Examined chemical fingerprints to determine the extent of migration. Scientifically demonstrated that not only did the LNAPL contaminate the property at hand, but also contaminated adjacent properties and was discharging directly into the Newtown Creek.

Litigation Support for Federal Superfund Site, Lawrence Aviation Industries, Port Jefferson, Long Island, New York—United States of America v. Lawrence Aviation Industries, Inc., et al., Civ. No. 04-818 (U.S.D.C., E.D.N.Y.): Provided litigation support for Lawrence Aviation Industries (LAI) to defend against a USDOJ lawsuit alleging widespread trichloroethylene contamination. After reviewing the investigation reports, determined that there was no scientific link to a portion of the alleged contamination, and, in fact, there appeared to be a second source. Appeared before USDOJ and EPA to argue these new findings in favor of LAI. Additionally, discussed the potential for EPA to relinquish site control to LAI, so that LAI could implement a more modern and effective remedial strategy, rather than the antiquated, likely unsuccessful technology mandated in the record of decision.



Underground Storage Tank Release Date Determination, Southern New Jersey—Used statistical analysis to determine when a UST began leaking on behalf of an insurance carrier for claim defense. Conducted a detailed analysis of the fuel delivery receipts as compared to the local weather conditions. Using statistical methods, the initial discharge timeframe was determined with 95 percent confidence.

Litigation Support for a Release Migrating toward I-95, Secaucus, New Jersey—Provided opinion on remedial investigation and action plans to negotiate a delay in litigation (with client). Worked with opposing party to incorporate additional scope of work into its investigation plan to fully characterize the release to groundwater. By successfully working with the opposing party's consultant, was able to delay the expense of trial for the client.

Litigation Support, Various Locations, New Jersey and New York—Provided technical review and opinions on various legal matters, mostly involving allocating liability for contamination for insurance defense purposes. Disputed claims of scientific certainty for age-dating analyses of various methods. Collected and analyzed samples to produce independent liability allocation opinions.

Professional Affiliations

Interstate Technology & Regulatory Council, *Vapor Intrusion (VI) Mitigation* team leadership (2020 to present), *Optimizing In Situ Remediation Performance and Injection Strategies* team (2018 to 2020)

Montclair Planning Board, Vice Chair (2017 to present), Class IV Member (2015 to present)

Montclair Environmental Commission, Commissioner (2015 to present), Alternate Commissioner (2013 to 2015)

National Society of Professional Engineers (2011 to present)

Urban Land Institute: NYC Infrastructure Product Council (2018 to present); Mentor (2018 to present); Redevelopment and Reuse Product Council (2012 to 2015); New York District Council, Mentoring Co-Chair (2013 to 2016); NY Mentor Program Chair (2011 to 2013)

Publications

ITRC. 2020. Optimizing injection strategies and in situ remediation performance. Contributing Author. Interstate Technology & Regulatory Council, Washington, DC. February.

Studer, J., M. Hasegawa, E. Christine, D. Allen, C. Turner, K. Brodock, and J. Rhodes. 2005. Surfactant-enhanced recovery of No. 2 fuel oil from beneath a building along coastal New Jersey: A case study. Proceedings of the Petroleum Hydrocarbons and Organic Chemicals in Ground Water Conference, Costa Mesa, CA, August 17–19. National Ground Water Association.



Presentations/Posters

Palko, E., and K. Brodock. 2020. PFAS 101. New Jersey Site Remediation Conference, February 5, New Brunswick, NJ.

Brodock, K, J. Periconi, and J. Almanzar. 2019. Per- and polyfluoroalkyl substances (PFAS): Regulatory landscape, technical issues and state of litigation. Lawline Continuing Legal Education seminar, June 24, New York, NY.

Brodock, K. 2019. Climate change and environmental justice. Panel presentation at the 2019 New York State Bar Association Environmental and Energy Law Section, January 18, New York, NY.

Brodock, K. 2018. Technological advances changing the way we conduct investigation and remediation within the next 10 years. Panel presentation at the 2018 Dow Environmental Remediation and Restoration Global Meeting, March 7, Lake Jackson, TX.

Martin, M., A. Frankel, and K. Brodock. 2018. Lessons learned from implementation of a potable water wellhead treatment system for a long chain perfluoroalkyl acid. Poster presented at the Emerging Contaminants Summit, March 6–7, Westminster, CO.

Tornatore, P.M., J. Rhodes, and K. Brodock. 2005. Improving experience based engineering estimates for environmental liabilities using Decisioneering® software. 2005 NGWA Conference on Remediation: Site Closure and the Total Cost of Cleanup, Houston, TX, November 7–8. National Ground Water Association.

Rhodes, J., and K. Brodock. 2005. Estimating environmental liabilities using probabilistic engineering methods. Web seminar.

Brodock, K., and J. Rhodes. 2005. Engineering estimates for environmental liability à la Crystal Ball. Crystal Ball Users Conference.

